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United States Nuclear Regulatory Commission
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NUREG-2179, Vol. 1

Environmental Impact Statement for the Combined License (COL) for the Bell Bend Nuclear Power Plant

Draft Report for Comment

Volume 1

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

Regulatory Branch
Baltimore District
U.S. Army Corps of Engineers
State College, PA 16801

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Manuscript Completed: March 2015
Date Published: April 2015

Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Regulatory Division
Baltimore District
U.S. Army Corps of Engineers
State College, PA 16801

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For any questions about the material in this report, please contact: Tomeka Terry, Environmental Project Manager, 301-415-1488 or by e-mail at Tomeka.Terry@nrc.gov.

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by PPL Bell Bend, LLC (PPL) for a combined construction permit and operating license (combined license or COL). The proposed actions related to the PPL application are (1) NRC issuance of a COL for a new power reactor unit at the Bell Bend Nuclear Power Plant (BBNPP) site in Luzerne County, Pennsylvania, and (2) U.S. Army Corps of Engineers (USACE) decision to issue, deny, or issue with modifications a Department of the Army (DA) permit to perform certain dredge and fill activities in waters of the United States and to construct structures in navigable waters of the United States related to the project. The NRC, contractors, and USACE make up the review team. This EIS documents the review team's analysis, which considers and weighs the environmental impacts of constructing and operating one new nuclear unit at the BBNPP site and at alternative sites, including measures potentially available for reducing or avoiding adverse impacts.

The EIS includes the evaluation of the impacts of construction and operation of BBNPP on waters of the United States pursuant to Section 404 of the Clean Water Act and on navigable waters of the United States pursuant to Section 10 of the Rivers and Harbors Appropriations Act of 1899. The USACE will base its evaluation of PPL's permit application, on the requirements of USACE regulations, the Clean Water Act Section 404(b)(1) Guidelines, and the USACE public interest review process.

After considering the environmental aspects of the proposed action before the NRC, the NRC staff's preliminary recommendation to the Commission is that the COL be issued as proposed. This recommendation is based on (1) the application, including the environmental report (ER), submitted by PPL; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

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Executive Summary

This environmental impact statement (EIS) presents the results of a U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for a combined construction permit and operating license (combined license or COL) for a new nuclear reactor unit at a proposed Bell Bend Nuclear Power Plant (BBNPP) site in Luzerne County, Pennsylvania. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff.

Background

On October 10, 2008, PPL Bell Bend, LLC (PPL) submitted an application to the NRC for a combined license or COL for the BBNPP.

Upon acceptance of PPL's application, the NRC review team began the environmental review process by publishing a Notice of Intent to prepare an EIS and conduct scoping in the *Federal Register,* on January 6, 2009. On March 30, 2012, PPL submitted a revised environmental report (ER) to provide detailed information regarding the revised site layout developed to avoid wetland impacts by relocating the power-block footprint. On June 15, 2012, following PPL's March 2012 submittal, the NRC published a second Notice of Intent in the *Federal Register* to conduct a supplemental scoping process. As part of the environmental review, the review team did the following:

- conducted public scoping meetings on January 29, 2009 in Berwick, Pennsylvania
- considered comments received during a 30-day supplemental scoping period beginning June 15, 2012 regarding the revised site layout that included a relocated power-block footprint developed to avoid wetland impacts
- conducted site visits to the BBNPP site in April and May 2009, May 2012, and March 2014
- conducted visits to alternative sites in March, April, and May 2009, and June 2010
- reviewed PPL's ER
- consulted with Tribal Nations and other agencies such as the U.S. Fish and Wildlife Service, Advisory Council on Historic Preservation, National Marine Fisheries Service, Pennsylvania Game Commission, Pennsylvania Historical & Museum Commission, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Fish and Boat Commission, and Pennsylvania Department of Environmental Protection
- conducted the review following guidance set forth in NUREG-1555:
  - "Standard Review Plans for Environmental Reviews for Nuclear Power Plants"
  - "Supplement 1: Operating License Renewal"
- considered public comments received during the 60-day scoping process beginning January 6, 2009

- considered public comments received during the 30-day supplemental scoping period beginning June 15, 2012 regarding the revised site layout that included a relocated power-block footprint developed to avoid wetland impacts.

Proposed Action

PPL initiated the proposed Federal action by submitting an application for BBNPP to the NRC. The NRC's Federal action is issuance of COL for the AVERA U.S. EPR reactor at the BBNPP site near Berwick, Pennsylvania.

The USACE is a cooperating agency in preparation of this EIS. The USACE's Federal action is its decision of whether to issue, deny, or issue with modifications a Department of Army (DA) permit pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 to authorize certain construction activities potentially affecting waters of the United States.[(1)]

Purpose and Need for Action

The purpose of the proposed NRC action, issuance of the COL, is to generate 1,600 MW(e) of electricity (baseload power) for sale with commercial operation starting June 2025.

The USACE determines both a basic and overall project purpose. The basic project purpose for the project is to generate electricity for additional baseload capacity. The overall purpose of the project is to provide 1,600 MW(e) of additional nuclear baseload electrical power to the northeast portion of the Pennsylvania, New Jersey, and Maryland Regional Transmission Organization grid.

Affected Environment

The BBNPP site is located near Berwick, Pennsylvania adjacent to the existing Susquehanna Steam Electric Station Units 1 and 2 (Figure ES-1). The site is approximately 115 mi northwest of Philadelphia, Pennsylvania. Cooling water for the plant would be obtained from the Susquehanna River. The BBNPP would use two natural draft cooling towers to transfer waste heat to the atmosphere. A portion of the water obtained from the Susquehanna River would be returned to the environment via a discharge structure located in the Susquehanna River downstream of the existing Susquehanna Steam Electric Station discharge structure. The remaining portion of the water would be released to the atmosphere via evaporative cooling.

(1) Waters of the United States" is used to include both "waters of the United States" as defined by Title 33 of the *Code of Federal Regulations* (CFR) Part 328 defining the extent of USACE geographic jurisdiction pursuant to Section 404 of the Clean Water Act and "navigable waters of the United States" as defined by 33 CFR Part 329 defining the extent of USACE geographic jurisdiction pursuant to Section 10 of the Rivers and Harbors Act of 1899.

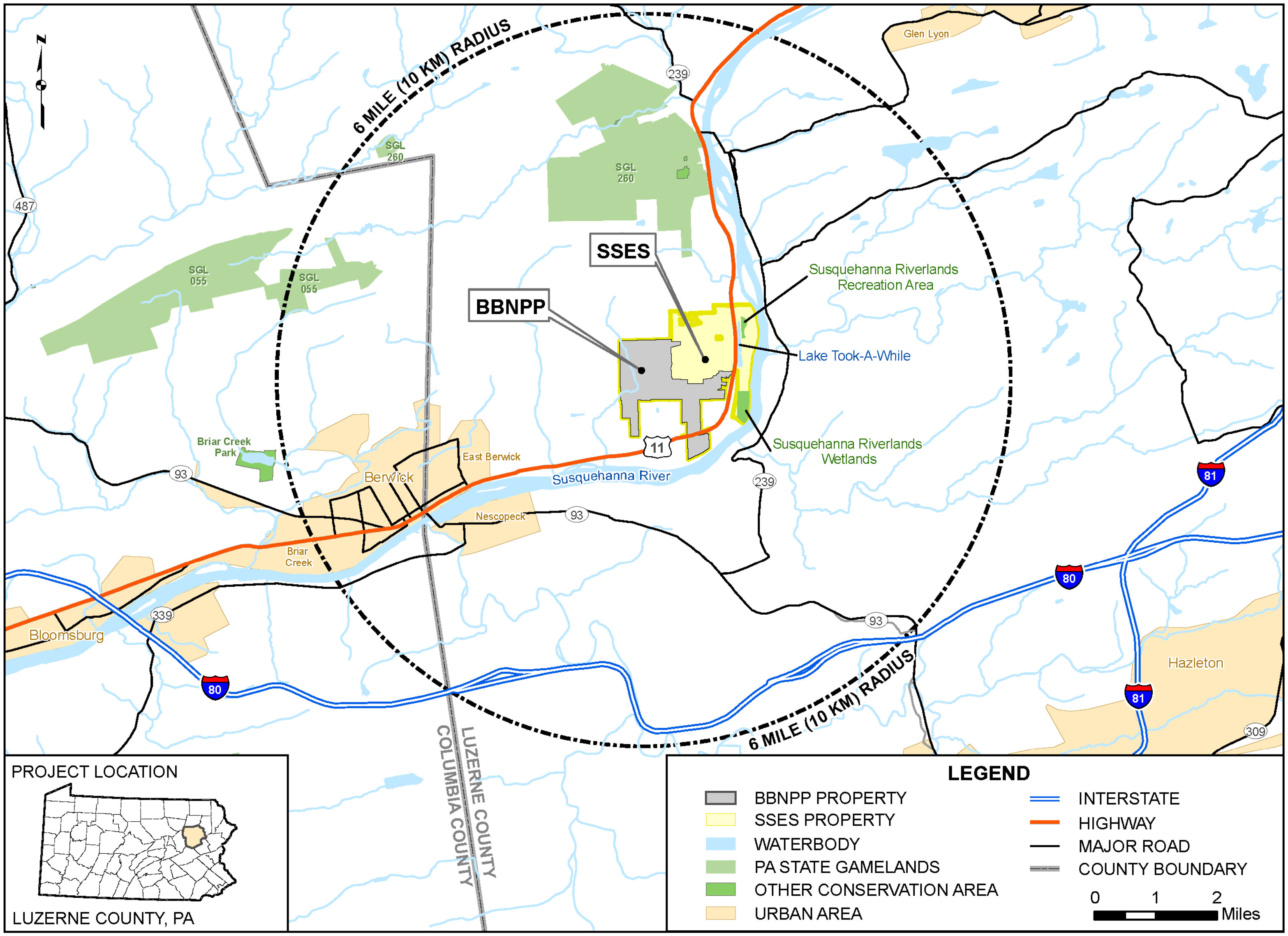

Figure ES-1. The BBNPP Site

During periods of low flow, PPL would rely on water released from Cowanesque Lake, located upstream from the BBNPP site near Tioga, Pennsylvania, to compensate for consumptive-water use. Releases from Cowanesque Lake during these periods would flow from the Cowanesque River into the Tioga River, and then into the Chemung River, which discharges to the North Branch of the Susquehanna River just south of the New York-Pennsylvania border.

Evaluation of Environmental Impacts

This EIS evaluates the potential environmental impacts of the construction and operation of a new nuclear plant related to the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface and groundwater
- waste (radiological and nonradiological)
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources
- fuel cycle, decommissioning, and transportation.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources. Table ES-1 summarizes construction and operation impacts. Table ES-2 summarizes the review team's assessment of cumulative impacts. The review team's detailed analysis which supports the impact assessment of the proposed new units can be found in Chapters 4, 5, and 7, respectively.

> **SMALL:** Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> **MODERATE**: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> **LARGE**: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Table ES-1. Environmental Impact Levels of the Proposed BBNPP Unit 1

Resource Category	Preconstruction and Construction	Operation
Land Use	SMALL	SMALL
Water-Related		
Water Use – Surface Water	SMALL	SMALL
Water Use – Groundwater Use	SMALL	SMALL
Water Quality – Surface Water	SMALL	SMALL
Water Quality – Groundwater	SMALL	SMALL

Table ES-1. (contd)

Resource Category	Preconstruction and Construction	Operation
Ecology		
Terrestrial Ecosystems	MODERATE (NRC-authorized construction impact level is small)	SMALL
Aquatic Ecosystems	SMALL	SMALL
Socioeconomic		
Physical Impacts	SMALL	SMALL
Demography	SMALL	SMALL
Economic Impacts on the Community	SMALL to MODERATE (beneficial)	SMALL to MODERATE (beneficial)
Infrastructure and Community Services	SMALL to MODERATE	SMALL
Environmental Justice[(a)]	NONE	NONE
Historic and Cultural Resources	SMALL	SMALL
Air Quality	SMALL	SMALL
Nonradiological Health	SMALL	SMALL
Nonradiological Waste	SMALL	SMALL
Radiological Health	SMALL	SMALL
Postulated Accidents	n/a	SMALL
Fuel Cycle, Transportation, and Decommissioning	n/a	SMALL

(a) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts to minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Table ES-2. Cumulative Impacts on Environmental Resources, Including the Impacts of the Proposed BBNPP

Resource Area	Cumulative Impact Level
Land Use	SMALL
Water-Related	
Water Use – Surface Water	MODERATE
Water Use – Groundwater	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	SMALL
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems	MODERATE to LARGE
Socioeconomic	
Physical impacts	SMALL to MODERATE
Demography	SMALL
Economic impacts on the community	SMALL to MODERATE (beneficial)

Table ES-2. (contd)

Resource Area	Cumulative Impact Level
Infrastructure and community services	SMALL to MODERATE
Environmental Justice[a]	NONE
Historic and Cultural Resources	SMALL
Air Quality	SMALL to MODERATE
Nonradiological Health	SMALL
Radiological Health	SMALL
Nonradiological Waste	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

(a) Refers to disproportionately high and adverse environmental or health impacts to any identified minority or low-income populations in the region.

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing a COL for a nuclear unit proposed for the BBNPP site. These alternatives included a no-action alternative (i.e., not issuing the COL) and alternative energy sources, siting locations, and system designs.

The no-action alternative would result in the COL not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of a new unit at the BBNPP site would not occur and the predicted environmental impacts would not take place. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the NRC staff's review of energy alternatives, the NRC staff concluded that, from an environmental perspective, none of the viable alternatives is clearly environmentally preferable to building a new baseload nuclear power generation plant at the BBNPP site. The NRC staff eliminated several energy sources (e.g., wind, solar, geothermal, and biomass) from full consideration because they are not currently capable of meeting the need of this project. None of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) was environmentally preferable to the proposed BBNPP unit.

After comparing the cumulative effects of a new nuclear power plant at the proposed site against those at the alternative sites, the NRC staff concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating a new nuclear power plant (Table ES-3). The three alternatives sites selected were as follows (Figure ES-2):

- Montour site, Montour County, Pennsylvania
- Humboldt site, Luzerne County, Pennsylvania
- Seedco site, Northumberland County, Pennsylvania.

Table ES-3. Comparison of Cumulative Impacts at the Proposed and Alternative Sites

Resource Area	Bell Bend[b]	Montour[c]	Humboldt[c]	Seedco[c]
Land Use	SMALL	MODERATE	MODERATE	MODERATE
Water Related				
Surface-Water Use	MODERATE	MODERATE	MODERATE	MODERATE
Surface-Water Quality	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater Use	SMALL	SMALL	SMALL	SMALL
Groundwater Quality	SMALL	SMALL	SMALL	SMALL
Ecology				
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic Ecosystems	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Socioeconomic[a]				
Physical impacts	SMALL except for MODERATE cumulative impacts from other planned road improvements	SMALL except for MODERATE cumulative impacts from other planned road improvements	SMALL except for MODERATE aesthetic impacts	SMALL except for MODERATE aesthetic impacts
Demography	SMALL	SMALL	SMALL	SMALL
Economic impacts on the community	SMALL and beneficial except for MODERATE and beneficial economic impacts on Columbia County and MODERATE and beneficial tax impacts on Salem Township and the Berwick Area School District	SMALL and beneficial except for MODERATE and beneficial economic impacts on Montour County and LARGE and beneficial tax impacts on Derry Township	SMALL except for MODERATE and beneficial economic impacts on Luzerne County and MODERATE and beneficial tax impacts on Hazle Township	SMALL except for MODERATE and beneficial economic impacts on Northumberland County and LARGE and beneficial tax impacts on Coal Township

Table ES-3. (contd)

Resource Area	Bell Bend[b]	Montour[c]	Humboldt[c]	Seedco[c]
Infrastructure and community services	SMALL except for MODERATE traffic impacts on area highways, MODERATE housing impacts in the Borough of Berwick, and MODERATE student impacts on the Berwick Area School District	SMALL except for MODERATE traffic impacts on area highways	SMALL except for MODERATE traffic impacts on area highways and MODERATE student impacts on the Hazleton Area School District	SMALL except for MODERATE traffic impacts on area highways and MODERATE student impacts on the Shamokin Area School District and the Mount Carmel Area School District
Environmental Justice[d]	NONE	NONE	NONE	NONE
Historic and Cultural Resources	SMALL	MODERATE to LARGE	SMALL	MODERATE to LARGE
Air Quality	SMALL for criteria pollutants to MODERATE for GHG emissions	SMALL for criteria pollutants to MODERATE for GHG emissions	SMALL for criteria pollutants to MODERATE for GHG emissions	SMALL for criteria pollutants to MODERATE for GHG emissions
Nonradiological Health	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

(a) Ranges indicate differences in counties.
(b) Cumulative impact determinations taken from Table 7-3 in the EIS.
(c) Cumulative impact determinations taken from Table 9-17 in the EIS.
(d) Refers to disproportionately high and adverse environmental or health impacts to any identified minority or low-income populations in the region.

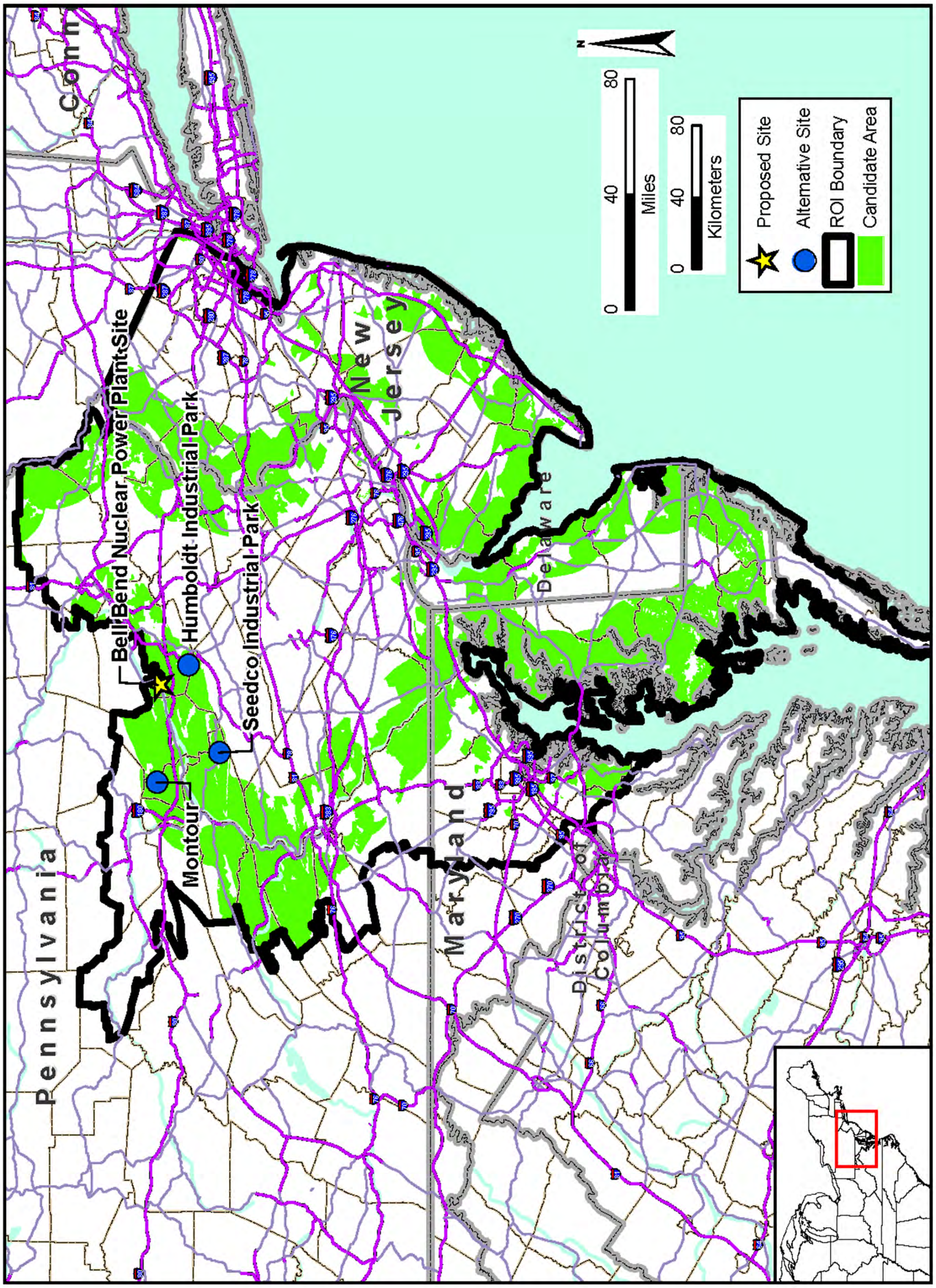

Figure ES-2. Location of Sites Considered as Alternatives to the BBNPP Site

Table ES-3 provides a summary of the cumulative impacts for the proposed and alternative sites. The NRC staff concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is clearly environmentally preferable.

Table ES-4 provides a summary of the EIS-derived impacts for a new nuclear power plant in comparison with the energy alternatives. The NRC staff concluded that none of the viable energy alternatives is clearly preferable to construction of a new baseload nuclear power-generating plant located within PPL's Region of Interest.

Table ES-4. Comparison of Environmental Impacts of a New Nuclear Power Plant and Energy Alternatives

Impact Category	Nuclear	Coal[(a)]	Natural Gas[(a)]	Combination of Alternatives[(a)]
Land Use	SMALL	LARGE	SMALL	MODERATE
Air Quality	SMALL for criteria pollutants SMALL incremental contribution to GHG emissions from BBNPP	MODERATE for criteria pollutants and for GHG emissions	SMALL for criteria pollutants MODERATE for GHG emissions	SMALL for criteria pollutants MODERATE for GHG emissions
Water Use and Quality	SMALL	SMALL	SMALL	SMALL
Ecology	MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Waste Management	SMALL	MODERATE	SMALL	SMALL
Socioeconomics (except Taxes and Economy)	SMALL to MODERATE Adverse	SMALL to MODERATE Adverse	SMALL Adverse	SMALL Adverse
Socioeconomics (Taxes and Economy)	MODERATE Beneficial	MODERATE Beneficial	MODERATE Beneficial	MODERATE Beneficial
Human Health	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL
Environmental Justice	NONE	NONE	NONE	NONE

(a) Impacts taken from Table 9-4 in the EIS. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4, 5, and Sections 6.1, and 6.2.

The NRC staff considered various alternative systems designs, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed BBNPP systems design.

Benefits and Costs

The review team compiled and compared the pertinent analytical conclusions reached in the EIS. It gathered all of the expected impacts from building and operating the proposed BBNPP and aggregated them into two final categories: (1) expected environmental costs and (2) expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of the section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of the proposed BBNPP, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of the proposed BBNPP.

Public Involvement

A 60-day scoping period was held from January 6, 2009 through March 9, 2009. On January 22, 2009, the NRC held two public scoping meetings in Berwick, Pennsylvania. In addition, a supplemental scoping period specific to the relocated power-block footprint was held from June 15, 2012 through July 16, 2012. The review team received oral comments during the public meetings and a total of 15 e-mails and 10 letters from both scoping periods on topics such as surface-water hydrology, ecology, socioeconomics, uranium fuel cycle, energy alternatives, and benefit-cost balance.

Once the draft EIS is published, the U.S. Environmental Protection Agency will issue a Notice of Availability in the *Federal Register*, which will begin a 75-day comment period for the public to submit comments on the results of the staff's environmental review. There are several ways to submit comments, which will be outlined in the *Federal Register* Notice. During the comment period, the NRC will hold public meetings near the BBNPP site to describe the results, respond to questions, and accept public comments.

Recommendation

The NRC's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the COL should be issued.

This recommendation is based on the following:

- the application, including the ER submitted by PPL
- consultation with Federal, State, Tribal, and local agencies
- site audits and alternative site audits
- consideration of public comments received during scoping
- the review team's independent review and assessment summarized in this draft EIS.

The NRC's determination is independent of the USACE's determination of whether to issue, deny, or issue with modifications the DA permit application for the Bell Bend Nuclear Power Plant. The USACE will conclude its Clean Water Act Section 404(b)(1) Guidelines and public interest analyses in its Record of Decision.

Abbreviations/Acronyms

7Q10	7-day average low flow that occurs on average once every 10 years
A.M.	ante meridian
ac	acre(s)
ac-ft	acre-feet
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
APE	Area of Potential Effect
AREVA	AREVA NP, Inc.
AVP	Wilkes-Barre/Scranton International Airport
BACT	best available control technology (
BAQ	Bureau of Air Quality
BBNPP	Bell Bend Nuclear Power Plant
BBS	(North American) Breeding Bird Survey
BEA	U.S. Bureau of Economic Analysis
BMP	best management practices
CAES	compressed air energy storage
CAIR	Clean Air Interstate Rule
CDF	core damage frequency
CED	Commission on Economic Development
CFR	*Code of Federal Regulations*
Ci	curie(s)
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COL	combined construction permit and operating license
CRGIS	Cultural Resources Geographic Information System
CUMP	Consumptive-Use Mitigation Plan
CWA	Clean Water Act
CWS	circulating-water system
d	day(s)
dB	decibel(s)
dBA	decibels on the A-weighted scale
DBA	design basis accidents
DBH	diameter at breast height

DEIS	draft environmental impact statement
DCD	design control document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DRBC	Delaware River Basin Commission
EAB	exclusion area boundary
EDG	emergency diesel generators
EIA	Energy Information Agency
EIS	environmental impact statement
EIT	earned income tax
EJ	environmental justice
EMA	Emergency Management Agency
EMF	electromagnetic fields
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESE	east-southeast
ESRP	Environmental Standard Review Plan
ESWEMS	Essential Service Water Emergency Makeup System
ESWS	Essential Service Water System
FE	Federally endangered
FERC	Federal Energy Regulatory Commission
FSAR	Final Safety Analysis Report
FWS	U.S. Fish and Wildlife Service
GAI	GAI Consultants, Inc.
GEIS	generic environmental impact statement
GHG	greenhouse gas
gpd	gallons per day
GW	gigawatt
HLW	high-level waste
HOP	highway occupation permit
HUD	U.S. Department of Housing and Urban Development
Hz	Hertz
I	(U.S.) Interstate
IAEA	International Atomic Energy Agency
IBA	Important Bird Area
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined-cycle
ISFSI	Independent Spent Fuel Storage Installation

kg/ha/mo	kilograms per hectare per month
Kh	horizontal hydraulic conductivity
KLD	KLD Associates, Inc. or KLD Engineering, P.C.
kV	kilovolt(s)
L_{90}	sound level exceeded 90 percent of the time (the residual sound level or background level)
lb	pound(s)
LEDPA	least environmentally damaging practicable alternative
L_{eq}	equivalent continuous sound level
LLRWHF	Low Level Radioactive Waste Handling Facility
LLW	low-level waste
LOS	level of service
LPZ	low-population zone
LST	local services tax
mA	milliampere(s)
MACCS	MELCOR Accident Consequences Code System
MEI	maximally exposed individual
Mgd	million gallons per day
mi	mile(s)
MMBtu	million British thermal units
MOA	Memorandum of Agreement
mph	mile(s) per hour
MSA	Metropolitan Statistical Area
MSES	Montour Steam Electric Station
msl	mean sea level
MT	metric tons
MTU	metric ton(nes) uranium
NAAQS	National Ambient Air Quality Standard
NAVD	North American Vertical Datum
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NGCC	natural-gas combined-cycle
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places

NY	New York
NYDEC	New York State Department of Environmental Conservation
NYNHP	New York Natural Heritage Program
O_3	ozone
ODCM	Offsite Dose Calculation Manual
ODNR	Ohio Department of Natural Resources Division of Wildlife
OSHA	Occupational Safety and Health Administration
P.M.	post meridian
PA	Pennsylvania
PADEP	Pennsylvania Department of Environmental Protection
PADLI	Pennsylvania Department of Labor and Industry
PaGWIS	Pennsylvania Groundwater Information System
PAWC	Pennsylvania American Water Company
Pb	lead
PCB	polychlorinated biphenyl
PDCNR	Pennsylvania Department of Conservation and Natural Resources
PennDOT	Pennsylvania Department of Transportation
PE	Proposed Federally endangered
PEM	palustrine forested (wetland)
PFBC	Pennsylvania Fish and Boat Commission
PFO	palustrine forested (wetland)
PGC	Pennsylvania Game Commission
PHMC	Pennsylvania Historical and Museum Commission
PJM	Pennsylvania, New Jersey, Maryland Interconnection, LLC
PM_{10}	particulate matter smaller than 10 micrometers in size
PM	particulate matter
$PM_{2.5}$	particulate matter smaller than 2.5 micrometers in size
PNHP	Pennsylvania Natural Heritage Program
PNNL	Pacific Northwest National Laboratory
PPL	Pennsylvania Power & Light
PPL Bell Bend, LLC	Pennsylvania Power & Light Bell Bend, LLC
PPUC	Pennsylvania Public Utility Commission,
PRA	probabilistic risk assessment
PSS	palustrine scrub-shrub (wetland)
RAI	Request(s) for Additional Information
RCRA	Resource, Conservation, and Recovery Act
REMP	radiological environmental monitoring program
RFC	ReliabilityFirst Corporation
RFI	request for information

RG	Regulatory Guide
RHAA	Rivers and Harbors Appropriation Act of 1899
RIMS II	Regional Input-Output Modeling System
ROI	region of interest
ROW	right(s)-of-way
RPS	Renewables Portfolio Standard
RV	recreational vehicle
Ryr	reactor year
SACTI	Seasonal and Annual Cooling Tower Impacts
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SBO	Station Blackout
SE	State endangered
SFY	State fiscal year
SHPO	State Historic Preservation Office (or Officer)
SIP	State Implementation Plan
SO_2	sulfur dioxide
SR	State Route
SRBC	Susquehanna River Basin Commission
SREP	Susquehanna Riverlands Environmental Preserve
SSES	Susquehanna Steam Electric Station
SWPPP	stormwater pollution prevention plan
T	ton(s)
TEDE	total effective dose equivalent
TIS	traffic impact study
TLD	thermoluminescent dosimeter
TRAGIS	Transportation Routing Analysis Geographic Information System
U.S. EPR	U.S. Evolutionary Power Reactor
U.S.C	United States Code
US 11	U.S. Highway 11
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
WSW	west-southwest

1.0 Introduction

By letter dated October 10, 2008 (PPL Bell Bend 2008-TN393), the PPL Bell Bend, LLC (PPL) applied to the U.S. Nuclear Regulatory Commission (NRC or the Commission)) for a combined construction permit and operating license (combined license or COL) for the proposed Bell Bend Nuclear Power Plant (BBNPP) (COL application).The NRC review team's evaluation of the environmental impacts of the proposed action is based on the April 12, 2013 revision of the COL application (PPL Bell Bend 2013-TN3447), including the Environmental Report (ER) (PPL Bell Bend 2013-TN3377), responses to requests for additional information, and supplemental information. Documents supporting the review team's evaluation are listed as references where appropriate.

The site proposed by PPL for one new nuclear unit is the BBNPP site in Salem Township, Luzerne County, Pennsylvania, approximately 115 mi northwest of Philadelphia, Pennsylvania (PPL Bell Bend 2013-TN3377). The location is adjacent to the west boundary of SSES Units 1 and 2, and near the west bank of the North Branch of the Susquehanna River. In its application, PPL specified the reactor design as AREVA NP Inc.'s (AREVA's) U.S. Evolutionary Power Reactor (U.S. EPR) design (PPL Bell Bend 2013-TN3377).

On June 30, 2011, PPL submitted a joint Federal/State Application (referenced as a Joint Permit Application) for a Pennsylvania Water Obstruction and Encroachment Permit and a U.S. Army Corps of Engineers (USACE) Section 404/Section 10 Permit to the USACE and the Pennsylvania Department of Environmental Protection. The USACE application number is CENAB-OP-RPA-2008-01401-P13 and the Pennsylvania Department of Environmental Protection Application number is E40-720. Revision 2 of the Joint Permit Application was received on November 23, 2011, and the review team's evaluation is based on this revision.

PPL's application for proposed BBNPP seeks (1) NRC issuance of a COL for construction and operation of one power reactor at the BBNPP site, and (2) USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act), as amended, 33 USC 1251 et seq. (TN662) and Section 10 of the Rivers and Harbors Appropriation Act of 1899, (33 USC 403 et seq.-TN660) to perform certain construction and preconstruction activities on the site. The USACE is participating in the preparation of this environmental impact statement (EIS) as a cooperating agency and the information contained in the EIS will be used to adequately fulfill the requirements of the USACE regulations and Clean Water Act Section 404(b)(1) Guidelines (hereafter referred to as 404(b)(1) Guidelines) (40 CFR Part 230-TN427). The USACE has the authority to issue permits for proposed work or structures in, over, or under, navigable waters and the discharge of dredged, excavated, and/or fill material into waters of the United States. The USACE would regulate activities that would temporarily or permanently affect jurisdictional wetlands and waterbodies involved in this project. The COL and Department of the Army Individual Permit applications and the NRC and USACE review processes are described in Section 1.1.1.

1.1 Background

The granting of a COL is Commission approval of the construction and operation of a nuclear power facility. The NRC regulations related to COLs are primarily found primarily in Title 10 of the *Code of Federal Regulations* (CFR) Part 52, Subpart C (TN251).Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.-TN661) requires the preparation of EIS for a major Federal actions that significantly affects the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51 (TN250). Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 (TN251) is an action that requires an EIS.

According to 10 CFR 52.80(b) (TN251), a COL application must contain an ER. The ER provides the applicant's input to the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51 (TN250). PPL's ER, which was included as Part 3 of the application, provides a description of the proposed actions related to the application and PPL's analysis of the potential environmental impacts of construction and operation of the proposed nuclear unit.

1.1.1 Application and Review

The purpose of the PPL application is to obtain a COL to construct and operate a baseload nuclear power plant. In addition to the COL, PPL must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of PPL's requested USACE action is to obtain a Department of the Army Individual Permit to construct the BBNPP, which proposes structures in, over, or under navigable waters and to discharge dredged, excavated, and/or fill material into waters of the United States, including jurisdictional wetlands. Collectively, the NRC staff (including its contractor staff at Pacific Northwest National Laboratory and Numark Associates, Inc.) and USACE staff who reviewed the ER and decided on impact levels are referred to as the "review team" throughout this EIS. Individual contributors to this EIS are listed in Appendix A.

1.1.1.1 NRC COL Application Review

PPL's ER focuses on the environmental effects of constructing and operating one U.S. EPR reactor. The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81 (TN251). Detailed procedures for conducting the environmental portion of the review are listed in in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (NRC 2000-TN614) and recent updates. Additional guidance on conducting environmental reviews is provided in NRC Interim Staff Guidance COL/ESP-ISG-026 *Environmental Issues Associated with New Reactors* (NRC 2014-TN3767).

In this EIS, the review team evaluates the environmental effects of constructing and operating a U.S. EPR reactor with a thermal power rating of 4,950 MW(t) at the BBNPP site. In addition to considering the environmental effects of the proposed action, this EIS addresses alternatives to the proposed action, including the no-action alternative and the building and operation of new reactor at alternative sites. The benefits of the proposed action (e.g., meeting an identified need for power) and measures and controls to limit adverse impacts are also evaluated. PPL's proposed action to construct and operate a new nuclear unit includes exemptions and departures from the U.S. EPR Design Control Document requested by PPL in Part 7 of its application. The environmental impacts of the requested departures are addressed in this EIS. The technical analysis for each design certification departure will be included in the NRC's Final Safety Evaluation Report including a recommendation for approval or denial of each departure.

By letter dated December 19, 2008, the NRC notified PPL that its application was accepted for docketing (NRC 2008-TN3615). Docket number 52-039 was established for the proposed unit. After acceptance of PPL's application, the NRC began the environmental review process by publishing in the *Federal Register* on January 6, 2009 a Notice of Intent to prepare an EIS and conduct scoping (74 FR 470-TN1785), in compliance with requirements set forth in 10 CFR Part 51. On January 29, 2009, the NRC held two public scoping meeting in Berwick, Pennsylvania, to obtain public input on the scope of the environmental review. On March 30, 2012, PPL submitted a revised ER, in accordance with 10 CFR 51.45 and 51.50 (TN250), to provide detailed information regarding the revised site layout developed to avoid wetland impacts by relocating the power-block footprint (PPL Bell Bend 2012-TN1169). On June 15, 2012, NRC published a Notice of Intent to conduct supplemental scoping on the revised site layout (77 FR 14759-TN1786). During both the initial and the supplemental scoping periods, the NRC staff also contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the agencies and organizations contracted is provided in Appendix B. Correspondence between NRC and the Federal, State, Tribal, regional, and local agencies is included in Appendix C. The NRC staff reviewed the comments received during both scoping processes and responses were written for each comment. Comments within the scope of the NRC environmental review and their associated responses are included in Appendix D. The scoping comments and responses are also documented in the *Bell Bend Nuclear Power Plant Combined License Scoping Summary Report* (NRC 2009-TN1787) and the *Scoping Summary Report Related to the Environmental Scoping Process for the Bend Nuclear Power Plant Combined License Application* (NRC 2014-TN3651).

To gather information and to become familiar with the sites and their environs, the review team visited the BBNPP site in April and May 2009, in May 2012, and in March 2014; the Montour, Martins Creek, and Sandy Bend alternative sites in March, April, and May 2009; the Montour, Humboldt, and Seedco alternative sites in June 2010; and the Cowanesque and Rushton Mine consumptive-use mitigation water source sites in March 2014. During visits to the BBNPP and alternative sites, the review team met with PPL staff and its contractors; Federal, State, regional and local public officials; and the public. Documents related to the BBNPP site and alternative sites were reviewed and are listed as references herein where appropriate.

To guide its assessment of the environmental impacts of the proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27-TN428). Table B-1 of 10 CFR Part 51 (TN250), Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC—SMALL, MODERATE, and LARGE:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the BBNPP site, including the environmental impacts associated with constructing and operating a nuclear reactor at the BBNPP site, the impacts of construction and operation of a nuclear reactor at alternative sites, the environmental impacts of alternatives to granting the COL, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's preliminary recommendation to the Commission regarding the issuance of the COL for the proposed unit at the BBNPP site.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency (EPA) Notice of Filing of the draft EIS to allow members of the public to comment on the results of the review. Two public meetings will be held near the site during the public comment period. These meetings will also serve as the USACE public hearings to acquire information or evidence that will be considered in evaluating a proposed Department of the Army Individual Permit. During these public meetings, members of the review team will describe the results of the environmental review, provide members of the public with information to assist them in formulating comments on the draft EIS, respond to questions, and accept comments. After the comment period, the review team will consider all of the comments and address the substantive, in-scope comments in the final EIS.

1.1.1.2 USACE Permit Application Review

The USACE is a cooperating agency, with the NRC serving as the lead agency in the development of this EIS, and participates as a member of the review team. In carrying out its regulatory responsibilities, the USACE will complete an independent evaluation of the applicant's Joint Permit Application to determine whether to issue or deny a Department of the Army Individual Permit for this project. This decision will be documented in USACE's Record of Decision, which will be issued after publication of the final EIS.

USACE's Record of Decision will reference information in the EIS and present any additional information required by the USACE to support its permit decision. USACE's role as a cooperating agency in the preparation of this EIS is intended to ensure the information presented in the EIS is adequate to fulfill the requirements of USACE regulations and the 404(b)(1) Guidelines (40 CFR Part 230-TN427) to construct the preferred alternative identified in the EIS. The 404(b)(1) Guidelines contain the substantive environmental criteria used by USACE in evaluating discharges of dredged or fill material into waters of the United States. USACE's Public Interest Review (33 CFR 320.4-TN424) directs the USACE to consider a number of factors as part of a balanced evaluation process. Both the USACE's 404(b)(1) Guidelines (40 CFR Part 230-TN427) and the Public Interest Review process will be part of its permit decision document and will not be addressed in this EIS.

The 404(b)(1) Guidelines (40 CFR Part 230-TN427) stipulate that no discharge of dredged or fill material into a waters of the United States (including jurisdictional wetlands) shall be permitted if there is a practicable alternative that would have less adverse impact on the aquatic environment, so long as the alternative does not have other significant adverse environmental consequences. Even if an applicant's preferred alternative is determined to be the least environmentally damaging practicable alternative (LEDPA), the USACE must still determine whether the LEDPA is in the public interest. The USACE Public Interest Review, described in 33 CFR 320.4 (TN424), directs the USACE to consider a number of factors in a balancing process. A permit may not be issued for an alternative that is not the LEDPA, nor will a permit be issued for an activity that is determined to be contrary to the public interest.

In this EIS, the USACE evaluates certain preconstruction, construction, and maintenance activities in the waters of the United States, including jurisdictional wetlands that would be impacted by the proposed project. The USACE decision will reflect the national concern for both protection and utilization of important resources. The benefit, which reasonably may be expected to accrue from the proposal, must be balanced against its reasonably foreseeable detriments. Factors that may be relevant to the proposal will be considered (e.g., conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, cumulative impacts thereof, and, in general, the needs and welfare of the people). Evaluation of the impact on the public interest will include application of the 404(b)(1) Guidelines promulgated by the Administrator, U.S. Environmental Protection Agency, under authority of Section 404(b) of the Clean Water Act (40 CFR Part 230-TN427). The USACE will address all of these issues in its permit decision document.

As part of the its public comment process, the USACE released a public notice on January 23, 2012, to solicit comments from the public; Federal, State, Tribal, regional, and local agencies; and other interested parties to consider and evaluate the impacts of PPL's proposed project (USACE 2012-TN265). Upon release of the draft EIS, the USACE will issue a second public notice, which will include notification for a public hearing.

The USACE will not have completed its evaluation of the proposed project until it fully considers the recommendations of the Federal, State, and local resource agencies and members of the public, assesses the cumulative impact of the total project, and completes the following consultations and coordination efforts: Section 106 of the National Historic Preservation Act (54 USC 300101 et seq. -TN4157); Section 7 of the Endangered Species Act (16 USC 1531 et seq.-TN1010); and Pennsylvania State Water Quality Certifications.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations for Nuclear Power Plants" (72 FR 57416-TN260), the Commission limited the definition of "construction" to those activities within its regulatory purview in 10 CFR 51.4 (TN250). Many of the activities required to construct a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the review of a COL application, or after a COL is granted. Although preconstruction activities are outside of NRC's regulatory authority, nearly all of them are within the regulatory authority of local, State, or other Federal agencies.

Because the preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities that require permits from USACE are considered to have direct effects related to its Federal permitting decision. Chapter 4 describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.3 Cooperating Agencies

NEPA lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have special expertise regarding an environmental issue or jurisdiction by law. These other agencies, referred to as "cooperating agencies," are responsible for assisting the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis and by making staff support available as needed by the lead agency.

In addition to a license from the NRC, most proposed nuclear power plants require a permit from USACE when impacts on waters of the United States are proposed. Therefore, the NRC and the USACE concluded that the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and USACE signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (USACE and NRC 2008-TN637). On December 28, 2008, the USACE became a cooperating agency during the review of the combined license application for BBNPP. Therefore, the Baltimore District of USACE is participating as a cooperating agency as defined in 10 CFR 51.14 (TN250).

As described in the MOU, the NRC is the lead Federal agency, and the USACE is a cooperating agency in the development of the EIS for the proposed BBNPP unit. Under Federal law, each agency has jurisdiction related to portions of the proposed project as major Federal actions that could significantly affect the quality of the human environment. The goal of this cooperative agreement is the development of one EIS that serves the needs of the NRC license decision process and the USACE permit decision process. While both agencies must meet the requirements of NEPA, the NRC and the USACE have additional mission requirements that must be met. The NRC makes license decisions under the Atomic Energy Act of 1954 (42 USC 2011 et seq.-TN663), and the USACE makes permit decisions under Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662), and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403 et seq.-TN660). The USACE is cooperating with NRC to ensure to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of USACE regulations; 404(b)(1) Guidelines, which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE Public Interest Review process.

As a cooperating agency, USACE is part of the NRC review team and is involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. The NRC public meeting with the USACE serves the dual purpose of both agencies with the USACE referring to the NRC-defined public meeting as its public hearing. The USACE district engineer or designee may participate in joint public hearings in accordance with 33 CFR Part 327 (TN1788) with other Federal or State agencies, provided the procedures of those hearings meet the requirements of this regulation. In those cases in which other Federal or State agencies allows cross-examination in their public hearings, the district engineer may still participate in the joint public hearing, but shall not require cross-examination as a part of his participation.

For the purpose of assessing environmental impacts under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1 of this EIS. This approach was vetted by the Council on Environmental Quality when the NRC established its environmental review framework for the renewal of operating licenses. However, for permit decisions under Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662), USACE can only permit the LEDPA and must address public interest factors. The EIS is intended to provide information to support the USACE permitting decision, as will be documented in USACE's Record of Decision. The goal of the process is for USACE to have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the USACE will need additional information from the applicant to complete the permit documentation; for example, information that the applicant could not make available by the time the final EIS is issued. In addition, any conditions required by the USACE (e.g., compensatory mitigation) will be addressed in the USACE permit, if issued. Mitigation may only be employed after all appropriate and practical steps to avoid and minimize adverse impacts to aquatic resources, including wetlands and streams, have been taken. All remaining unavoidable resources must be compensated to the extent appropriate and practicable. The USACE permit, if issued, would include special conditions that the applicant must confirm the created and enhanced wetlands meet the Federal wetland criteria outlined in the report *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, dated January 2012 (USACE 2012-TN3809), in accordance with "Compensatory Mitigation for Losses of Aquatic Resources; Final Rule," as published in April 10, 2008, *Federal Register*, Vol 73, No. 70, Pages 19594 – 19705 (33 CFR Part 332-TN1472). If the USACE does not find the wetland and stream mitigation satisfactory, it would determine if adverse impacts to the waterway and wetlands are more than minimal and if any project modification would be warranted. Further, PPL would assume all liability for accomplishing the corrective work.

1.1.4 Concurrent NRC Reviews

In reviews that are separate but parallel to the EIS process, the NRC staff analyzes the safety characteristics of the proposed site and emergency planning information. These analyzes are documented in a Safety Evaluation Report (SER) issued by NRC. The SER presents the conclusions reached by NRC regarding (1) whether there is reasonable assurance that one U.S. EPR reactor can be constructed and operated at the BBNPP site without undue risk to the health and safety of the public; (2) whether the PPL emergency preparedness program for BBNPP meets the applicable requirements in 10 CFR Part 50 (TN249), 10 CFR Part 52 (TN251), 10 CFR Part 73 (TN423), and 10 CFR Part 100 (TN282); and (3) whether site characteristics are such that adequate security plans and measures referenced in the regulations identified above can be developed.

The reactor design referenced in PPL's COL application is the U.S. EPR, which is undergoing design certification review separately from the EIS process (NRC 2014-TN3964). Subpart B of 10 CFR Part 52 (TN251) contains NRC regulations related to standard design certification. An application for a standard design certification undergoes an extensive review. If the final design is different from the design considered in the EIS, the staff will determine whether the changes are significant enough to warrant an additional environmental review.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52 (TN251), of a COL authorizing the construction and operation of one new U.S. EPR reactor at the BBNPP site. This EIS provides the NRC staff's analyses of the environmental impacts that could result from building and operating a new unit at the BBNPP site or at one of three alternative sites. These impacts are analyzed by the NRC staff to determine whether the proposed site is suitable for one new unit and whether any of the alternative sites are considered to be obviously superior to the proposed site.

The proposed USACE Federal action is a permit decision on a Department of the Army Individual Permit application pursuant to Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662) and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403 et seq.-TN660). If issued, the USACE permit would authorize the impact to waters of the United States, including jurisdictional wetlands, for the construction of the BBNPP and various associated, integral project components, including construction of the cooling-water intake system (including intake and blowdown pipelines), grading around the power block, creating access roads, expanding the existing SSES switchyard, and constructing a new 500-kV transmission line onsite from the BBNPP to the switchyard.

1.3 The Purpose and Need for the Proposed Action

1.3.1 NRC's Proposed Action

The purpose and need for the proposed action, authorization of the construction and operation of a U.S. EPR at the BBNPP site, is to generate 1,600 MW(e) of electricity (baseload power) for sale (PPL Bell Bend 2013-TN3377) with commercial operation starting June 2025 (PPL Bell Bend 2014-TN3625). Chapter 8 of this EIS evaluates the need for additional baseload power. Chapter 9 of the EIS discusses the alternatives to the proposed action, including the no-action alternative.

A license from the NRC to construct and operate nuclear power plants is necessary for the construction and operation of the power plant. Preconstruction and certain long-lead-time activities (e.g., ordering and procuring certain components and materials necessary to construct the plant) may begin before the COL is granted. PPL must obtain and maintain permits or authorizations from other Federal, State, and local agencies and permitting authorities prior to undertaking certain activities. The ultimate decision whether or not to build a facility and the schedule is not within the purview of the NRC or the USACE and would be determined by the license holder if the authorization is granted.

1.3.2 The USACE Permit Action

The PPL permit application to the USACE is for work to prepare the site and construct support facilities for a new nuclear power plant adjacent to existing SSES Units 1 and 2. Defining the project purpose is critical to the evaluation of any project and in evaluating compliance with the 404(b)(1) Guidelines (40 CFR Part 230-TN427). The 404(b)(1) Guidelines and subsequent 404(q) guidance require that the USACE define both the basic and the overall project purpose to ensure appropriate consideration of alternatives.

The basic purpose is the most simple or irreducible purpose of the project and is used to determine whether the applicant's project is "water dependent" (Section 230.10(a)(3)). The water-dependency test contained in the 404(b)(1) Guidelines creates a presumption that activities that do not require access or proximity to or siting within special aquatic sites to fulfill their basic project purpose are not water dependent. Therefore, the 404(b)(1) Guidelines state that practicable alternatives to non-water-dependent activities are presumed to exist, are less damaging, and are environmentally preferable to alternatives that involve discharges into special aquatic sites (e.g., wetlands and riffle pool complexes) (40 CFR 230.10(a)(3) [TN427]).

The basic project purpose for the project is to generate electricity for additional baseload capacity. Constructing facilities to create energy supplies are not water-dependent activities, and in accordance with the 404(b)(1) Guidelines, practicable alternatives which do not involve discharges into special aquatic sites are presumed to exist unless clearly demonstrated otherwise (40 CFR 230.10(a)(3) [TN427]).

In addition to defining the basic project purpose, the USACE must also define the overall project purpose. The overall project purpose establishes the scope of the alternatives analysis and is used for evaluating practicable alternatives under the 404(b)(1) Guidelines. In accordance with the 404(b)(1) Guidelines and USACE Headquarters guidance (USACE 1989-TN2365), the overall project purpose must be specific enough to define the applicant's needs, but not so narrow and restrictive as to preclude a proper evaluation of alternatives. The USACE is responsible for controlling every aspect of the 404(b)(1) Guidelines analysis. In this regard, defining the overall project purpose for issuance of USACE permits is the sole responsibility of the USACE. While generally focusing on the applicant's statement, the USACE will, in all cases, exercise independent judgment in defining the purpose and need for the project from both the applicant's and the public's perspective.

The overall purpose of the project is to provide 1,600 MW(e) of additional nuclear baseload electrical power to the northeast portion of the Pennsylvania, New Jersey, and Maryland Regional Transmission Organization grid. The USACE concurs with the stated project purpose and long-term need to generate electricity to meet the growing demand in eastern Pennsylvania and in Delaware, Maryland, New Jersey, and Virginia.

1.4 Alternatives to the Proposed Action

Section 102(2)(C)(iii) of NEPA (42 USC 4321 et seq.-TN661) states that EIS to include a detailed statement on alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including a chapter in the EIS that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A [TN250]). Chapter 9 of this EIS addresses the following five categories of alternatives to the proposed action: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, (4) system design alternatives, and (5) onsite alternatives to reduce impacts on waters of the United States, including jurisdictional wetlands and natural and cultural resources.

In the no-action alternative, the proposed action would not go forward. The NRC could deny PPL's application for a COL. The no-action alternative or permit denial alternatives also are available to the USACE. The no-action alternative is one which results in no construction requiring a Department of the Army Individual Permit. It may be brought by (1) the applicant electing to modify its proposal to eliminate work under the jurisdiction of the USACE or (2) by the denial of the permit. If the request and/or permit were denied, the construction and operation of a new nuclear generating unit at the BBNPP site would not occur and any benefits intended by an approved COL would not be realized. Energy source alternatives focus on those alternatives that could generate baseload power. The alternative selection process used to determine alternate site locations for comparison with the BBNPP site is addressed below. System design alternatives include heat-dissipation and circulating-water systems; intake and discharge structures; and water-use and water-treatment systems. Finally, onsite alternatives evaluated by the USACE to reduce potential impacts on waters of the United States, including jurisdictional wetlands and cultural and natural resources, are described in Appendix J. In its ER, PPL defines a region of interest for use in identifying and evaluating potential sites for power generation. The staff used reconnaissance-level information to evaluate the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of new power reactors at those sites. The alternative sites include one greenfield site, owned by PPL directly adjacent to the existing Montour coal-fired power plant in Derry Township, Pennsylvania, and two brownfield sites on privately held land, the Humboldt site in Luzerne and Schuylkill Counties and the Seedco site in Northumberland County (PPL Bell Bend 2013-TN3377). The objective of the comparison of environmental impacts is to determine if any of the alternative sites are obviously superior to the BBNPP site.

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662), the USACE is required by regulation to apply the criteria set forth in the 404(b)(1) Guidelines (40 CFR Part 230-TN427). These 404(b)(1) Guidelines establish criteria that must be met in order for the proposed activities to be permitted pursuant to Section 404. Specifically, these 404(b)(1) Guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences [40 CFR 230.10(a) (TN427)]. An area not presently owned by the applicant, which could reasonably be obtained, used, expanded or managed in order to fulfill the basic purpose of the proposed activity, may be considered if it is otherwise a practicable alternative.

1.5 Compliance and Consultations

PPL is required to hold certain Federal, State, and local environmental permits and to meet applicable statutory and regulatory requirements before building and operating a new unit. In its ER, PPL provided a list of environmental approvals and consultations associated with the proposed U.S. EPR design (PPL Bell Bend 2013-TN3377). Potential authorizations and consultations relevant to the proposed COL are included in Appendix H. In the development of this EIS, the NRC contacted the appropriate Federal, State, Tribal, and local agencies to identify any consultation, compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the BBNPP site for building and operating the U.S. EPR reactor. A chronology of the correspondence is provided in Appendix C. A list of key consultation correspondence is provided in Appendix F along with a biological assessment for the northern long-eared bat and the Indiana bat.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the proposed nuclear reactor unit. Chapter 3 describes the power plant layout, structures, and activities related to building and operation that are used as the basis for evaluating the environmental impacts Chapters4 and 5 separately examine the respective environmental impacts of building and operating the proposed nuclear reactor unit. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning. Chapter 7 examines the cumulative impacts of the proposed action as defined in 40 CFR Part 1508 (TN428). Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action; analyzes alternative energy sources, sites and system design; and compares the proposed action with these alternatives. Chapter 10 summarizes the findings of the preceding chapters and provides a benefit – cost evaluation; it also presents the NRC staff's preliminary recommendation with respect to the Commission's approval of the proposed site for COL based on the evaluation of environmental impacts.

The appendices to the EIS provide the following additional information:

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B– Organizations Contacted
- Appendix C– NRC and USACE Environmental Review Correspondence
- Appendix D – Scoping Comments and Responses
- Appendix E – Draft Environmental Impact Statement Comments and Reponses
- Appendix F – Key Consultation Correspondence
- Appendix G – Supporting Documentation on Radiological Dose Assessment
- Appendix H – Authorizations and Consultations
- Appendix I – Greenhouse Gas Footprint Estimates for a 1,000 MW(e) Reference Reactor

- Appendix J – PPL Bell Bend, LLC Least Environmentally Damaging Practicable Alternative Onsite and Offsite
- Appendix K – PPL Bell Bend, LLC Mitigation Plan Summary for Wetland and Stream Impact
- Appendix L – PPL's Responses to Comments Received by the U.S. Army Corps of Engineers from the Public Notice
- Appendix M – Severe Accident Mitigation Alternatives

References for sources cited in the narrative are located at the end of each volume of this EIS. Appendix references are found in the final sections of the applicable appendices.

2.0 Affected Environment

The site proposed by PPL Bell Bend, LLC (PPL) for the proposed Bell Bend Nuclear Power Plant (BBNPP) is a greenfield site near Berwick, in Salem Township, Luzerne County, Pennsylvania. The site, which is approximately 115 mi northwest of Philadelphia, Pennsylvania (PPL Bell Bend 2013-TN3377), is adjacent to the west boundary of Susquehanna Steam Electric Station (SSES) Units 1 and 2 and near the west bank of the North Branch of the Susquehanna River. The location of the proposed BBNPP is described in Section 2.1, followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, nonradiological health, and radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects and consultations.

2.1 Site Location

PPL's location for the proposed BBNPP unit in relationship to the counties, cities, and towns within a 50-mi radius of the site is shown in Figure 2-1. Figure 2-2 shows additional details within a 6-mi radius of the site for the proposed BBNPP unit. The BBNPP site is located north and west of the North Branch of the Susquehanna River. The BBNPP site consists of approximately 975 ac within the 2,055-ac BBNPP project area, as depicted in Figure 2-3. The Borough of Berwick is located approximately 5 mi southwest of the BBNPP site. The nearest population center that has more than 25,000 residents is Wilkes-Barre, Pennsylvania (20 mi northeast).

2.2 Land Use

This section discusses existing land use on and near the BBNPP site. Section 2.2.1 describes land use on the site and in the vicinity, defined as the area within a 6-mi radius of the site. Section 2.2.2 describes land use within existing and proposed transmission-line corridors and other offsite areas potentially affected by BBNPP facilities, including areas potentially affected by Consumptive-Use Mitigation Plan (CUMP) activities. Section 2.2.3 discusses land use within the BBNPP project region, defined as the area within a 50-mi radius of the BBNPP site. A discussion of State, county, and township plans and their relationship to the proposed BBNPP unit is included in Section 2.5.

2.2.1 The Site and Vicinity

The BBNPP site encompasses approximately 975 ac of the approximately 2,055-ac BBNPP project area. The BBNPP project area also includes the existing 680-ac SSES and the 400-ac Riverlands Recreation Area (which totals 1080 ac). The Riverlands Recreation Area includes a nature center, hiking trails, playgrounds, picnic facilities, a fishing lake (Lake Took-A-While), and a Wetlands Nature Area (PPL Bell Bend 2013-TN3377).

As of 2014, PPL Susquehanna, LLC; PPL Bell Bend, LLC; and other PPL corporate entities own the land within the BBNPP project area. The BBNPP project area comprises two major land parcels: the SSES site and the BBNPP project site. PPL Susquehanna, LLC owns 90 percent

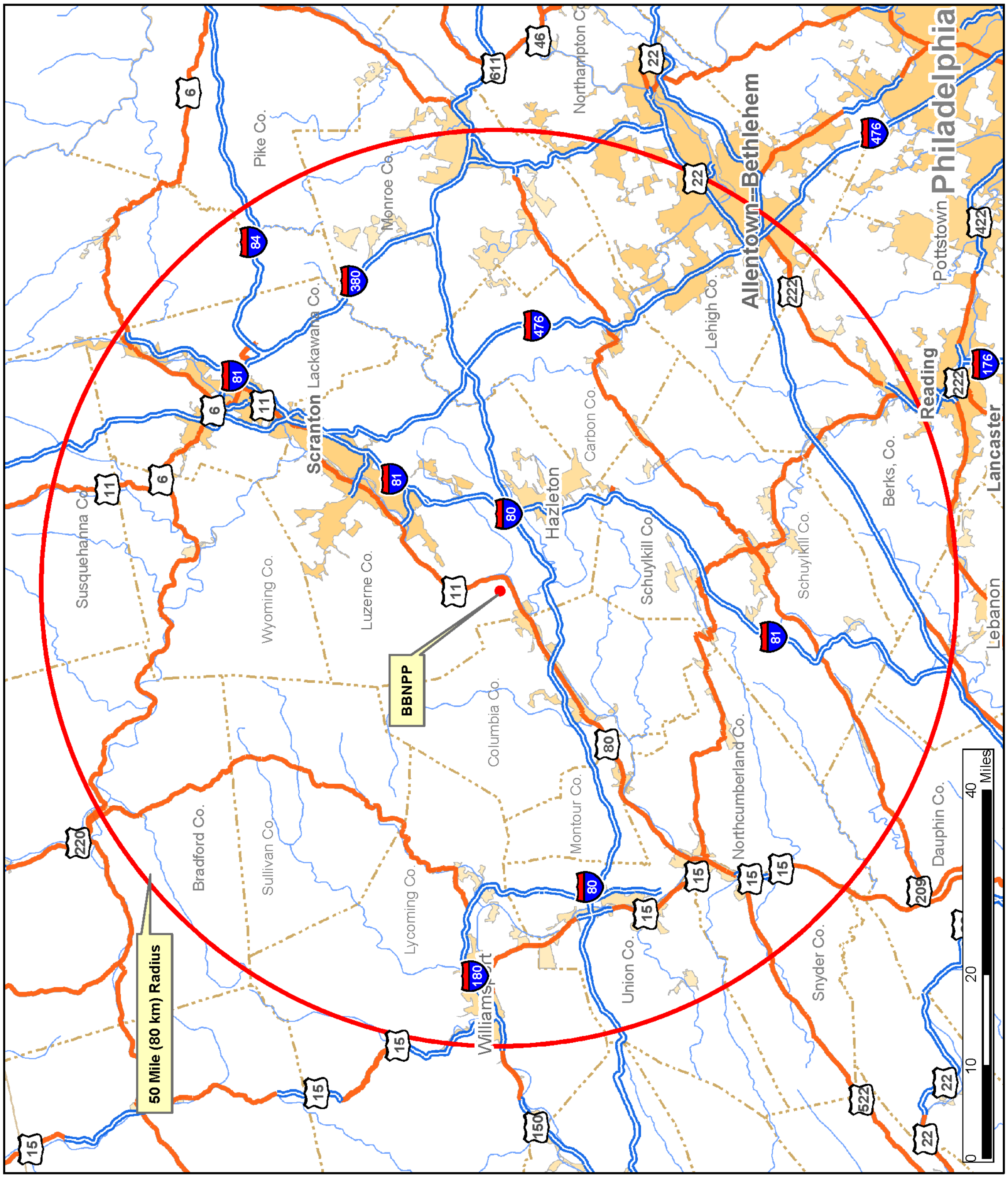

Figure 2-1. BBNPP Site 50-Mile (80-km) Region

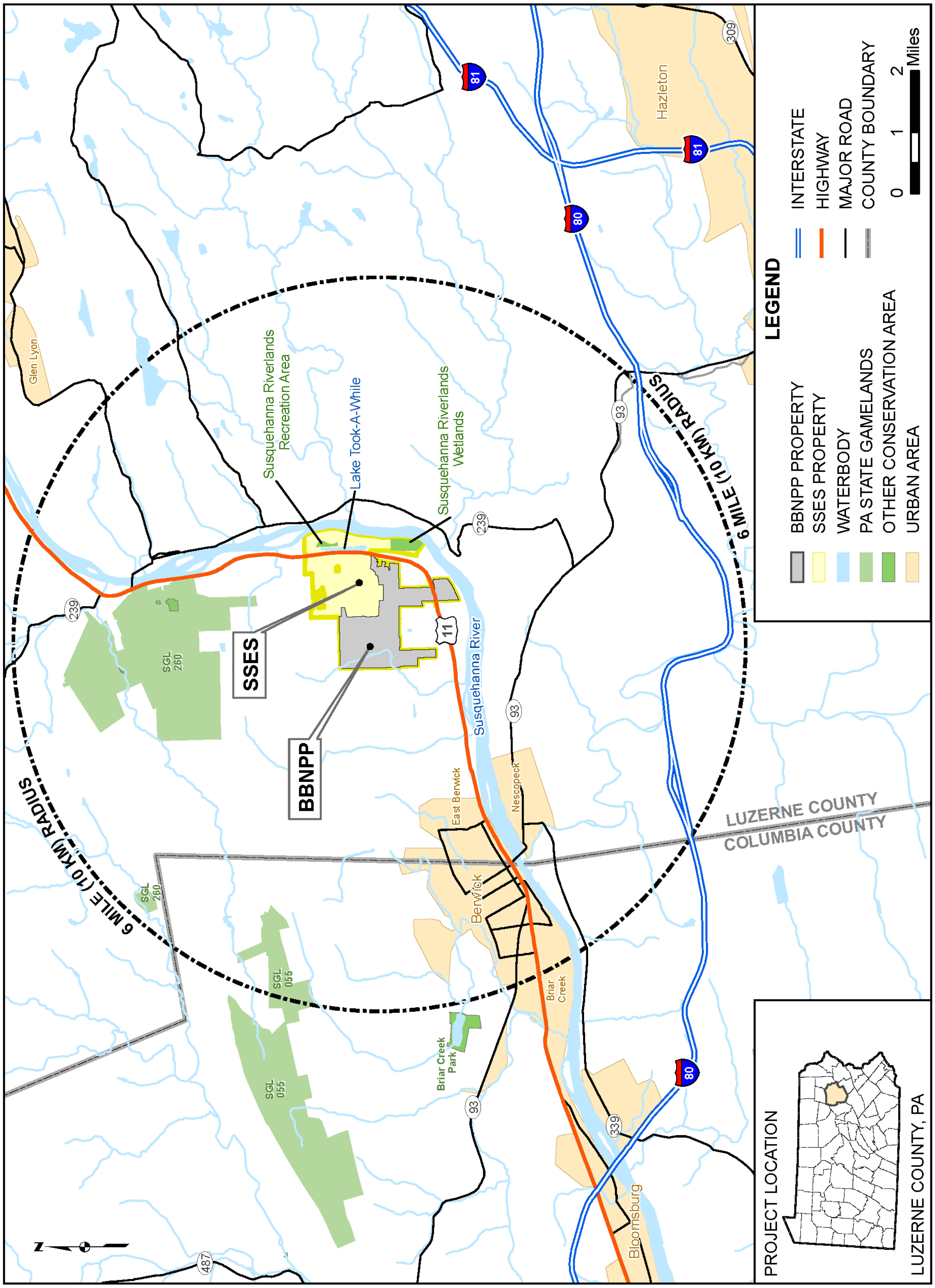

Figure 2-2. BBNPP Site 6-mi (10-km) Region

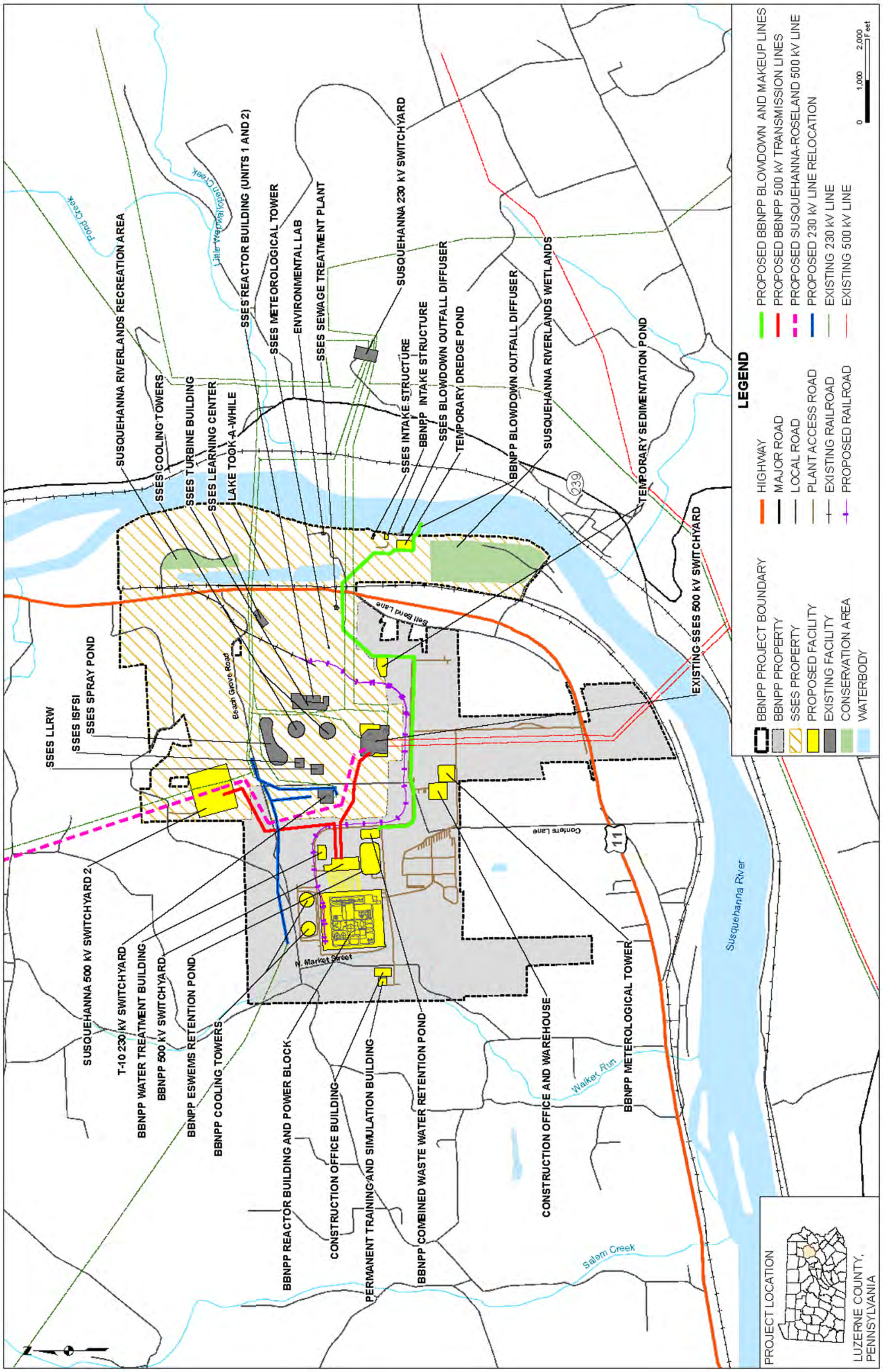

Figure 2-3. BBNPP Site and Proposed New Plant Layout

of SSES Units 1 and 2, and Allegheny Electric Cooperative, Inc. owns 10 percent of SSES Units 1 and 2. In July 2014, PPL submitted a request to NRC to transfer ownership of the SSES site to Talen Electric, a PPL spinoff corporation (PPL Susquehanna 2014-TN4211). PPL Susquehanna, LLC or Talen Electric (whoever owns the SSES site at the time) would retain ownership of the SSES site and facilities. PPL Bell Bend, LLC would become the sole owner of the BBNPP project site and the owner/operator of the new BBNPP project facilities (PPL Bell Bend 2013-TN3377).

The BBNPP site is located approximately 200 to 300 ft above the elevation of the Susquehanna River just to the east. In general, the site slopes from the north to the south and east. Site elevation ranges from around 500 ft above mean sea level (msl) at the southernmost point near the river to more than 1,000 ft above msl in the northern portion of the site. The BBNPP power block would be constructed at a finished ground-surface elevation approximately 719 ft above msl (PPL Bell Bend 2013-TN3377). The steepest slopes occur north of Beach Grove Road in the northern part of the project area, while the central, southern, and eastern parts of the project area tend to have more rolling topography.

Figure 2-4 shows existing land use within the BBNPP project area based on the National Land Cover Database maintained by the U.S. Geological Survey (USGS). Table 2-1 summarizes the acreages and percent totals for each land-use category identified within the BBNPP project area.

According to the applicant, non-commercial forest land accounts for the largest amount of land area within the project area at approximately 1,142 ac, or approximately 56 percent of the total land area. Agricultural use accounts for approximately 440 ac (approximately 21 percent). The distribution of agricultural land in production has been reduced since the USGS land-use data were collected, as noted in the discussion of prime farmland below. PPL currently leases out approximately 205 ac on the project area for agricultural use. Urban/built-up use (i.e., developed area) accounts for approximately 221 ac (11 percent). Areas encompassed by wetlands, water, and barren land account for approximately 159 ac (PPL Bell Bend 2013-TN3377).

According to the applicant, two residences exist within the proposed exclusion area for the new reactor (PPL Bell Bend 2013-TN3377). One residence (currently occupied) is located near the intersection of Beach Grove Road and Township Road 436 (Market Street). A second residence (no longer present as of 2014) was located on the west side of Township Road 436, approximately 0.35 mi south of the first residence. PPL also stated that two additional residences are within the BBNPP project area but outside of the proposed exclusion area. One (currently occupied) is located on the west side of Township Road 436 approximately 0.54 mi south of the first residence. A fourth residence (currently occupied) is located near the intersection of the new plant entrance road and U.S. Highway 11 (US 11). All but the latter were owned by PPL as of 2012; the latter was under contract for purchase. All of these properties would be under PPL ownership prior to constructing the new plant (Aarts 2012-TN3987).

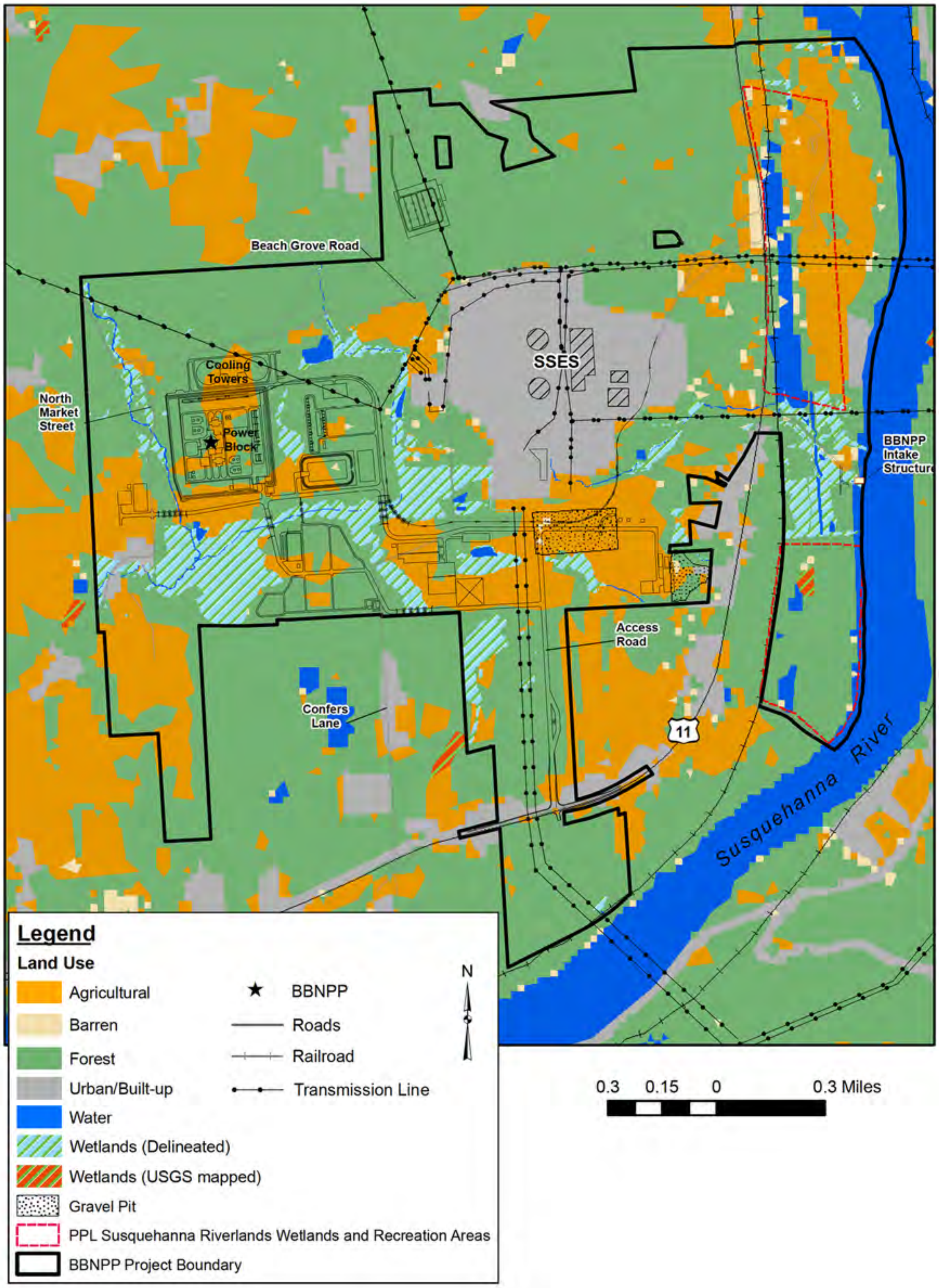

Figure 2-4. Land Use within the BBNPP Project Area (PPL Bell Bend 2013-TN3377)

Table 2-1. Land-Use Categories[(a)] within the BBNPP Project Area

Land Use	Acres	Percent
Forest	1,141.7	55.6
Agricultural	440.0	21.4
Urban/Built-Up[(b)]	220.8	10.7
Wetlands	159.0	7.7
Water	71.9	3.5
Barren	21.5	1.0
Total	2,054.9	100.0

(a) Land-use concepts such as "forest" and "agricultural" may be interpreted differently than in the context of terrestrial habitat addressed in Section 2.4.1. Values and totals presented may differ slightly because of the rounding methodology used. Values represent mapped USGS land categories dated 2008.
(b) Most urban/built-up land within the BBNPP project area is occupied by existing SSES facilities.

Source: PPL Bell Bend 2013-TN3377

The existing plant entrance road is located at an unsignalized intersection with US 11, also known as Salem Boulevard. US 11 is a two-lane road with a center turn lane that runs along the northwestern bank of the Susquehanna River and crosses the eastern portion of the BBNPP project area. An existing railroad line (North Shore Railroad) runs adjacent to US 11. A spur from the existing railroad line serves the SSES site (PPL Bell Bend 2013-TN3377).

Several two-lane county roads also traverse the BBNPP project area. These include Confers Lane, Township Road 436, Stone Church Road, Beach Grove Road, Thomas Road, and Klines Road (PPL Bell Bend 2013-TN3377). The Susquehanna River is fairly shallow, swift-flowing, and is not amenable to commercial navigation (Infoplease 2012-TN3183). Normal summer flows on the river accommodate small, shallow-draft, powered and nonpowered water craft (PFBC 2014-TN3184).

The Farmland Protection Policy Act (7 USC 4201 et seq.-TN708) defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. The designations are based on mapped soil data and are independent of whether the land is actually in agricultural use at the time of designation. According to the applicant, three types of soil rated as prime farmland by the U.S. Department of Agriculture's Natural Resources Conservation Service are located on approximately 825 ac within the BBNPP project area (Figure 2-5). Additional soils on the BBNPP project area have been designated as farmlands of statewide importance (PPL Bell Bend 2013-TN3377).

As depicted in Figure 2-5, approximately 197 ac of the prime farmland soils within the project area have been previously developed (i.e., graded, excavated, covered, filled, or disturbed in some manner) (PPL Bell Bend 2013-TN3377). Thus, approximately 628 ac of prime farmland remain undeveloped and hence potentially usable as farmland in the future. According to the applicant, approximately 205 ac were leased in 2013 to local farmers for cultivation. The applicant intends to continue this arrangement on an annual basis until the decision is made to construct the BBNPP project (PPL Bell Bend 2014-TN3537).

According to the applicant, no significant mineral resources have been identified within or adjacent to the BBNPP project area. Siltstone, sand, and gravel are present onsite; however, the siltstone is located far underground and could not be mined economically. Deposits of sand and gravel underlie most portions of the Susquehanna River valley, and a small amount of these deposits is likely present within the Susquehanna River floodplain. PPL owns all mineral rights within the BBNPP site (PPL Bell Bend 2013-TN3377).

A culm bank removal project (i.e., the Spike Island Operation) is proposed to be conducted on State game lands approximately 3.5 mi north of the BBNPP site. A culm bank is a pile of coal dust and other debris from coal mining. The Spike Island Operation would remove a mining refuse pile that covers 6 ac. After removal of the refuse pile, the site would be restored to a natural condition. Approval of the project is pending before the Pennsylvania Department of Environmental Protection (PADEP) (PPL Bell Bend 2013-TN3377).

While natural-gas development associated with the Marcellus Shale formation is widespread in the Susquehanna River Basin, the PADEP (PADEP 2013-TN3951) states that the nearest known active well to the BBNPP site as of 2012 is approximately 22 mi northeast of the proposed plant location and 5 mi east of Wilkes-Barre. The largest concentrations of active wells are more than 20 mi north and northwest of the BBNPP site in Wyoming and Sullivan Counties (PADEP 2013-TN3951).

As shown in Figure 2-6, most of the land within the BBNPP project area is zoned as Special Industrial District (I-3). The Riverlands Recreation Area is zoned as Conservation District (C-1). Smaller parcels located adjacent to US 11 are zoned as Highway Business District (B-3) or Agricultural District (A-1).

The I-3 zone was established by Ordinance 2011-03, adopted by the Salem Township Board of Supervisors on February 8, 2011. The ordinance included electrical power-generating plants (other than wind-energy facilities) as a conditional use within the I-3 zone. On the same date, the Board of Supervisors adopted Ordinance 2011-02 that amended the Salem Township Zoning Ordinance and Map by zoning the BBNPP site as I-3 (Cormany 2012-TN1172).

An estimated 159 ac of wetlands occur in scattered locations across portions of the project area and are discussed further in Section 2.4.1. Several areas within the project area are subject to seasonal flooding (PPL Bell Bend 2013-TN3377). The 100-year floodplain of the Susquehanna River extends approximately 2,000 ft into the project area in the lowlands between the Susquehanna River and the rail line that parallels US 11 (Figure 2-7). The 100-year flood elevation in this area is approximately 513 to 515 ft National Geodetic Vertical Datum of 1929 (PPL Bell Bend 2013-TN3377). The plant-grade elevation of the BBNPP would be more than 200 ft above the 100-year floodplain. However, the intake and blowdown structures and parts of the routes for the proposed blowdown and makeup water lines for the proposed BBNPP unit extend across the 100-year floodplain. A much smaller and narrower 100-year floodplain winds through the central and the western part of the BBNPP project area along Walker Run and its unnamed tributaries.

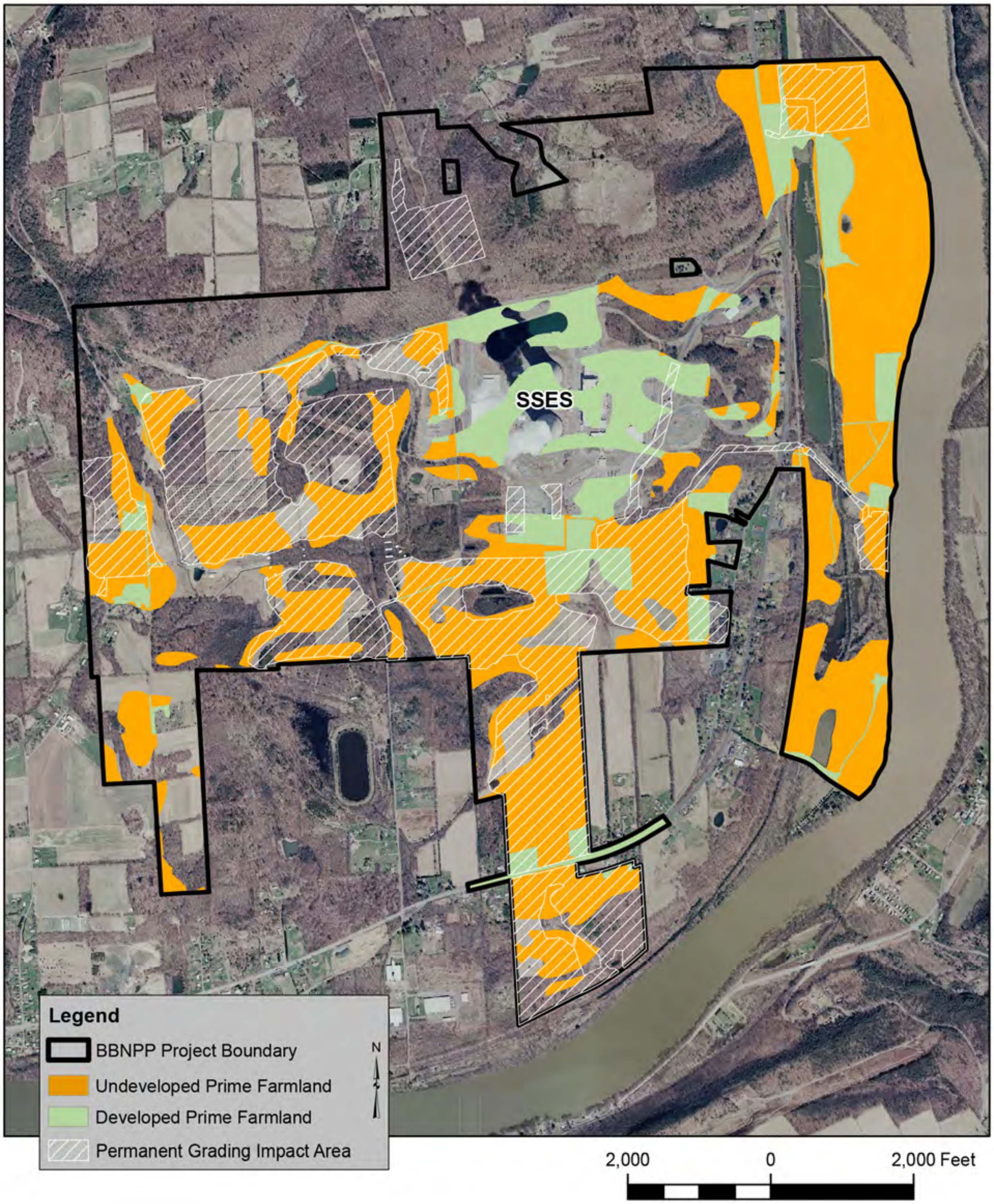

Figure 2-5. Prime Farmland within the BBNPP Project Area (PPL Bell Bend 2013-TN3377)

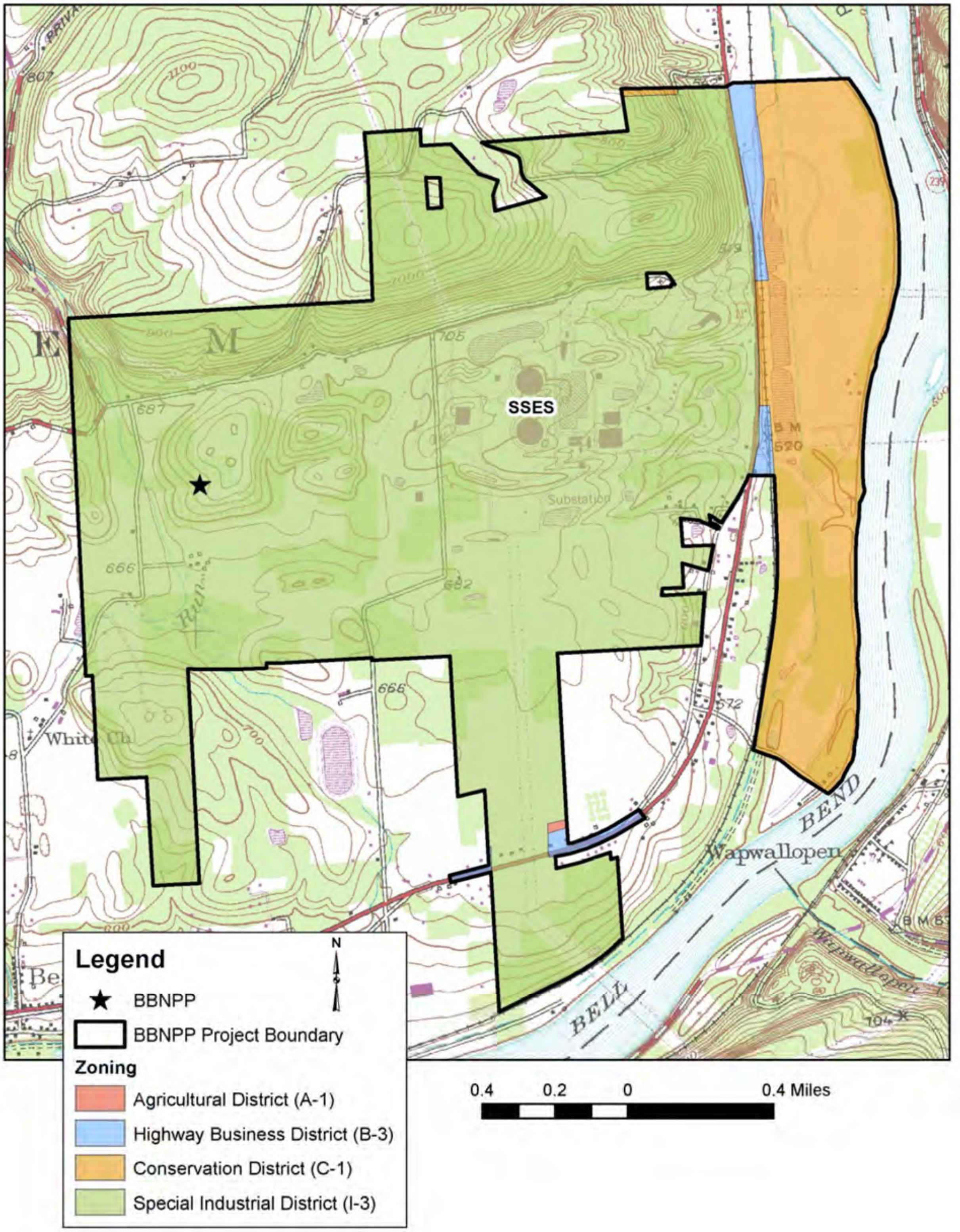

Figure 2-6. BBNPP Project Area Zoning (PPL Bell Bend 2013-TN3377)

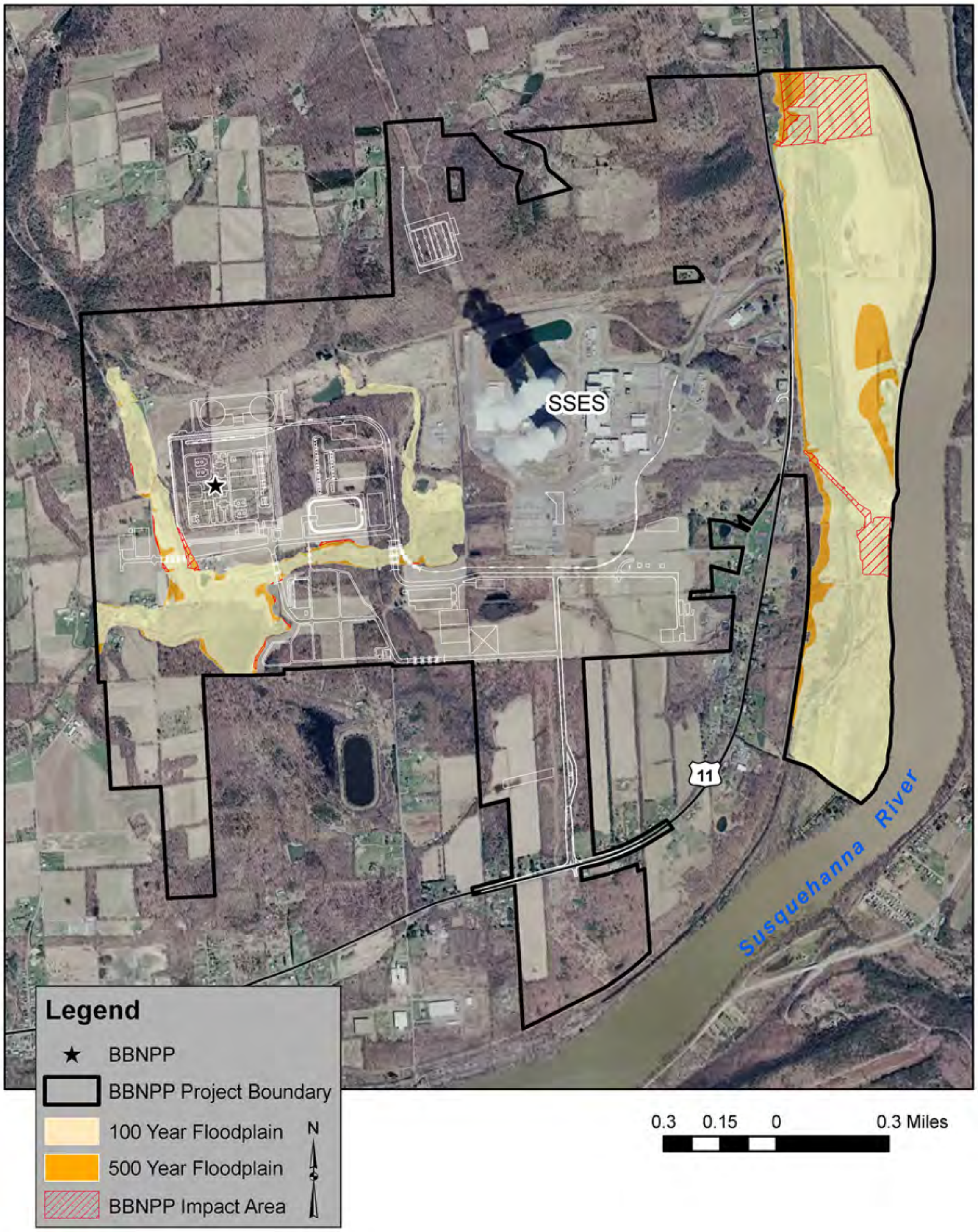

Figure 2-7. 100-Year Floodplain within the BBNPP Project Area (PPL Bell Bend 2013-TN3377)

Figure 2-8 shows existing land use within the BBNPP project vicinity (area within a 6-mi radius of the BBNPP site). Table 2-2 summarizes the acreages and percent totals for each land-use category identified within the BBNPP project vicinity. The most common land use in the BBNPP project vicinity is forest, which accounts for approximately 47,419 ac (66 percent), followed by agricultural use, which accounts for approximately 14,727 ac (20 percent). Together, these two land-use categories cover approximately 86 percent of the land area within the BBNPP project vicinity, closely reflecting the rural and undeveloped character of this portion of Luzerne County.

Table 2-2. Land Use within the Project Vicinity

Land Use	Acres	Percent
Forest	47,419	66
Agricultural	14,727	20
Urban/Built-Up	6,411	9
Water	2,468	3
Wetlands	902	1
Barren	455	<1
Total	72,382	100.0

Source: PPL Bell Bend 2013-TN3377

Developed areas in the BBNPP project vicinity include the Borough of Berwick and the communities of East Berwick, Foundryville, Nescopeck, Beach Haven, Wapwallopen, and Shickshinny. Residential development in the Borough of Berwick and surrounding communities consists primarily of single-family homes in urban and suburban neighborhoods. Residential use outside of these areas is characterized by single-family homes on large rural lots and small farms. Industrial and commercial development is concentrated primarily in the Borough of Berwick, the Borough of Nescopeck, and several areas along US 11.

Several small quarries are located in the project vicinity along US 11. One of the quarries is located approximately 2.3 mi north of the BBNPP project area. It has a planned capacity of 92 million tons (PPL Bell Bend 2014-TN3537; PPL Bell Bend 2014-TN3539). Another large quarry is located on the south bank of the Susquehanna River approximately 1.5 mi east of Nescopeck. No known active natural-gas wells are located in the BBNPP project vicinity (PADEP 2013-TN3951).

According to the applicant, there are no known claims by Native Americans on lands within the BBNPP project area or the BBNPP project vicinity. In addition, no lands of special land use, including Native American or military reservations, State and national parks, national monuments, national forests, wild and scenic rivers, designated coastal-zone areas, or wilderness areas are located on the BBNPP site or within the BBNPP project area (PPL Bell Bend 2013-TN3377).

Two State game lands and two State parks are present within the BBNPP project vicinity. These include State Game Land No. 55 (approximately 2,511 ac) located approximately 5 mi northwest of the BBNPP site and State Game Land No. 260 (3,087 ac) located approximately 2 mi north of the BBNPP site (Figure 2-8). The Pennsylvania Game Commission (PGC) manages State game lands with the goal of preserving wildlife and wildlife habitat while also promoting and perpetuating recreational hunting and trapping (PGC 2009-TN3185).

The applicant further notes that two State park parcels, known as the Theta Lands, occupy 109 ac, approximately 4 mi northeast of the proposed BBNPP site. The Theta Lands are part of

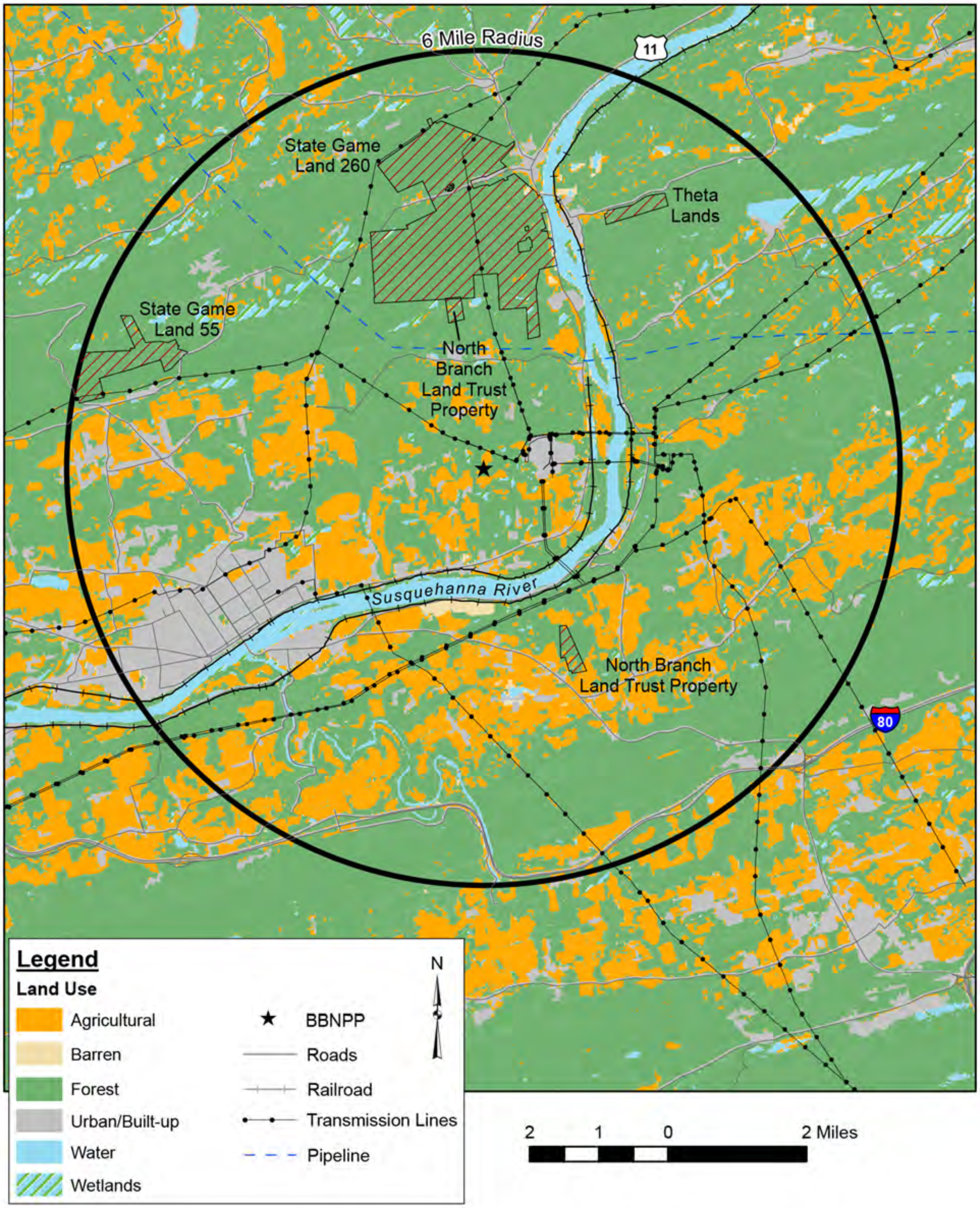

Figure 2-8. Land Use within the Project Vicinity (PPL Bell Bend 2013-TN3377)

the Theta Lands Conservation Project that encompasses more than 10,000 ac (4,047 ha) in Luzerne and Lackawanna Counties. These lands were acquired with State and local funds to preserve wildlife habitat, provide recreational opportunities, and protect critical watersheds. There are no known national parks, national forests, or national monuments within the BBNPP project vicinity (PPL Bell Bend 2013-TN3377).

In addition, the applicant reported that two small areas of private trust lands also are located in the BBNPP project vicinity. These lands are maintained as conservancy lands by private owners through the North Branch Land Trust. One property (approximately 40 ac) is located about 2 mi north of the BBNPP site and connects with State Game Land No. 260. The second property (approximately 88 ac) is located approximately 3 mi south of the BBNPP site (PPL Bell Bend 2013-TN3377).

2.2.2 Transmission-Line Corridors and Offsite Areas

Transmission-Line Corridors

Substantial transmission infrastructure associated with the SSES plant already exists within the BBNPP project area (Figure 2-4), including the Susquehanna 500-kV switchyard that contains two 500-kV circuits and is located south of the SSES cooling towers. The 500-kV switchyard is connected to the Susquehanna 230-kV switchyard by a 500-kV/230-kV transformer. The T-10 230-kV switchyard, located on the west side of Confers Lane, has three 230-kV circuits (PPL Bell Bend 2013-TN3377).

The applicant describes how the SSES plant is connected to the regional grid by several major transmission lines (Figure 2-9). These include Stanton #2, a single-circuit 230-kV line that runs generally northeast from the SSES plant for approximately 30 mi within a 100- to 400-ft-wide corridor; Wescosville, a 500-kV line that connects the SSES plant with the Alburtis substation and runs generally southeast from the plant for approximately 75 mi within a 100- to 400-ft-wide corridor; and Sunbury #2, a 500-kV line that shares a corridor with the Sunbury #1 230 kV line and runs approximately 30 mi in a west-southwest direction within an approximately 325-ft-wide corridor. These existing transmission lines cross primarily agricultural and forest land with low population densities. The longer lines cross numerous U.S. and State highways. Farmlands crossed by transmission lines continue to be used as farmland (PPL Bell Bend 2013-TN3377).

In addition to the existing transmission lines described above, PPL Electric Utilities is developing a new 500-kV transmission line from Susquehanna to the Roseland Substation in New Jersey (Figure 2-9). According to the applicant, the Susquehanna-to-Roseland transmission line is a PJM Interconnection, LLC (PJM) Regional Transmission Expansion Plan project required to maintain regional grid reliability. The project involves removing old lattice steel structures, drilling and pouring new concrete foundations, setting new steel poles, and stringing new wires. Work on the new transmission line, generally moving west to east through Luzerne, Lackawanna, Wayne, Pike, and Monroe Counties in Pennsylvania, began in summer 2012. The new transmission line is expected to be in service in time to meet peak summer electricity demand in 2015 (PPL Electric Utilities 2014-TN3191). About 95 percent of the new 145-mi transmission line will follow the path of an existing transmission line; therefore, impacts on people and the environment will be minimized.

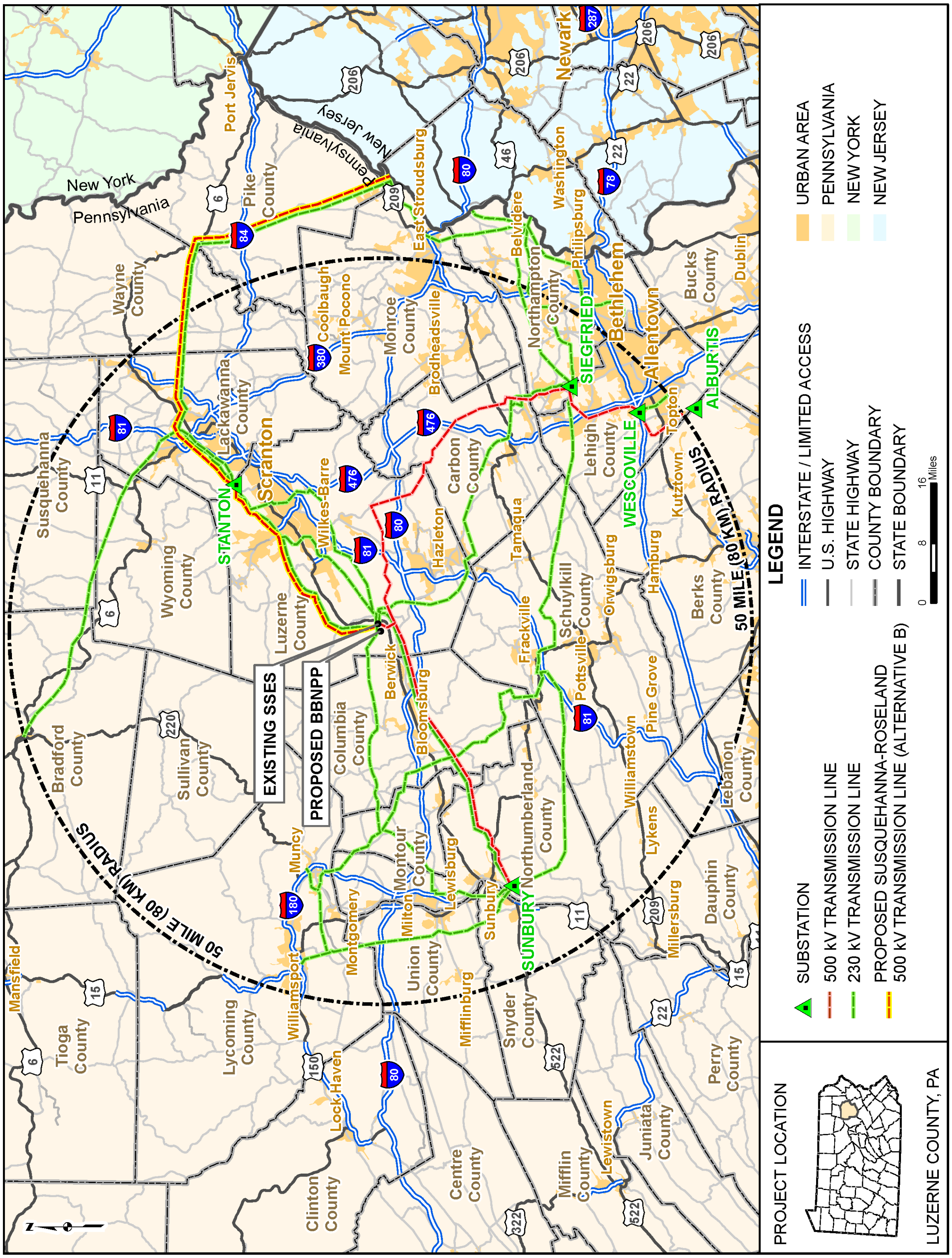

Figure 2-9. Major Highways and Utility Corridors within the Region (PPL Bell Bend 2013-TN3377)

No modifications of the existing transmission system outside the BBNPP project area would be required for the sole purpose of supporting the BBNPP project. All required transmission-system upgrades would occur within the BBNPP project area. Proposed transmission-system upgrades within the BBNPP project area are described in Section 3.2.2.3.

Consumptive-Water-Use Mitigation

PPL has applied to the Susquehanna River Basin Commission (SRBC) for a permit to consumptively use 43 cfs (28 Mgd) of water from the North Branch of the Susquehanna River during BBNPP operations. The SRBC has the regulatory authority to approve this use and to impose consumptive- water-use mitigation requirements. In lieu of granting conditional approval prior to receipt of a final application, the SRBC described general conditions that would be required for a future application to be approved in its December 28, 2012, letter to PPL (SRBC 2012-TN3565). In this letter, the SRBC stated that consumptive- water-use mitigation will be required when certain passby flow levels are reached. The mitigation will be in the form of compensating water releases from upstream sources in an amount equal to the consumptive use at the BBNPP. The consumptive-water-use mitigation releases will be triggered by discharge measurements at the USGS Wilkes-Barre stream gage (01536500, Susquehanna River at Wilkes-Barre, Pennsylvania) (SRBC 2012-TN3565). The discharges for these triggers are designated monthly passby flow values at the BBNPP point of use (SRBC 2012-TN3565). The SRBC set passby flow values for the months of May to October. For the remainder of the year, no passby flow values were recommended, and thus no consumptive-water-use mitigation would be required.

On October 21, 2013, PPL described its primary plan for consumptive - water use mitigation, which would rely on water released from Cowanesque Lake to compensate for BBNPP consumptive use (PPL Bell Bend 2013-TN3541). Releases from Cowanesque Lake flow from the Cowanesque River into the Tioga River, and then into the Chemung River, which discharges to the North Branch of the Susquehanna River just south of the New York-Pennsylvania border (see Figure 2-10). Implementation of PPL's plan would require purchasing rights to 36.8 cfs (23.8 Mgd) of Cowanesque Lake water currently allocated for mitigation of consumptive use downstream of the BBNPP. PPL stated that it controls sufficient water at the Holtwood Dam hydroelectric site to compensate for consumptive use downstream of the BBNPP (PPL Bell Bend 2013-TN3541).

In addition, PPL (PPL Bell Bend 2013-TN3541) stated that it plans to reallocate to BBNPP the 13.6 cfs (8.8 Mgd) of Cowanesque Lake water currently used to mitigate consumptive use by PPL's Montour Steam Electric Station on the West Branch of the Susquehanna River. To satisfy the Montour Steam Electric Station consumptive-use mitigation needs, PPL plans to expand its existing Rushton Mine water-treatment facility. Rushton Mine is a former underground coal mine that is currently owned by PPL, which pumps and treats groundwater from the mine to reduce acid drainage to receiving waters. PPL operates the pump and treat system under a National Pollutant Discharge Elimination System permit. The facility currently discharges an estimated maximum of 6.9 cfs (4.5 Mgd) to Moshannon Creek (PPL Bell Bend 2013-TN3541), a tributary to the West Branch Susquehanna River with a confluence near Karthaus, which is approximately 20 mi northeast of Rushton Mine and upstream of the Montour Steam Electric Station (see Figure 2-10).

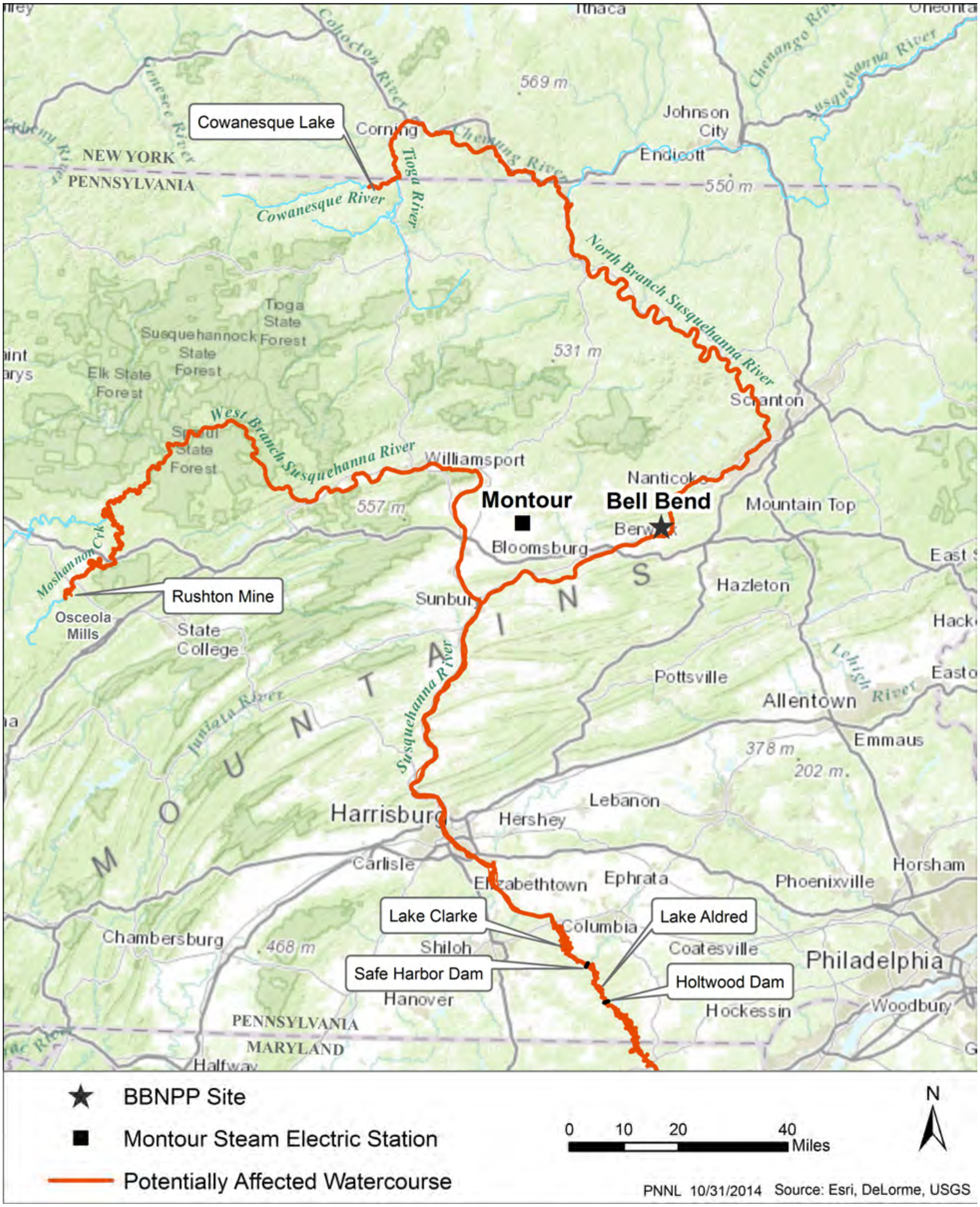

Figure 2-10. Waterbodies and Power Plants that Are Part of PPL's Primary Plan for Consumptive-Use Mitigation

When releasing water for consumptive-use mitigation, PPL's primary plan would alter Cowanesque Lake levels, river flows from downstream of Cowanesque Dam to Holtwood Dam, and river flows from downstream of the Rushton Mine discharge to the confluence of the West Branch Susquehanna River with the North Branch of the Susquehanna River near Sunbury (see Figure 2-10).

Lands abutting the shorelines of the subject reservoirs, rivers, and streams are typically low-lying forests and farmland. Some shoreline areas are publicly owned, but many other such areas are privately owned. Some of the shoreline lands, such as those adjoining Cowansque Lake, are publicly owned and managed for recreational use. Many other shoreline lands are managed for conservation. The Rushton Mine property is owned by PPL and is undeveloped forest and scrub land except for the existing wastewater-treatment facilities that treat the mine discharges.

2.2.3 The Region

The region for the BBNPP project is defined as the area within a 50-mi radius of the BBNPP site, excluding the site itself and the BBNPP project vicinity described above. All or portions of 22 Pennsylvania counties are located within the region. Table 2-3 summarizes the acreages and percent totals for each identified land-use category and Figure 2-11 shows existing land use within the region. As for the project vicinity, the most common types of land use in the region are forest use and agriculture. Together these two categories account for approximately 4.3 million ac (86 percent) of the approximately 5.0 million ac in the region. Major highways and utility corridors located within the region are shown in Figure 2-9.

Major public lands, trust lands, State and local parks, and protected wild and natural areas within the BBNPP project region are shown in Figure 2-12 and summarized in Table 2-4. The largest single category of public land in the region (approximately 1.2 million ac) is State Game Lands, which are managed by the PGC. There are no lands of recognized Tribal entities eligible for funding and services from the U.S. Bureau of Indian Affairs located within the BBNPP project region (PPL Bell Bend 2013-TN3377).

Table 2-3. Land Use within the BBNPP Project Region

Land Use	Acres	Percent
Forest	3,279,101	65
Agricultural	1,042,837	21
Urban/Built-Up	468,132	9
Water	84,026	2
Wetlands	83,797	2
Barren	68,592	1
Totals	5,026,485	100

Source: PPL Bell Bend 2013-TN3377

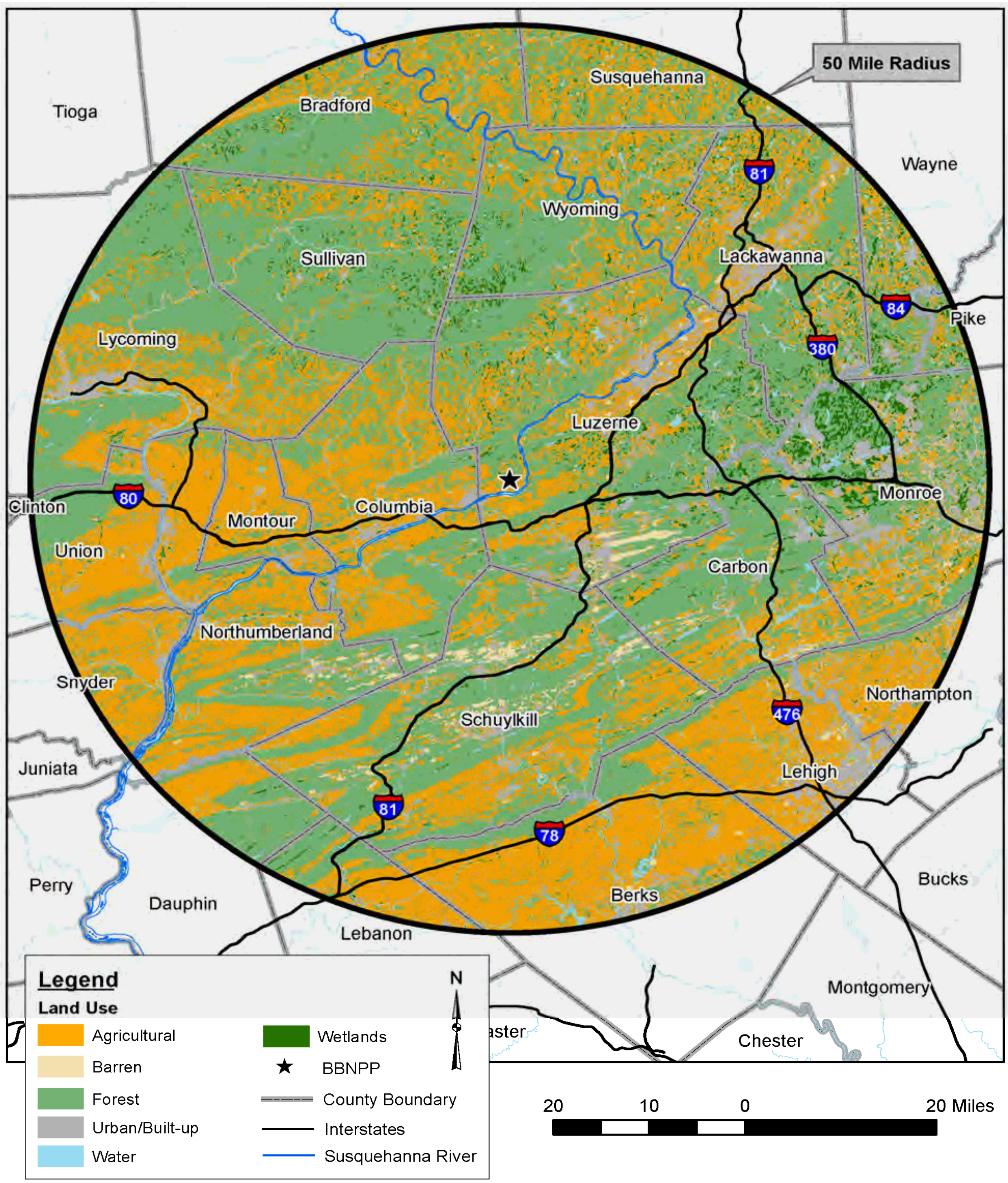

Figure 2-11. Land Use within the Region (PPL Bell Bend 2013-TN3377)

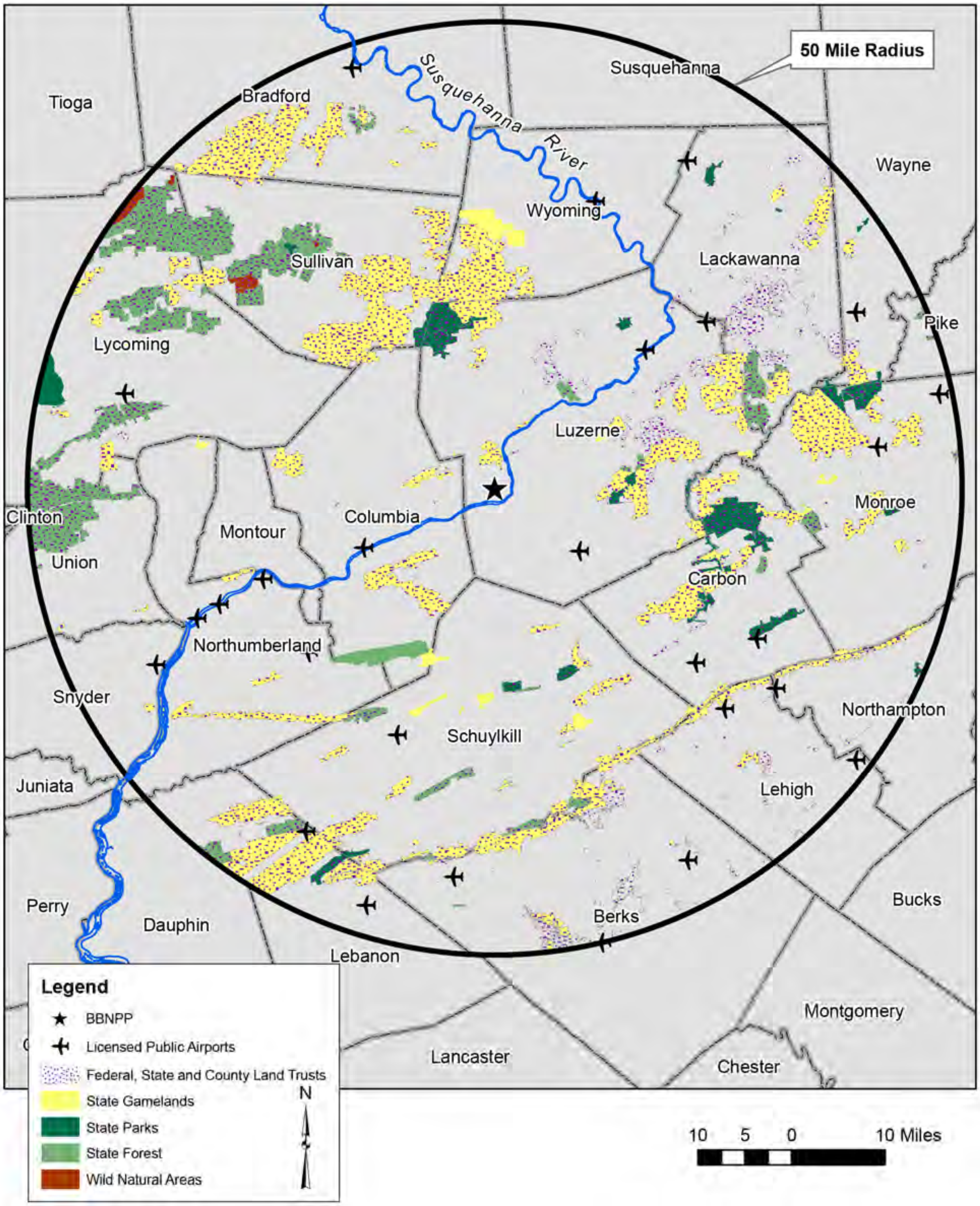

Figure 2-12. Major Public and Trust Lands in the Region (PPL Bell Bend 2013-TN3377)

Table 2-4. Major Public and Trust Lands within the BBNPP Project Region

Type of Land	Number	Acres
State Game Lands	110	1,169,225
State Forest Lands	6	378,692
State Park Lands	23	104,407
Trust Lands	268	27,394
County and Local Parks	255	15,096
Wild and Natural Areas	8	10,563
Totals	670	1,705,377

Source: PPL Bell Bend 2013-TN3377

Agricultural products grown in the BBNPP project region include barley, corn, soybean, wheat, vegetables, hay, poultry, and cattle (USDA 2009-TN3186). The 2007 annual yields for these products in the 22 counties partially or completely within the BBNPP project region are listed in Table 2-5.

Table 2-5. Regional Agricultural Products and Yields (2007)

County	Barley, bushels	Corn, bushels	Soybean, bushels	Wheat, bushels	Vegetables, Melons, Potatoes, acres	Hay, tons	Poultry, head	Cattle, head
Bradford	1,251	993,452	24,895	98,885	192	118,099	2,886	63,730
Berks	275,334	6,510,218	1,134,237	583,555	1,132	97,807	1,860,472	66,950
Carbon	6,000	133,541	10,613	4,494	346	10,977	1,236	1,087
Columbia	8,378	2,543,591	336,431	275,330	4,107	25,369	----	9,119
Dauphin	69,599	1,890,936	405,077	196,229	334	37,449	788,324	14,968
Lackawanna	----	101,075	----	----	841	15,686	1,304	3,687
Lebanon	185,989	3,759,992	681,745	315,166	817	39,228	1,504,824	56,793
Lehigh	21,398	3,672,868	654,464	449,310	1,674	24,527	22,948	3,573
Luzerne	----	1,000,534	101,875	69,251	1,471	15,808	7,755	4,996
Lycoming	2,008	2,002,767	253,069	79,039	1,166	45,934	----	19,531
Monroe	----	340,004	47,920	15,996	246	7,475	1,058	1,002
Montour	6,718	589,673	148,612	61,856	231	12,446	----	7,680
Northhampton	13,533	3,189,508	511,220	190,094	561	34,050	3,010	6,327
Northumberland	90,352	3,955,720	673,653	206,903	1,549	24,454	131,286	20,995
Pike	----	----	----	----	----	----	234	174
Schuylkill	27,571	1,956,586	278,273	233,654	2,756	34,832	1,651,628	12,011
Snyder	17,159	1,096,618	241,023	72,609	1,221	30,302	300,957	25,564
Sullivan	----	167,888	----	----	35	14,415	899	3,906
Susquehanna	----	124,856	----	----	90	79,552	3,463	29,555
Union	18,925	1,007,912	296,403	118,674	383	24,427	326,185	21,517
Wayne	----	----	----	----	137	40,687	2,651	12,446
Wyoming	----	318,041	----	----	430	28,981	1,511	5,909

Source: USDA 2009-TN3186

2.3 Water

This section describes the hydrologic processes governing movement and distribution of water in the existing environment at the proposed BBNPP site. Surface waterbodies (Section 2.3.1.1), groundwater resources (Section 2.3.1.2), existing water uses (Section 2.3.2), and water quality (Section 2.3.3) in the vicinity of the site are described. In addition, water monitoring used to characterize the site hydrology (Section 2.3.4) is described. Descriptions are limited to only those parts of the hydrosphere that may affect or be affected by building and operating the proposed BBNPP unit.

Section 2.9.1 provides information about the existing climate at the site, including temperature and precipitation.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could be affected by building and operating the proposed BBNPP unit. A summary of the existing hydrologic conditions of the BBNPP project area is provided in Section 2.3.1 of the environmental report (ER) (PPL Bell Bend 2013-TN3377). The hydrologic features of the site related to site safety are described by the applicant in Section 2.4 of the Final Safety Analysis Report (FSAR) (PPL Bell Bend 2013-TN3447). The review team gathered additional information during several site visits and meetings with local water-resource agencies (NRC 2009-TN1889; NRC 2012-TN1890). Descriptions are based on information from these and other sources of publicly available hydrologic information.

During operation of the proposed BBNPP unit, the Susquehanna River would be the source of makeup water for normal plant operations. Blowdown from the cooling towers and other treated water would be discharged back to the Susquehanna River. The proposed water-intake and discharge systems would be completely separate from existing SSES systems, which also withdraw water from and discharge water back to the Susquehanna River. Potable and sanitary water for BBNPP would be supplied by an existing municipal utility, the Berwick District of the Pennsylvania American Water Company (PAWC). PPL does not propose to use or develop any onsite groundwater resources for building or operating the proposed BBNPP unit.

As described in Section 2.2.2, the SRBC will require mitigation in the form of releases from upstream sources to compensate for BBNPP consumptive water use during low-flow conditions. According to PPL's primary consumptive-use mitigation plan (CUMP) (described in Section 2.2.2), these releases would alter Cowanesque Lake water levels, river flows downstream of Cowanesque Dam, and river flows on Moshannon Creek downstream of Rushton Mine.

The environment described in this section includes the following:

- the Susquehanna River, because it is the source of makeup water for normal plant operations and it would receive the effluents discharged from the plant
- Walker Run and its tributaries, because most of the BBNPP site is in its watershed

- small ponds and unnamed streams in the BBNPP project area and vicinity that may be affected during site preparation or that may receive stormwater runoff during the construction period or during operation
- the groundwater system in the vicinity of BBNPP, because it may be affected by construction activities
- Cowanesque Lake, Cowanesque River, and Moshannon Creek, because these waterbodies are most directly affected by PPL's CUMP.

2.3.1.1 Surface-Water Hydrology

Susquehanna River

The Susquehanna River originates in south-central New York State and flows south, draining much of central Pennsylvania before flowing into Chesapeake Bay at Havre de Grace, Maryland. The entire Susquehanna River Basin covers 27,510 mi^2 and is divided into six major sub-basins (see Figure 2-13). Its drainage patterns are influenced by the long parallel ridges and valleys of the Appalachian Plateau physiographic province and the Ridge and Valley physiographic province. The BBNPP site is located in the Middle Susquehanna sub-basin, which, along with the Upper Susquehanna and Chemung sub-basins, is drained by the North Branch of the Susquehanna River and its tributaries. The area of these three sub-basins is 11,310 mi^2 or approximately 40 percent of the entire Susquehanna River Basin area. The North Branch of the Susquehanna River joins the West Branch of the Susquehanna River at Sunbury, Pennsylvania, approximately 40 mi downstream of the BBNPP site (SRBC 2012-TN2443).

The BBNPP site is on the west side of the river, approximately 22 mi downstream of Wilkes-Barre, Pennsylvania, and approximately 5 mi upstream of Berwick, Pennsylvania (PPL Bell Bend 2013-TN3377). The site is adjacent to the bend in the North Branch of the Susquehanna River, which flows south and then turns to flow abruptly west (Figure 2-13).

No dams are located on the main stem of the Susquehanna River upstream of the BBNPP site; however, almost 500 water-control structures are located on the many tributaries that flow into the river upstream of the site (PPL Bell Bend 2013-TN3377). Eight of these structures are considered major enough to exert some influence on flows at the BBNPP site (Table 2-6, Figure 2-14). These eight dams and associated reservoirs are managed by the U.S. Army Corps of Engineers (USACE) for the stated purposes of flood control, recreation, and water supply. Several of these reservoirs (e.g., Cowanesque and Whitney Point) release water for flow augmentation during low-flow periods. None of these dams are used for hydroelectric power generation. The nearest downstream dam, the Adam T. Bower Memorial Dam, is located below the confluence of the West Branch of the Susquehanna River and North Branch of the Susquehanna River at Sunbury.

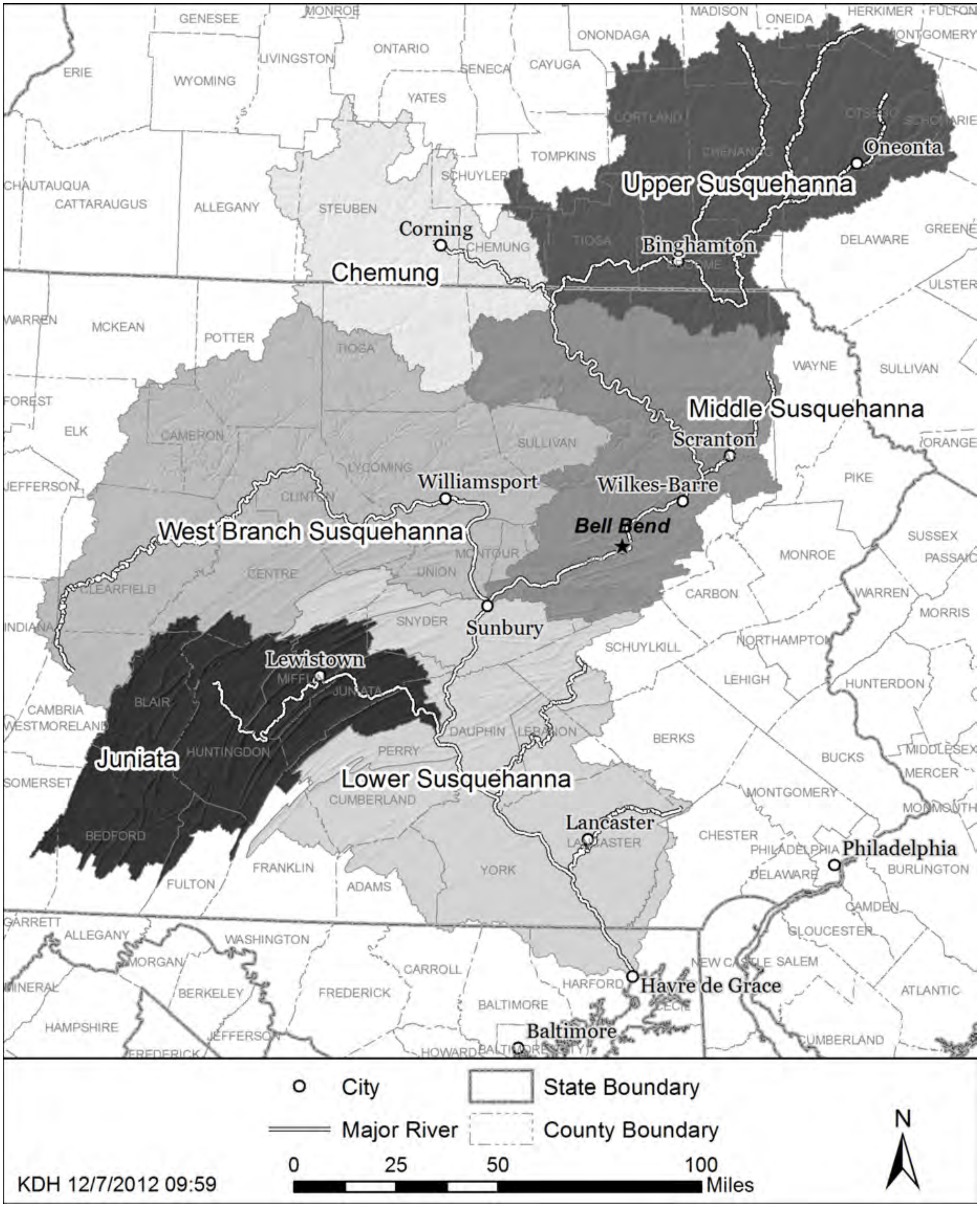

Figure 2-13. Susquehanna River Basin and Sub-Basins

Table 2-6. Major Reservoirs Upstream of the Proposed BBNPP Site (Source: USACE 2012-TN1599 except as indicated)

Reservoir	Location (Waterbody, Sub-Basin)	Purpose	Maximum Storage Capacity (ac-ft)[a]	Drainage Area (mi^2)	Date Completed
Almond Lake	Hornell, New York (Canacadea Creek, Chemung sub-basin)	Flood Control, Recreation	22,600	56	1949
Arkport Dam	Hornell, New York (Canisteo River, Chemung sub-basin)	Flood Control	10,800	31	1940
Cowanesque	Tioga County, Pennsylvania (Cowanesque River, Chemung sub-basin)	Flood Control, Water Supply, Recreation	171,000	298[a]	1980
Tioga[b]	Tioga, Pennsylvania (Tioga River, Chemung sub-basin)	Flood Control, Recreation	143,200	280	1980
Hammond[b]	Tioga, Pennsylvania (Crooked Creek, Chemung sub-basin)	Flood Control, Recreation	136,000	122	1980
Whitney Point	Whitney Point, New York (Otselic River, Upper Susquehanna sub-basin)	Flood Control, Recreation	176,000	255	1942[a]
East Sidney	Unadilla, New York (Ouleout Creek, Upper Susquehanna sub-basin)	Flood Control, Recreation	58,350	102	1950
Stillwater	Forest City, Pennsylvania (Lackawanna River, Middle Susquehanna sub-basin)	Flood Control, Recreation	17,000	37	1960

(a) Source: PPL Bell Bend 2013-TN3377, Table 2.3-12
(b) Tioga and Hammond reservoirs are joined by a gated connecting channel. An uncontrolled spillway on Hammond Dam serves both reservoirs. A gated outlet conduit in Tioga Dam controls flow from both reservoirs.

The nearest gaging stations to the proposed BBNPP site that measure streamflow are USGS 01536500, Susquehanna River at Wilkes-Barre, Pennsylvania, located 24 mi upstream of the BBNPP site (hereafter referred to as the Wilkes-Barre gage) and USGS 01540500, Susquehanna River at Danville, Pennsylvania, located about 28 mi downstream of the site (Figure 2-14; Table 2-7). Another streamflow gage is located below the confluence of the West Branch of the Susquehanna River and North Branch of the Susquehanna River at Sunbury.

Streamflow in the Susquehanna River follows a seasonal pattern typical of the northeastern United States. Flows follow the pattern of precipitation, with flows moderated by freezing in the winter months, followed by higher flows in March and April as spring rains combine with snowmelt. The review team determined that because of its proximity and duration of record, USGS 01536500 is most representative of flow conditions at the BBNPP site. Historically, the highest monthly mean flows occur in March and April, and the lowest flows occur in August and September (Table 2-8) (USGS 2010-TN1609).

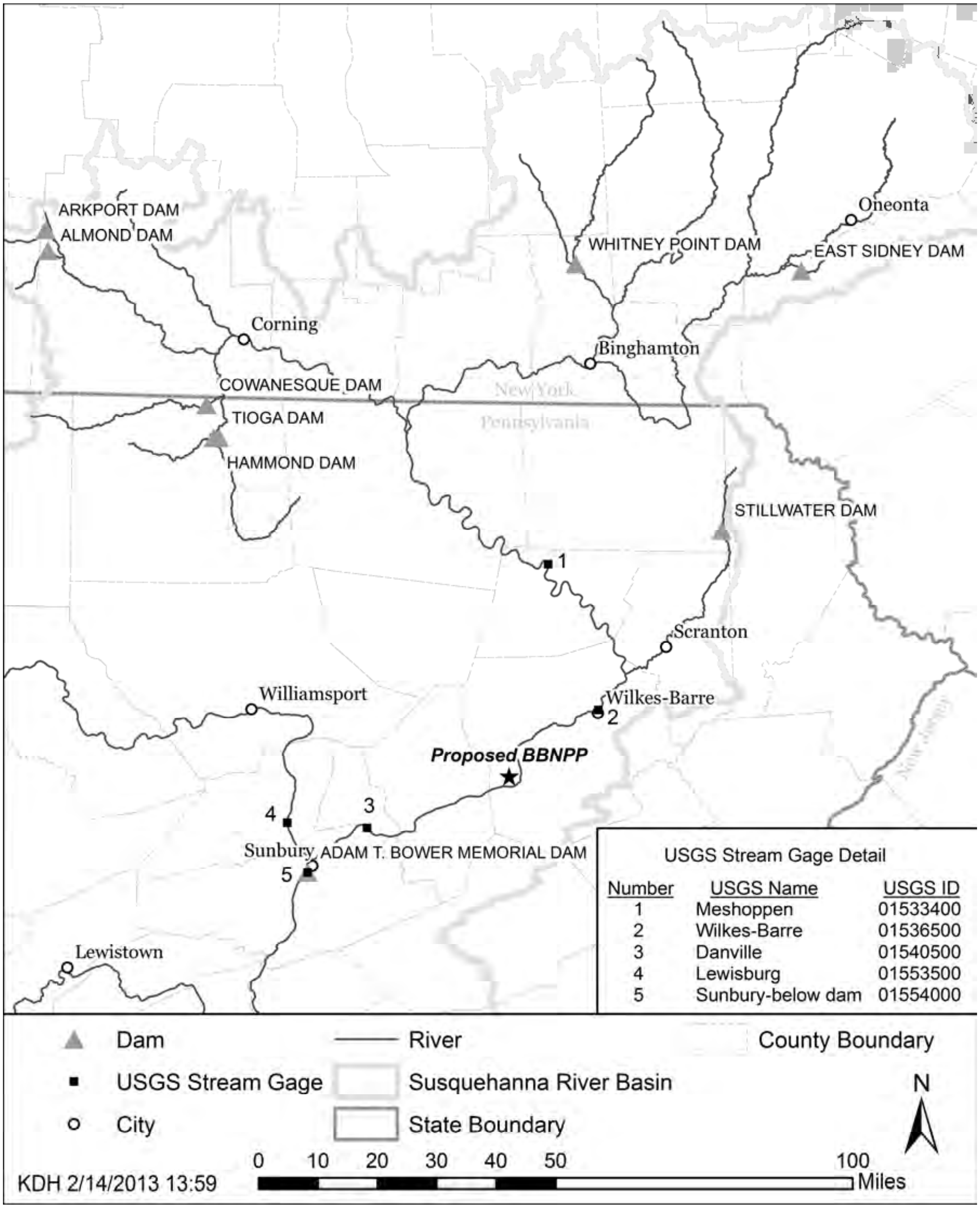

Figure 2-14. Dams and Gaging Stations in the North Branch Susquehanna River Drainage

Table 2-7. USGS Streamflow Gaging Stations in the Vicinity of BBNPP

USGS Gage	Description	Drainage Area (mi^2)	Period of Record for Discharge
01536500	Susquehanna River at Wilkes-Barre	9,960	04/01/1899 - present
01540500	Susquehanna River at Danville	11,220	04/01/1905 - present
01554000	Susquehanna River at Sunbury (below dam)	18,300	10/01/1937 - present

Source: USGS 2012-TN1598

Table 2-8. Monthly Mean Flow Statistics for the Susquehanna River at Wilkes-Barre

	Monthly Mean Flow, Susquehanna River at Wilkes-Barre (cfs)		
Month	Average	Minimum (year)	Maximum (year)
October	7,186	705 (1965)	39,860 (1978)
November	11,490	724 (1965)	32,130 (1928)
December	14,520	1,357 (1909)	44,610 (1997)
January	14,500	1,386 (1931)	40,740 (1996)
February	14,900	2,710 (1920)	43,030 (1976)
March	30,350	10,250 (1965)	80,560 (1936)
April	30,900	6,918 (1946)	100,000 (1993)
May	16,230	3,388 (1903)	39,590 (1943)
June	9,378	2,137 (1999)	54,330 (1972)
July	5,594	1,086 (1962)	29,010 (1902)
August	4,184	853 (1964)	19,560 (1994)
September	4,620	637 (1964)	37,600 (2004)

Source: USGS 2010-TN1609

The USGS summary statistics for the Wilkes-Barre gage include a mean annual discharge of 13,770 cfs from 1900 to 2013, with the annual discharge for individual years ranging from 6,186 cfs (in 1965) to 26,430 cfs (in 2011) (see Figure 2-15). The Susquehanna River Basin experienced the most severe droughts of record during periods from 1930 to 1934 and from 1962 to 1965 (SRBC 2013-TN3568). Mean annual discharge at the Wilkes-Barre gage during the period 1962 to 1965 was 9,322 cfs, approximately 68 percent of the long-term (1900 to 2013) mean.

While the continuous flow record for Wilkes-Barre is very long, the early years are less useful for characterizing present-day flow rates because flow rates were modified as upstream flow-control structures were built. As shown in Table 2-6, the last major dams were completed in 1980, and their combined drainage area is 1,181 mi^2, or about 12 percent of the drainage area at the Wilkes-Barre gage. The USGS calculated “post-regulation” streamflow statistics for the Wilkes-Barre gage starting in water year 1981 to characterize streamflow once all the flood-control dams were operational (Stuckey and Roland 2011-TN1902). Selected USGS pre- and post-regulation streamflow statistics are shown in Table 2-9. The upstream flood-control dams moderate the very high and very low flows by holding back floodwater during very high flows, and releasing that water over a longer period of time. Therefore, most downstream flow statistics show an increase after 1981. For example, the median flow (flow that is exceeded 50 percent of the time) at the Wilkes-Barre gage was 7,050 cfs for water years 1900 to 1979, and 8,530 cfs for water years 1981 to 2007.

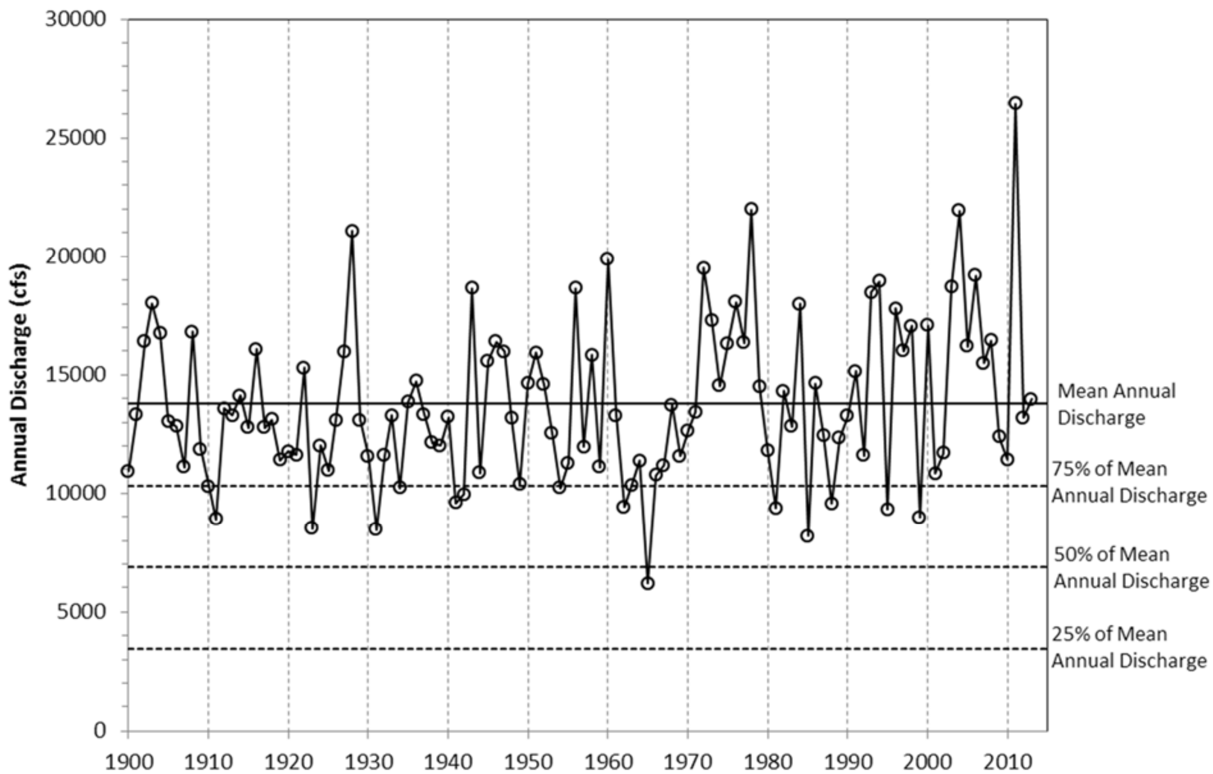

Figure 2-15. Susquehanna River Annual Discharge at Wilkes-Barre (USGS Gage 01536500)

Table 2-9. Pre- and Post-Regulation Flow Statistics for the Susquehanna River at Wilkes-Barre

Flow Statistic	Entire Period of Record[(a)] (WY1899−2010)	Pre-Regulation Flow (cfs)[(b)] (WY1900−1979)	Post-Regulation Flow (cfs)[(b)] (WY1981−2008)	Recent 10 Years[(c)] (WY2004−2013)
Mean annual flow	13,660	13,500	14,400	16,661
Flow that is exceeded 99% of the time	Not calculated	837	997	1,310
Flow that is exceeded 95% of the time	Not calculated	1,250	1,390	1,940
Flow that is exceeded 90% of the time	1,700	1,670	1,830	2,610
Flow that is exceeded 50% of the time	7,400	7,050	8,530	10,700
Flow that is exceeded 10% of the time	32,500	18,600	19,000	35,900
1-day, 10-year	Not calculated	778	828	1,050
7-day, 10-year (7Q10)	Not calculated	811	872	Lowest 7 day avg in 10 yr: 1,069

(a) Source: USGS 2010-TN1609
(b) Source: Stuckey and Roland 2011-TN1902
(c) Source: Review team calculation

In the vicinity of the proposed BBNPP intake and discharge structures, the Susquehanna River is about 800 ft wide and forms a relatively large pool starting about 0.2 mi upstream of the proposed intake location and extending about 0.7 mi downriver (PPL Nuclear Development 2011-TN2274, Enclosure C, Aquatic Habitat). The deepest parts of the pool are approximately 16 to 18 ft deep (Figure 2-16).

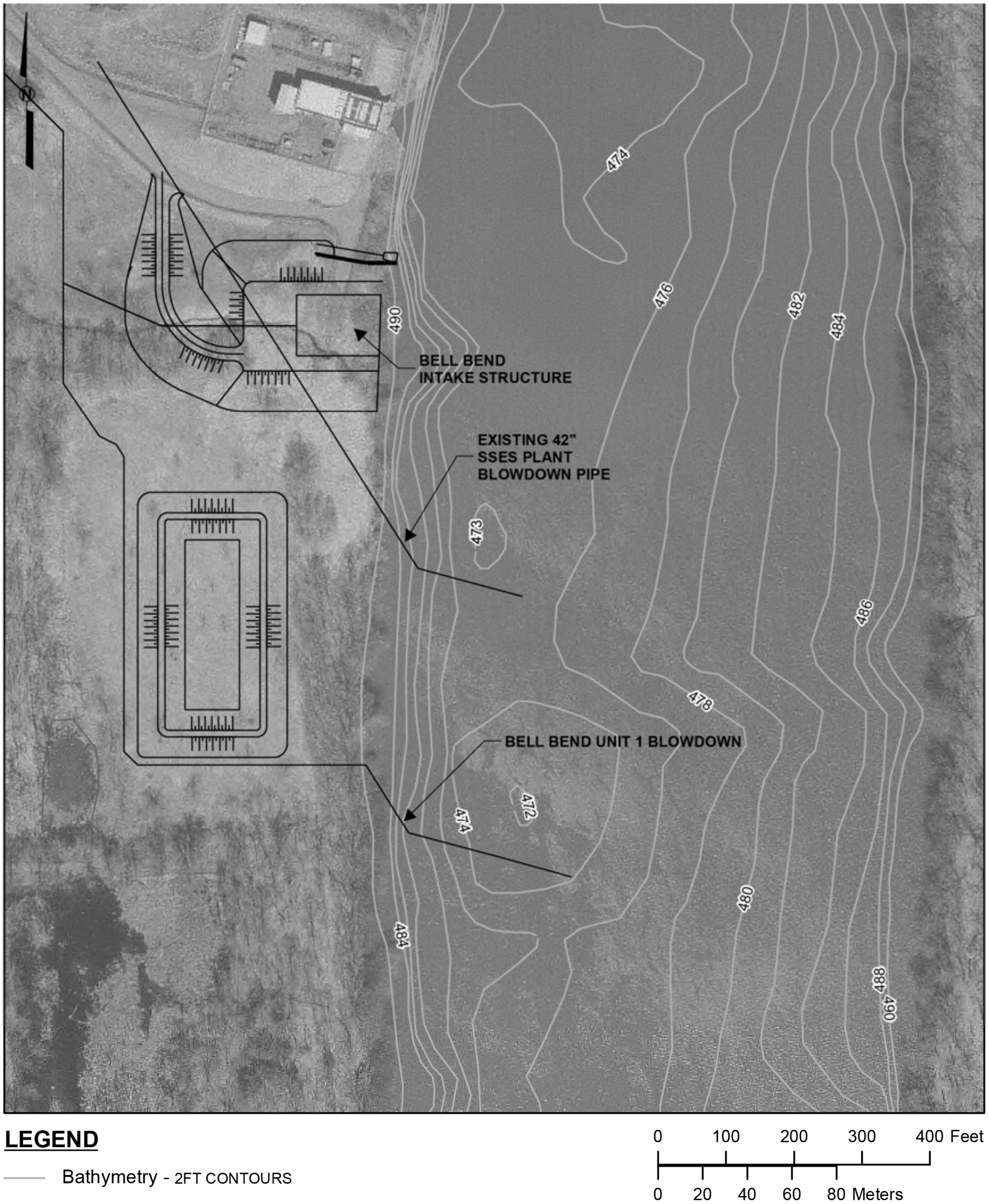

Figure 2-16. Bathymetry of the Susquehanna River at the Proposed BBNPP Intake and Discharge Locations (contours are elevation in feet NAVD88) (PPL Bell Bend 2013-TN3377)

Several small streams enter the river near the site. Wapwallopen and Little Wapwallopen Creeks flow in from the east, across the river from the site. Walker Run and several smaller unnamed creeks flow in from the west side of the river on or near the site. Salem Creek and Nescopeck Creek enter the river downstream of the site from the north and south, respectively (Figure 2-17).

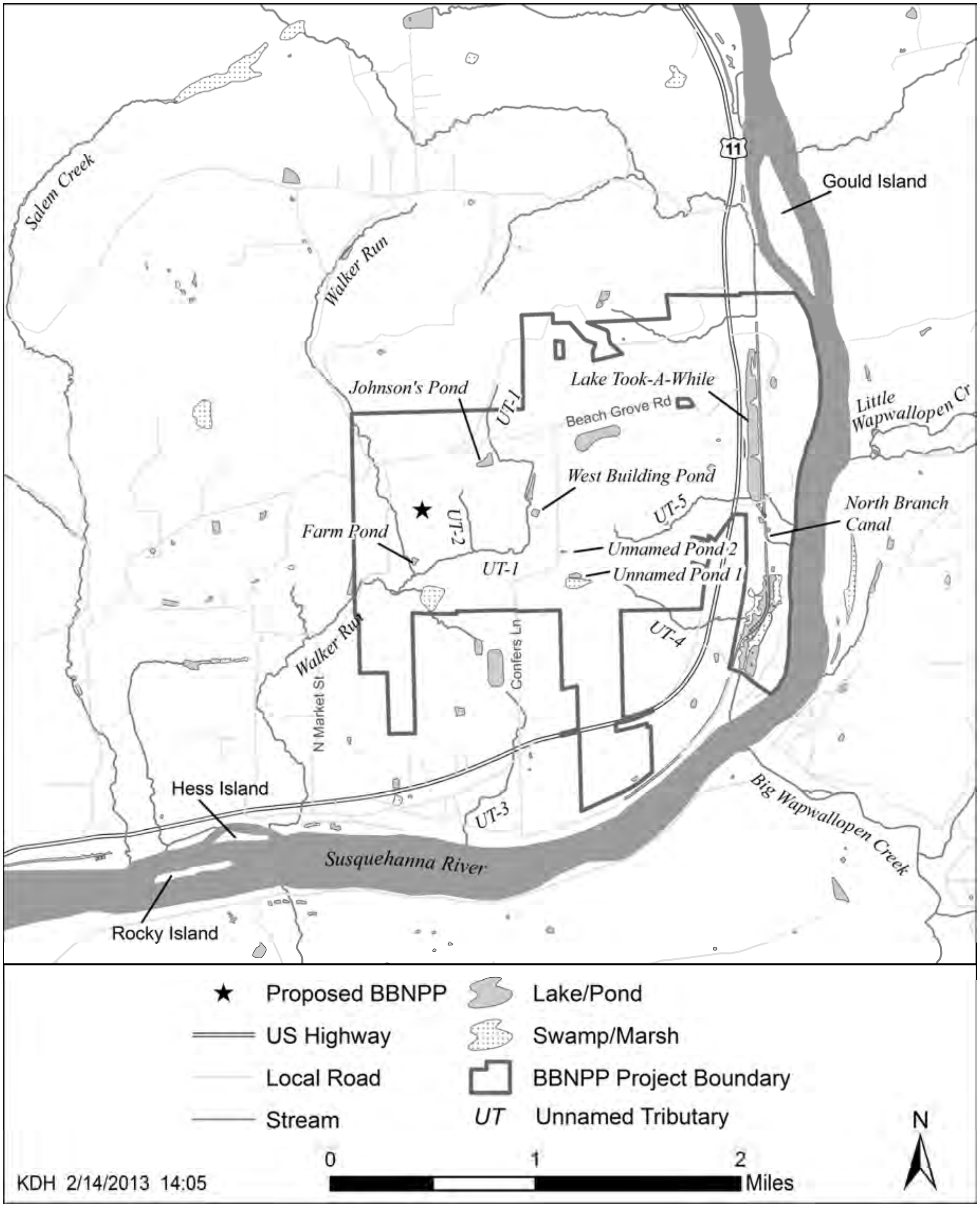

Figure 2-17. Waterbodies on and in the Vicinity of the BBNPP Project Area

Walker Run and Other Local Waterbodies

Walker Run is a small stream with a drainage area of about 4.3 mi^2 consisting of mixed forest and field. A drainage divide exists at about Confers Lane, dividing the Walker Run drainage flowing west from other surface drainage flowing east to drain the SSES site. Walker Run originates north of the BBNPP site and flows about 4 mi south to enter the Susquehanna River at Beach Haven, Pennsylvania (Figure 2-17). Walker Run drops about 290 ft in elevation from its headwaters on Lee Mountain to its mouth at Beach Haven. In Table 2.3-17 of the ER, PPL provided a summary of the estimated water budget for five sub-basins of the North Branch of the Susquehanna River (i.e., the Towanda Creek, Wapwallopen Creek, Tunkhannock Creek, East Branch Chillisquaque Creek, and Fishing Creek basins) (PPL Bell Bend 2013-TN3377). The average combined surface-water runoff and groundwater discharge for the five sub-basins was 20.8 in./yr. Using this combined rate and the Walker Run drainage area, the review team estimated the annual average discharge rate from the Walker Run watershed to be 6.6 cfs.

Two unnamed tributaries (Unnamed Tributary 1 and Unnamed Tributary 2) flow south and then west, draining much of the proposed BBNPP site, before entering the main stem of Walker Run near the southwest corner of the site. Unnamed Tributary 1 is the longest, originating north of Johnson's Pond, flowing past Johnson's Pond through the former Beaver Pond area, then turning to flow west-southwest into the main stem near Market Street. Unnamed Tributary 2 is a short creek that originates near a forested wetland that is referred to as Wetland 11 or the Teardrop Wetland and flows south into Unnamed Tributary 1 (Figure 2-17). Unnamed Tributary 2 flows through a drainage pipe under an open field for about 570 ft between Wetland 11 and Unnamed Tributary 1.

Several other small streams and ponds are present on and near the BBNPP project area (Figure 2-17). Several small ponds are located within the Walker Run drainage area: Johnson's Pond, a former Beaver Pond (drained in 2010); West Building Pond; and Farm Pond. Two small unnamed ponds (Unnamed Pond 1 and Unnamed Pond 2) are located just east of Confers Lane. A small stream, Unnamed Tributary 5, runs east from SSES into Lake Took-A-While, which is an elongated pond created in 1979 for recreational fishing (Mangan 2000-TN392). Lake Took-A-While is located in the eastern part of the project area, adjacent to the Susquehanna River, as is the remnant North Branch Canal that was historically used for transportation. Unnamed Tributary 4 drains into the Susquehanna Riverlands Natural Area from the southeast portion of the SSES site. Unnamed Tributary 3 drains south from near the BBNPP project area and enters the Susquehanna River approximately 1 mi upstream of Walker Run. The distinctive man-made oval "racetrack" pond is in the Unnamed Tributary 3 drainage (Figure 2-17). The small pond to the northwest of the oval "racetrack" pond is connected to the wetlands in the southern part of the BBNPP site through a small unnamed stream (see Figure 2-17) in an area of flat topography (USGS 2010-TN3495). Figure 2.3-3 in the ER places this small pond and stream outside the Walker Run watershed (PPL Bell Bend 2013-TN3377). However, PPL also stated that the small pond drains to the northwest into the wetlands and ultimately to Walker Run (PPL Bell Bend 2014-TN3494). The flat topography in this area suggests that the surface flows are likely to be small.

The present hydrology of Walker Run, its tributaries, and other local waterbodies reflects a legacy of past hydrologic modifications. Stream channels were straightened, drainage pipes laid to drain agricultural land, and small ponds were constructed. Some sections of stream were historically impounded as mill ponds or by beaver dams that have since been removed. There are numerous wetlands associated with the streams, as the streams are connected to groundwater from the surficial Glacial Outwash aquifer (PPL Bell Bend 2013-TN3377). Wetlands in the BBNPP project area are described in more detail in Section 2.4.1.

Other Susquehanna River Basin Waterbodies Affected by BBNPP Consumptive-Use Mitigation

Potential impacts from releases of water for mitigation of consumptive use by BBNPP are likely to be greatest near the source of those releases. The primary plan for BBNPP mitigation, described in Section 2.2.2, involves releases from Cowanesque Lake into the Cowanesque River below the dam. Cowanesque Lake and Dam are operated by the USACE for flood risk management, recreation, environmental stewardship, and water-supply storage to mitigate for downstream consumptive use (USACE 2013-TN3383). A normal pool elevation of 1,080 ft. is currently maintained by the USACE to facilitate boating, fishing, and swimming in the lake. An average conservation release of 15 cfs is targeted during drought conditions to maintain flow in the Cowanesque River below the dam. The Cowanesque River discharges to the Tioga River about 2 mi below the dam. Flows in the Tioga River are regulated by releases from the Tioga-Hammond Reservoir complex, operated by the USACE. The median values of monthly flows during water years 1981 to 2013 in the Cowanesque River below the dam (USGS Gage 1520000) and in the Tioga River at Tioga Junction (USGS Gage 1518700) are shown in Figure 2-18. During the summer months, median monthly flow in the Tioga River is more than twice that in the Cowanesque River.

During drought conditions, inflow to Cowanesque Lake may be insufficient to maintain a lake elevation of 1,080 ft. Drawdown in lake elevation occurred during nine of the years between 1991 and 2010, and on a total of 481 days (USACE 2013-TN3383). For 78 percent of the days when drawdown occurred, lake elevation was at least 1,077 ft. On 10 percent of the days with drawdown, lake elevation was less than 1,075 ft and five percent of the time it was less than 1,070 ft. Water-supply releases from the lake for consumptive-use mitigation contribute to lake drawdown. Water-supply releases of 1,280 ac-ft and 2,630 ac-ft in 1991 and 1995, respectively, accounted for 1.5 and 1.8 ft of drawdown (USACE 2013-TN3383). With a change in the Susquehanna River flows triggering consumptive-use mitigation (described in Section 2.3.2.1), water-supply releases from Cowanesque are expected to occur more frequently and for longer periods of time. Based on hydrologic simulation results, the likelihood of at least 5 ft of drawdown occurring in any given year will increase from 20 to 23 percent with the change in mitigation triggers (USACE 2013-TN3383).

PPL's primary plan for BBNPP consumptive-use mitigation involves increasing discharges to Moshannon Creek from the Rushton Mine (as described in Section 2.2.2), located about 2 mi south of the Phillipsburg, Pennsylvania. Moshannon Creek is a tributary to the West Branch of the Susquehanna River. This stretch of Moshannon Creek has a designated protected water use for aquatic life of trout stocking and migratory fishes (Pennsylvania Code, Title 25, Chapter 93.9l [TN611]). Moshannon Creek is impaired for aquatic life by acid mine drainage (PADEP 2013-TN2432). At the point where the discharge from Rushton Mine occurs, Moshannon Creek is affected by untreated discharges from upstream mines. Water from Rushton Mine is currently treated prior to discharge, thus improving water quality in the creek. The current average discharge from the mine is 10.7 cfs (6.9 Mgd) (PPL Bell Bend 2013-TN3541). No active gaging stations are located on Moshannon Creek; however, daily discharge from 1940 to 1993 was recorded at a currently inactive gage site near Osceola Mills (USGS Gage 01542000). The median values of monthly flows at this gage are shown in Figure 2-19 for the period of record. The current average discharge from Rushton Mine is approximately 40 percent of the lowest median monthly flows.

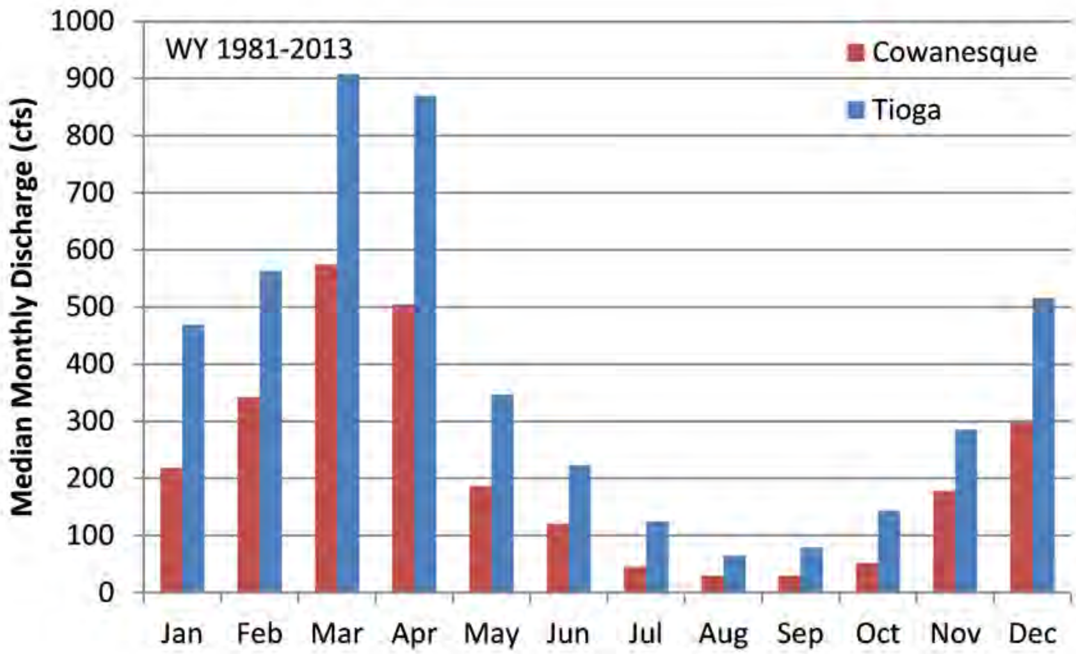

Figure 2-18. Median Monthly Flows in the Cowanesque and Tioga Rivers Below the Dams during Water Years 1981 to 2013

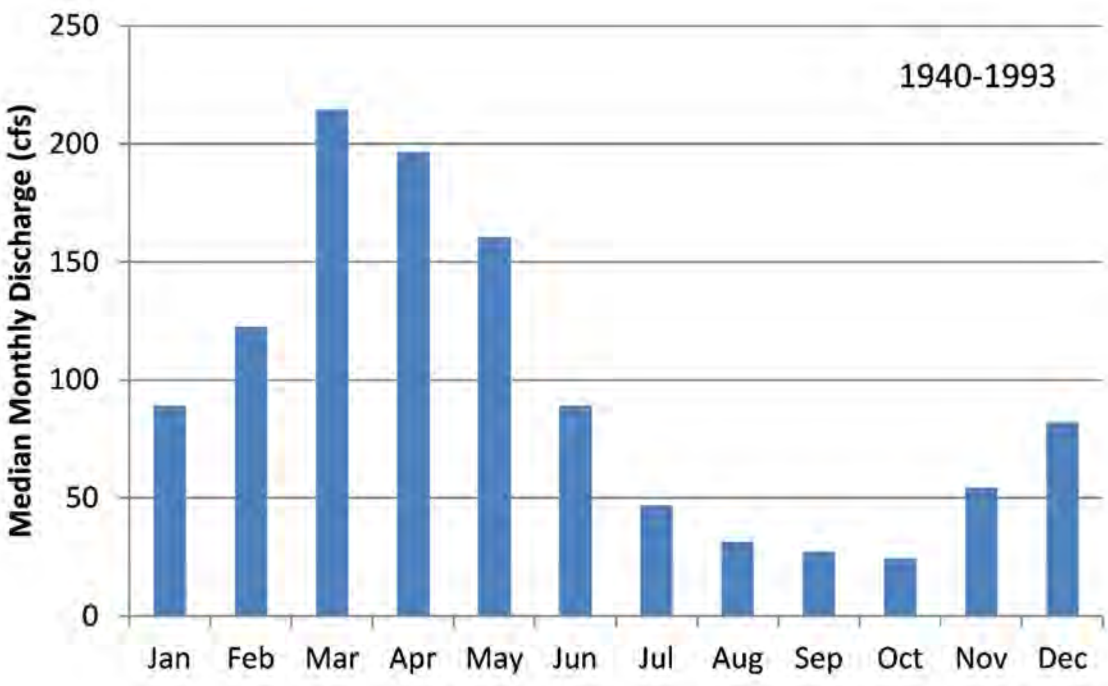

Figure 2-19. Median Monthly Flow in Moshannon Creek during 1940 to 1993

2.3.1.2 Groundwater Hydrology

The geology of the BBNPP site and the surrounding region is described in detail in FSAR Section 2.5 (PPL Bell Bend 2013-TN3447). The BBNPP site is located in the Valley and Ridge physiographic province, a region characterized by elongated mountain ridges of resistant sandstone and conglomerate rocks and valleys of more easily eroded limestone, dolomite, and shale (Trapp and Horn 1997-TN1865). BBNPP lies within a glaciated region of the province, with valleys filled, or partially filled, with glacial deposits and significant alluvial deposits along streams and rivers (Trapp and Horn 1997-TN1865). This section describes the characteristics of regional and local groundwater resources. Use of onsite groundwater is not proposed for building and operation of BBNPP.

Regional Groundwater Description

Regional groundwater hydrology in the vicinity of the BBNPP site is described in Section 2.3 of the ER (PPL Bell Bend 2013-TN3377) and in Section 2.4.12.1 of the FSAR (PPL Bell Bend 2013-TN3447). The hydrogeologic description provided in these documents is consistent with the regional description provided in Segment 11 of the *Ground Water Atlas of the United States* (Trapp and Horn 1997-TN1865). Regionally, groundwater occurs in Paleozoic sedimentary rocks that include sandstone, siltstone, shale, and limestone approximately 33,000 ft thick in the BBNPP site vicinity. Unconsolidated surficial deposits rest atop the Paleozoic rocks. Groundwater is present in all rock formations and the surficial deposits. Sand and gravel from glacial outwash and alluvium are deposited along major stream valleys, and form productive local aquifers. A majority of the more productive aquifers, found in valleys, are formed of carbonate rocks. Extensive aquitards are not found in the BBNPP site region as the rocks in the uppermost 300 ft are folded, faulted, and fractured. Most groundwater flow in the rock aquifers is along fractures and bedding planes, with additional pathways due to solution cavities in carbonate rocks. Springs are common in the Valley and Ridge physiographic province, particularly from carbonate rocks (Trapp and Horn 1997-TN1865).

In Table 2.3-17 of the ER, PPL provided a summary of estimated groundwater recharge rates in five sub-basins of the North Branch of the Susquehanna River (i.e., the Towanda Creek, Wapwallopen Creek, Tunkhannock Creek, East Branch Chillisquaque Creek, and Fishing Creek basins) (PPL Bell Bend 2013-TN3377). Recharge estimates were based on data from 1961 to 1980 on rainfall rates, direct runoff, groundwater discharge to wells and streams, changes in groundwater storage, and evapotranspiration. Groundwater recharge varied from 15 to 40 percent of precipitation across the sub-basins and study periods, with an average recharge of 29 percent of precipitation (12 in./yr of recharge from 41 in./yr of precipitation).

The U.S. Environmental Protection Agency (EPA) has designated six sole-source aquifers in EPA Region III, which includes Pennsylvania. The nearest designated sole-source aquifer, approximately 55 mi to the east of the BBNPP site, is the upstream portion of the Delaware River that serves as the streamflow source zone for the New Jersey Coastal Plain aquifer (EPA 2007-TN3552). Because all sole-source aquifers are a significant distance from BBNPP and are outside the groundwater-flow system of the BBNPP site, they would not be affected by building and operating the proposed BBNPP.

The SRBC has identified potentially stressed areas and water challenged areas as part of its groundwater-management plan (SRBC 2005-TN3590). The only area identified in the North Branch of the Susquehanna River is the area along the Chemung River from the confluence with the Tioga River and downstream to South Corning, New York (SRBC 2005-TN3590). The Glacial Outwash aquifer is this area is potentially stressed from heavy industrial and public water-supply use.

Onsite Groundwater Description

To characterize the local hydrogeology, existing data from the SSES site were combined with results from the 2007 site investigation of the initial BBNPP location and 44 geotechnical boreholes completed for the 2010 site investigation of the proposed BBNPP location (PPL Bell Bend 2013-TN3447). The maximum depth of the boreholes was 420 ft in a borehole at the proposed nuclear island location. A total of 51 groundwater monitoring wells were installed during the two site investigations to characterize onsite groundwater flow. Two hydrogeologic units were identified at the site: the Glacial Outwash aquifer and the underlying claystone and shale bedrock aquifer of the Harrell and Mahantango Formations (PPL Bell Bend 2013-TN3447). Although no lithologic or hydraulic distinction exists, the bedrock aquifer was divided into shallow and deep aquifers with the division between them set arbitrarily at 175 ft below ground surface (PPL Bell Bend 2013-TN3447).

Glacial Outwash Aquifer

Ground elevations at the BBNPP site range from approximately 660 ft NAVD88 along Walker Run in the southwest corner of the site to approximately 800 ft NAVD88 in the vicinity of the power block (USGS 2010-TN3495). Glacial deposits of variable thickness cover the bedrock at the BBNPP site and are largely the result of deposits during the last major glacial advance 22,000 to 17,000 years ago (PPL Bell Bend 2013-TN3377). Upland deposits are classified as till (glacial moraine) by Inners (1978-TN3497); in the power block area, the surficial deposits are identified in the FSAR as intensely weathered shale (PPL Bell Bend 2013-TN3447). Kame terrace and glacial outwash deposits (predominately sand and gravel) exist in the lower-elevation regions of the site, primarily north and south of the power block area (referred to in the ER and FSAR as the northern and southern troughs). Some alluvial deposits exist along Walker Run. Saturated thickness of the Glacial Outwash aquifer is greater in the lower-elevation regions of the site, as shown in Figure 2.3-36 of the ER (PPL Bell Bend 2013-TN3377).

Shallow Bedrock and Deep Bedrock Aquifers

The description of the bedrock geology provided in the FSAR (PPL Bell Bend 2013-TN3447) is consistent with that of Inners (1978-TN3497). Shale and claystone bedrock of the Harrell and Mahantango formations underlies the glacial outwash material. The Harrell formation is about 120 ft thick and occurs at the BBNPP site north of the power block. The underlying Mahantango formation is estimated to be 1,500 ft thick and occurs over the remainder of the BBNPP site. The uppermost portion of the Mahantango is the Tully member, a 50 to 75 ft shale that occurs in the BBNPP power block area. The shale and claystone bedrock has low primary porosity and permeability. Water storage and transmission occurs primarily in secondary porosity features (i.e., fractures, joints, and bedding plane separations). For two boreholes examined using optical and acoustic methods, intervals where fracture density was higher appeared to correspond to locations of measurable permeabilities as obtained from borehole packer tests (PPL Bell Bend 2013-TN3447). The intervals of higher fracture density in these boreholes occurred at depths of 200 ft or more. As described in Section 2.4.12 of the FSAR (PPL Bell Bend 2013-TN3447), the bedrock aquifer was divided into shallow and deep aquifers to evaluate three-dimensional groundwater-flow characteristics, with the division arbitrarily set at 175 below ground surface.

Hydrogeological Investigations

To characterize BBNPP site hydrogeology, PPL installed 41 monitoring wells during the 2007 site investigation. An additional 10 monitoring wells were installed during the 2010 site investigation in the area of the proposed power block. Of these 51 wells, 15 were screened in the Glacial Outwash aquifer, 28 in the Shallow Bedrock aquifer, and eight in the Deep Bedrock aquifer. Locations of monitoring wells are shown in Figure 2-20. These wells provide information on the fluctuation of water levels, subsurface flow directions, and hydraulic gradients.

Recharge to groundwater at the site results primarily from infiltration locally and on the highlands north of the site. The groundwater level rises and falls seasonally, depending on the rate of infiltration of meteoric water and evapotranspiration. Groundwater elevations typically decline in the summer and fall when precipitation is low and evapotranspiration is high. For the monitoring wells in the Glacial Outwash aquifer, groundwater elevations have been, in general, lowest in the fall and highest in winter (PPL Bell Bend 2013-TN3377). Typically, seasonal variation in groundwater elevation was 5 to 10 ft during the periods of observation with a maximum variation of greater than 30 ft in one of the wells screened in the Deep Bedrock aquifer (PPL Bell Bend 2013-TN3377). During periods of low recharge, groundwater continues to flow toward sinks like streams, wells, seeps, and the North Branch of the Susquehanna River. Several small groundwater-fed ponds are currently on or adjacent to the proposed BBNPP site. Four of these ponds—Johnson's Pond (G6), Beaver Pond (G7), Unnamed Pond # 1 (G9), and Farm Pond (G8), which are shown in Figure 2-21—are part of the surface-water monitoring network. In general, water levels in these four ponds track groundwater levels in the Glacial Outwash aquifer. In addition, surface-water levels were measured at onsite streams and used to infer coincident water levels in the surficial groundwater.

Some of the monitoring wells were arranged as two- or three-well vertical clusters (i.e., wells were screened at different elevations, but in close lateral proximity). Well clusters were used to measure vertical hydraulic gradients and to predict potential areas of groundwater recharge and discharge.

Hydraulic Properties

As summarized below, PPL characterized the hydraulic properties of the site aquifers with slug tests and pumping tests in completed monitoring wells, and with packer tests in geophysical boreholes (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2013-TN3447). Results of the tests were provided in Tables 2.3-27, 2.3-28, and 2.3-29 of the ER (PPL Bell Bend 2013-TN3377).

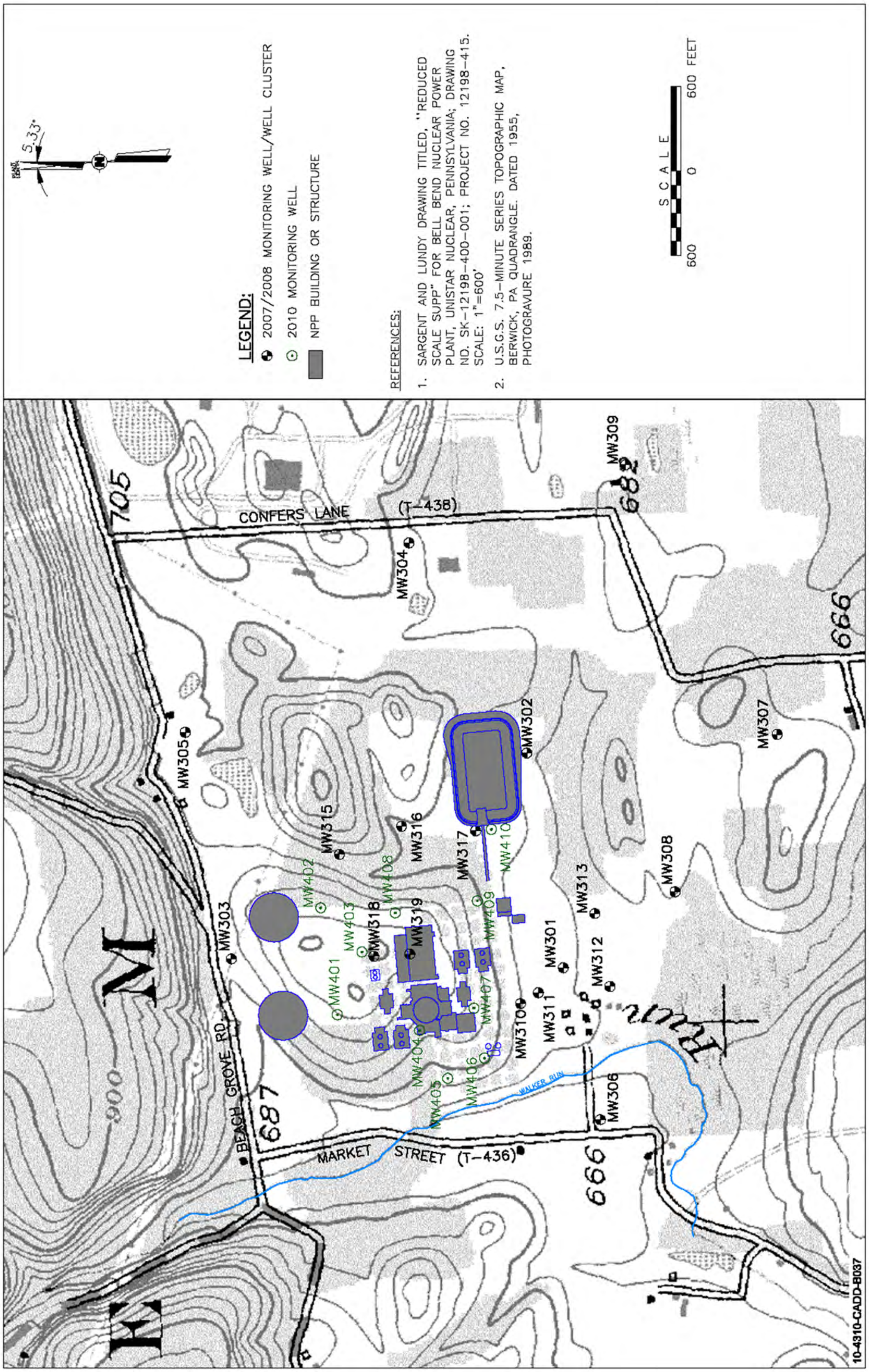

Figure 2-20. Groundwater Monitoring Well Locations (PPL Bell Bend 2013-TN3377)

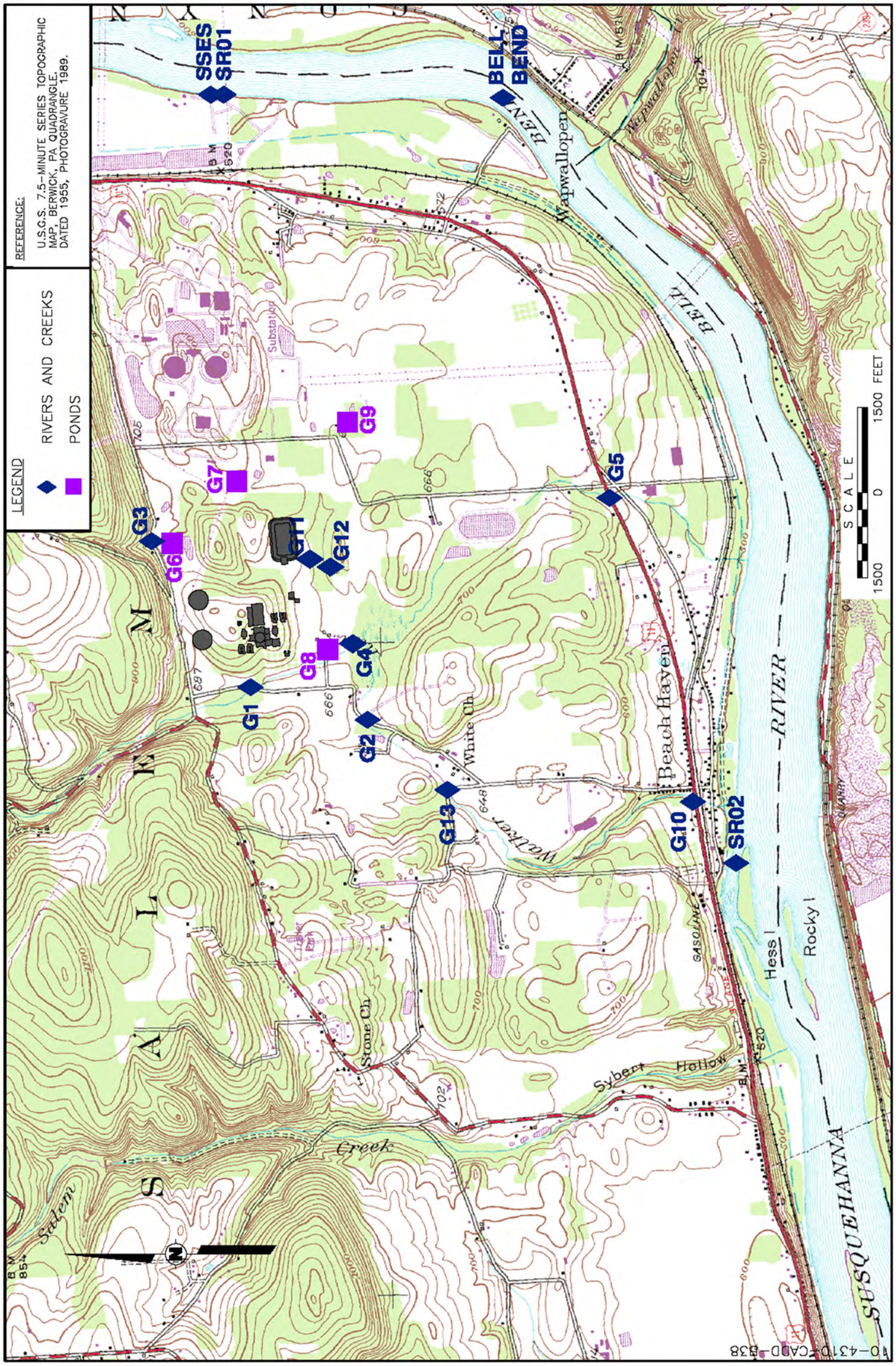

Figure 2-21. Surface-Water Monitoring Locations (PPL Bell Bend 2013-TN3377)

Glacial Outwash Aquifer

PPL characterized horizontal hydraulic conductivity, Kh, in the Glacial Outwash aquifer using slug tests in 15 monitoring wells at the BBNPP site. The calculated Kh values from these tests ranged from 0.0338 to 96.3 ft/day with a geometric mean value of 9.84 ft/day. Kh values were relatively high (23.8 to 96.3 ft/day) for the eight wells located south of the power block, within the area referred to in the FSAR as the southern trough (PPL Bell Bend 2013-TN3447). Previous slug tests in the Glacial Outwash aquifer at the adjacent SSES site yielded Kh values between 1.8 and 6.6 ft/day.

In addition, PPL characterized hydraulic conductivity of the Glacial Outwash aquifer at the BBNPP site with a pump test using a 24-hr constant pumping rate and three observation wells. The resulting geometric mean Kh value from this test was 186 ft/day. Previous pump tests at the adjacent SSES site yielded Kh values from 3.3 to 200 ft/day. A median specific yield of 0.322 for the Glacial Outwash aquifer also was estimated by PPL from the pump test results and assumed to be equivalent to the effective porosity. PPL used a Kh value of 186 ft/day and an effective porosity value of 0.322 to represent the Glacial Outwash aquifer in groundwater-flow calculations.

Shallow and Deep Bedrock Aquifers

Slug tests from 15 wells completed in the Shallow Bedrock aquifer yielded Kh values ranging from 0.139 to 38.5 ft/day with an geometric mean value of 1.54 ft/day. Four pumping tests were conducted in the Shallow Bedrock aquifer at the BBNPP site. The geometric mean Kh resulting from these tests was 1.5 ft/day and the geometric mean storage coefficient was 1.6E-4. Packer tests were conducted in nine open bedrock borings using borehole intervals from 12.6 to 23 ft in length, with 51 intervals covering the Shallow Bedrock aquifer. Estimates of Kh from the packer tests ranged from 0.00113 to 1.08 ft/day with a geometric mean estimate of 0.00549 ft/day.

Slug tests from five wells completed in the Deep Bedrock aquifer yielded Kh values ranging from 0.0325 to 4.27 ft/day with a geometric mean value of 0.335 ft/day. Packer tests were conducted in 39 borehole intervals covering the Deep Bedrock aquifer. Estimates of Kh ranged from less than 0.00113 to 0.334 ft/day with a geometric mean estimate of 0.0043 ft/day. No pumping tests were conducted in the Deep Bedrock aquifer.

Groundwater Pathways

Observation well data and subsurface pathways are described in Section 2.3.1.2 of the ER (PPL Bell Bend 2013-TN3377). In general, water-table elevations in the Glacial Outwash aquifer are expected to reflect the topography at the BBNPP site; the observed hydraulic head measurements in monitoring wells are consistent with this interpretation. The highest groundwater heads in the Glacial Outwash aquifer were observed in wells located north of the power block area, in what is referred to in the ER as the northern trough. Water-table elevations measured in the Glacial Outwash aquifer in April 2011 and interpreted groundwater-flow pathways are shown in Figure 2-22. Groundwater in the northern trough flows westward toward Walker Run and eastward toward Unnamed Tributary 1. Groundwater head measurements in the Glacial Outwash aquifer are consistent with the interpretation that the streams and ponds onsite are discharge areas for the shallow groundwater.

Groundwater heads in the Shallow Bedrock aquifer also reflect the site topography. In general, measured heads were higher in wells located on the topographic high where the power block is located and lower in the surrounding troughs, as shown in Figure 2-23. Areas of higher elevation likely act as groundwater recharge areas with groundwater-flow pathways directed toward the lower elevations. The groundwater pathways shown in Figure 2-23, with flow from the power block area occurring primarily toward Walker Run and the lowlands south of the site, are consistent with this interpretation. Bedrock groundwater heads in the northern trough are influenced by the groundwater recharge in the highlands north of the site.

Relatively few wells are screened in the Deep Bedrock aquifer and none are located on the topographic high where the power block is located. Measured groundwater heads and estimated flow pathways in the Deep Bedrock aquifer are shown in Figure 2-24. The pathways shown reflect the regional groundwater conditions, with flow generally occurring toward the North Branch of the Susquehanna River. This interpretation is consistent with the regional groundwater description provided in Section 2.3.1.2. Groundwater heads and pathways for other measurement dates were provided in the ER (PPL Bell Bend 2013-TN3377) and were not significantly different than those shown here.

PPL used well pairs in the multiple well clusters to evaluate vertical hydraulic gradients. Differences in hydraulic head between two wells in a cluster screened at different elevations indicated a potential for vertical flow. However, hydraulic gradient by itself would not produce vertical flow unless a continuous permeable path exists along which flow can occur (e.g., along a bedding plane or within connected fractures and joints in the bedrock aquifer). Based on the observed vertical gradients, PPL concluded that upward flow from the bedrock aquifer to the Glacial Outwash aquifer occurs on the BBNPP site in the regions of relatively low elevation; that is, in portions of the northern trough, along Walker Run, along Unnamed Tributary 1 and Unnamed Tributary 2, and in most areas south of the site (Figure 2.3-79 of the ER, PPL Bell Bend 2013-TN3377). This conclusion is consistent with a conceptual model of shallow, unconfined groundwater flow in which topographic highs are areas of groundwater recharge and topographic lows are areas of groundwater discharge to seeps, streams, and wetlands.

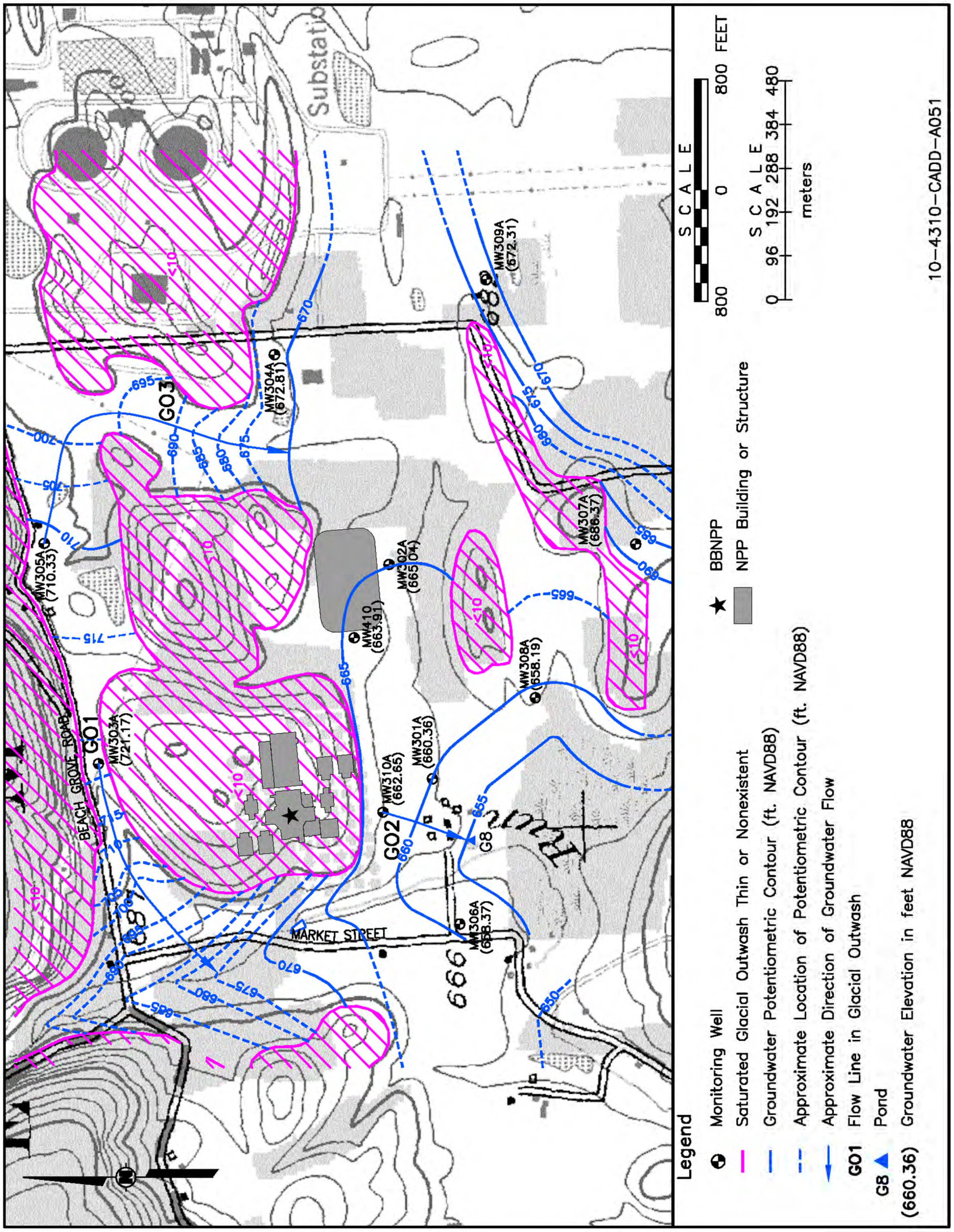

Figure 2-22. Glacial Outwash Aquifer Water Level (PPL Bell Bend 2013-TN3377)

Figure 2-23. Shallow Bedrock Aquifer Hydraulic Head and Flow Pathways (PPL Bell Bend 2013-TN3377)

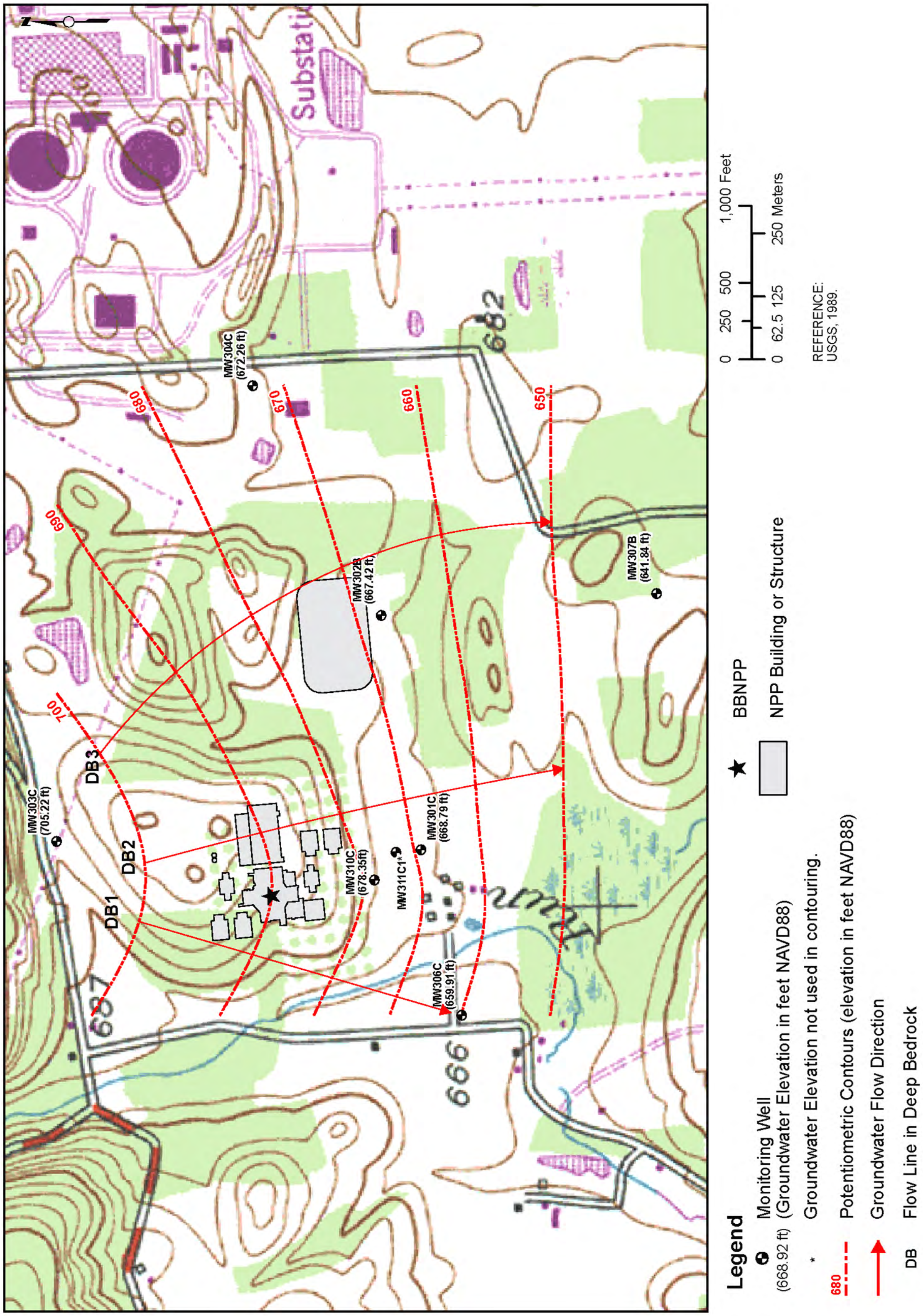

Figure 2-24. Deep Bedrock Aquifer Hydraulic Head and Flow Pathways (PPL Bell Bend 2013-TN3377)

2.3.2 Water Use

This subsection describes surface-water and groundwater uses that could affect or be affected by the construction and operation of the proposed BBNPP unit. Descriptions of the types of consumptive and nonconsumptive uses, identification of their locations, and quantification of water withdrawals and returns are included in Section 2.3.2 of the ER (PPL Bell Bend 2013-TN3377). Water use, for the purposes of this subsection, is broadly defined as encompassing human water-supply needs for drinking and domestic uses, industrial uses, and agricultural uses. It also includes instream uses that do not involve water diversion (e.g., navigation, recreation, and aquatic habitat needs). Water use at the BBNPP site is described in Chapter 3.

The SRBC has basinwide authority to manage the water resources in the Susquehanna River Basin. It was formed in 1971 after enactment of the Susquehanna River Basin Compact, an equal partnership between the Federal government and the states of New York, Pennsylvania, and Maryland to "… manage the Susquehanna basin's water resources through proper planning, development and regulation" (18 CFR Parts 801-808-TN2010; SRBC 2013-TN3568). The SRBC is authorized and required to form and adopt a comprehensive plan for the use of water resources in the basin. The *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* (Comprehensive Plan) (SRBC 2013-TN3568) guides SRBC water-resource management and development activities. The SRBC also is required to adopt an annual water resources program to implement the actions identified in the comprehensive plan (SRBC 2013-TN3568). The SRBC has established six priority areas of management responsibility for the Susquehanna River Basin: (1) water supply, (2) water quality, (3) flooding, (4) ecosystems, (5) Chesapeake Bay, and (6) coordination, cooperation, and public information. In each area, planning and management is coordinated with individual State water-resource programs to avoid duplication and inconsistencies.

With an average annual precipitation of 42 in., water resources in the Susquehanna River Basin are considered to be "abundant and renewable" (SRBC 2013-TN3568), but there are many demands for water that must be managed along with the supply. One of the goals of the SRBC is "… to be a leader in issues concerning the conservation, utilization, allocation, development, and management of water resources within the Susquehanna River Basin" (SRBC 2013-TN3568). For purposes that include avoiding conflict among water users, protecting public health, protecting fisheries and aquatic habitat, and protecting the Chesapeake Bay, the SRBC regulates the following actions (SRBC 2013-TN3568):

- surface-water and groundwater withdrawals of 100,000 gal or more per day (peak 30-day average)
- consumptive water uses and out-of-basin diversions of 20,000 gal or more per day (peak 30-day average)
- all *in-basin diversions*.

The SRBC also requires mitigation for consumptive use of surface water during low-flow periods, and coordinates drought contingency planning.

In Pennsylvania, the PADEP requires registration and water-use reporting by all public water suppliers, hydroelectric power facilities, and other major water users (i.e., anyone withdrawing more than 10,000 gal per day).

2.3.2.1 Surface-Water Use

The major surface-water users in the Middle Susquehanna sub-basin are electrical generating facilities, municipal facilities, and other industrial facilities. Other significant water uses include agriculture, recreation, and fish and wildlife.

Consumptive Surface-Water Use

Consumptive use, including out-of-basin diversions, in the Susquehanna watershed result in a decrease in supply downstream of the user. SRBC-approved consumptive use in the basin totaled 563 Mgd in 2005 (SRBC 2008-TN699), with public water supply (325 Mgd) and power generation (148 Mgd) composing 84 percent of the total approved use. The City of Baltimore is the single largest downstream user with authorization for an out-of-basin diversion of up to 250 Mgd from the Lower Susquehanna sub-basin, although actual diversions are significantly less and diversions are limited during certain drought conditions (SRBC 2013-TN3568). A significant out-of-basin diversion (60 Mgd) from the Lower Susquehanna sub-basin also is approved for the Chester, Pennsylvania, Water Authority (SRBC 2013-TN3568). The next four largest consumptive uses approved by the SRBC are for power generation at Peach Bottom Atomic Power Station (28 Mgd) and Three Mile Island Generating Station (TMI) (19 Mgd) in the Lower Susquehanna sub-basin, SSES (48 Mgd) in the Middle Susquehanna sub-basin, and the Montour Steam Electric Station (26 Mgd) in the West Branch Susquehanna sub-basin (SRBC 2008-TN699; SRBC 2013-TN3568).

Most of the consumptive use in the Susquehanna River Basin occurs in the Lower Susquehanna sub-basin, downstream of Sunbury, where approximately 441 Mgd of consumptive use is approved by the SRBC, accounting for almost 80 percent of the 563 Mgd basinwide total approved use (SRBC 2008-TN699). The Middle Susquehanna sub-basin, where the proposed BBNPP unit would be located, accounts for about 70 Mgd of SRBC-approved consumptive use (about 12 percent of the basin total) (SRBC 2008-TN699). The West Branch sub-basin has approved consumptive use of about 39 Mgd (about 7 percent of the total). Beyond the 563 Mgd of approved consumptive uses, SRBC estimates that additional consumptive use of 320 Mgd exists in the basin for agricultural use, small users, and grandfathered uses (SRBC 2008-TN699).

According to the PADEP, electrical generation accounted for 71 percent of water use in the Middle and Upper Susquehanna sub-basins as of 2003; public water supplies accounted for 19 percent; and industrial, agricultural, mining, and commercial uses combined account for the remaining 10 percent of consumptive use in that region (PADEP 2012-TN1781). In the vicinity of the proposed BBNPP, PPL's SSES is the largest consumptive water user, with an approved consumptive use of 48 Mgd (74 cfs) (PPL Bell Bend 2013-TN3377; SRBC 2007-TN2073). PPL's Montour Steam Electric Station, located approximately 26 mi west of BBNPP, is approved by the SRBC for consumptive use of 26.2 Mgd (40.5 cfs) from the West Branch of the Susquehanna River (SRBC 2006-TN3573).

The recent and rapid development of unconventional natural-gas resources in Pennsylvania has resulted in a demand for water for hydraulic fracturing of the gas wells. The gas wells are heavily concentrated in Bradford, Tioga, Lycoming, and Susquehanna Counties in northern Pennsylvania. These counties are mostly in the Chemung sub-basin and upper portion of the Middle Susquehanna sub-basin (MSAC 2011-TN3580). Therefore, water demand also is concentrated there. Hydraulic fracturing of a typical gas well requires 4 to 5 million gal of water over a few days; SRBC considers all of this water to be consumptively used because only a small percentage flows back to the surface (SRBC 2013-TN2449). Unconventional gas development has primarily occurred in small watersheds where preferred water-withdrawal rates may affect the relatively small streams affected (MSAC 2011-TN3580; SRBC 2013-TN2449). Average consumptive use in the Susquehanna River Basin for the entire unconventional natural-gas industry was estimated by the SRBC to be 10.4 Mgd (SRBC 2013-TN3568). The SRBC estimated that future use at full build-out is expected to be 30 Mgd (SRBC 2013-TN2449).

SRBC-approved projects require mitigation for consumptive use during low-flow periods, either by discontinuing consumptive use, releasing water from storage at or above the point of consumption, or paying a fee in lieu of providing compensatory water (SRBC 2008-TN699). Release of stored water currently is used to mitigate 112 Mgd of consumptive use (SRBC 2008-TN699). The SRBC owns 5,360 ac-ft of storage in the Curwensville Lake reservoir on the West Branch of the Susquehanna River (SRBC 2005-TN3583) and 23,495 ac-ft in the Cowanesque Lake reservoir in the Chemung sub-basin (EA 2012-TN3371). Of the water storage in Cowanesque Lake owned by the SRBC, 4,582 ac-ft are dedicated to mitigate the full consumptive use by TMI (19 Mgd) (SRBC 2011-TN3572), 13,061 ac-ft are available to mitigate up to 40 Mgd of consumptive use by SSES (SRBC 2007-TN2073), and 3,000 ac-ft are available to mitigate part of the consumptive use (about 9 Mgd) of the Montour Steam Electric Station (SRBC 2007-TN2073; PPL Bell Bend 2013-TN3541).

Consumptive-use mitigation releases from Cowanesque Lake are initiated when the Susquehanna River flow rate reaches a low-flow triggering value. Mitigation for TMI is triggered by flow at Harrisburg (USGS Gage 01570500), and mitigation for SSES and Montour Steam Electric Station is triggered by flow at Wilkes-Barre (USGS Gage 01536500). Mitigation releases are currently initiated when flow at a triggering gage falls below the 7-day average low flow that occurs on average once every 10 years (usually referred to as the 7Q10 flow) plus the associated consumptive use. The 7Q10 flows at Wilkes-Barre and Harrisburg are 826 and 2,631 cfs, respectively (EA 2012-TN3371). Since the SRBC's storage in Cowanesque Lake became available in 1990, consumptive-use mitigation releases have occurred twice: 1,280 ac-ft in 1991 and 2,630 ac-ft in 1995 (USACE 2013-TN3383).

Because the use of a single annual 7Q10 value as a trigger for consumptive-use mitigation was deemed unprotective of ecosystem flow needs, the SRBC adopted a new low-flow protection policy in 2012 that strives to maintain natural flow variability while providing more effective management of flows during drought conditions (SRBC 2012-TN2453). As part of this policy, the SRBC adopted triggers for mitigation releases based on seasonal or monthly flows that reflect the natural flow variability. A joint study by the SRBC, the USACE, and The Nature Conservancy evaluated flow statistics appropriate for maintaining ecosystem flow needs (DePhilip and Moberg 2010-TN1652) and recommended that withdrawals and consumptive-use be managed such that, for the Susquehanna River main stem, there are no changes in the monthly low flows that are exceeded 95 percent of the time (referred to as the monthly P95 flows).

The SRBC evaluated alternative consumptive-use mitigation triggers for Cowanesque Lake releases, including the use of monthly P95 flow values (EA 2012-TN3371). Several of the alternatives were evaluated by the USACE for impacts resulting from a change in dam operations (USACE 2013-TN3383). In addition to flood control, USACE objectives for Cowanesque Dam operation are to maintain the normal pool elevation of 1,080 ft for recreation and to maintain a minimum release of 15 cfs during drought conditions. The preferred alternative was to use monthly P95 flow values to trigger consumptive-use mitigation releases during the months of August, September, and October (USACE 2013-TN3383). In addition, releases in July are triggered by the August P95 flow value and releases in November are triggered by the October P95 flow value. The 7Q10 and P95 flow values are listed in Table 2-10. Because the P95 values are larger than the 7Q10 values, consumptive-use mitigation releases will occur more frequently after the preferred alternative is implemented. Based on discussions with the USACE in January 2014, the review team expects that the preferred alternative for Cowanesque Dam operation will be implemented prior to operation of the proposed BBNPP unit.

Table 2-10. Susquehanna River 7Q10 and P95 Flow Values Used to Trigger Consumptive-Use Mitigation Releases from Cowanesque Lake (USACE 2013-TN3383)

	Wilkes-Barre		Harrisburg	
Month	**7Q10**	**P95**	**7Q10**	**P95**
July	826	970	2,631	3,620
August	826	970	2,631	3,620
September	826	860	2,631	3,100
October	826	970	2,631	3,240
November	826	970	2,631	3,240

Nonconsumptive Surface-Water Use

The main nonconsumptive surface-water uses in the Middle Susquehanna sub-basin and in the vicinity of the proposed BBNPP are for aquatic habitat and recreational activities (e.g., fishing, boating, and swimming). The river in the vicinity of the site is not used for commercial navigation, but historically, canals were built and used for water transportation. As noted in Section 2.3.1.1, a remnant of the North Branch Canal runs parallel to the river on the eastern edge of the project area. Boating and swimming are not permitted in the immediate vicinity of the existing SSES and proposed BBNPP intake and discharge locations (PPL Bell Bend 2013-TN3377). As noted in Section 2.3.1.1, no hydropower dams are located on the Susquehanna River upstream of the BBNPP site. The nearest downstream dam, at Sunbury, is an inflatable dam used in the summer to create Lake Augusta for recreation. The SRBC manages the Susquehanna River to protect nonconsumptive uses during low flows, primarily by limiting withdrawals, setting passby flow requirements for consumptive users, and releasing water from upstream reservoirs (SRBC 2012-TN2453).

2.3.2.2 Groundwater Use

SRBC estimated that groundwater use throughout the Susquehanna River Basin was 391 Mgd, with 30 percent of this total for public water supplies, 23 percent for mining, 20 percent for domestic supply, 12 percent for industrial use, 11 percent for agriculture, and 3 percent for commercial uses (SRBC 2005-TN3590). About 127 Mgd of groundwater use is estimated to occur in sub-basins of the North Branch of the Susquehanna River, including the Chemung sub-basin, with the largest uses being 48 percent for public water supply, 23 percent for domestic supply, 14 percent for industrial use, and 7 percent for agriculture. In the Upper Susquehanna-Lackawanna portion of the watershed where BBNPP is located, approximately 67 percent of groundwater use is for public and domestic water supplies.

PPL describes groundwater use in the vicinity of the proposed BBNPP site in Section 2.3.2.2 of the ER (PPL Bell Bend 2013-TN3377). The information provided in the ER was obtained from the Pennsylvania Groundwater Information System (PaGWIS) database, maintained by the Pennsylvania Department of Conservation and Natural Resources (PDCNR), and from two databases maintained by the PADEP. In the ER, PPL presented information on locations of wells within 25- and 5-mi radii of the BBNPP site. The majority of wells located within 25 mi of BBNPP are for domestic use, with a significant number of public water-supply wells also identified. Other wells were associated with industrial, commercial, agricultural, and mining uses. Groundwater wells located within 5 mi of BBNPP were primarily for domestic water supply. PPL also provided additional information about the 12 groundwater wells located within about 1 mi of the BBNPP power block area (PPL Bell Bend 2014-TN3494). Of these wells, nine were identified as domestic use, two as public water supply, and one as abandoned. PPL was identified as the owner of six of the wells, including the abandoned well and one of the public water-supply wells. PPL stated that the other public water-supply well, screened at a depth of 380 ft and withdrawing at a rate of 60 gpm, is most likely in the Deep Bedrock aquifer. PPL also stated that the remaining domestic wells, screened at depths of 100 to 150 ft with estimated well yields of 8 to 117 gpm, are most likely withdrawing water from the Shallow Bedrock aquifer. The review team concludes that these statements are consistent with the hydrogeologic description of the area presented in Section 2.3.1.2.

The SSES plant is a significant user of groundwater. It uses an onsite groundwater well system, consisting of two wells, for its potable water, pump seal cooling, sanitation, and fire-protection uses. One well serves as the primary water source and the other well is for backup. These wells are screened in the Glacial Outwash aquifer at a depth of about 75 ft and have a combined capacity of 200 gpm (PPL Bell Bend 2013-TN3377). To serve the SSES-owned buildings adjacent to the SSES plant site, there are three additional wells that provide a minor amount of water for drinking and sanitary uses (PPL Bell Bend 2013-TN3377).

The largest groundwater withdrawals in the region are from the public water-supply wells for the PAWC in Berwick, approximately 5 mi southwest of the BBNPP site. Information on the wells was obtained during a meeting with PAWC staff on March 20, 2014 (NRC 2014-TN3639). The PAWC serves a local population of 15,000 people in Columbia and Luzerne Counties. Water is obtained from three wells located on the north bank of the North Branch of the Susquehanna River, with a combined potential yield of 4.6 Mgd. These wells are 160, 90, and 87 ft deep and draw water from depths greater than 40 ft. A fourth well exists but is not permitted; it is 120 ft deep and rated at 1.5 Mgd. PAWC staff indicated that the wells do not draw water from the Susquehanna River. Average withdrawals from the well system were about 1.6 Mgd for the period of 2004 to 2013 (PAWC 2014-TN3786).

PPL stated that no onsite groundwater would be used during building and operation of the proposed BBNPP (PPL Bell Bend 2013-TN3377). Water needed for construction and operation (e.g., dust control, concrete batch plant operation, potable or sanitary water) would be provided by a pipeline from the Berwick PAWC (PPL Bell Bend 2013-TN3377). Currently, no groundwater is used at the proposed BBNPP site.

2.3.3 Water Quality

The following sections describe the quality of surface-water and groundwater resources in the Susquehanna River Basin and in the vicinity of the proposed BBNPP site. Pennsylvania water-quality standards are provided in Pennsylvania Code, Title 25, Chapter 93 (TN611). The primary water-supply source for the proposed BBNPP unit and the receiving waterbody for plant discharges is the North Branch of the Susquehanna River in the Middle Susquehanna sub-basin. The North Branch of the Susquehanna River adjacent to BBNPP has a designated protected water use for aquatic life of warm-water and migratory fishes. Walker Run has a designated protected water use for aquatic life of cold-water fishes and migratory fishes (Pennsylvania Code, Title 25, Chapter 93.9k).

2.3.3.1 Surface-Water Quality

The PADEP monitors water quality in the Susquehanna River Basin and produces an integrated water-quality report that satisfies the requirements of Clean Water Act Sections 305(b) and 303(d) (PADEP 2013-TN2432). The narrative section of the integrated report describes the assessment of water quality, the Commonwealth’s water pollution control programs, and surface-water monitoring. Waterbodies are assessed for the uses of aquatic life, water supply, fish consumption, and recreation. The 303(d) list identifies impaired waterbodies that do not meet water-quality standards for one or more of these designated uses. Impairment causes on the main-stem Susquehanna River, including the West Branch and the Chemung and Tioga Rivers, are mercury, metals, pH, siltation, nutrients, thermal modifications, polychlorinated biphenyls (PCBs), and pathogens. Impaired uses on these waterbodies are fish consumption, aquatic life, and recreation. In many cases impaired reaches are a few miles or less in length. The longest impaired reach is 208 mi in the Upper Susquehanna-Tunkhannock Hydrologic Unit (Code 02050106; PADEP 2013-TN2432) (between Ulster and Pittston, Pennsylvania, upstream of Wilkes-Barre); the reach is impaired for fish consumption from mercury and PCB contamination from an unknown source. In the Upper Susquehanna-Lackawanna Hydrologic Unit (Code 02050107; PADEP 2013-TN2432), where the BBNPP site is located, 0.17 mi of the Susquehanna River are impaired for aquatic life from acid mine drainage and 2.72 mi are impaired for aquatic life from an unknown source of metals. Moshannon Creek is listed as impaired for aquatic life caused by siltation from acid mine drainage.

Water-quality surveys of the Middle Susquehanna sub-basin were completed by the SRBC in 1984, 1993, 2001, and 2008 (Buda 2009-TN623). As part of the 2008 survey, the SRBC monitored North Branch of the Susquehanna River water quality at locations about 5 mi upstream and 12 mi downstream from the BBNPP discharge location. Water quality at locations about 5 mi upstream and 15 mi downstream from the BBNPP discharge location were monitored by the SRBC as part of a 2010 biological assessment (Shenk 2011-TN698). Water-quality parameters evaluated by the SRBC in the 2008 and 2010 surveys included temperature, dissolved oxygen, conductivity, pH, acidity, alkalinity, total suspended and dissolved solids, ammonia, nitrogen, nitrite, nitrate, turbidity, phosphorous, orthophosphate, total organic carbon, hardness, calcium, magnesium, sodium, chloride, sulfate, iron, manganese, and aluminum. Sodium concentrations were above the water-quality standard at all sampling locations in 2008 and 2010 (Buda 2009-TN623; SRBC 2014-TN3604). At the upstream location, the water-quality standards were satisfied for all other water-quality parameters. At the downstream locations orthophosphate concentrations in 2008 and 2010 and phosphorous concentrations in 2008 exceeded the water-quality standards (Buda 2009-TN623; SRBC 2014-TN3604). The North Branch of the Susquehanna River was rated as moderately impaired for biological condition at these monitoring locations (Shenk 2011-TN698). In addition, this stretch of the North Branch of the Susquehanna River is SRBC-designated as mine-drainage impaired (SRBC 2013-TN2942).

The water temperature of the North Branch of the Susquehanna River downstream from the BBNPP site has been monitored daily since November, 2010 at USGS Gage 01540500, Susquehanna River at Danville (USGS 2012-TN1598). The daily maximum temperature exceeded 35°C in July 2012 and 30°C in July 2013. The daily mean temperature exceeded 29°C during both of these periods. Daily minimum temperature reached 0°C during the winters of 2012 to 2014. At this same location, and over the same period of time, daily mean specific conductance varied from 97 to 390 μS/cm, daily median pH varied from 6.8 to 9.1, and daily mean dissolved oxygen varied from 5.7 to 14.4 mg/L.

PPL has monitored water quality quarterly since 1968 in the Susquehanna River at locations 750 ft upstream of the SSES intake and 2,260 ft downstream of the SSES discharge (PPL Bell Bend 2013-TN3377). Maximum, minimum, and average values for a variety of water-quality parameters were provided in Table 2.3-45 of the ER for the period from 1968 to 1977. Yearly average values of water quality from 2002 to 2006 are provided in Table 2.3-46 of the ER for the upstream and downstream monitoring locations. During the 2002 to 2006 period, differences in yearly average water quality between the upstream and downstream locations were minor.

PPL also conducted quarterly water-quality monitoring of the Susquehanna River during 2007 and 2008 as part of the BBNPP site characterization. Monitoring locations were downstream of Walker Run (the SR02 location in Figure 2-21) and at the location 750 ft upstream of the SSES intake (the SR01 location in Figure 2-21). The minimum and maximum values of water-quality parameters were reported in Table 2.3-42 of the ER (PPL Bell Bend 2013-TN3377); maximum values are provided in Table 2-11 for selected water-quality parameters. Maximum measured values of all reported water-quality parameters satisfied applicable water-quality standards.

PPL conducted quarterly sampling of other onsite waterbodies during 2007 to 2008 and 2010 to 2011. Nine of the monitored locations were on streams and four were from ponds (monitoring locations are shown in Figure 2-21). Minimum and maximum measured values during the 2010 to 2011 monitoring period were provided in Table 2.3-50 of the ER (PPL Bell Bend 2013-TN3377); maximum values are provided in Table 2-11 for selected water-quality parameters. Maximum measured values met water-quality standards except for maximum temperature and total phosphorus concentration. The high temperature was measured in one of the ponds and occurred in March. All other temperature measurements were less than 30.5ºC.

Table 2-11. Susquehanna River and BBNPP Site Water Quality (maximum values unless indicated) (adapted from Tables 2.3-42 and 2.3-50 of the ER [PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3748])

Parameter	Water-Quality Standard[(a)]	Susquehanna River 2007−2008	BBNPP Site 2010-2011
Temperature, ºC (July−August maximum)	30.5	27.98	43.54
Dissolved oxygen, mg/L (minimum)	5	7.08[(d)]	0.48[(d)]
pH	6 to 9	6.82−7.86[(e)]	6.23−8.78[(e)]
Alkalinity as $CaCO_3$, mg/L (minimum)	20	43[(d)]	< 5[(d)]
Ammonia nitrogen, mg/L	17[(b)]	0.27	0.43
Total chloride, mg/L	250	50	8.4
Total fluoride, mg/L	2	ND[(f)]	ND
Total sulfate, mg/L	250	47	37
Total iron, mg/L	1.5	0.28	0.7
Total manganese, mg/L	1	0.1	0.11
Total aluminum, mg/L	750	0.34	0.52
Total magnesium, mg/L	35	11	5.7
Total sodium, mg/L	20	31	5.3
Nitrite plus Nitrate as N, mg/L	10	0.73	4.4
Fecal coliform, colonies/100 mL (geometric mean)	2,000	250	2,600
Total coliform, colonies/100 mL (monthly average)	5,000	5,400	5,800
Osmotic pressure, millimoles/kg	50	----	----
Total residual chlorine, mg/L (1-hr Average)	0.019	----	----
Antimony, ug/L	220	ND	ND
Arsenic, ug/L	150	ND	ND
Beryllium, ug/L	N/A	ND	ND
Cadmium, ug/L	0.25	ND	ND
Chromium III, ug/L	74	ND	ND
Chromium VI, ug/L	10	ND	ND
Copper, ug/L	9	2	1.5
Lead, ug/L	2.5	0.66	1.3
Mercury, ug/L (Hg^{2+})	0.77	ND	ND
Nickel, ug/L	52	3.2	2.3
Selenium, ug/L	4.6	ND	ND
Silver, ug/L	3.22	ND	ND
Thallium, ug/L	13	ND	ND
Zinc, ug/L	118	ND	ND
PCB, ug/L	0.14	----	----
Barium, ug/L	4,100	ND	32
Strontium, ug/L	4,000	180	110
Vanadium, ug/L	100	ND	ND
Conductivity, umhos/cm	800[(c)]	431	310
Total dissolved solids, mg/L	500[(c)]	250	110
Total phosphorus, mg/L	0.1[(c)]	ND	0.29
Total hardness, mg/L	300[(c)]	140	80
Total orthophosphate, mg/L	0.02[(c)]	ND	ND

(a) Pennsylvania Code Title 25, Chapter 93.7, or Pennsylvania Code Title 25, Chapter 93.8, Fish and Aquatic Life Criteria Continuous Concentration (at Hardness=100, where applicable) (PA Code 25-93-TN611)
(b) Water-quality standard depends on pH and temperature
(c) Shenk 2011-TN698
(d) Minimum value
(e) Range of values
(f) ND = not detected.

2.3.3.2 Groundwater Quality

PPL describes the site-specific water-quality characteristics in Section 2.3.3.2 of the ER (PPL Bell Bend 2013-TN3377). PPL performed a baseline investigation of the proposed BBNPP site groundwater system between October 2007 and March 2011. Groundwater samples were collected and analyzed at 14 monitoring wells in the Glacial Outwash aquifer, nine wells in the Shallow Bedrock aquifer, and three wells in the Deep Bedrock aquifer during the initial investigation in 2007 to 2008. Groundwater samples from the monitoring wells in the vicinity of the relocated power block area also were collected and analyzed during the secondary investigation in 2010 to 2011,. The results of those analyses are summarized in Tables 2.3-43, 2.3-48, 2.3-51, and 2.3-52 of the ER (PPL Bell Bend 2013-TN3377). Locations of monitoring wells were provided in Figure 2.3-31 of the ER.

Although, the Pennsylvania drinking-water standards, regulated by PADEP and applicable to public water systems (Pennsylvania Code, Title 25, Chapter 109 [PA Code 25-109 -TN3952]), are not applicable to groundwater at the proposed BBNPP site, PPL performed a one-time analysis of drinking-water-quality parameters on groundwater samples collected during February 2008 from three wells screened in the Glacial Outwash aquifer. The purpose of the analysis was to determine the presence or absence of volatile organic compounds and synthetic organic chemicals. The analyzed parameters are listed in ER Table 2.3-44. None of the listed chemicals were detected.

Water-quality parameters measured in field surveys and their minimum and maximum values in all wells for both the 2007 to 2008 and 2010 to 2011 periods are provided in Table 2-12. Other groundwater analytes measured included the parameters listed in Table 2-11, plus a set of radionuclides (i.e., Ba-140, Cs-134, Cs-137, Co-58, Co-60, Fe-59, La-140, Mn-54, Ni-95, K-40, H-3, Zn-65 and Zr-95).

Table 2-12. Groundwater Quality for BBNPP Monitoring Wells, 2007-2008 and 2010-2011 Monitoring Periods (adapted from ER Tables 2.3-48 and 2.3-51 [PPL Bell Bend 2013-TN3377])

Parameter	Minimum	Maximum
Temperature, ºC	4.71	16.09
Dissolved oxygen, mg/L	0	10.17
pH	5.40	11.18
Conductivity, umhos/cm	48	580
Turbidity, JTU	0	1,093.3
Oxidation-reduction potential, mV	-317.5	271.9
Salinity, ppt	0.02	0.29
Total dissolved solids, mg/L	5	377

During the 2007 to 2008 monitoring effort, maximum levels of iron (2.5 mg/L) exceeded the PADEP secondary standard of 0.3 mg/L. Maximum levels of manganese (0.72 mg/L) exceeded the PADEP secondary standard of 0.05 mg/L. The range of pH (5.40 to 11.18) exceeded the PADEP “reasonable goal for drinking” range of 6.5 to 8.5. Although the PADEP does not publish maximum contaminant levels for salinity or sodium concentrations, maximum groundwater concentrations of sodium from the site were less than the Fish and Aquatic Life Criteria Continuous Concentration standard (see Table 2-11). The highest concentration level for tritium, 1,020 pCi/L, was detected in a sample collected in February 2008 from the shale bedrock aquifer. None of the groundwater samples exceeded PADEP primary drinking-water standards.

There were significant differences in groundwater quality between the Glacial Outwash aquifer and the bedrock aquifers. Oxidation potential and dissolved oxygen levels were greater in the Glacial Outwash aquifer than in the Shallow and Deep Bedrock aquifers. The pH of water in the Glacial Outwash aquifer also was significantly lower than in the bedrock aquifers. Alkalinity and hardness were greater in the bedrock aquifers. These findings indicate that near-surface groundwater is recharged locally with well-oxygenated and slightly acidic water, while the bedrock aquifers are conditioned by longer contact with carbonate minerals and possibly reducing agents like pyrite present in the rock.

Temperatures fluctuated most significantly in the Glacial Outwash aquifer. For example, during the period from October 31, 2007, to October 4, 2008, the temperature in a Glacial Outwash aquifer monitoring well north of the proposed BBNPP unit cooling towers ranged from 4.7 to 13.4°C. The corresponding range for deeper wells at the same location was 10.3 to 13.19°C in the Shallow Bedrock aquifer and 11.38 to 14.7°C in the Deep Bedrock aquifer. These measurements also reflect the local recharge of colder water, and to some extent thermal conduction during winter, which affects shallow groundwater the most.

All sanitary wastewater from the BBNPP would be connected to the Berwick Area Joint Sewer Authority. Nonradioactive wastewater other than sanitary wastewater, including floor and equipment drainage, stormwater runoff outside the radiological control areas of the power block, and plant blowdown would be treated by onsite wastewater-treatment operations in compliance with the National Pollutant Discharge Elimination System permit for the BBNPP site, as described in Section 2.3.3.1.3 of the ER (PPL Bell Bend 2013-TN3377).

2.3.4 Water Monitoring

PPL described the pre-application programs for hydrologic and chemical monitoring related to the proposed BBNPP in Sections 6.3 and 6.6 of the ER (PPL Bell Bend 2013-TN3377).

2.3.4.1 Surface-Water Monitoring

PPL considered the existing SSES monitoring program as part of the pre-application monitoring for the proposed BBNPP. The SSES program monitors the water quality of the North Branch of the Susquehanna River on a quarterly basis both upstream and downstream of the SSES intake and discharge locations. As described in Section 2.3.1, the USGS monitors water flow and temperature in the North Branch of the Susquehanna River daily. The SRBC also monitors Susquehanna River water quality as part of its Large River Assessment Project.

As described in Section 2.3.3.1, PPL completed quarterly monitoring of the North Branch of the Susquehanna River and onsite streams and ponds as part of its pre-application monitoring program during 2007 to 2008 and 2010 to 2011. Field measurements included pH, temperature, dissolved oxygen, conductivity, turbidity, salinity, and oxidation-reduction potential.

In addition, laboratory measurements of biological water-quality parameters, inorganic chemical concentrations, and other water-quality indicators were completed.

2.3.4.2 Groundwater Monitoring

PPL installed 51 groundwater monitoring wells on the BBNPP site as part of its pre-application monitoring program, as described in Section 2.3.1.2. Of these wells, 28 were screened in the Glacial Outwash aquifer, 15 were screened in the Shallow Bedrock aquifer, and 8 were screened in the Deep Bedrock aquifer. Hydraulic head was measured monthly for approximately 12 months during 2007 to 2008 and during 2010 to 2011. Concurrently, water-surface elevations were measured in onsite streams and ponds and used to infer coincident water levels in surficial groundwater. Monitoring of groundwater hydraulic head was used to infer groundwater-flow direction and pathways.

As described in Section 2.3.3.2, PPL monitored groundwater quality in the 15 Glacial Outwash aquifer wells and in 21 of the bedrock aquifer wells. Quarterly measurements were made during 2007 to 2008; measurements during 2010 to 2011 were less frequent. Field and laboratory water-quality parameters measured were similar to those for the surface-water monitoring described in Section 2.3.4.1.

2.4 Ecology

This section describes the terrestrial, wetland, and aquatic ecology of the site and vicinity that might be affected by building, operating, and maintaining the proposed new unit at the BBNPP site. Section 2.4.1 and Section 2.4.2 provide general descriptions of terrestrial and aquatic environments, respectively, on and near the BBNPP site. Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from building, operating, and maintaining new nuclear power-generating facilities, including two new onsite transmission-line corridors and relocation of an existing onsite transmission-line corridor, a new onsite railroad spur, and a new onsite plant-access road (see Section 3.2). In addition, these descriptions support the evaluation of mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts and facilitate the comparison of the alternative sites (see Section 9.3) to the BBNPP site. Descriptions include monitoring programs for terrestrial, wetland, and aquatic environments. The information in this section is based on qualitative data recently gathered to determine the distribution and abundance of fauna and flora and waters of the United States on the BBNPP site.

2.4.1 Terrestrial and Wetland Ecology

This section identifies terrestrial and wetland ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by building, operating, and maintaining the proposed BBNPP. It also identifies "important" terrestrial resources, including habitats and species, as defined in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (NRC 2000-TN614), that might be affected by the proposed action, as well as mitigation activities and monitoring programs.

2.4.1.1 Terrestrial Resources – Site and Vicinity

The BBNPP site lies within the Northern Shale Valley subdivision of the Ridge and Valley ecoregion (USGS 2012-TN1800). The Ridge and Valley ecoregion extends from southeastern New York southwest through northeastern Alabama and is characterized by alternating forested ridges and agricultural valleys (USGS 2012-TN1800; Woods et al. 1999-TN1805; Woods et al. 2003-TN1806). Three land-cover types dominate the ecoregion: forest (56 percent), agriculture (about 30 percent), and developed areas (about 9 percent) (USGS 2012-TN1800). The greatest recent land-cover change has been the conversion of forest to disturbed lands, followed by the reversion of disturbed lands back to forest. Forest and disturbed land are both being converted to developed land (USGS 2012-TN1800). The Northern Shale Valley subdivision is characterized by rolling valleys and low hills and is underlain mostly by shale, siltstone, and fine-grained sandstone. Local relief varies from approximately 50 to 500 ft. Natural vegetation varies from north to south, and in the north is characterized as mostly Appalachian oak forest dominated by white oak (*Quercus alba*) and northern red oak (*Q. rubra*). Today, farming is prevalent over much of the landscape, and woodland occurs on steeper sites (Woods et al. 1999-TN1805; Woods et al. 2003-TN1806).

The percentages of USGS land-cover types in the BBNPP site vicinity (i.e., within 6 mi of the BBNPP site) and region (i.e., within 50 mi of the BBNPP site) are provided in Table 2-13. Land-cover type percentages in the BBNPP site vicinity are typical of the region and the Ridge and Valley ecoregion (described above) (Table 2-13). Agriculture, forestry, and mineral extraction have played a key role in shaping upland terrestrial and wetland communities in the region (PNHP 2006-TN1570).

Table 2-13. USGS Land-Cover Type Percentages in the BBNPP Vicinity (within 6 mi of the BBNPP site) and Region (within 50 mi of the BBNPP site)

Land-Cover Type	Vicinity Percentage	Region Percentage
Urban or Built-Up	9	9
Barren	<1	1
Wetlands	1	2
Water	3	2
Forest	66	65
Agriculture	20	21
Total	100	100

Source: PPL Bell Bend 2013-TN3377

The BBNPP project area occupies approximately 2,055 ac adjacent to the SSES and Susquehanna River within the southern portion of the Middle Susquehanna Sub-basin (SRBC 2012-TN2443). Terrain within the project area ranges from steeply sloping hills in the west to the relatively level floodplain of the Susquehanna River in the east. Elevation varies across the BBNPP project area by over 500 ft, from the steeply sloped hills in the northwestern portion of the site to the Susquehanna River floodplain (PPL Bell Bend 2013-TN3377).

The BBNPP site has been substantially altered to support agriculture, electric power generation (i.e., SSES), and canal transportation uses associated with the North Branch Canal. The original forest cover was cleared for these purposes and for the production of lumber and firewood. Existing forest habitat is second-growth and fragmented because of these activities. Currently, onsite vegetation management consists of agricultural crop production and maintenance of transmission-line corridors (PPL Bell Bend 2013-TN3377). Crop production occurs on approximately 205 ac of leased land that was actively farmed (i.e., for corn [*Zea mays*], snap beans [*Phaseolus vulgaris*], and soybeans [*Glycine max*]) in 2013, and which will likely continue to be farmed until the initiation of site preparation, at which time onsite farming activities will cease (PPL Bell Bend 2014-TN3537). Vegetation-maintenance practices within onsite transmission-line corridors are discussed in Section 5.3.1.1.

Further, the Susquehanna River watershed is one of the most flood-prone areas in the United States; on average, a major devastating flood occurs every 14 years (SRBC 2012-TN1791). These flood events have played a key role in shaping the terrestrial and wetland communities found in the river floodplain along the Susquehanna River throughout the region, including portions of the BBNPP project area site east and south of U.S. Highway 11 (US 11) (PNHP 2006-TN1570; PPL Bell Bend 2014-TN3537).

Upland and wetland plant communities and habitat types and wildlife communities of the BBNPP site are typical of the vicinity, region, and ecoregion and are described in more detail in the following subsections.

Upland Plant Communities and Habitat Types

Most forest cover in Pennsylvania presently comprises deciduous forest (57 percent of total land area) (PGC and PFBC 2005-TN3815; McWilliams et al. 2007-TN1893). Early successional forests in the form of regenerating clearcuts are fairly widespread in the Commonwealth, but are decreasing in frequency on some public lands because of declines in timber harvests and maturation of existing thickets. Most Pennsylvania forest is considered second-growth forest; the original forest was largely harvested by the close of the nineteenth century (PGC and PFBC 2005-TN3815).

The extent of terrestrial habitat types on the BBNPP project area is presented in Table 2-14.

Table 2-14. Terrestrial Habitat Types on the BBNPP Project Area

Habitat	Terrestrial	Acres
Upland Forest	Yes	772
Upland Scrub/Shrub	Yes	107
Old-Field/Former Agricultural	Yes	242
Agricultural	Yes	333
PFO Wetlands	Yes	113
PSS Wetlands	Yes	9
PEM Wetlands	Yes	37
Developed	No	383
Waterbodies	No	43
Streams	No	16
Total		2,055

Field mapping and survey of plant communities were conducted from July 2007 through August 2008, April to June 2010, and in July 2011. The field surveys covered only those parts of the BBNPP project area closest to lands likely to be included in the eventual footprint of disturbance. The approximate distribution of terrestrial plant communities across the BBNPP project area was identified using readily available natural resources mapping tools (e.g., aerial photography). Plant community boundaries within the survey area were subsequently ground-truthed and mapped, and individual plant species were identified in the field. Plant communities and habitat types across the BBNPP project area are depicted in Figure 2-25 (PPL Bell Bend 2013-TN3377). A total of 197 common upland and wetland plant species (i.e., 37 tree and sapling species, 7 woody vine species, 23 shrub species, and 130 herbaceous species) were documented in the survey area (Normandeau 2011-TN489). A similar number of plant species (i.e., 188) were documented from 1972 to 1974 on the adjacent SSES site (PPL 1978-TN4036).

Upland Deciduous Forest

Approximately 772 ac of the BBNPP project area is composed of upland deciduous forest. Common overstory species in upland deciduous forest include northern red oak, white oak, black cherry (*Prunus serotina*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), bitternut hickory (*Carya cordiformis*), sweet birch (*Betula lenta*), black walnut (*Juglans nigra*), black locust (*Robinia pseudoacacia*), yellow poplar (*Liriodendron tulipifera*), and red maple (*Acer rubrum*). Understory species are predominantly composed of spicebush (*Lindera benzoin*), round-leaved greenbrier (*Smilax rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), and saplings of overstory species. Groundcover species include may-apple (*Podophyllum peltatum*), garlic mustard (*Allaria petiolata*), hayscented fern (*Dennsteadtia punctilobula*), tree clubmoss (*Lycopodium obscurum*), partridge berry (*Mitchella repens*), ground cedar (*Lycopodium tristachyum*), and stilt grass (*Eulalia viminea*) (Normandeau 2011-TN489).

Much of the upland deciduous forest across the project area has been in a stage of progressive maturation for several decades, as evidenced by vegetation surveys conducted from 1977 through 1994 (Ecology III 1995-TN1782) and from 2007 through 2011 (Normandeau 2011-TN489). Most of the upland deciduous forest is composed of well-developed overstory and understory strata, and many canopy trees are over 12 in. in diameter at breast height (PPL Bell Bend 2013-TN3377). Upland deciduous forest on the BBNPP site, although disturbed in the past as indicated above, is representative of the red oak-mixed hardwood forest community type, one of the naturally occurring broadleaf terrestrial forest types in Pennsylvania (Fike 1999-TN3816) that was present during early settlement of the Commonwealth (Pearson 1975-TN3851). The red oak-mixed hardwood forest community type occurs on moderately mesic sites and, therefore, is variable in composition (Fike 1999-TN3816). However, as is the case on the BBNPP site (Normandeau 2011-TN489), the most prevalent characteristic is the presence of the northern red oak as a dominant or co-dominant species (Fike 1999-TN3816; Pearson 1975-TN3851). The red oak-mixed hardwood forest community type includes much of Pennsylvania's hardwood-dominated forests (Fike 1999-TN3816).

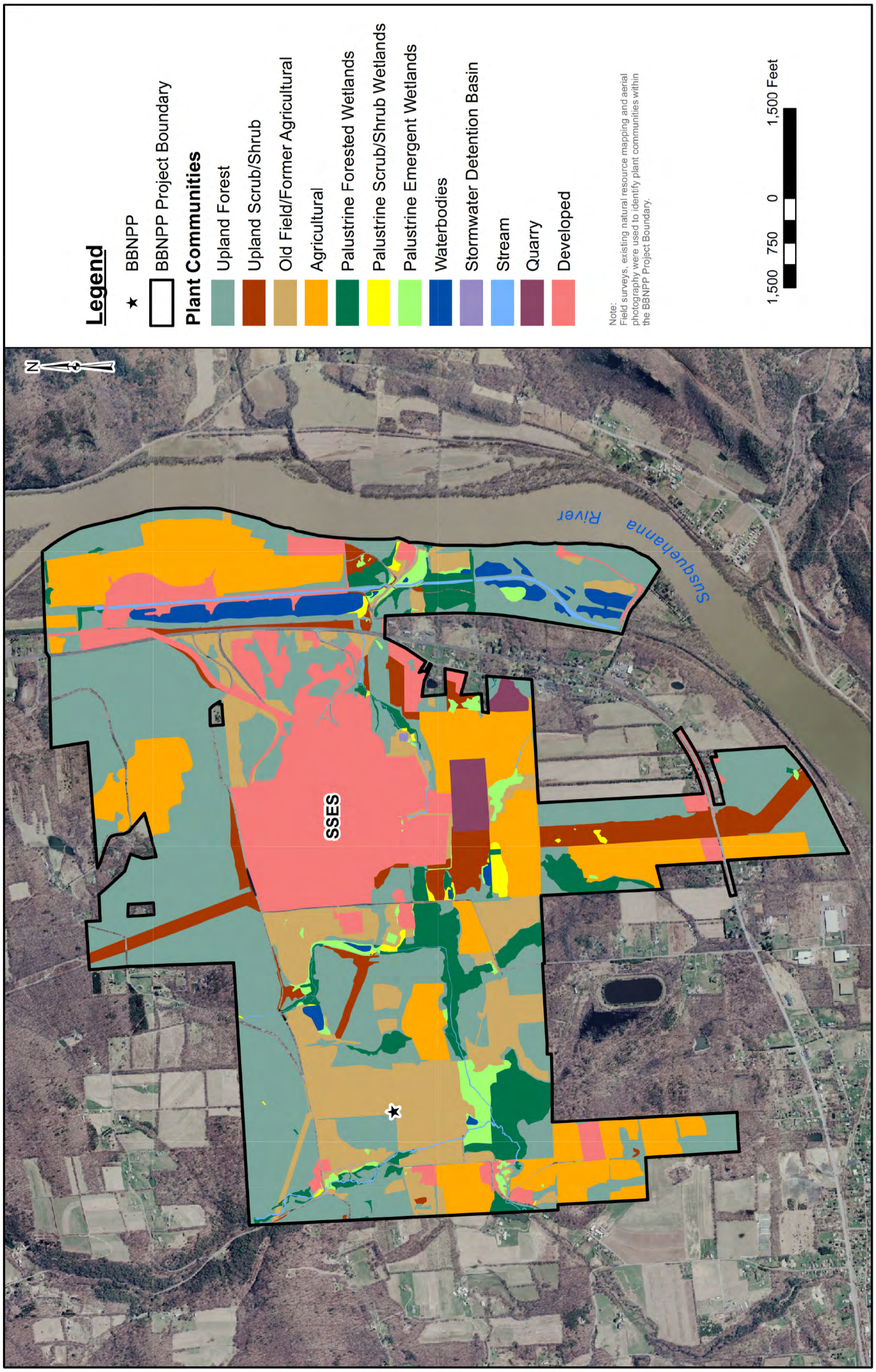

Figure 2-25. Plant Communities in the BBNPP Project Area

Pennsylvania contains more timber today than at any time since the late 1800s (Casalena 2006-TN3817). Approximately 57 percent of the land area in Pennsylvania is deciduous forest, including most of the overall forest habitat (PGC and PFBC 2005-TN3815; McWilliams et al. 2007-TN1893). However, the amount of early successional deciduous forest has been decreasing for decades in Pennsylvania because timber harvest rates have not kept pace with the succession of forest vegetation. At the other end of the succession spectrum, mature deciduous forest (i.e., generally over 150 years old) is estimated to account for less than 1 percent of the forest in the Commonwealth. In contrast to these two ends of forest succession, mid-to-late successional second-growth deciduous forest is considered to be increasing across the Commonwealth, although large contiguous blocks are declining—due largely to habitat fragmentation. For example, in 1965, 45, 35, and 19 percent of timber stands were in sawtimber, poletimber, and seedling-sapling size categories, respectively. By 2002, sawtimber stands had increased to 60 percent while pole timber and seedling-sapling categories declined to approximately 32 and 8 percent, respectively. Since 1955, the area of seedling/sapling stands has decreased by well over 50 percent (PGC and PFBC 2005-TN3815). The value of deciduous forest to wildlife in the project area is evidenced by the number of avian species of conservation concern to the Commonwealth that are strongly associated with early-succession, second-growth, and mature deciduous forest and which have been observed on the BBNPP site and adjacent Important Bird Area (IBA) No. 72 (Table 2-17; also see Section 2.4.1.3)).

Upland Scrub/Shrub

Scrub/shrub plant community types are found along onsite transmission lines and in several abandoned farm fields onsite where species composition is the result of secondary succession or is maintained in an early successional condition by transmission-line corridor maintenance practices. They cover approximately 107 ac of the BBNPP project area. These plant community types are characterized by woody species such as gray birch (*Betula populifolia*), bush honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*), Allegheny blackberry (*Rubus allegheniensis*), and Russian olive (*Elaeagnus angustifolia*) (Normandeau 2011-TN489; Normandeau 2011-TN1224).

Such scrub/shrub communities occur in areas that have undergone substantial human disturbance (e.g., farming, grazing, and timber harvesting) (PPL 1971-TN4038; PPL 1978-TN4036). Based on substantial prior disturbance and the dominant species listed above, scrub/shrub plant communities on the BBNPP site do not appear to be representative of any naturally occurring shrubland plant community types in Pennsylvania (Fike 1999-TN3816).

Shrub/thicket habitats in Pennsylvania may occur either as temporal or near-permanent habitat patches (e.g., barrens [see Section 9.3.3.3]). Temporal thicket patches result primarily from farmland abandonment (discussed below), reclamation and/or succession of reclaimed strip mines, and forest clear-cutting. The amount of early successional forest habitat has been decreasing for decades in Pennsylvania because, as noted previously, timber harvest rates have not kept pace with succession of forest vegetation. Thicket species that inhabit temporary clearings within forests are replaced by later successional species that accompany forest maturation, decreasing the habitat connectivity of thickets and the gene flow and dispersal of thicket-associated species. As a result of replacement by later successional stands, temporary, early successional habitats are becoming fragmented and degraded (PGC and PFBC 2005-

TN3815). The value of scrub/shrub habitat to wildlife is evidenced by the number of scrub/shrub avian species of conservation concern to the Commonwealth that have been observed on the BBNPP site and adjacent IBA No. 72 (Table 2-17).

Old-Field/Former Agricultural

Old-field vegetation covers approximately 243 ac of the BBNPP project area. Old-field vegetation is composed largely of an assemblage of grasses and herbaceous plants. Old-field vegetation extends over much of the fallow farmland in the western section of the BBNPP site. However, during 2008 some of this habitat was returned to agricultural use for the production of corn (Normandeau 2011-TN1224). As noted previously, crop production (i.e., corn, snap beans, and soybeans) currently occurs on approximately 205 ac of leased land onsite that was actively farmed as recently as 2013.

Plant communities on fallow agricultural fields (e.g., abandoned apple orchard) and pastures on the BBNPP site are characterized by herbaceous species such as daisy fleabane (*Erigeron annuus*), Canada thistle (*Cirsium arvense*), wrinkled goldenrod (*Solidago rugosa*), flat-top fragrant goldenrod (*Euthamia graminifolia*), Canada goldenrod (*Solidago canadensis*), white heath aster (*Aster pilosus*), giant foxtail grass (*Setaria faberi*), lamb's quarters (*Chenopodium album*), red clover (*Trifolium pretense*), common ragweed (*Ambrosia artemisiifolia*),common sheep sorrel (*Rumex acetosella*), common cinquefoil (*Potentilla simplex*), and an abundance of grasses and sedges such as, yellowfruit sedge (*Carex annectens*), creeping bentgrass (*Agrostis stolonifera*), little bluestem (*Andropogon scoparius*), poverty oatgrass (*Danthonia spicata*), and common timothy (*Phleum pretense*) (Normandeau 2011-TN489; Normandeau 2011-TN1224).

Herbaceous communities on old-field/former agricultural sites exist because of previous farming or other agricultural practices (PPL 1971-TN4038; PPL 1978-TN4036). Based on substantial prior disturbance and the dominant species listed above, herbaceous plant communities on the BBNPP site do not appear to be representative of any naturally occurring herbaceous plant community types in Pennsylvania (Fike 1999-TN3816).

Most grassland habitats in Pennsylvania are the result of disturbance by humans, primarily for agriculture and surface mining. About 25 percent of the state's area is in open habitats, with the majority of it maintained as farmland, one of the four primary types of open habitat in the Commonwealth. Both the number of farms and the amount of land devoted to farming have decreased since about 1900 in Pennsylvania. Acreage of cropland and pasture land has declined, with much of it having been abandoned and allowed to revert back to forest (PGC and PFBC 2005-TN3815). For example, more than 60 percent of Pennsylvania was in farmland in 1900. By 1992, only 25 percent of Pennsylvania's land area remained in farms. The decline in farming has slowed in recent years, with the amount of farmland in Pennsylvania having declined by 6 percent between 1982 and 1992, but slowing to a 1 percent decline from 1997 to 2002 (Casalena 2006-TN3817). Associated with this decrease has been a decline in farmland wildlife that may be due to a shift from smaller to larger farms under more intense mechanized production. Small farms that are less intensively managed than their larger-farm counterparts provide a mix of open habitat, abandoned fields, hedgerows, and woods that provide food and cover to grassland-associated species (PGC and PFBC 2005-TN3815). This type of habitat mosaic exists on the BBNPP site. The value of this habitat to wildlife is evidenced by the fairly large number of grassland avian species of conservation concern to the Commonwealth that have been observed on the BBNPP site and adjacent IBA No. 72, where this habitat also exists (Table 2-17).

Wetland and Floodplain Plant Communities and Habitat Types

The jurisdictional boundaries of wetlands and streams within and adjacent to potential areas of disturbance for the proposed BBNPP facilities were delineated between July 2007 and July 2011 (Normandeau 2011-TN1224). A first area of wetlands was delineated from 2007 through 2009, a second area in 2010, and a third area in 2011 (PPL Bell Bend 2011-TN3818).

The PADEP regulates development activities within wetlands and streams and surrounding floodways under Title 25 Pennsylvania Code (Environmental Protection) Chapter 105 (Dam Safety and Waterway Management) Subchapter A (General Provisions) Section 17 (Wetlands) (PA Code 25-105-TN1835; PADEP 2014-TN3819). The USACE regulates development activities in wetlands and streams under Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662). Thus, boundaries for wetlands and streams were established in accordance with PADEP and USACE regulatory requirements (Normandeau 2011-TN1224).

The wetlands delineation determined that the survey area was primarily upland habitat. Wetlands consist of palustrine emergent (herbaceous), palustrine scrub/shrub, and palustrine forest communities, which are described below (Normandeau 2011-TN1224). Wetlands on the BBNPP project area total 159 ac, most of which are deciduous forested wetlands (PPL Bell Bend 2011-TN3818; PPL Bell Bend 2013-TN3377). Most (97 percent) of Pennsylvania's estimated 403,924 ac of wetlands is palustrine (PADEP 2014-TN3819), with deciduous forested wetland being the most extensive palustrine-wetland type statewide and in Luzerne County (Tiner 1990-TN3820; PADEP 2014-TN3819; PGC and PFBC 2005-TN3815).

Wetlands and floodplains within the BBNPP project area are associated with two distinct watersheds: Walker Run and the North Branch of the Susquehanna River. Confers Lane serves as an approximate divide between the two watersheds within the BBNPP site. The majority of wetlands delineated within the Walker Run watershed are contiguous to Walker Run or one of its unnamed tributaries. Wetlands are also located adjacent to unnamed tributaries to the Susquehanna River. Isolated wetlands, lacking a surface connection to a surface waterbody, are present in both watersheds. These wetlands are situated primarily in topographic depressions (LandStudies 2011-TN502; PPL Bell Bend 2011-TN3818). Vernal pools, broadly categorized as ephemeral wetlands (Zedler 2003-TN3821), occur onsite in the Wetlands Natural Area, and are described in Section 2.4.1.3.

Most of Walker Run and its eastern tributary were channelized to facilitate farming operations (PPL Bell Bend 2013-TN3377) and wetlands were drained to create farmland (LandStudies 2011-TN502). In addition, topographic alterations due to infrastructure construction altered surface-water flow paths and divided wetlands (LandStudies 2011-TN502). Thus, the existing wetlands associated with Walker Run have been subjected to disturbance. Many wetlands are currently composed of multiple vegetation communities and several contain large areas of open water (Normandeau 2011-TN1224). The wetlands of the BBNPP site are described below and are shown in Figure 2-26.

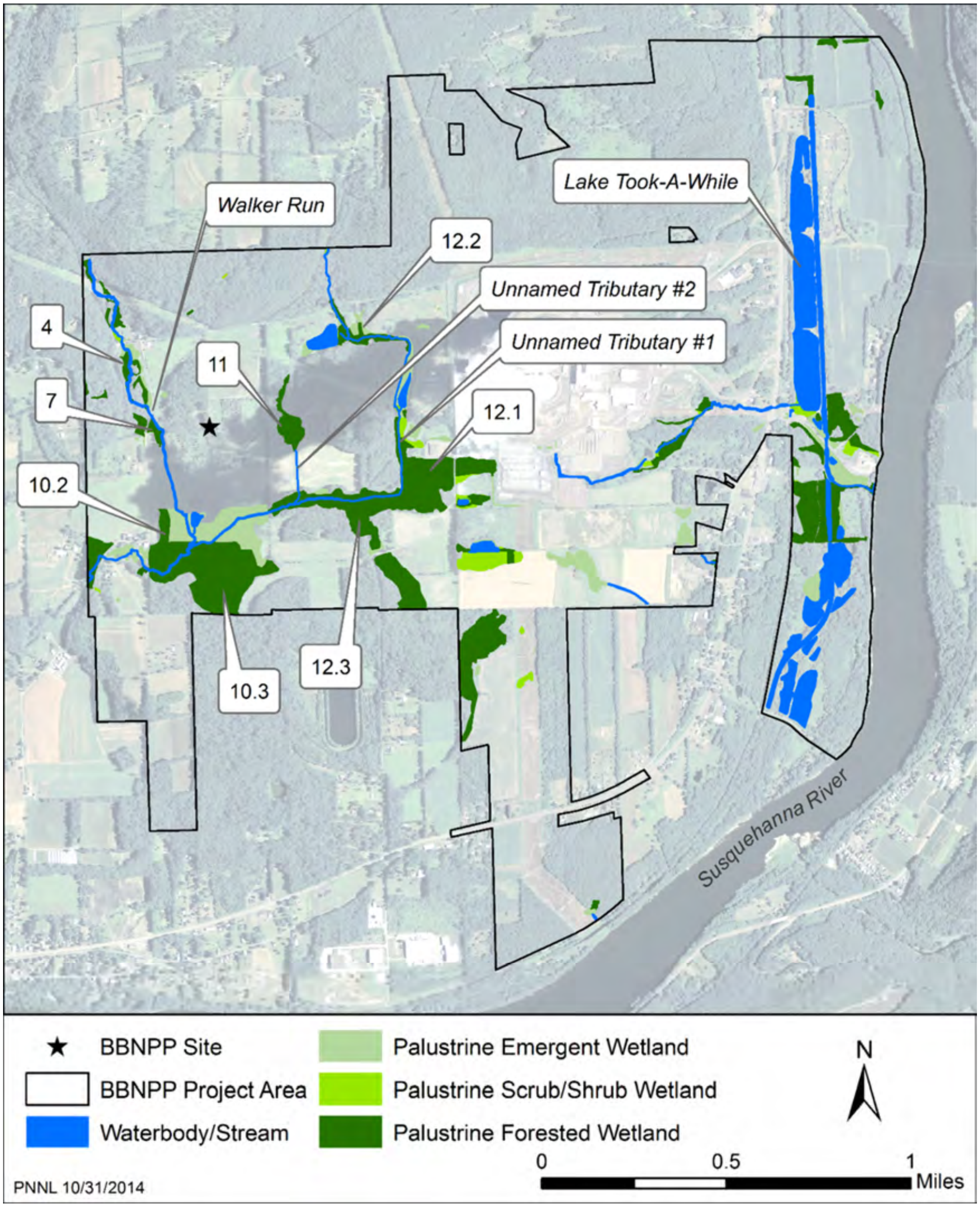

Figure 2-26. Wetlands and Waterways in the BBNPP Project Area. Only wetlands identified as habitat for important species discussed in Section 2.4.1.3 are numbered.

Both 100- and 500-year floodplains are generally coincident with wetlands and riparian areas in the Walker Run watershed and the North Branch of the Susquehanna River east of US 11. Thus, the wetland plant communities described below are also representative of the majority of the floodplains that occur on the BBNPP site.

Palustrine Emergent Wetlands

Palustrine emergent wetlands, totaling approximately 36.8 ac, are located throughout the BBNPP site (Normandeau 2011-TN1224; PPL Bell Bend 2013-TN3377). A diverse group of herbaceous hydrophytic plants is present in these wetlands, including soft rush (*Juncus effusus*), sedges (*Carex spp.*), arrow-leaf tearthumb (*Polygonum sagittatum*), common boneset (*Eupatorium perfoliatum*), giant goldenrod (*Solidago gigantea*), seedbox (*Ludwigia alternifolia*), nutsedges (*Cyperus spp.*), blue vervain (*Verbena hasta*), New York ironweed (*Vernonia noveboracensis*), swamp aster (*Aster puniceus*), cut-leaf coneflower (*Rudbeckia laciniata*), broad-leaved cattail (*Typha latifolia*), reed canary grass (*Phalaris arundinacea*), and purple loosestrife (*Lythrum salicaria*) (Normandeau 2011-TN1224). Based on substantial prior disturbance on the BBNPP site and the dominant species listed above, palustrine emergent wetland plant communities on the BBNPP site do not appear to be representative of naturally occurring palustrine emergent wetland plant community types in Pennsylvania (Fike 1999-TN3816).

As noted above, most (97 percent) of Pennsylvania's wetlands are palustrine, and emergent wetlands represent 13 percent of Pennsylvania palustrine wetlands. Pennsylvania lost 38 percent of its emergent wetlands between 1956 and 1969, a greater loss rate than both the national average (14 percent) and regional average (27 percent). The major causes of emergent wetland loss include conversion to lakes, ponds, and reservoirs; channelization or draining for development; conversion to farmland; and urban development. In addition, much of the net loss of emergent wetlands was caused by succession to other vegetated wetland types (e.g., forested and shrub wetlands). Large emergent wetlands, or undisturbed areas of small emergent wetlands mixed with fields (e.g., those on the BBNPP site and IBA No. 72) are needed to conserve emergent wetland wildlife species. Emergent wetlands provide important habitat for ducks, muskrat (*Ondatra zibethicus*), herons, rails, frogs, and salamanders (PGC and PFBC 2005-TN3815). The value of emergent wetlands to wildlife in the project area is evidenced by the fairly large number of emergent wetland avian species of conservation concern to the Commonwealth that have been observed on the BBNPP site and adjacent IBA No. 72, where these habitats also exist (Table 2-17).

Palustrine Scrub/Shrub Wetlands

Several large palustrine scrub/shrub wetlands, totaling approximately 9.4 ac, are located in the western part of the BBNPP site (Normandeau 2011-TN1224; PPL Bell Bend 2013-TN3377). In addition, hydrophytic shrubs are a component of many wetlands across the site. Spicebush is overwhelmingly the most abundant wetlands-preferring shrub onsite. Other frequently occurring wetland shrubs include highbush blueberry (*Vaccinium corymbosum*), meadowsweet (*Spirea latifolia*), alders (*Alnus spp.*), silky dogwood (*Cornus ammomum*), arrowwood (*Viburnum dentatum*), and gray dogwood (*Cornus racemosa*) (Normandeau 2011-TN1224). Based on substantial prior disturbance on the BBNPP site and the dominant species listed above, palustrine scrub/shrub wetland plant communities on the BBNPP site do not appear to be representative of naturally occurring palustrine scrub/shrub wetland plant community types in Pennsylvania as described by Fike (1999-TN3816).

As noted above, 12 percent of Pennsylvania's palustrine wetlands are shrub/scrub wetlands. Scrub/shrub wetlands have not declined as much as emergent wetlands in the last several decades. Wildlife species associated with scrub wetlands include black bear (*Ursus americanus*), black duck (*Anas rubripes*), wood duck (*Aix sponsa*), wood frog (*Rana sylvatica*), and American woodcock (*Scolopax minor*) (PGC and PFBC 2005-TN3815). The value of scrub/shrub wetlands to wildlife in the project area is evidenced by the scrub/shrub avian species of conservation concern to the Commonwealth that have been observed on the BBNPP site and adjacent IBA No. 72, where these habitats also exist (Table 2-17).

Palustrine Forested Wetlands

Palustrine forested wetlands, totaling approximately 112.8 ac, are the principal wetland type on the BBNPP site (Normandeau 2011-TN1224; PPL Bell Bend 2013-TN3377). Large contiguous blocks of this habitat extended across the western portion of the site. Most of the forested wetland is composed of well-developed overstory and understory strata, and many canopy trees are more than 12 in. in diameter at breast height (PPL Bell Bend 2013-TN3377). Trees commonly found in forested wetlands include red maple, silver maple (*Acer saccharinum*), black gum (*Nyssa sylvatica*), pin oak (Q*uercus palustris*), and river birch (*Betula nigra*). In addition, upland species (e.g., white ash and yellow poplar) were present on upland microsites scattered throughout some forested wetlands (Normandeau 2011-TN1224).

Understories of forested wetlands largely consist of spicebush, highbush blueberry, arrowwood, and winterberry (*Ilex verticellata*). Skunk cabbage (*Symplocarpus foetidus*) predominates in the groundcover along with sedges, jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), clearweed (*Pilea pumila*), cinnamon fern (*Osmunda cinnamomea*), stout woodreed grass (*Cinna arundinacea*), and swamp dewberry (*Rubus hispidus*) (Normandeau 2011-TN1224).

Much of the palustrine forested wetland on the BBNPP site, although it developed around disturbed conditions surrounding Walker Run and one of its unnamed tributaries, is representative of the red maple-black gum palustrine forest community type (Eichelberger 2011-TN3862; Fike 1999-TN3816), a type of red maple swamp that is common in the glaciated northeastern United States (FWS 1993-TN4019). Red maple-black gum palustrine forest is one of the naturally occurring broadleaf palustrine forest types in Pennsylvania, based primarily on the dominance/co-dominance of red maple and black gum, as well as other shared species in the canopy, shrub, and herb layers (Eichelberger 2011-TN3862; Fike 1999-TN3816).

As noted above, 36 percent of Pennsylvania's palustrine wetlands are forested (PGC and PFBC 2005-TN3815). Forested wetlands have not declined as much as emergent wetlands in the last several decades. Beaver (*Castor canadensis*) populations have increased statewide since the early 1990s. Impoundments created by beaver can increase small wooded wetland habitat for waterfowl and wading birds. In addition, bears use forested swamp habitats (PGC and PFBC 2005-TN3815). Beaver have created wetlands on the BBNPP site; and in this instance the wetland is emergent (Normandeau 2011-TN1224). The value of forested wetlands to wildlife in the BBNPP project area is evidenced by the forested wetland avian species of conservation concern to the Commonwealth that have been observed on the BBNPP site and adjacent IBA No. 72, where these habitats also exist (Table 2-17).

Exceptional Value Wetlands

PADEP Chapter 105 Dam Safety and Waterway Management regulations define Exceptional Value Wetlands. According to Title 25 Pennsylvania Code (Environmental Protection) Chapter 105 (Dam Safety and Waterway Management) Subchapter A (General Provisions) Section 17 (Wetlands) (PA Code 25-105-TN1835), Exceptional Value Wetlands are wetlands that exhibit one or more of the following characteristics:

1. Wetlands that serve as habitat for fauna or flora listed as "threatened" or "endangered" under the Endangered Species Act of 1973 (16 USC 1531 et seq.-TN1010); the Wild Resource Conservation Act (PA P.L. 597, No. 170-TN1810); 30 Pennsylvania Consolidated Statutes (relating to the Fish and Boat Code) (30 Pa. C.S. -TN3824); or 34 Pennsylvania Consolidated Statutes (relating to the Game and Wildlife Code) (34 Pa. C.S.-TN3825).
2. Wetlands hydrologically connected to or located within 0.5 mi of wetlands identified in the previous entry and that maintain the habitat of the threatened or endangered species within said wetlands.
3. Wetlands located in or along the floodplain of the reach of a Wild Trout Stream or waters listed as having Exceptional Value under Pennsylvania Code, Title 25, Chapter 93, Water Quality Standards (PA Code 25-93-TN611) and the floodplain of streams tributary thereto, or wetlands within the corridor or watercourse or body of water that has been designated as a national wild or scenic river in accordance with the Wild and Scenic Rivers Act of 1968 (16 USC 1271 et seq.-TN1811) or designated as wild or scenic under the Pennsylvania Scenic Rivers Act (PA P.L. 1277, No. 283-TN1812).
4. Wetlands located along an existing public or private drinking-water supply, including both surface-water and groundwater sources, which maintain the quality or quantity of the drinking-water supply.
5. Wetlands located in areas designated by the PDCNR as "natural" or "wild" areas within State forest or park lands, wetlands located in areas designated as Federal wilderness areas under the Wilderness Act (16 USC 1131 et seq.-TN1807) or the Federal Eastern Wilderness Areas Act of 1975 (16 USC 1132 et seq.-TN3826), or wetlands located in areas designated as National Natural Landmarks by the Secretary of the Interior under the Historic Sites Act of 1935 (16 USC 461 et seq.-TN1808).

Wetlands on the BBNPP site are not located in or along the floodplain of an Exceptional Value water, because neither Walker Run or the Susquehanna River are designated as having Exceptional Value in the PADEP Water Quality Standards regulations (i.e., Pennsylvania Code, Title 25, Chapter 93, Water Quality Standards, Section 93.4b Qualifying as High Quality or Exceptional Value Waters [PA Code 25-93-TN611]) (Normandeau 2011-TN1224). Walker Run is not used as a public or private drinking-water supply. The Susquehanna River may be used as a water supply in some regions of Pennsylvania; however, the river is not used for this purpose in the vicinity of the BBNPP site. The BBNPP site is owned in its entirety by PPL and none of the above State or Federal designations apply (PDCNR 2014-TN3829). Thus, on these bases, BBNPP site wetlands do not qualify as having Exceptional Value (Normandeau 2011-TN1224).

However, Walker Run and the Susquehanna River are classified as having the protected uses of cold-water fishes and warm-water fishes, respectively (PA Code 25-93-TN611). Walker Run is not designated by the Pennsylvania Fish and Boat Commission (PFBC) as a Class A Wild Trout Stream, but it is designated as a Wild Trout Stream (PFBC 2012-TN1910). It is also included in the PFBC May 2014 list of “Pennsylvania Stream Sections that Support Wild Trout” from its headwaters downstream to its confluence with the North Branch of the Susquehanna River (PFBC 2014-TN3827). Designation by PFBC as a Wild Trout Stream is based on collection of small numbers of Brown Trout (*Salmo trutta*) in Walker Run on the BBNPP site and at locations upstream and downstream of the site in April and July 2008. The size range of the specimens indicated the presence of a naturally reproducing Brown Trout population (Normandeau 2011-TN488). This was confirmed by a subsequent PFBC fisheries survey of Walker Run in June 2009 (PFBC 2009-TN503). Thus, the wetlands located in or along the floodplain of Walker Run and its unnamed tributaries, meet the criteria specified in Title 25 Pennsylvania Code (Environmental Protection) Chapter 105 (Dam Safety and Waterway Management) Subchapter A (General Provisions) Section 17 (Wetlands) (1) Exceptional Value Wetlands (PA Code 25-105-TN1835).

Jurisdictional Determination

As noted above, wetlands on the BBNPP site were delineated in groups in three sequential time intervals, the first group from 2007 through 2009, the second in 2010, and the third in 2011. The first group underwent a preliminary jurisdictional determination inspection by USACE on selected dates from September through November 2009 (PPL Bell Bend 2011-TN3818). A preliminary jurisdictional determination inspection of the second group by USACE was conducted on September 21, 2010 (PPL Bell Bend 2011-TN3818). A third preliminary jurisdictional determination inspection was not conducted by USACE because there would be no project impacts on the wetlands delineated in 2011 (PPL Bell Bend 2011-TN3818). Prior to or concurrent with issuance of the Department of the Army authorization, the USACE will issue an approved jurisdictional determination verifying which wetlands and other waters of the United States would be jurisdictional.

Wetland Functions and Values

PPL evaluated the functions and values of the subject wetlands using the USACE Highway Methodology (USACE 1999-TN1793) and reported the results in 2011 (LandStudies 2011-TN502). Wetland functions are self-sustaining properties of a wetland that exist in the absence of society. Values are the societal benefits derived from either one or more wetland function and physical characteristic (USACE 1999-TN1793). Wetland functions cover nine subject areas: groundwater recharge, groundwater discharge, flood-flow alteration, fish habitat, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, sediment/shoreline stabilization, and wildlife habitat. Wetland values cover five subject areas: recreation, educational and scientific value, uniqueness and heritage, visual quality and aesthetics, and endangered species habitat (USACE 1999-TN1793). However, the assessment did not include a consideration of the value “endangered species habitat”. Provision of habitat for Federally listed threatened or endangered species is however covered in Section 2.4.1.3.

The functions and values of 35 wetlands or groups of wetlands (i.e., assessment areas) within areas potentially subject to disturbance by the BBNPP project were assessed in 2011. Of the 35 wetlands or groups of wetlands, 18 are associated with Walker Run and 17 with the North Branch of the Susquehanna River. Of the latter, six are located in Susquehanna Riverlands (see Section 2.4.1.3) (LandStudies 2011-TN502).

For each assessment area, the Highway Methodology classifies each function or value as unsuitable, suitable, or principal. A determination of unsuitable suggests that the assessment area lacks the physical, biological, and/or social characteristics needed to substantially perform the function or possess the value. A determination of suitable indicates that the assessment area possesses the properties requisite to performing the function or possessing the value. A determination of principal goes beyond suitability to suggest that the function is an important physical component of a wetland ecosystem, or that the value is of special value to society, locally, regionally, and/or nationally. The selection of a function or value as principal is based on best professional judgment (LandStudies 2011-TN502).

Roughly half of the assessment areas evaluated were ranked as suitable for eight of the functions (i.e., groundwater recharge, groundwater discharge, flood-flow alteration, fish habitat, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, and sediment/shoreline stabilization). Most of the other assessment areas were ranked as unsuitable for these eight functions. Only a few of the assessment areas were ranked as principal for providing these functions (LandStudies 2011-TN502).

Most of the assessment areas evaluated were ranked as unsuitable for the four values (i.e., recreation, educational and scientific value, uniqueness and heritage, visual quality and aesthetics). Only a few were ranked as providing these as suitable or principal values (LandStudies 2011-TN502).

Roughly half of the assessment areas were considered to provide wildlife habitat as a principal function. Roughly one-quarter were considered to provide suitable wildlife habitat, and approximately one-quarter were considered unsuitable for wildlife. Roughly half of the assessment areas associated with Walker Run were considered to provide wildlife habitat as a principal function, while most of the other half were considered unsuitable for wildlife. Roughly half of the assessment areas associated with the North Branch of the Susquehanna River were considered to provide wildlife habitat as a principal function. Roughly one-quarter were considered to provide suitable wildlife habitat, and approximately one-quarter were considered unsuitable for wildlife. All of the assessment areas associated with the Susquehanna Riverlands were considered to provide wildlife habitat as a principal function or to provide suitable wildlife habitat; none were considered unsuitable for wildlife (LandStudies 2011-TN502).

Wildlife Species of the Site and Vicinity

A series of wildlife field surveys were conducted on the BBNPP site for birds, mammals, reptiles, and amphibians from July 2007 through September 2008 and in May and June 2010. A total of 124 species of birds, 33 species of mammals, 12 species of reptiles, and 15 amphibian species were observed during the surveys (Normandeau 2011-TN490). Similar numbers of bird (i.e., 129), mammal (i.e., 26), amphibian (i.e., 13), and reptile (i.e., 10) species were documented from 1972 to 1974 on the adjacent SSES site (PPL 1978-TN4036). A substantially larger number of bird species (i.e., 248) were observed across a larger area within 8 km (5 mi) of SSES from 1977 through 1994 (Ecology III 1995-TN1782).

Mammals

A total of 64 species of native and introduced mammals currently reside in Pennsylvania (Wright and Kirkland 1998-TN3852), all of which could occur in the vicinity of the BBNPP site (Normandeau 2011-TN490). Small and medium-sized mammals were trapped at select locations in each of the major habitat types (i.e., upland forest, upland scrub/shrub, and old-field) on the BBNPP site. Trapping occurred from May through September 2008 and from May through June 2010. In addition to trapping, mammals or their signs (e.g., tracks, scat, and burrows) were observed directly in 40 survey sectors that encompass the potentially affected area of the BBNPP site. Survey sectors were delineated based on habitat type and topographic features (e.g., roads, transmission lines, and stone walls). Pedestrian surveys were conducted during 48 field days in the 40 survey sectors from mid-October 2007 through mid-September 2008. In addition, mist net surveys were conducted for the Indiana bat (*Myotis sodalis*) (see Section 2.4.1.3) at select locations on the BBNPP site in June and July 2008 and May and June 2013 (Normandeau 2011-TN490; Normandeau 2014-TN3828).

A total of 33 mammal species were determined to be present based on direct observation, their signs, or mist-netting (Normandeau 2011-TN490; Normandeau 2014-TN3828). The habitat affinities of species are provided parenthetically below. Nearly two-thirds of all detections were of only four species: white-tailed deer (*Odocoileus virginianus*) (general, i.e., species has a broad range of habitat affinities), eastern gray squirrel (*Sciurus carolinensis*) (deciduous forest, general), eastern chipmunk (*Tamias striatus*) (general), and eastern cottontail (*Sylvilagus floridanus*) (brush thickets, hedgerows, general) (Normandeau 2011-TN490). All are considered year-long residents of the BBNPP site and vicinity.

Other large and medium-sized common mammal species detected include beaver (streams, rivers, lakes, ponds), Virginia opossum (*Didelphis virginiana*) (general), woodchuck (*Marmota monax*) (brush thickets, hedgerows, grasslands, agricultural lands, old-field), common muskrat (*Ondatra zibethicus*) (marshes, streams, rivers, lakes, ponds), porcupine (*Erethizon dorsatum*) (mixed forest), coyote (*Canis latrans*) (general), gray fox (*Urocyon cinereoargenteus*) (brush thickets, hedgerows, deciduous forest), red fox (*Vulpes vulpes*) (brush thickets, hedgerows, agricultural lands, old-field), raccoon (*Procyon lotor*) (coniferous forest), black bear (deciduous and coniferous forest), long-tailed weasel (*Mustela frenata*) (general), mink (*Mustela vison*) (marshes, streams, rivers), and striped skunk (*Mephitis mephitis*) (general) (Normandeau 2011-TN490). All are considered year-long residents of the BBNPP site and vicinity.

Small common mammal species detected include masked shrew (*Sorex cinereus*) (general), northern short-tailed shrew (*Blarina brevicauda*) (general), red squirrel (*Tamiasciurus hudsonicus*) (deciduous and mixed forest), southern flying squirrel (*Glaucomys volans*) (deciduous and mixed forest), white-footed mouse (*Peromyscus leucopus*) (general), deer mouse (*Peromyscus maniculatus*) (general), meadow vole (*Microtus pennsylvanicus*) (grasslands, marshes), house mouse (*Mus musculus*) (near humans, agricultural lands, old-field), meadow jumping mouse (*Zapus hudsonicus*) (grasslands, agricultural lands, old-field), little brown myotis (*Myotis lucifugus*) (streams, rivers, lakes, ponds), big brown bat (*Eptesicus* *fuscus*) (coniferous forest), eastern red bat (*Lasiurus borealis*) (forest edges and hedgerows), tri-colored bat (*Perimyotis subflavus*) (woods, rock or cliffs, buildings and caves), and northern long-eared bat (*Myotis septentrionalis*) (forest, buildings, caves, mines) (Normandeau 2011-TN490; Normandeau 2014-TN3828). All are considered year-long residents of the BBNPP site and vicinity, except for the bat species. The little brown myotis, big brown bat, tri-colored bat, and northern long-eared bat undergo local migrations between summer roosts and winter hibernacula. The eastern red bat migrates from summer roosts to the southern United States where it hibernates (Menzel et al. 2003-TN1783; Fergus Undated-TN3844). The northern long-eared bat, tri-colored bat, and little brown myotis are rare and are discussed in greater detail in Section 2.4.1.3.

It is noteworthy that black bears were observed during the recent surveys of the BBNPP site (Normandeau 2011-TN490) but not during surveys conducted from 1972 to 1974 at SSES (PPL 1978-TN4036). In Pennsylvania, excessive hunting pressure caused declining bear populations before 1980. Limiting hunting and more reliable food resources (due to the increased forest maturation discussed previously) have enabled the bear population to dramatically increase over the past two decades; bears are currently more abundant than at any other time since European settlement (Ternent 2006-TN1879).

Birds

A substantial number of bird studies have been conducted on and in the near vicinity of the BBNPP site, and have covered the habitat types present on the BBNPP site described above. Many of the avian species encountered in these studies occur and others could potentially occur on the BBNPP site, particularly those identified in IBA No. 72 (Figure 2-27).

Gross (2004-TN3982) conducted avian surveys in six areas of IBA No. 72 (described in Section 2.4.1.3), also known as the Susquehanna Riverlands IBA (Figure 2-27). Habitat types surveyed spanned three forested areas, a wetlands area, old-fields, and a picnic area. A total of 247 species were recorded, with 126 species breeding. High densities of forest canopy and thicket species were recorded (Gross 2004-TN3982).

Ecology III (1995-TN1782) conducted surveys for avian species of special concern as part of the SSES Environmental Monitoring Program between 1977 and 1994, largely within 5 mi (8 km) of SSES, and surveys for breeding birds in 1994 at two forested locations: one adjacent to the northwest side of SSES (Township Road 419 Forest) and one southeast of SSES on the east side of the North Branch of the Susquehanna River in IBA No. 72 (Council Cup Forest). Between 1977 and 1994, efforts focused on wetlands, particularly in the Wetlands Natural Area (Figure 2-27), and along the shoreline of the Susquehanna River and in the Council Cup Forest. Of the 248 species documented from 1977 through 1994, 37 were considered to be of special concern (i.e., listed as endangered, threatened, or candidate for listing by the Commonwealth of Pennsylvania in 1994). In 1994, 48 breeding species were documented at Township Road 419 Forest and at Council Cup Forest (Ecology III 1995-TN1782).

The North American Breeding Bird Survey (BBS) route nearest to the BBNPP site is near Berwick (Berwick Route 72902). Between 1996 and 2007, 121 species of breeding birds were identified along this route (Sauer et al. 2011-TN3830).

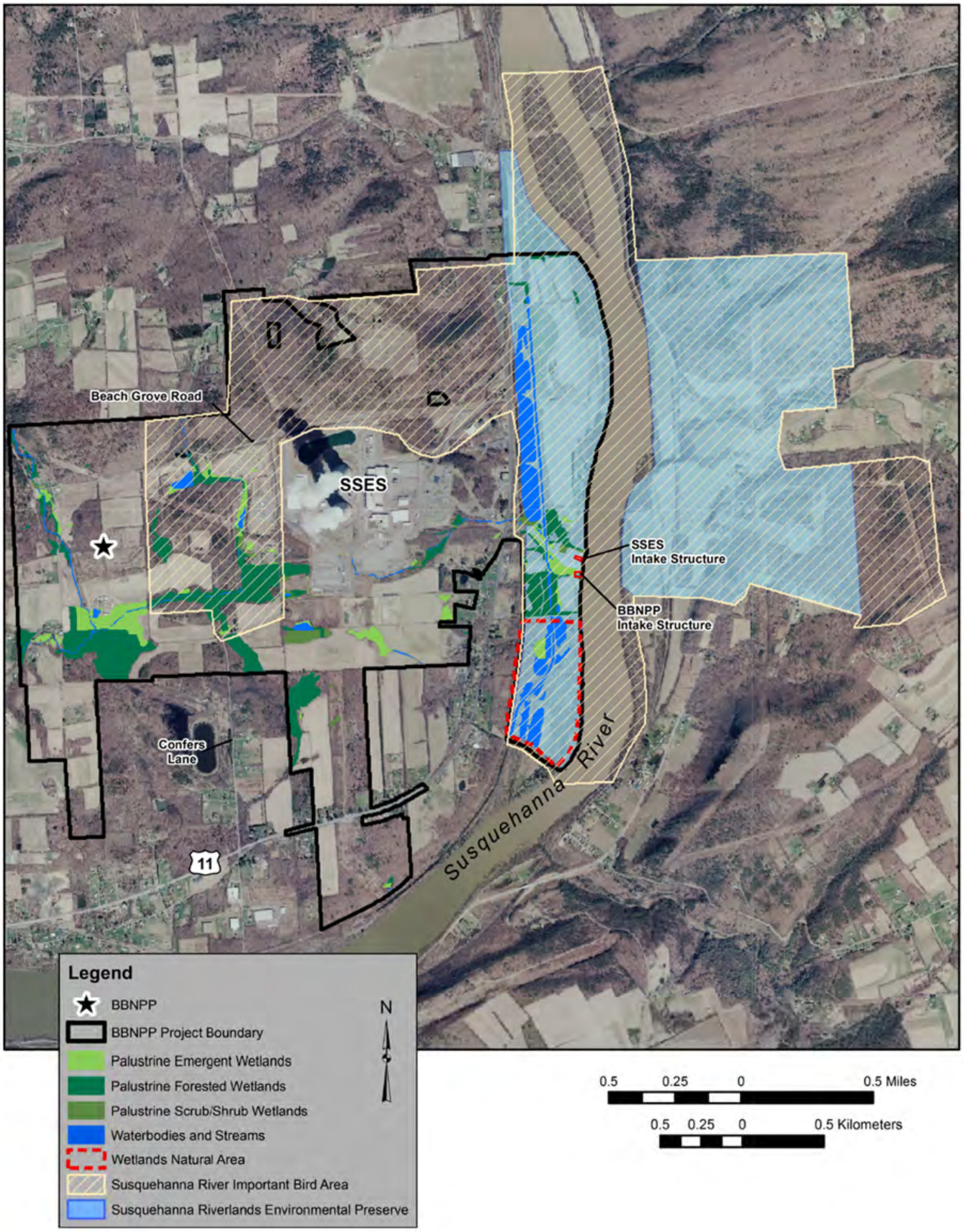

Figure 2-27. Important Terrestrial Habitats in the BBNPP Project Area

Birds were recorded by sight or calls during pedestrian surveys over 48 field days in the 40 survey sectors that make up the potentially affected area of the BBNPP site. Surveys were conducted from mid-October 2007 through mid-September 2008 and in May and June 2010. A total of 124 bird species were observed; 84 species were identified as likely breeding and 39 species were identified as migrants or winter residents (Normandeau 2011-TN490).

The top 10 species identified during the course of the study, based on total number of individuals observed, were Canada goose (*Branta canadensis*), European starling (*Sturnus vulgaris*), American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), blue jay (*Cyanocitta cristata*), song sparrow (*Melospiza melodia*), gray catbird (*Dumetella carolinensis*), mourning dove (*Zenaida macroura*), tufted titmouse (*Baeolophus bicolor*), and red-winged blackbird (*Agelaius phoeniceus*). The American crow was among the top 10 during all four seasons. The American robin was among the top four in all seasons except winter. The blue jay was among the top five for all seasons except summer. The gray catbird was the most abundant species during summer but was absent during winter due to migration (Normandeau 2011-TN490).

A general description of each group of avian species observed during surveys conducted by Normandeau (2011-TN490) of the potentially affected area of the BBNPP site is provided below, including a description of forest interior dwelling species. Table 2-17 identifies State-listed and State-ranked avian species that have been observed on the BBNPP site, including the onsite portion of the IBA No. 72, and the habitat types with which they are strongly associated. A portion of IBA No. 72 located on the BBNPP site was surveyed by Normandeau (2011-TN490). The description of the IBA No. 72 provided in Section 2.4.1.3 indicates that it was selected because it provided diverse habitats considered essential for bird conservation in the region. The high number of State-listed and State-ranked avian species that use the BBNPP project area (see Table 2-17), and the fact that these include many whose presence is indicative of high-habitat quality (PGC and PFBC 2005-TN3815), suggest that avian habitats on the BBNPP site, particularly those within the IBA No. 72, are of relatively high quality.

Waterfowl. The Susquehanna River south of Danville, Pennsylvania (located about 20 mi west-southwest of the BBNPP site) is the principal migratory waterfowl flyway in eastern Pennsylvania (PPL 1971-TN4038; USGS 2013-TN3831). However, much of the waterfowl traffic does not stop in the area of the BBNPP site (PPL 1971-TN4038).

Eight waterfowl species were observed: Canada goose, mallard duck (*Anas platyrhynchos*), American green-winged teal (*Anas crecca*), American black duck, wood duck, American widgeon (*Anas americana*), ring-necked duck (*Aythya collaris*), and snow goose (*Chen caerulescens*) (Normandeau 2011-TN490). The Canada goose, mallard duck, American black duck, and wood duck are assumed to breed in the vicinity, based on known breeding distribution (Kaufman 2000-TN3832) and observation in the area during the breeding season (Normandeau 2011-TN490). The other species may be present onsite during migration (Kaufman 2000-TN3832). The Susquehanna River provides abundant habitat for waterfowl. Walker Run and its tributaries, because they are narrow and shallow, provide limited habitat for waterfowl.

Shorebirds. Two shorebird species were observed: killdeer (*Charadrius vociferus*) and American woodcock (also considered an upland game bird) (Normandeau 2011-TN490). Both species are considered to breed in the vicinity (Kaufman 2000-TN3832; Normandeau 2011-TN490). Cleared and open areas of the BBNPP site provide suitable habitat for killdeer, which may be found in fields and pastures, often far from water. Forest thickets and adjacent fields provide habitat for the woodcock, which is also found far from water.

Waterbirds and Wading Birds. Four waterbird species were observed: great blue heron (*Ardea herodias*), green heron (*Butorides virescens*), ring-billed gull (*Larus delawarensis*), and double-crested cormorant (*Phalacrocorax auritus*) (Normandeau 2011-TN490). The great blue heron and green heron are colonial nesting species, and both are considered to breed in the vicinity (Kaufman 2000-TN3832; Normandeau 2011-TN490). The ring-billed gull and double-crested cormorant may be present onsite during migration (Kaufman 2000-TN3832). The Susquehanna River provides abundant habitat for waterbirds. Walker Run and its tributaries, because they are narrow and shallow, provide limited habitat for waterbirds.

Upland Game Birds. Five upland game species were observed: wild turkey (*Meleagris gallopavo*), mourning dove (*Zenaida macroura*), ring-necked pheasant (*Phasianus colchicus*), rock dove (*Columba livia*), and ruffed grouse (*Bonasa umbellus*) (Normandeau 2011-TN490). All five species are year-round residents (Kaufman 2000-TN3832). The ruffed grouse and wild turkey inhabit forest habitat while the mourning dove, ring-necked pheasant, and rock dove are birds of open areas, fields, and pastures.

Birds of Prey. Eleven raptor species were observed: American kestrel (*Falco sparverius*), black vulture (*Coragips atratus*), broad-winged hawk (*Buteo platypterus*), Cooper's hawk (*Accipiter cooperii*), great horned owl (*Bubo virginianus*), northern harrier (*Circus cyaneus*), peregrine falcon (*Falco peregrinus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipiter striatus*), and turkey vulture (*Cathartes aura*) (Normandeau 2011-TN490). The broad-winged hawk, red-shouldered hawk, and sharp-shinned hawk are forest birds. The American kestrel, northern harrier, and red-tailed hawk are birds of open habitats. The black vulture, Coopers hawk, great horned owl, and turkey vulture are habitat generalists. All species except the peregrine falcon may nest in the vicinity of the BBNPP site. The peregrine falcon would occur there only during migration (Kaufman 2000-TN3832; Normandeau 2011-TN490). The peregrine falcon is discussed in greater detail in Section 2.4.1.3.

Woodpeckers. Five woodpecker species were observed: downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), pileated woodpecker (*Dryocopus pileatus*), red-bellied woodpecker (*Melanerpes carolinus*), and northern flicker (Normandeau 2011-TN490). All five species are year-round residents and are assumed to breed in the vicinity (Kaufman 2000-TN3832).

Perching Birds (including Forest Interior Specialists). About one-half of the species observed were perching birds (or passerines). Perching birds may be resident breeders, stopover migrants that breed further north, or year-long residents. Eight of the 10 most common avian species observed during the course of the surveys (identified above) were passerines: European starling, American robin, American crow, blue jay, song sparrow, gray catbird, tufted titmouse, and red-winged blackbird (Normandeau 2011-TN490). Passerines are found in all habitats on the BBNPP site. Species of conservation concern in the Commonwealth were observed; however, those of greatest conservation concern are forest interior specialists (PGC and PFBC 2005-TN3815).

Forest interior breeding birds need relatively large contiguous tracts of forest to support viable breeding populations, although they may also breed in less than optimum conditions and may also occur in other than forest interior habitat. There are 27 species of neotropical migratory birds that are considered forest interior breeders in the northeastern United States (Therres 1993-TN1790). A total of 26 of those 27 species have been documented in the project area: Acadian flycatcher (*Empidonax virescens*), American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), blackburnian warbler (*Dendroica fusca*), black-throated blue warbler (*Dendroica caerulescens*), black-throated green warbler (*Dendroica virens*), blue-gray gnatcatcher *(Polioptila caerulca*), Canada warbler (*Wilsonia canadensis*), cerulean warbler (*Dendroica cerulea*), hooded warbler (*Wilsonia citrina*), Kentucky warbler (*Oporomis formosus*), Louisiana waterthrush (*Seiurus motacilla*), northern parula (*Parula americana*), northern waterthrush (*Seiurus noveboracensis*), ovenbird (*Seiurus aurocapillus*), prothonotary warbler (*Protonotaria citrea*), red-eyed vireo (*Vireo olivaceus*), scarlet tanager (*Piranga olivacea*), Swainson's thrush (*Catharus ustulatus*), veery (*Catharus fuscescens*), wood thrush (*Hylocichla mustelina*), whip-poor-will (*Caprimulgus vociferous*), worm-eating warbler (*Helmitheros vermivorus*), yellow-bellied flycatcher (*Empidonax flaviventrus*), yellow-throated vireo (*Vireo flavifrons*), and yellow-throated warbler (*Dendroica dominica*) (PPL 1978-TN4036; Audubon and Cornell 2014-TN3582; Ecology III 1995-TN1782; Normandeau 2011-TN490; Wilson et al. 2012-TN3833).

Based on observations in the project area during the breeding season, 19 of these 26 species likely nest in the project area (PPL 1978-TN4036; Audubon and Cornell 2014-TN3582; Ecology III 1995-TN1782; Normandeau 2011-TN490; Wilson et al. 2012-TN3833). The other 7 species are unlikely to nest in the project area because (1) the area is somewhat outside their breeding range (i.e., Swainson's thrush, yellow-throated warbler, yellow-bellied flycatcher) (Kaufman 2000-TN3832), (2) the species rarely breeds within the portion of its breeding range that encompasses the project area (i.e., northern waterthrush, cerulean warbler, prothonotary warbler) (Kaufman 2000-TN3832), or (3) the species once was but is no longer a common breeder in the project area (i.e., whip-poor-will) (Ecology III 1995-TN1782).

Amphibians and Reptiles

Currently, 74 reptile and amphibian species occur in Pennsylvania (PFBC 2014-TN3869), many of which could occur in the vicinity of the BBNPP site (Normandeau 2011-TN490). Amphibians and reptiles were surveyed in the potentially affected area of the BBNPP site over a 213-hour period during 28 days between May and September 2008. Methods included random opportunistic sampling, cover boards, traps, dip nets, and road searches. In addition, observations of reptiles and amphibians were included in the pedestrian surveys, which included 48 field days between mid-October through mid-September 2008 and in May and June 2010. As shown in Table 2-15, 27 species (i.e., 12 species of reptiles and 15 species of amphibians) were detected (i.e., either observed or identified via their vocalizations) during the studies of the BBNPP site (Normandeau 2011-TN490).

Table 2-15. Amphibians and Reptiles Observed on the BBNPP Site

Scientific Name	Common Name	Scientific Name	Common Name
Amphibians			
Frogs/Toads		**Salamanders/Newts**	
Acris crepitans crepitans	northern cricket frog	*Desmognathus fuscus*	dusky salamander
Bufo americanus americanus	eastern American toad	*Eurycea bislineata*	northern two-lined salamander
Hyla versicolor	gray treefrog	*Eurycea longicauda longicauda*	longtail salamander
Pseudacris crucifer crucifer	northern spring peeper	*Notophthalmus viridescens viridescens*	eastern red-spotted newt
Rana catesbeiana	bullfrog	*Plethodon cinereus*	redback salamander
Rana clamitans	green frog	*Plethodon glutinosus*	northern slimy salamander
Rana palustris	pickerel frog	*Pseudotriton ruber*	northern red salamander
Rana sylvatica	wood frog		
Reptiles			
Turtles		**Snakes**	
Chelydra serpentina	snapping turtle	*Coluber constrictor constrictor*	northern black racer
Chrysemys picta picta	eastern painted turtle	*Diadophis punctatus*	ringneck snake
Glyptemys insculpta	wood turtle	*Lampropeltis triangulum triangulum*	eastern milksnake
Graptemys geographica	map turtle	*Nerodia sipedon sipedon*	northern water snake
Terrapene carolina carolina	eastern box turtle	*Storeria dekayi dekayi*	northern brown snake
		Thamnophis sauritus	eastern ribbon snake
		Thamnophis sirtalis sirtalis	eastern garter snake

A general description of each group of amphibian and reptile species observed during surveys of the potentially affected area of the BBNPP site is provided below. Table 2-15 identifies amphibian and reptile species of conservation concern to the Commonwealth that have been observed in the potentially affected area of the BBNPP site and the habitat types with which they are primarily associated.

<u>Frogs and Toads</u>. Eight species of frogs and toads were observed during the surveys. The habitats of the frogs and toads on the BBNPP site range from fully aquatic (e.g., bullfrog [*Rana catesbeiana*]) to semi-aquatic (e.g., toad species and treefrogs). All species of frogs and toads observed during the surveys (Table 2-15) are closely tied to the water habitats where they reproduce (e.g., wetlands, temporary pools, and low-gradient streams and rivers). Further, with the exception of the bullfrog, all make extensive use of adjacent terrestrial habitats (e.g., forest, grassland, and cropland) as juveniles and adults. All eight species, except the northern cricket

frog, are considered abundant in the Commonwealth of Pennsylvania. The northern cricket frog is considered rare and is discussed further in Section 2.4.1.3 (Normandeau 2011-TN490).

Salamanders and Newts. Seven species of salamanders and newts were observed during the surveys (Table 2-15). The habitats of salamanders and newts on the BBNPP site range from mostly aquatic (e.g., red-spotted newt [*Notophthalmus viridescens*]), to semi-aquatic (e.g., all salamander species observed except the redback salamander [*Plethodon cinereus*] and northern slimy salamander [*Plethodon glutinosus*]), to completely terrestrial (e.g., redback salamander and slimy salamander). The semi-aquatic salamanders and fully aquatic newt are closely tied to the water habitats where they reproduce (e.g., streams, pools, and wetlands). The adult semi-aquatic salamanders also use adjacent terrestrial habitat (e.g., riparian forests), as do both larval and adult life stages of the fully terrestrial redback salamander and northern slimy salamander. All seven salamander/newt species observed are considered abundant in the Commonwealth of Pennsylvania (Normandeau 2011-TN490).

Turtles. Five species of turtles were observed during the surveys (Table 2-15). The habitats of turtles on the BBNPP site include aquatic habitats ranging from rivers and streams to still-water habitats such as wetlands. The lifestyles of these turtles range from mostly aquatic (common snapping turtle [*Chelydra serpentina*], map turtle [*Graptemys geographica*], painted turtle [*Chrysemys picta picta*]) to semi-aquatic (wood turtle [*Glyptemys insculpta*] and box turtle [*Terrapene carolina carolina*]). All five turtle species leave the water to nest and to bask. Nesting (egg deposition) is accomplished in soft substrates near water. Hibernation/burrowing during inactive periods may occur in soft soil or in fallen logs/debris, soft substrates underwater, or under rocks or in holes in banks, depending on the species and habitat availability. The snapping turtle, painted turtle and map turtle are considered common to abundant in the Commonwealth of Pennsylvania. The wood turtle and box turtle may be considered relatively rare and are discussed further in Section 2.4.1.3 (Normandeau 2011-TN490).

Snakes. Seven snake species were observed during the surveys (Table 2-15). The habitats of snake species on the BBNPP site range from mostly aquatic (e.g., northern watersnake [*Nerodia sipedon*]) to terrestrial habitats near water (e.g., eastern ribbon snake [*Thamnophis sauritus*]), inhabiting a wide variety of both wetland and terrestrial habitats depending on the region (e.g., eastern garter snake [*Thamnophis sirtalis sirtalis*], eastern milksnake [*Lampropeltis triangulum triangulum*] and northern brown snake [*Storeria dekayi dekayi*]), to no apparent affinity for water or terrestrial habitats near water (e.g., northern black racer [*Coluber constrictor constrictor*], ringneck snake [*Diadophis punctatus*]). All seven snake species spend periods of inactivity underground or in crevices or burrows, and they deposit eggs in soil, litter, debris, or abandoned mammal burrows. All seven species, except the eastern ribbon snake, are considered abundant in the Commonwealth of Pennsylvania. The eastern ribbon snake is considered rare and is discussed further in Section 2.4.1.3 (Normandeau 2011-TN490).

2.4.1.2 Terrestrial Resources – Offsite Areas

Transmission-Line Corridors

No new offsite transmission-line corridors are needed to connect BBNPP to the existing electrical grid (PPL Bell Bend 2013-TN3377). Ecological resources of the project footprint on the BBNPP site, within which are located the two proposed onsite transmission-line corridors, the area onsite proposed for relocation of an existing transmission-line corridor, and the corridors proposed for a new onsite railroad spur and a new onsite plant-access road, are discussed under site and vicinity (Section 2.4.1.1).

Consumptive-Use Mitigation Areas

PPL's primary mitigation plan for consumptive use of water out of the North Branch of the Susquehanna River is summarized in Section 2.2 and Figure 2-10 and described in greater detail by Meyer (2014-TN3566). This section describes, in a broad sense, terrestrial ecological resources along the waterbodies that would be affected by the CUMP.

The CUMP affects waterbodies spanning two states (i.e., Pennsylvania and New York) and three major physiographic provinces (i.e., the Appalachian Plateau, the Ridge and Valley, and the Piedmont). Approximately 95 percent of this area was forested before European settlement. The effects of large-scale deforestation and land-use conversion peaked in the early 1900s when only 30 percent of the forest cover remained. Since then, forest cover has more than doubled. The dominant vegetation type today throughout the area of the CUMP is deciduous forest (DePhilip and Moberg 2010-TN1652).

Rivers and Streams

Vegetation. Some river and stream banks within the North Branch of the Susquehanna River and West Branch of the Susquehanna River systems are completely vegetated; some have light residential encroachment, such as yards and small parks; and some have completely engineered areas to limit flooding. Further, floodplain habitat varies throughout the North Branch of the Susquehanna River and West Branch of the Susquehanna River systems. The types and spatial extent of the floodplains are often controlled by topography. Many floodplain areas have been used for agriculture because of the presence of fertile soils deposited by floods. At some locations, flood walls impair the functionality of the floodplain (PFBC 2011-TN3834). Islands are also prevalent within major tributaries in the North Branch of the Susquehanna River and West Branch of the Susquehanna River systems and can provide important habitat for nesting birds (PFBC 2011-TN3834; DePhilip and Moberg 2010-TN1652).

The Nature Conservancy (DePhilip and Moberg 2010-TN1652) grouped 11 vegetation community types into four major series that occur over an increasing elevation gradient/decreasing moisture gradient perpendicular to streams and rivers in the Susquehanna River Basin: submerged and emergent, herbaceous, scrub/shrub, and floodplain forest. The structure of riparian and floodplain vegetation communities depends to a great degree on flow. Vegetation community composition and structure depend on disturbance frequency and severity, inundation frequency and duration, landscape position, substrate stability, and the available propagules or seed bank.

Submerged vegetation communities are discussed in Section 2.4.2.1. Emergent vegetation communities occur in areas of river and stream channels that are semi-permanently and permanently inundated. Areas with emergent vegetation include island heads, edges of bars, and channels and terraces. Prominent emergent communities within the Susquehanna River

Basin include water willow (*Justicia americana*) and lizard's tail (*Sarurus cernuus*). These communities rely upon ice scour and floods for regeneration (DePhilip and Moberg 2010-TN1652).

Herbaceous communities occur within portions of river and stream channels that are temporarily flooded on a seasonal basis. Prominent herbaceous community types within the Susquehanna River Basin include Indian grass (*Sorghastrum nutans*)—willow (*Salix* spp.) riverine shrubland, sedge (*Carex* spp.)--spotted joe-pye weed (Eutrochium spp.), and the riverside scour community (including bedrock outcrops, shorelines and flats). These communities are maintained by moderate-to-severe ice scour associated with high flow events during the winter months and by inundation from seasonal and high flows in the spring and summer (DePhilip and Moberg 2010-TN1652). The riverside scour and Indian grass-willow communities are described further in Table 2-17.

Scrub/shrub communities are transitional between herbaceous and floodplain forest areas, and are maintained by limited growth during periods of inundation, structural damage from ice scour and floods, and poorly developed soils. Scrub/shrub communities are typically found on flats, bars, and low terraces of islands and banks. Prominent scrub/shrub community types within the Susquehanna River Basin include speckled alder (*Alnus rugosa*)–dogwood (*Cornus florida*) riverine shrubland, mixed hardwood riverine shrubland (sycamore [*Platanus occidentalis*], silver maple, river birch [*Betula nigra*]), and black willow (*Salix nigra*) slackwater shrubland (DePhilip and Moberg 2010-TN1652).

Prominent floodplain forest communities within the Susquehanna River Basin include sycamore, sycamore-mixed hardwood (river birch and green ash [*Fraxinus pennsylvanica*]), and silver maple. Sycamores are found on well-drained coarse gravel and cobble substrate and silver maples in slower, backwater habitats. Both communities rely on high overbank flows to maintain suitable substrate size and moisture conditions for seedling establishment and dispersal and to reduce competition with upland woody species (DePhilip and Moberg 2010-TN1652).

Wildlife. Stream bank areas and associated riparian habitats vary along the North Branch of the Susquehanna River and West Branch of the Susquehanna River. These areas are often important habitat for amphibian, reptile, bird, and mammal species. Contemporary surveys of amphibian and reptile populations in the West Branch of the Susquehanna River and North Branch of the Susquehanna River are limited mostly to tributaries, wetlands, and terrestrial areas outside the West Branch of the Susquehanna River and North Branch of the Susquehanna River proper. A total of 12 salamander, 11 frog and toad, 13 snake, 8 turtle, and 3 lizard species are known to occur along the these rivers. More numerous are the bird and plant species that occur along the North Branch of the Susquehanna River and West Branch of the Susquehanna River (PFBC 2011-TN3834).

The Nature Conservancy (DePhilip and Moberg 2010-TN1652) identified groups of reptiles, amphibians, birds, and mammals representative of the flow needs for larger groups of species within the same taxa in the Susquehanna River Basin. Species within a group share a sensitivity or response to one or more aspects of the flow regime due to a common life-history trait. Life-history information for select species relevant to the CUMP is provided below.

Amphibians and Reptiles. The Nature Conservancy (DePhilip and Moberg 2010-TN1652) identified 14 amphibian and reptile species that represent the major life-history traits of the other 9 species in the Susquehanna River Basin and categorized them as aquatic-lotic, semi-aquatic-lotic, and riparian/floodplain-terrestrial/vernal. Aquatic-lotic species spend most life stages in flowing water (stream channel), have stream-dependent feeding habits, or have morphological traits (e.g., are lungless) adapted to life in flowing water. Representative aquatic-lotic species are the northern map turtle, common musk turtle (*Sternotherus odoratus*), northern water snake, queen snake (*Regina septemvittata*), eastern hellbender (*Cryptobranchus alleganiensis*), and dusky salamander. Adult northern map turtles generally use rivers more than about 150 ft wide and prefer water more than about 3 ft deep for hibernation, mating, and growth. Adults bask on large woody debris and rocky outcrops in the channel. Habitat connectivity is important because map turtles move to nest. Juveniles use shallow, nearshore areas. Northern map turtles feed on mollusks, aquatic insects, and fish. Common musk turtles, like map turtles, use aquatic habitats for hibernation, mating, and adult growth. Musk turtles use small shallow streams and backwaters of large rivers. Musk turtles are carnivorous and feed by walking on the bottom and are seldom observed out of water. The northern water snake occupies fast- and slow-moving streams and feeds on fish and amphibians. The queen snake inhabits moderate- to fast-moving streams where crayfish, its primary prey, are abundant. Hibernation of these snake species occurs in crevices, including muskrat and crayfish burrows, from mid-October to April. Lungless salamanders (e.g., the dusky salamander and other species) live in stream banks and riparian areas. Because these species require gas exchange through their skin, they are sensitive to changes in surface-water hydrology and water temperature. Further, they are common in headwater and small streams, particularly where fish are absent; nest in stream banks; and are dependent on streamside vegetation and bank stability.

Semi-aquatic-lotic species rely on flowing water (e.g., stream channel) for one or more life stages and spend the other life stages in floodplains or uplands. Representative semi-aquatic-lotic species include the wood turtle, eastern ribbon snake, and northern leopard frog (*Rana pipiens*). Wood turtles are common in headwater streams and small- to medium-sized rivers. They hibernate in stream banks and bottoms. Mating occurs in water in early fall. The species is primarily found in riparian areas but uses streams for refuge during droughts. The eastern ribbon snake occurs in a variety of habitats but feeds on amphibians and fish; thus it occurs in near-permanent standing or flowing water. The species may hibernate in or out of water. Northern leopard frogs use the vegetated margins of slow-flowing streams and rivers and hibernate in stream bottoms. The species uses vernal habitats for breeding and egg-laying (DePhilip and Moberg 2010-TN1652).

Riparian/floodplain-terrestrial/vernal species do not use flowing water (e.g., stream channel) for any life stage, but rely on overbank flows to maintain floodplain habitats. Species include the eastern hognose snake (*Heterodon platirhinos*), eastern gray treefrog, Fowler's toad (*Bufo fowleri*), eastern spadefoot (*Scaphiopus holbrookii*), and the mole salamanders (*Ambystoma* spp.). Riparian/floodplain-terrestrial/vernal species benefit from overbank flows that maintain vernal habitats and that maintain floodplain vegetation succession (e.g., Fowler's toad and eastern gray treefrogs), and mole salamanders use vernal pools for mating and/or egg and larval development) (DePhilip and Moberg 2010-TN1652).

Birds. Some bird species use food resources from streams and food and habitat along stream banks, islands, and floodplains. These include colonial water birds, fish-eating birds, and bank and riparian nesting birds such as the belted kingfisher (*Megaceryle alcyon*), bank swallow (*Riparia riparia*), and Acadian flycatcher (*Empidonax virescens*) (DePhilip and Moberg 2010-TN1652). Colonial water birds and fish-eating bird species are discussed in the consumptive-use subsection of Section 2.4.1.3, because the species identified by DePhilip and Moberg (2010-TN1652) are also important species. The belted kingfisher and bank swallow nest in vertical banks along watercourses. The kingfisher feeds primarily on fish, but also feeds on amphibians and aquatic insects. The Acadian flycatcher builds its nest in the fork of a small branch in a tree, usually over water. The bank swallow and Acadian flycatcher feed on metamorphosed aquatic insects and other insects.

Mammals. Some species nest in and/or use food resources from streams. These include the muskrat (*Ondatra zibethicus*). The muskrat feeds primarily on roots, shoots, stems, and leaves, but also eats crayfish, frogs, fish, and snails. Muskrats nest in stream banks with the den entrance located below water and the nest chamber above (DePhilip and Moberg 2010-TN1652). Other species identified by DePhilip and Moberg (2010-TN1652) nest in and/or use food resources from streams. These important species are also discussed in the consumptive-use subsection of Section 2.4.1.3.

Cowanesque Lake

Vegetation. This subsection discusses lacustrine emergent wetlands associated with shallow-water areas along the periphery of the lake. Emergent vegetation is different from submerged aquatic vegetation (discussed in Section 2.4.2.2) in that the former comprises rooted vascular plants that grow above rather than to the water surface. Wetlands with a direct hydrologic connection to Cowanesque Lake were identified to a landward extent of 50 ft from the perimeter of the lake in 2011. Two of these are man-made wetlands, the rest are naturally occurring. The two man-made wetlands (15 and 60 ac) were mitigation areas created by USACE associated with raising the lake elevation (from 1,045 to 1,080 ft) in 1990; the 60-ac wetland is located at the upstream end where the Cowanesque River enters Cowanesque Lake. These wetlands were planted with alkali bulrush (*Scirpus maritimus*), arrowhead (*Sagittaria rigida*), duck potato (*Saggitaria latifolia*), giant smartweed (*Polygonum pensylvanicum*), sago pondweed (*Stuckenia pectinata*), wild celery (*Vallisneria americana*), and giant wild rice (*Zizania aquatica*) (EA 2012-TN3371). The planted species provide forage for waterfowl, waterbirds, and passerine birds.

The 13 naturally occurring emergent wetlands compose more than 11 ac. The majority of these are located along the northern shoreline and along the western shoreline where the Cowanesque River enters Cowanesque Lake. Common, and often dominant, species over most of the wetland acreage include obligate and facultative wetland species (e.g., soft stem bulrush [*Scirpus validus*], purplestem beggarticks [*Bidens connata*], northern arrowwood, and broadleaf cattail). Both the natural and man-made wetlands stabilize soil and control erosion, thereby reducing sediment input into the lake; filter nutrients and thereby improve water quality; and provide breeding and spawning areas for waterfowl and amphibians (EA 2012-TN3371).

Wildlife. A 1-ac duck island was created in Cowanesque Lake as part of the USACE's mitigation associated with raising the lake elevation in 1990. No other wildlife mitigation improvements were performed that were dependent upon lake levels for functionality

(USACE 2011-TN3965). A total of 51 mammal species potentially occur in the Cowanesque Lake vicinity. Of these, only three have a semi-aquatic lifestyle and an affinity for shoreline/wetland habitats: beaver, muskrat, and northern water shrew (*Sorex palustris albibarbis*) (USACE 2002-TN3966). Muskrats occupy wetlands, build nests with underwater entrances in banks, and consume primarily vegetation; however, they also consume mussels, frogs, crayfish, fish, and turtles (FWS 1984-TN3836). Beavers inhabit riparian zones around lakes, ponds, and streams, build lodges with underwater entrances (in streams they create wetlands by damming stream channels), and consume vegetation (FWS 1982-TN3835). The water shrew is described in Table 2-17 in Section 2.4.1.3.

A total of 110 avian species potentially occur in the Cowanesque Lake vicinity. Of these, only six have an affinity for shoreline/wetland habitats: great blue heron, green-backed heron (*Butorides virescens*), mallard, Canada goose, American black duck, and swamp sparrow (*Melospiza georgiana*) (USACE 2002-TN3966). The mallard, Canada goose, and American black duck inhabit wetlands surrounding lakes, nest on the ground near water, and consume aquatic and terrestrial vegetation and grain (Cornell 2014-TN3837). The swamp sparrow occupies wetlands; nests in emergent marsh vegetation; and feeds in shallow water on seeds, fruits, and aquatic invertebrates (Cornell 2014-TN3837). The heron species are described in Section 2.4.1.3. The bottom of the upstream end of Cowanesque Lake was not cleared prior to reformulation and inundation in 1990, and therefore provides ample cover to support nearshore fish that may serve as a prey base for piscivorous birds such as bald eagles, ospreys, and great blue herons (see Table 2-17 in Section 2.4.1.3).

A total of 12 salamander, 11 snake, 7 frog, 5 turtle, 1 newt, 1 toad, and 1 lizard species potentially occur in the Cowanesque Lake vicinity (USACE 2002-TN3966). Salamander/newt species that have an affinity for lake/pond shoreline/wetland habitats include those that are mostly aquatic (e.g., eastern red-spotted newt) to those that are semi-aquatic (e.g., spotted salamander [*Ambystoma maculatum*] and four-toed salamander [*Hemidactylium scutatum*]). Red-spotted newt adults lay eggs on underwater plants in spring; eggs hatch in 1 to 2 months; larvae feed on small aquatic insects and crustaceans, leave the water in late summer and spend up to 4 years on land as efts (overwintering also occurs on land), and return to the water as adults to reproduce (FCPS 2014-TN3838). Adult spotted salamanders overwinter in burrows near water, lay eggs in shallow water in spring (which hatch in 4 to 8 weeks), and larvae metamorphose in 2 to 4 months (SREL 2014-TN3839). Adult four-toed salamanders live under stones and leaf litter in hardwood forests surrounding boggy areas. They breed in spring and attach eggs to vegetation at water's edge; their eggs hatch 6 to 8 weeks later; and their larvae remain aquatic for about 9 weeks before subsequent maturation occurs on land (SREL 2014-TN3839).

Snake species that have an affinity for shoreline/wetland habitats include the northern water snake, eastern garter snake, and northern ribbon snake. The eastern garter snake, northern ribbon snake, and northern water snake occupy habitats near water (i.e., edges of ponds, lakes, ditches, and streams) or are often found in water where they feed on water-dependent species such as worms, slugs, frogs, toads, salamanders, fish, and tadpoles (SREL 2014-TN3839).

Frog/toad species that have an affinity for lake/pond shoreline/wetland habitats include those that are mostly aquatic (e.g., bullfrog) and those that are semi-aquatic (e.g., American toad, northern spring peeper, gray treefrog, green frog, northern leopard frog, and pickerel frog). The northern leopard frog is described in Table 2-17 in Section 2.4.1.3. Bullfrogs breed and lay eggs in permanent water and their larvae mature in 1 to 3 years. Adults and larvae overwinter in underwater mud/debris and adults are often found in water or at the water's edge (SREL 2014-TN3839). American toads live and hibernate (in burrows) on land and lay eggs on underwater vegetation. Eggs hatch in 1 to 2 weeks and larvae metamorphose in 2 months (SREL 2014-TN3839). The northern spring peeper hibernates on land (i.e., under logs or tree bark), reproduces in spring, and lays eggs on underwater vegetation. Eggs hatch in several days and larvae metamorphose in about 8 weeks (Minnesota DNR 2014-TN3840; SREL 2014-TN3839). The gray treefrog is arboreal outside the breeding season; however, breeding and egg-laying take place in wetlands. Tadpoles transform by mid-to late summer (Michigan DNR 2014-TN3841; SREL 2014-TN3839). The green frog lays eggs in floating masses May through July. Larvae take up to 2 years to transform and adults live in water and shoreline areas. The green frog hibernates in water in bottom sediments (Michigan DNR 2014-TN3841; SREL 2014-TN3839). The northern leopard frog breeds in permanent waters in early spring and its larvae transform by mid-summer. Adults occupy wet meadows, grassy ponds, and lake shores, often far from water and hibernate in water in bottom sediments (EPA Undated-TN3860; Michigan DNR 2014-TN3841). Pickerel frog adults occupy and breed in swampy areas with short vegetation, larval transformation requires about 3 months, and hibernation occurs in water in bottom sediments (Michigan DNR 2014-TN3841; SREL 2014-TN3839).

Turtle species that have an affinity for lake/pond shoreline/wetland habitats include those that are mostly aquatic (snapping turtle [*Chelydra serpentina*], midland painted turtle [*Chrysemys picta marginata*], musk turtle) and those that are semi-aquatic (wood turtle, spotted turtle [*Clemmys guttata*]). The snapping turtle prefers still or slow-moving water with soft bottoms and abundant vegetation. The species consumes mostly aquatic vegetation, but also scavenges dead aquatic animals (Shiels 2007-TN3990). The spotted turtle inhabits shallow bodies of water with a soft bottom and aquatic vegetation, such as small marshes, marshy pastures, bogs, fens, woodland streams, swamps, small ponds, vernal pools, and lake margins. The species consumes various aquatic and terrestrial invertebrates and also eats plant material and carrion (NatureServe 2014-TN3855). The painted turtle occupies shallow water where aquatic vegetation is profuse and the bottom is soft and muddy as in ponds, marshes, ditches, edges of lakes, and backwaters of streams. The species consumes insects, crayfish, mollusks, and aquatic vegetation (VDGIF 2014-TN3989). The musk turtle and wood turtle and described above. The wood turtle is also described in Section 2.4.1.3.

2.4.1.3 Important Species and Habitats

The NRC has defined important species as those that are rare or meet other specific critera for deserving individualized evaluation (NRC 2000-TN614). The NRC has defined rare species as including Federally threatened or endangered species and those that are proposed or candidates for listing as Federally threatened or endangered (NRC 2000-TN614). The U.S. Fish and Wildlife Service (FWS) identifies Federally threatened or endangered species in 50 CFR 17.11 and 50 CFR 17.12 (TN1648). Rare species include those listed as threatened, endangered, or other Species of Concern by State agencies (NRC 2000-TN614). Thus, in Pennsylvania, rare (or important) species include those listed as threatened, endangered, rare, or vulnerable, or species that are candidates for listing as threatened or endangered by the

PDCNR, PFBC, and/or PGC. In Pennsylvania, rare (or important) species also include those that have a State rank indicating rarity and conservation concern, i.e., critically imperiled (S1; having 5 or fewer occurrences in the State), imperiled (S2; having 6 to 20 occurrences in the State), or vulnerable (S3; rare, having 21 to 100 occurrences in the State). The NRC has also defined important species as those that are commercially or recreationally valuable; essential to the maintenance and survival of other species that are rare (as defined above) or commercially or recreationally valuable; critical to the structure and function of the ecosystem; or biological indicators of environmental change (NRC 2000-TN614).

BBNPP Site

In a letter dated June 12, 2012, the NRC requested that the FWS Field Office in State College, Pennsylvania, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the BBNPP site (NRC 2012-TN3842). On March 14, 2013, the FWS provided a response letter indicating that the Indiana bat was the only Federally listed, proposed, or candidate species known to occur in or near the BBNPP project area (FWS 2013-TN3847). The Indiana bat was surveyed on the BBNPP site during the summers of 2008 and 2013 and was not captured (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828). Because the BBNPP site is less than 10 mi from three winter hibernacula and contains suitable Indiana bat (roosting) habitat, it is assumed to be used by the species during the fall swarming period (FWS 2009-TN3868) (see Section 2.4.1.3). Since the response letter of March 14, 2013 (FWS 2013-TN3847), the FWS proposed listing the northern long-eared bat as endangered (78 FR 61046-TN3207). The northern long-eared bat is known to occur on the BBNPP site (Normandeau 2011-TN490; Normandeau 2014-TN3828). The life-history attributes, habitat affinities, and occurrences of these species relevant to the review of PPL's application are summarized in this section and covered in greater detail in NRC's draft biological assessment published separately from this draft EIS.

Important Terrestrial Species

Federally and State-listed and State-ranked mammal, bird, amphibian and reptile, and plant species identified in correspondence from the FWS (2013-TN3847), Pennsylvania Natural Heritage Program (PNHP) (2013-TN3900), PGC (2012-TN3864), and PFBC were recently searched for during general surveys of mammals, birds, amphibians, reptiles, and plants commissioned by PPL for the BBNPP site (Normandeau 2011-TN489; Normandeau 2014-TN3828). Unlike the above taxonomic groups, recent butterfly surveys (Normandeau 2011-TN490) targeted only important species identified by the PNHP (PNHP 2013-TN3900). The specific locations of survey routes, transects, sampling points, etc., for each taxonomic group are provided in the individual study reports (Normandeau 2011-TN489; Normandeau 2011-TN490; Normandeau 2014-TN3828). A summary of the level of effort, temporal and spatial coverage, and results of each recent survey with regard to general biota in each taxonomic group is provided in Section 2.4.1.1. Surveys were conducted previously for birds, mammals, amphibians, and reptiles on the adjacent SSES site from 1972 to 1974 (PPL 1978-TN4036). In addition, avian and plant surveys were conducted on and in the vicinity of SSES from 1977 through 1994 (Ecology III 1995-TN1782). Second Breeding Bird Atlas surveys were conducted from 2004 through 2009 in two 9.6-mi^2 blocks (Wilson et al. 2012-TN3833) that encompass the BBNPP project area. Finally, a compilation of bird species documented in IBA No. 72 between 1900 and 2014 (Audubon and Cornell 2014-TN3582) was also considered.

Federally listed species, State-listed species, and State-ranked species and communities with occurrences within 21 mi of the center of the BBNPP site (PNHP 2013-TN3900) are listed in Table 2-16. Federally listed species, State-listed species, and State-ranked species and communities observed or likely to occur on and in the vicinity of the BBNPP site during the above-referenced surveys are indicated in Table 2-16. Mammals, birds, amphibians, reptiles, and plants are both State-listed and State-ranked, while insects are State-ranked but not State-listed (PNHP 2014-TN3885). Thus, both State-listing status and State rank are provided for mammals, amphibians, reptiles, plants in Table 2-16 and only State ranks are provided for insects. State-listing status and State rank are provided separately for birds in Table 2-17 because of the large number of rare species that use IBA No. 72.

Federally Listed Species

No current Federally listed species have been detected in surveys of the BBNPP site. However, the northern long-eared bat, currently proposed for Federal listing as endangered, was detected in surveys of the BBNPP site (Normandeau 2011-TN490; Normandeau 2014-TN3828). In addition, the Indiana bat, listed as a Federally endangered species, although not detected in surveys, the FWS (2009-TN3868) assumes it occurs in suitable habitat on the BBNPP site during the fall swarming period because it occurs within 10 mi of a hibernaculum (see below), and is thus treated as occurring onsite. Correspondence with FWS regarding these species is detailed in NRC's draft biological assessment published separately from this draft EIS. Information about the occurrence of these species in the project area, as well as life-history attributes of these species that are pertinent to the review of PPL's application, are summarized below.

Indiana Bat (*Myotis sodalis*) – Federally Endangered (FE). The Indiana bat is a small insectivorous bat that is a true hibernator; it enters hibernation in the fall and survives on stored fat until spring. Mating occurs in late August and September during fall swarming, when the bats move in and out of winter hibernacula at night and roost individually in surrounding forests during daytime. Hibernation occurs communally in abandoned mines and caves. Reproductive females migrate from hibernacula to summer roosting habitat where they establish maternity colonies. Maternity roosts are found in dead or nearly dead trees or dead parts of living trees. Males and nonreproductive females are most commonly found in the vicinity of their hibernaculum but may also disperse throughout the summer range and roost individually or in small groups in trees. In summer and fall, Indiana bats primarily use wooded or semi-wooded habitats, usually near water. Foraging often occurs in riparian areas, ponds, and wetlands, but also takes place in upland forests and fields. Flying insects are the Indiana bat's typical prey. Significant threats to the Indiana bat include human-induced disturbance and alterations at hibernation sites, loss of summer roosting habitat, contaminants, and white-nose syndrome (described below) (Normandeau 2012-TN1784).

The historic range of the Indiana bat includes much of the eastern United States. The species has disappeared from, or greatly declined in, most of its former range in the northeastern United States (Normandeau 2012-TN1784). Rangewide, the total population of hibernating Indiana bats was estimated to be about 534,239 in 2013 (FWS 2013-TN3848). About 42 percent of the total hibernating population occurs in Indiana, with 0.02 percent (about 120 hibernating bats) estimated to occur in Pennsylvania (FWS 2013-TN3848). The population of hibernating Indiana bats in Pennsylvania has dropped by about 77 percent since 2011 (FWS 2013-TN3848).

Table 2-16. Federally and State-Listed and State-Ranked Terrestrial Species (Except Birds [see Table 2-17]) and Communities Occurring within the Geographic Area of Interest (21-mi radius) around the BBNPP Site (PNHP 2013-TN3900) and Their Known or Likely Presence in the Project Area Based on Field Surveys

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
Plants							
Amelanchier bartramiana	oblong-fruited serviceberry		PE	S1	Yes	No	Swamps, sphagnum bogs, and peaty thickets[(b)]
Amelanchier humilis	serviceberry			S1	Yes	No	Dry, open, high ground and bluffs[(b)]
Amelanchier obovalis	coastal juneberry			S1	Yes	No	Peaty barrens, thickets, and roadsides[(b)]
Aplectrum hyemale	puttyroot		PR	S3	Yes	No	Moist woodlands, forested slopes, and stream banks[(c)]
Arabis missouriensis	Missouri rock-cress		PE	S1	Yes	No	Dry slopes[(b)]
Bartonia paniculata	screw-stem			S3	Yes	No	Hummocks in wet woods, wooded bogs, and sphagnous pond margins[(b)]
Bidens discoidea	small beggarticks			S3	Yes	No	Bogs, vernal ponds, and swampy ground[(b)]
Carex bicknellii	Bicknell's sedge		PE	S1	Yes	No	Dry woods, thickets, fields, and serpentine barrens[(b)]
Carex disperma	soft-leaved sedge		PR	S3	Yes	No	Swamps, wet thickets, wetlands, and bogs[(c)]
Carex lasiocarpa	slender sedge		PR	S3	Yes	No	Bogs, wetlands, and marshes[(c)]
Carex limosa	mud sedge			S2	Yes	No	Bogs, floating sphagnum moss mats at bog pools[(c)]
Carex longii	Long's sedge			S2S3	Yes	No	Swamps, open thickets, moist meadows, old gravel pits, and swales[(b)]
Carex polymorpha	variable sedge		PE	S2	Yes	No	Openings along woods and road margins[(c)]
Cyperus diandrus	umbrella flatsedge		PE	S2	Yes	No	Shorelines of ponds, lakes, and streams and in bogs and marshes[(c)]
Dodecatheon radicatum	jeweled shooting-star		PT	S2	No	No	Moist, shaded areas of limestone outcrops and river bluffs[(c)]
Dryopteris clintoniana	Clinton's wood fern			S2	Yes	No	Swampy woodlands[(c)]

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
Plants							
Elymus trachycaulus	slender wheatgrass			S3	Yes	No	Sunny, well-drained habitats such as woods borders, rocky banks, grasslands, barrens, thickets, and utility rights-of-way[(c)]
Eurybia radula	rough-leaved aster			S2	Yes	No	Wet woods, swamps, seeps, bogs, and along streams[(c)]
Gaultheria hispidula	creeping snowberry		PR	S3	Yes	No	Bogs, peaty wetlands, and swamps[(c)]
Helianthemum bicknellii	Bicknell's hoary rockrose		PE	S2	Yes	No	Open rocky places, riverbed scours, exposed banks, slopes, woods, rock outcrops, and serpentine barrens[(c)]
Juncus filiformis	thread rush		PR	S3	Yes	No	Bogs and sandy shores[(b)]
Juncus militaris	bayonet rush		PE	S1	Yes	No	Shorelines of shallow lakes, ponds, rivers[(q)]
Ledum groenlandicum	common Labrador-tea		PR	S3	Yes	No	Bogs and peaty wetlands[(c)]
Lonicera hirsuta	hairy honeysuckle			S1	Yes	No	Moist woods, swamps, and rocky thickets[(b)]
Lupinus perennis	lupine		PR	S3	Yes	No	Woods borders, open woods, and clearings[(c)]
Muhlenbergia uniflora	fall dropseed muhly		PE	S2	Yes	No	Bogs and peaty wetlands[(c)]
Piptatherum pungens	slender mountain-ricegrass		S2	PE	No	No	Sunny, well-drained, sandy habitats, rocky open woods, bedrock outcrops, heath barrens, balds, and mountain summits[(c)]
Platanthera blephariglottis	white-fringed orchid			S2S3	Yes	No	Bogs, peaty wetlands, swamps, and floating sphagnum moss mats at bog pools[(c)]
Platanthera ciliaris	yellow-fringed-orchid			S2	Yes	No	Bogs, moist meadows, and woods[(b)]
Polemonium vanbruntiae	Jacob's-ladder		PE	S1	Yes	No	Wet soil in woods, thickets, and openings[(c)]
Polystichum braunii	Braun's holly fern		PE	S1	Yes	No	Cool, rocky slopes and shaded ravines[(b)]
Potentilla tridentata	three-toothed		PE	S1	No	No	Rock outcrops at high elevations[(c)]

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
	cinquefoil						
Prunus pumila var. susquehanae	Susquehanna sand cherry			S2	No	No	Dry, exposed rock outcrops and mountain tops[b]
Ribes lacustre	swamp currant			S1	Yes	No	Damp soil on rocky slopes and talus, moist to seepy rock outcrops and cliffs, cool woods, and swamps[c]
Rosa virgiana	Virginia rose			S1	Yes	No	Pastures, fields, open woods, thickets, and roadsides[b]
Schoenoplectus subterminalis	water bulrush			S3	Yes	No	Lakes, ponds, and slow-moving streams[c]
Schoenoplectus torreyi	Torrey's bulrush		PE	S1	Yes	No	Shallow water along shorelines of lakes and ponds[b]
Scirpus ancistrochaetus	northeastern bulrush	FE	PE	S3	Yes	No	Edges of seasonal pools, wet depressions, beaver ponds, wetlands, and small ponds[b]
Stellaria borealis	mountain starwort			S1S2	Yes	No	Seeps and spring-fed streamlets in wooded areas[c]
Streptopus amplexifolius	white twisted-stalk		PT	S1	No	No	Cool shaded areas on seepy cliffs and rock outcrops[c]
Utricularia cornuta	horned bladderwort		PT	S2	Yes	No	Shallow water or wet peaty substrate in ponds, bogs, seepages, and along shorelines[c]
Utricularia intermedia	flat-leaved bladderwort		PT	S2	Yes	No	Bogs, wetlands, floating bog mat islands, and shorelines[c]
Viola selkirkii	great-spurred violet			S3S4	Yes	No	Cool, moist woods, humus/moss rock outcrops and boulders[c]
Vittaria appalachiana	Appalachian gametophyte fern		PT	S2	No	No	Cool, damp, shaded rock outcrops and cliffs in forested areas[c]
Insects							
Amblyscirtes vialis	common roadside skipper			S2	Yes	No	Riparian forest[d]
Boloria selene myrina	silver-bordered fritillary			S3	Yes	Yes[e]	Open, marshy or boggy areas with violets[d]

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
Carterocephalus palaemon mandan	Arctic skipper			S2	Yes	No	Glades, roadsides, swampy places, streamside grassy openings in forests, sometimes bogs or fens[d]
Chlosyne harrisii	Harris' checkerspot			S3	Yes	No	Bog/fen, wetlands, riparian, grassland/old-field, and rights-of-way[d]
Erynnis persius persius	Persius duskywing			S1	Yes	No	Bog/fen, scrub/shrub wetland, riparian, and forest[d]
Euphyes conspicua	black dash				Yes	Yes[e]	Open, shrubby or partially wooded (e.g., red maple) bogs/fens, wetlands, and riparian areas[d]
Euphydryas phaeton	Baltimore checkerspot			S3	Yes	Yes[f]	Bogs/fens, wetlands; riparian, grassland/old-field, and woodland areas[d]
Glena cognataria	blueberry gray			S1	No	No	Heathlands, bogs, and pine barrens[e]
Hemileuca maia	barrens buckmoth			S1S2	No	No	Scrub oak-pine sand barrens and oak woods[g]
Hesperia leonardus	Leonard's skipper			S3	Yes	No	Grasslands/old-fields, shrubland, and woodland[d]
Itame sp. 1 nr. inextricata	barrens Itame (Cf I. Inextricata)			S1	No	No	Xeric pine-oak scrub[d]
Lethe eurydice	eyed brown			S3	Yes	No	Open sedge meadows and open wetlands[d]
Lycaena epixanthe	bog copper			S2	No	No	Acid bogs and wetlands containing cranberries[c]
Poanes massasoit	mulberry wing			S2	Yes	Yes[f]	Bogs/fens, wetlands, and riparian areas[d]
Speyeria atlantis	Atlantis fritillary			S3	Yes	No	Bogs/fens, forested wetlands, riparian, grassland, and woodland areas[d]
Sphinx gordius	apple sphinx			S3	Yes	No	Bogs and deciduous forest[g]
Reptiles and Amphibians							
Acres crepitans	northern cricket frog		PE	S1	Yes	Yes[e]	Slow-moving creeks, pools, herbaceous and scrub/shrub wetlands, and bogs/fens in open country[h]

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
Clemmys guttata	spotted turtle			S3	Yes	Yes[(i)]	Slow-moving creeks, pools, wetlands, bogs/fens[(d)]
Glyptemys insculpta	Wood turtle			S3S4	Yes	Yes[(e,i)]	Low-gradient creeks, moderate-gradient medium-sized rivers, forested wetlands, and herbaceous wetlands[(d)]
Heterodon platirhinos	eastern hognose snake			S3	Yes	No	Riparian, cropland/hedgerow, grassland/old-field, and woodland areas[(d)]
Lithobates pipiens	northern leopard frog			S2S3	Yes	Yes[(i)]	Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes[(d)]
Terrapene carolina carolina	eastern box turtle			S3S4	Yes	Yes[(e,i)]	Wide variety of habitats from wooded swamps to dry, grassy fields[(j)]
Thamnophis sauritus	eastern ribbon snake			S3	Yes	Yes[(e)]	Slow-moving creeks, pools, wetlands, riparian, and bare rock/scree[(d)]
Mammals							
Felis rufus	bobcat			S3S4	Yes	Yes[(e)]	Large forest tracts with thick undergrowth[(d)]
Glaucomys sabrinus	northern flying squirrel		PE	SU	No	No	Old-growth forests with moist soil[(k)]
Lontra canadensis	river otter			S3	Yes	Yes[(f)]	Lowland marshes and swamps interconnected with meandering streams and small lakes[(l)]
Microtus chrotorrhinus	rock vole			S2	Yes	No	Forested wetlands, coniferous/mixed forests, and woodlands[(d)]
Myotis lucifugus	little bown myotis			S1	Yes	Yes[(e)]	Hibernation in caves, tunnels, mines. Maternity sites in man-made structures, caves, and hollow trees[(d)]
Myotis leibii	eastern small-footed myotis		PT	S1B, S1N	Yes	No	Hibernation in caves and mines. Maternity sites in forests[(d,k)]
Myotis septentrionalis	northern myotis	PE		S1	Yes	Yes[(e,m)]	Hibernation in caves and mines Maternity sites in riparian areas, conifer/mixed late successional forests[(c,d)]
Myotis sodalis	Indiana bat	LE	PE	SUB,	Yes	Yes[(n)]	Hibernation in caves and mines.

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
				S1N			Maternity sites in trees in upland and wetland forest, and buildings[(d,k)]
Neotoma magister	Allegheny woodrat		PT	S3	No	No	Bare rock/talus/scree surrounded by unfragmented hardwood or mixed forest[(d,k)]
Perimyotis subflavus	tri-colored bat			S1	Yes	Yes[(m)]	Hibernation in caves, mines. Maternity sites in tree foliage in riparian, and upland woodland/grassland areas[(d)]
Sorex palustris albibarbis	water shrew			S3	Yes	No	Stream and lake edges and boulders[(c)]
Communities							
	calcareous opening/cliff			S2	No	No	Calcareous cliffs, outcrops, rocky slopes with variable vegetation composition[(c)]
hemlock (*Tsuga canadensis*)	hemlock palustrine forest			S3	No	No	Wetland forests dominated or co-dominated by eastern hemlock[(c)]
	herbaceous vernal pool			S3S4	Yes	Yes[(o)]	Seasonally fluctuating water levels, variable herbaceous composition[(c)]
hemlock (*Tsuga canadensis*)	hemlock - mixed hardwood palustrine forest			S3S4	No	No	Wetland forests dominated by a mixture of conifer and hardwood species[(c)]
oak (*Quercus* spp.)	dry oak - heath woodland			S3	No	No	Dry sites dominated by various oak species[(c)]
leatherleaf (*Chamaedaphne calyculata*) – bog rosemary (*Andromeda polifolia*)	leatherleaf – bog rosemary peatland			S2S3	No	No	Bogs dominated by leatherleaf with bog rosemary associated[(c)]
leatherleaf (*Chamaedaphne calyculata*) cranberry (*Vaccinium oxycoccos and/or macrocarpon*)	leatherleaf – cranberry peatland			S2S3	No	No	Bogs dominated by leatherleaf, cranberry, and sphagnum moss[(c)]
little bluestem (*Schizachyrium scoparium*) −	little bluestem - Pennsylvania sedge opening			S3S4	No	No	Dry acidic sites without invasion of woody plant species[(c)]

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat
Pennsylvania sedge (*Carex pensylvanica*)							
	low heath shrubland			S1	No	No	Sites dominated by huckleberry(*Vaccinium* spp)[(c)]
pitch pine (*Pinus rigida*) rhodora (*Rhododendron canadense*) – scrub oak (*Quercus ilicifolia*)	pitch pine – rhodora - scrub oak woodland			S1	No	No	Part of the "Mesic till barrens complex" with pitch pine dominant in the overstory and rhododendron and scrub oak dominant in the understory[(c)]
pitch pine (*Pinus rigida*) – scrub oak (*Quercus ilicifolia*)	pitch pine – scrub oak woodland			S2S3	No	No	Sites with acidic, dry soils and drought-stressed trees of small stature where pitch pine is dominant and scrub oak is dominant in the understory[(c)]
red maple (*Acer rubrum*) – black gum (*Nyssa sylvatica*)	red maple – black gum palustrine forest			S3S4	Yes	Yes[(p)]	Wetland forest dominated by red maple or black gum[(c)]
red spruce (*Picea rubens*)	red spruce – mixed hardwood palustrine forest			S3	No	No	Wetland forests dominated by a mixture of conifer and hardwood species[(c)]
red spruce (*Picea rubens*)	red spruce palustrine forest			S3	No	No	Wetland forests dominated or co-dominated by red spruce[(c)]
scrub oak (*Quercus ilicifolia*)	scrub oak shrubland			S3	No	No	Sites without a tree layer dominated by scrub oak[(c)]
	Talus cave community			S2S4	No	No	None provided[(c)]
Virginia pine (*Pinus virginianus*)	Virginia pine – mixed hardwood shale woodland			S2	No	No	Dry shale slopes with southerly exposure dominated by Virginia pine and various hardwood tree species[(c)]

(a) Federal status: E = Federally endangered. State status: PE = Pennsylvania endangered, PT = Pennsylvania threatened, PR = Pennsylvania rare; NatureServe rank S1 = critically imperiled (five or fewer populations, especially vulnerable to extirpation), S2 = imperiled (20 or fewer populations, very vulnerable to extirpation), S3 = vulnerable (80 or fewer occurrences, vulnerable to extirpation), S4 = apparently secure (uncommon but not rare, some cause for long-term concern) (PNHP 2014-TN3975).
(b) Morris Arboretum 2014-TN3858.
(c) PNHP 2014-TN3885.
(d) NatureServe 2014-TN3855.
(e) Normandeau 2011-TN490.
(f) PNHP 2006-TN1570.

Table 2-16. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	Potentially Suitable Habitat Onsite	Observed or Likely to Occur Onsite	Habitat

(g) Lotts and Naberhaus 2014-TN3857.
(h) NYNHP 2012-TN3909.
(i) PPL 1978-TN4036.
(j) Davidson College 2014-TN3863.
(k) PGC 2013-TN3845.
(l) Hardisky 2013-TN3386.
(m) Normandeau 2014-TN3828.
(n) FWS 2009-TN3868.
(o) PPL Bell Bend 2013-TN3377.
(p) Normandeau 2011-TN490.
(q) PNHP 2013-TN1777.

Table 2-17. State-Listed and State-Ranked Avian Species Occurring within the Geographic Area of Interest (21-mi Radius) around the BBNPP Site (PNHP 2013-TN3900) and Their Known or Likely Presence in the Project Area Based on Field Surveys

Scientific Name	Common Name	State-Listing Status[a]	State Rank[a]	Habitat	Observed Onsite	Likely to Nest Onsite
Accipter gentilis	northern goshawk		S2S3B, S3N	Breeding – mature hardwood-hemlock forest[b]; nonbreeding – heavily forested and open habitats[m]	Yes[c]	No[d,e]
Anas crecca	green-winged teal		S1S2B, S3N	Freshwater ponds, marshes, shallow edges of lakes; nests in dense emergent vegetation[n,m]	Yes[c,f]	No[d,e,f]
Ardea alba	great egret	PE	S1B	Shallow rivers, streams, ponds, lakes, marshes; nests colonially in adjacent trees or shrubby growth[n,o]	Yes[c]	No[c,d,e]
Ardea herodias	great blue heron		S3S4B, S4N	Forest wetland, herbaceous wetland, riparian, temporary pool; nests colonially in adjacent trees[n,m]	Yes[f,h,i]	Yes[d,h]
Asio flammeus	short-eared owl	PE	S1B, S3N	Reclaimed strip mines, open, uncut grassy fields, large meadows, airports, and marshland[o]	Yes[c]	No[c,d,e,g]
Asio otus	long-eared owl	PT	S2B, S2S3N	Deciduous and evergreen forests, orchards, farm woodlots, and riparian woods[m,o]	Yes[c]	No[d,e,g]
Bartramia longicauda	upland sandpiper	PE	S1B	Large fallow fields, pastures, and grassy areas[o]	Yes[c]	No[d,e]
Botaurus lentiginosus	American bittern	PE	S1B	Large freshwater wetland[o] and herbaceous wetland[m]	Yes[c,h]	No[d,e]
Caprimulgus vociferus	whip-poor-will		S3B	Forest, open woodland[n,m]	Yes[c,j]	No[d,e,f]
Catharus ustulatus	Swainson's thrush		S2S3B, S5N	Mixed hardwood or conifer forests[b]	Yes[c,h]	Yes[d,e]
Chlidonias niger	black tern	PE	S1B	Marsh with emergent vegetation and open water[o]	Yes[c]	No[c,d,e,g]
Chordeiles minor	common nighthawk		S3B	Open and semi-open areas[n,m]	Yes[c,h,s]	No[d,e,f]
Circus cyaneus	northern harrier	PT	S2B, S4N	Open wetlands, dry uplands[b], and cultivated/old-fields[m]	Yes[c,f]	No[d,e,f]
Cistothorus palustris	marsh wren		S2S3B	Herbaceous wetland[n,m]	Yes[c]	Yes[d]
Cistothorus platensis	sedge wren	PE	S1B	Damp meadows or marshes with sedges/grasses/small shrubs[o]	Yes[c]	No[d,e,g]
Colinus virginianus	northern bobwhite		S1	Broad array of vegetation types, particularly early successional[n,m]	Yes[c]k	No[d,e]
Empidonax flaviventris	yellow-bellied flycatcher	PE	S1S2B	Shady coniferous forest and forested wetland[o]	Yes[c,f]	No[c,d,e,f]
Falco peregrinus	peregrine falcon	PE	S1B, S1N	Breeding – cliffs overlooking rivers, tall buildings, and bridges[o]; nonbreeding – open habitats of all kinds[m]	Yes[c,f,i]	No, nests within 2 mi[p,f]

Table 2-17. (contd)

Scientific Name	Common Name	State-Listing Status[a]	State Rank[a]	Habitat	Observed Onsite	Likely to Nest Onsite
Fulica americana	American coot		S3B, S3N	Freshwater lakes, ponds, marshes, larger rivers, and adjacent land[n,m]	Yes[c,h]	No[c,d,e,g]
Gallinago delicata	Wilson's snipe		S3B, S3N	Forested wetland, herbaceous wetland, scrub/shrub wetland, riparian, and bog/fen[n,m]	Yes[c,h]	No[d,e,g]
Gallinula galeata	common gallinule		S3B	Freshwater marshes, canals, rivers, lakes, ponds, in areas of emergent vegetation and grassy borders[m]	Yes[i]	No[d,e]
Haliaeetus leucocephalus	bald eagle		S3B	Large and medium rivers, riparian, and forested wetland[q,r,s,o,m]	Yes[c,f,i]	No, nests within 10 mi[f]
Ixobrychus exilis	least bittern	PE	S1B	Marshlands containing cattails and reeds[o]	Yes[c]	No[c,d,e]
Lanius ludovicianus migrans	migrant loggerhead shrike	PE	S1B	Short grass areas with scattered shrubs and fencerows or small utility lines[o]	Yes[c]	No[c,d,e,g]
Melanerpes erythrocephalus	red-headed woodpecker		S3B, S4N	Open woodland with scattered trees, parks, cultivated areas, and gardens[m]	Yes[f]	No[d,e]
Nycticorax nycticorax	black-crowned night-heron	PE	S1B	Low to moderate-gradient streams, forested wetland, herbaceous wetland, and sand/dune[o,m]	Yes[h]	No[d,e]
Pandion haliaetus	osprey	PT	S3B	Lakes, ponds, rivers and marshes bordered by trees[o], forested wetland, riparian, and cliffs[m]	Yes[c,i]	No, nests within 10 mi[f]
Parkesia noveboracensis	northern waterthrush		S3B	Wooded swamps, ponds, slow-moving rivers, and thickets of bogs[m]	Yes[f,h,i]	No[d,e]
Piranga rubra	summer tanager		S3B	Deciduous woods near gaps and edges[m]	Yes[c]	No[d,e,g]
Podilymbus podiceps	pied-billed grebe		S3B, S4N	Wetlands near open water[b]	Yes[h]	No[d,e]
Porzana carolina	sora		S3B	Forested wetland, herbaceous wetland, scrub/shrub wetland, bog/fen, and riparian[n,m]	Yes[h,i]	Yes[d]
Progne subis	purple martin		S3B	Open and partly open habitats, frequently near water, nests in standing snag/hollow tree[m]	Yes[f,h,i]	No[d,e,h]
Protonotaria citrea	prothonotary warbler		S2S3B	Mature deciduous floodplain, river, and swamp forests[m]	Yes[c]	No[d,e]
Rallus limicola	Virginia rail		S3B	Spring/brook, herbaceous wetland, bog/fen, and riparian[m]	Yes[i]	Yes[d,e]
Sterna hirundo	common tern	PE	SXB	Sandy shorelines and barren islands of large lakes[o]	Yes[c,h]	No[c,d,e]
Spiza americana	dickcissel	PE	S2B	Breeding – large grassy fields; nonbreeding – shrubs, thickets, and hedgerows[o]	Yes[c]	No[c,d,e,g]
Riparia riparia	bank swallow		S3S4B	Nests in steep sand, dirt, or gravel banks in open and partly open habitats near flowing water[m]	Yes[f,i]	Yes[e,f]
Tyto alba	barn owl		S2S3B, S2S3N	Open areas with cavities for nesting(natural tree cavities or human-made structures[b]	Yes[i]	Yes[d,e]

Table 2-17. (contd)

Scientific Name	Common Name	State-Listing Status[a]	State Rank[a]	Habitat	Observed Onsite	Likely to Nest Onsite
Vermivora chrysoptera	golden-winged warbler		S2S3B	Deciduous woodland, swampy areas; scrub; overgrown pastures; abandoned farmland; powerline right-of-ways; recently logged sites; bogs; and forest openings[m]	Yes[f,i]	Yes[f]

(a) State status: PE = Pennsylvania endangered, PT = Pennsylvania threatened. NatureServe rank: S1 = critically imperiled (five or fewer populations, especially vulnerable to extirpation), S2 = imperiled (20 or fewer populations, very vulnerable to extirpation), S3 = vulnerable (80 or fewer populations, vulnerable to extirpation), S4 = apparently secure (uncommon but not rare, some cause for long-term concern), B = breeding, N = nonbreeding, X = presumed extinct (PNHP 2014-TN3975).
(b) PNHP 2014-TN3885.
(c) Ecology III 1995-TN1782.
(d) Audubon and Cornell 2014-TN3582.
(e) Wilson et al. 2012-TN3833.
(f) Normandeau 2011-TN490.
(g) Kaufman 2000-TN3832.
(h) PPL 1978-TN4036.
(i) PNHP 2014-TN3885.
(j) Previously a rare nesting species in the project area.
(k) Previously an uncommon resident in the project area.
(m) NatureServe 2014-TN3855.
(n) Cornell 2014-TN3837.
(o) PGC 2013-TN3845.
(p) Brauning 2007-TN3861.
(q) 64 FR 36454-TN1848.
(r) 72 FR 37346-TN918.
(s) Formerly a common nesting species in the project area.

Nine summer maternity sites have been found in seven Pennsylvania counties and summer habitats have been recorded in four counties; however, no maternity sites or summer habitats have been found or recorded in Luzerne County. Winter hibernacula have been documented at 19 locations in 10 Pennsylvania counties, including Luzerne County. Luzerne County has three known bat hibernacula, all within a 10-mi radius of the BBNPP project area, the Glen Lyon Anthracite Mine, Dogtown Mines, and the Penn Wind Hazleton 09 site. All three of these hibernacula occur in abandoned anthracite mines and no interior bat counts have been possible because of safety concerns. Instead, the total population of all bat species combined is estimated based on fall swarming activity near the mine entrances. The total hibernating population for all bat species at the Glen Lyon hibernaculum is estimated to be 50,000 to 100,000 individuals, and the Indiana bat component could range from dozens to more than 100 individuals. Unpublished information indicates that bat abundance at Glen Lyon mines has decreased substantially since the introduction of white-nose syndrome. No population estimates are available for either the Dogtown Mines hibernaculum or the Penn Wind Hazleton 09 hibernaculum. Indiana bat hibernacula are assigned priority numbers ranging from Priority 1 (highest) to Priority 4 (lowest) based on the number of Indiana bats present. All three hibernacula in the vicinity of the BBNPP site are designated as Priority 4 sites, which have current or observed historic populations of fewer than 50 bats (Normandeau 2012-TN1784).

The Indiana bat was not captured during summer mist-netting surveys conducted on the BBNPP site from June through July 2008 and in July 2013 (see Section 2.4.1.1) (Normandeau 2011-TN490; Normandeau 2014-TN3828). Potential roost trees were identified and quantified in forested areas of the BBNPP site proposed for clearing via surveys conducted from September 28 through October 20, 2010, and on July 13 and 14, 2011 (Normandeau 2010-TN3856; Normandeau 2011-TN493). The species is assumed to use suitable habitat for fall foraging, roosting, and swarming if such habitat occurs within a 10-mi radius of a winter hibernaculum occupied by the species (FWS 2009-TN3868). Because the BBNPP site occurs less than 10 mi from three hibernacula and contains suitable Indiana bat habitat (potential roost trees), it is assumed to be used by the species during the fall swarming period. A more detailed treatise of the above information about the Indiana bat is provided in the NRC's draft biological assessment, which is located in Appendix F.

Northern Long-Eared Bat (*Myotis septentrionalis*) – Proposed Federally Endangered (PE). The northern long-eared bat is a small insectivorous bat that is a true hibernator. The northern long-eared bat ranges over 39 states in the eastern and north-central United States, and has been considered to be more prevalent in the eastern portion of its range. The species predominantly overwinters in hibernacula that include caves and abandoned mines, but has also been found overwintering in other types of man-made habitat that resemble cave or mine hibernacula (e.g., railroad tunnels, sewers, aqueducts, and wells). The species arrives at hibernacula in August or September, enters hibernation in October and November, and leaves the hibernacula in March or April. A total of 112 of the 780 known hibernacula in the United States are found in Pennsylvania. Migration distances between hibernacula and summer roosts are typically 35 to 55 mi (78 FR 61046-TN3207).

Breeding occurs when males swarm hibernacula from late July in northern regions to early October in southern regions. Fertilization of a single egg occurs in the spring following hibernation (78 FR 61046-TN3207). During the summer, the species roosts singly or in colonies underneath tree bark or in cavities or crevices of both live and dead trees (Johnson et al. 2011-TN1852; 78 FR 61046-TN3207), but may also roost in colonies in man-made structures (e.g., inside buildings, under eaves, or behind shutters). Males and nonreproductive females may also roost in caves and mines during summer. Summer roost selection is similar to that of the Indiana bat. Adult females give birth to a single pup in May to early June. Volancy occurs in 21 days (78 FR 61046-TN3207).

Most hunting takes place on forested hillsides and ridges above the understory but under the canopy. Therefore, mature forests are an important foraging habitat for the species (78 FR 61046-TN3207; PGC and PFBC 2005-TN3815). The species consumes a variety of night-flying insects (e.g., moths, beetles, and flies) (78 FR 61046-TN3207; NatureServe 2014-TN3855).

The northern myotis is known to occupy hibernacula in Luzerne County near the BBNPP site. The species was observed in October 1996 at the Glen Lyon Mine in Newport Township and September 1994 at Dogtown Mine in Salem Township (PNHP 2006-TN1570). Four adult males were captured during the June and July 2008 mist-netting surveys conducted for the Indiana bat on the BBNPP site, three surrounding Wetland 11 (3.63 ac), and one where Wetland 12.1 (13.97 ac) (north end) and Wetland 12.2 (10.31 ac) (south end) meet along the eastern tributary to Walker Run (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2011-TN490). The capture of adult males indicates the likely presence of male night roosts onsite (Normandeau 2011-TN490), potentially in the vicinity of their capture. No females have been captured on the BBNPP site (Normandeau 2014-TN3828).

A more detailed treatise of the above information about the northern long-eared bat provided in the NRC's draft biological assessment, which is located in Appendix F.

State-Listed and State-Ranked Species

The State-listed and State-ranked species detected during surveys of the BBNPP project area or that could occur in the project area based on PNHP (PNHP 2013-TN3900), PGC (2012-TN3864), and PFBC correspondence are described below.

The NRC consulted a number of historical and recent avian field studies conducted in the project area to characterize use of the BBNPP site and especially the IBA No. 72 by State-listed and State-ranked bird species. Most notable among these studies are the list of species documented from 1972 to 1974 on the SSES site (PPL 1978-TN4036); summary of species documented in the 8 km (5 mi) area around SSES from 1977 through 1994 by Ecology III (1995-TN1782); Second Breeding Bird Atlas data from avian studies conducted from 2004 through 2009 in two 9.6 mi^2 blocks (52D12 and 52D14) (Wilson et al. 2012-TN3833) that include the BBNPP project area; species documented in IBA No. 72 between 1900 and 2014 (Audubon and Cornell 2014-TN3582); and species documented from the potentially affected area of the BBNPP site from 2007 through 2008 and in 2010 by Normandeau (2011-TN490).

All the State-listed avian species in Table 2-17, except for the bald eagle, osprey, and peregrine falcon, and most of the State-ranked species listed in Table 2-17, use the project area and IBA No. 72 only for staging during migration (see Table 2-17 for those observed but not likely to nest onsite). Only eight of the State-ranked species are known to nest or were observed in the project area during the nesting season (Table 2-17). The references cited in Table 2-17 indicate that the presence of the IBA No. 72 figures prominently in these species staging and nesting in the project area (see description of IBA No. 72 below).

Eastern Small-Footed Myotis (*Myotis leibii*) – State Threatened (PT). The eastern small-footed myotis is a small, insectivorous bat that hibernates in caves primarily under large rocks or in crevices and mine shafts in the winter, and roosts in caves (or cracks and crevices in rock walls) and hollow trees (under bark) in the summer. Little is known about the species' reproductive behavior or habitat or food requirements because very few have been captured during summer mist-netting surveys (PGC 2013-TN3845).

The eastern small-footed myotis has been documented in hibernacula within 5 mi of the BBNPP site (Normandeau 2011-TN490). The species was observed in October 2000 at the Dogtown Mine in Salem Township (PNHP 2006-TN1570). There are no known caves or mine shafts on the BBNPP site that could serve as potential hibernacula, and no observations of this species were made during the Indiana bat mist-netting surveys conducted onsite from June through July 2008 (Normandeau 2011-TN490) and in July 2013 (Normandeau 2014-TN3828). However, because of the proximity of hibernacula, the species may use the BBNPP site for foraging and roosting during the fall swarming period. Further, because there have been summer captures of the species in Luzerne County (PGC 2013-TN3845), the species may use forest habitat onsite for summer maternity roosting in the future.

Northern Cricket Frog (*Acris crepitans*) – State Endangered (PE). The northern cricket frog ranges over much of the eastern United States from New York to Florida (NatureServe 2014-TN3855), and is known to occur in Luzerne County (PHNP 2014-TN3974). The species has experienced declines in 17 states (Kenney and Stearns 2013-TN3853), particularly in the Northeast in New York and Pennsylvania (NatureServe 2014-TN3855). The northern cricket frog reproduces in permanent, shallow water in low-gradient creeks, temporary pools, lakes, bogs/fens, herbaceous wetlands, scrub/shrub wetlands (NatureServe 2014-TN3855), and sites surrounded at least partially by forest (Kenney and Stearns 2013-TN3853; WDNR 2013-TN3956). The species moves in upland margins around the periphery of its breeding waterbody, and may move more than 0.6 mi among neighboring waters (Kenney and Stearns 2013-TN3853). Females lay 200 to 400 eggs in clusters usually attached to vegetation 0.5 to 2.0 cm below the water surface, but sometimes at the water bottom or at the water surface (Kenney and Stearns 2013-TN3853). The species is a colonial breeder (NatureServe 2014-TN3855).

In the northern portion of its range, the northern cricket frog may be active until late October, November, or early December, depending on weather and location. In the State of New York, a second annual peak of observations of the species occurs in September and October (the first peak being during the breeding season). In fall, the species tends to be found further from its natal waters, which may represent dispersal, foraging, or searches for wintering areas (Kenney and Stearns 2013-TN3853). The species inhabits the upland margins of breeding habitats (NatureServe 2014-TN3855; Kenney and Stearns 2013-TN3853), cannot tolerate inundation for more than 24 hours, and is not freeze tolerant (WDNR 2013-TN3956). Thus, the species hibernates on land in close to water, about 3 to 10 cm below the soil surface in cracks, depressions, or burrows excavated by other animals (Kenney and Stearns 2013-TN3853). Hibernacula may be communal (Kenney and Stearns 2013-TN3853).

The species was not observed on the BBNPP site during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), but two individuals were recorded in November 2007 (based on nonbreeding calls) at different locations, one around Wetlands 4 and 7 and one around Wetland 10.3, both along Walker Run (Figure 2-26) (LandStudies 2011-TN502), separated by a distance of approximately 0.5 mi (Normandeau 2011-TN490). It is unlikely that occupied locations separated by a gap of less than several kilometers of suitable habitat would represent independent occurrences over the long term (in contrast, 0.6 mi of unsuitable habitat may separate occurrences) (NatureServe 2014-TN3855). Thus, because habitat along the length of Walker Run is likely suitable based on the above description, the individuals observed at Wetlands 4, 7, and 10.3 are likely part of the same occurrence or population, and Walker Run may serve as a dispersal corridor between the wetlands. In addition, the species is likely to be more widely distributed on the BBNPP site (Normandeau 2011-TN490), particularly along Walker Run but also elsewhere onsite.

Bobcat (*Felis rufus*) – State Vulnerable/Apparently Secure (S3/S4). The bobcat is a medium-sized predator that ranges across most of the continental United States and Mexico and southern Canada. The species inhabits a wide variety of habitats across its range (NatureServe 2014-TN3855). In the project area, the species most likely inhabits deciduous forest and brush thickets and hedge rows (Normandeau 2011-TN490). The species home range is generally less than 100 km^2, with home ranges of several square kilometers reported in some states (NatureServe 2014-TN3855). Bobcat tracks were observed during the 2008 surveys of the BBNPP site (Normandeau 2011-TN490).

Northern River Otter (*Lontra canadensis*) – State Vulnerable (S3). The northern river otter ranges over much of North America. Otters were likely found in every major watershed in Pennsylvania during the late 1800s; however, habitat destruction, water pollution, and unregulated harvest caused the extirpation of the species from most of Pennsylvania by the early to mid-1900s. Restoration efforts began in 1982, leading to successful population recovery. Otters inhabit diverse aquatic habitats, including inland area lowland marshes and swamps interconnected with meandering streams and small lakes. Otters are primarily non-selective fish eaters, with crustaceans, reptiles, amphibians, birds, insects, and mammals being of lesser importance. Adequate food (associated with in-water structures that provide cover), temporary dens and resting sites, and riparian vegetation are important habitat components (Hardisky 2013-TN3386). Home ranges are typically within 20 to 30 mi of shoreline (NatureServe 2014-TN3855). Northern rivers otters were reported as occurring in the Susquehanna Riverlands but without specific locations or dates provided (PNHP 2006-TN1570). River otters were not observed onsite during recent field surveys (Normandeau 2011-TN490).

Little Brown Myotis (*Myotis lucifugus*) – State Critically Imperiled (S1). The little brown myotis is an insectivorous bat that inhabits bogs/fens, forested and herbaceous wetlands, riparian areas, and upland forest/shrub/grassland habitats. The species uses human-made structures, caves, and hollow trees for maternity sites. Foraging usually occurs in woodlands near water. Hibernation sites include caves, tunnels, abandoned mines, and similar sites (NatureServe 2014-TN3855).

The species was observed during the 1972 and 1973 surveys for SSES but no location was specified (PPL 1978-TN4036). Five adult females that were either pregnant or lactating and three adult males were captured during the June and July 2008 surveys of the BBNPP site (Normandeau 2011-TN490). Two adult males and one pregnant female were captured at two separate locations surrounding Wetland 11 (3.63 ac). One adult male and three lactating females were captured where Wetland 12.1 (13.97 ac) (north end) and Wetland 12.2 (10.31 ac) (south end) meet along the eastern tributary to Walker Run. One lactating female was also captured at a separate but nearby location toward the northern end of Wetland 12.1 (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2011-TN490). The species was not observed during mist-netting studies conducted onsite in July 2013 (Normandeau 2014-TN3828).

Tri-Colored Bat (*Perimyotis subflavus*) – State Critically Imperiled (S1). The tri-colored bat is an insectivorous bat that inhabits riparian areas and upland woodland/grassland habitats. The species prefers large trees and woodland edges. Summer roosts are mainly in tree foliage and occasionally in buildings. Hibernation sites usually are in caves or mines. Maternity colonies use man-made structures or tree cavities, often in open areas (NatureServe 2014-TN3855).

The species was not observed during mist-netting studies conducted on the BBNPP site in June and July 2008 (Normandeau 2011-TN490). However, two adult pregnant females were captured onsite at Wetland 11 (3.63 ac) during the July 2013 mist-netting studies (Normandeau 2014-TN3828).

Eastern Hognose Snake (*Heterodon platirhinos*) – State Vulnerable (S3). The eastern hognose snake occupies riparian areas and cropland/hedgerow, grassland/herbaceous, old-field, and forest habitat. The species has an affinity for loose soils for burrowing and amphibian prey, particularly toads. The eastern hognose snake hibernates in self-dug dens or in abandoned woodchuck, fox, or skunk burrows (NatureServe 2014-TN3855). The species is expected to occur locally (Normandeau 2011-TN490), but was not observed either during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036) or during recent surveys of the BBNPP site (Normandeau 2011-TN490). Habitat onsite is considered marginally suitable to support the species because of limited sandy soils and a relatively low abundance of toads. Thus, if the species does exist onsite, it is likely uncommon (Normandeau 2011-TN490).

Eastern Ribbon Snake (*Thamnophis sauritis*) – State Vulnerable (S3). The eastern ribbon snake ranges over the eastern seaboard of the United States from Canada to Florida, and is known to occur in Luzerne County (PHNP 2014-TN3974). The species inhabits wet meadows, marshes, seasonally flooded prairies, bogs, ponds, lake shorelines, swamps, and shallow slow streams, also hardwood hammocks and other wet or moist forest. It feeds primarily on amphibians and fishes obtained in or near water (NatureServe 2014-TN3855). The greatest concentration of amphibians on the BBNPP site is found along Walker Run (Normandeau 2011-TN490). Hibernation sites include burrows, ant mounds, underground in uplands, or underwater (NatureServe 2014-TN3855). One adult of the species was observed during recent surveys of the BBNPP site at the north end of Wetland 10.2 along Walker Run north of the confluence of its eastern tributary (Figure 2-26) (Normandeau 2011-TN490).

<u>Eastern Box Turtle (*Terrapene carolina carolina*) – State Vulnerable/Apparently Secure (S3/S4)</u>. The eastern box turtle inhabits a wide variety of habitats from wooded swamps to dry, grassy fields. Ideal habitat consists of moist forested areas with abundant underbrush. Although a terrestrial species, it uses shallow water at the edge of ponds or streams or puddles. Hibernation and nesting occur in upland areas in loose soil (Davidson College 2014-TN3863). The box turtle was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), and during recent surveys of the BBNPP site four adults were found to be widely distributed over the site in or on the margins of open fields (Normandeau 2011-TN490).

<u>Northern Leopard Frog (*Lithobates pipiens*) – State Imperiled/Vulnerable (S2/S3)</u>. Northern leopard frogs live in and around springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes. The species also inhabits wet meadows and fields. Wintering sites are usually underwater (NatureServe 2014-TN3855). The northern leopard frog was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), but not during recent surveys of the BBNPP site (Normandeau 2011-TN490). Because there is ample suitable habitat on the BBNPP site, the species should be considered to potentially occur there.

<u>Spotted Turtle (*Clemmys guttata*) – State Vulnerable (S3)</u>. The spotted turtle is a semi-aquatic species that inhabits shallow water in low-gradient creeks, temporary pools, lakes, bogs/fens, herbaceous wetlands, and scrub/shrub wetlands. Females travel up to several hundred meters to nest in upland soils. Hibernation occurs in the muddy bottom of waterways (NatureServe 2014-TN3855). The spotted turtle was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), but not during recent surveys of the BBNPP site (Normandeau 2011-TN490). Because there is ample suitable habitat on the BBNPP site, the species should be considered to potentially occur there.

<u>Wood Turtle (*Glyptemys insculpta*) – State Vulnerable/Apparently Secure (S3/S4)</u>. The wood turtle is an aquatic species that inhabits low-gradient creeks, moderate-gradient medium-sized rivers, forested wetlands, and herbaceous wetlands during much of the year, but may move widely during summer through riparian and upland areas such as hardwood forest, grassland/herbaceous, and sand dune habitats within about 300 m of water. Nesting occurs in sandy banks or sand-gravel bars along streams, or man-made disturbances as road grades, railroad grades, sand pits, or plowed fields (NatureServe 2014-TN3855). Overwintering occurs in bottoms or banks of streams (NatureServe 2014-TN3855). The wood turtle was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036) and two to four adults were observed during recent surveys of the BBNPP site near Walker Run north of the confluence of its eastern tributary and along Beach Grove Road about 0.5 mi east of the northwest corner of the BBNPP site (Normandeau 2011-TN490). Wood turtles were also observed anecdotally by landowners for a number of years at the northwest corner of the BBNPP site near where Beach Grove Road crosses Walker Run (Normandeau 2011-TN490).

<u>Baltimore Checkerspot (*Euphydryas phaeton*) – State Vulnerable (S3)</u>. The Baltimore checkerspot is a nonmigratory butterfly species that occupies bogs/fens, herbaceous and scrub/shrub wetlands, riparian areas, and moist grassland/herbaceous areas, old-fields, and hardwood forest that contain host (food) plants (NatureServe 2014-TN3855). On the BBNPP site, the checkerspot is most likely to use moist areas such as wet meadows, bogs, and marshes that contain food plants (PDCNR 2013-TN3886). The species was not observed

during surveys conducted in July 2008 in wet meadow and emergent marsh vegetation on the BBNPP site (Normandeau 2011-TN490). However, it was observed previously in June 1999 in the Susquehanna Riverlands Environmental Preserve (SREP) both east and west of the Susquehanna River (PNHP 2006-TN1570; PPL Bell Bend 2014-TN3865) in the BBNPP project area. Considering that the species is known to occur in the vicinity and on the site, and suitable habitat exists onsite, as discussed below, the species could occur there although it was absent during the 2008 surveys.

Larval and adult food plant species known to occur on the BBNPP site are listed by Normandeau (2011-TN490). Some of the larval food plants are common in upland habitats, such as English plantain (*Plantago lanceolata*) in old-field/former agricultural areas and white ash (*Fraxinus americana*) in upland deciduous forest (Normandeau 2011-TN489), while others are more common in wetland habitats, such as arrowwood in scrub/shrub wetlands and forested wetlands (Ecology III 1995-TN1782). Some of the adult food plants are abundant in upland habitats, such as common milkweed (*Asclepias syriaca*) and multiflora rose in old-field/former agricultural areas, while others are more common in wetland habitats, such as swamp milkweed (*Asclepias incarnata*) in emergent wetlands (Normandeau 2011-TN489). Because the checkerspot is most likely to use moist areas, wetlands containing host plants are considered the most important habitats for the species onsite.

Black Dash (*Euphyes conspicua*) – State Vulnerable (S3). The black dash butterfly is a nonmigratory species that occupies relatively open and shrubby or partially wooded (e.g., red maple) bogs/fens, forested wetlands, herbaceous wetlands, riparian areas, and scrub/shrub wetlands that are at least co-dominated by uptight sedge (*Carex stricta*), a larval food plant of the black dash butterfly (NatureServe 2014-TN3855). Larval food plants may also include other sedge species (*Carex* spp.) (Lotts and Naberhaus 2014-TN3857). Adult food plants include buttonbush (*Cephalanthus occidentalis*), jewelweed (*Impatiens capensis*), and swampthistle (*Cirsium muticum*) (Lotts and Naberhaus 2014-TN3857). Uptight sedge and other sedge species are present on the BBNPP site (Ecology III 1995-TN1782; Normandeau 2011-TN489; Normandeau 2011-TN490). Jewelweed is the only adult food plant present on the BBNPP site (Ecology III 1995-TN1782; Normandeau 2011-TN489; Normandeau 2011-TN490). Sedges are most common in emergent wetlands onsite. Jewelweed is found in forested wetlands onsite (Normandeau 2011-TN489). A total of 10 to 12 black dash butterflies were observed in marsh habitat on the BBNPP site during surveys conducted in July 2008 (Normandeau 2011-TN490).

Mulberry Wing (*Poanes massasoit*) – State Imperiled (S2). The mulberry wing is a nonmigratory butterfly species that occupies bogs/fens, herbaceous, scrub/shrub and forested wetlands, and riparian areas dominated by uptight sedge (*Carex stricta*), a caterpillar host plant (NatureServe 2014-TN3855). On the BBNPP site, the mulberry wing is most likely to use marshes or bogs that contain uptight sedge (PDCNR 2013-TN3886). The species was not observed during surveys conducted in July 2008 in wet meadow and emergent marsh vegetation of the BBNPP site (Normandeau 2011-TN490). However, it was observed previously in July 1997 in the SREP both east and west of the Susquehanna River (PNHP 2006-TN1570; PPL Bell Bend 2014-TN3865) in the BBNPP project area. Considering that the species is known to occur in the vicinity and on the site, and suitable habitat exists onsite, as discussed below, the species may occur there although absent in the 2008 surveys.

Larval and adult food plant species known to occur on the BBNPP site are listed by Normandeau (2011-TN490). Larval food plants are restricted to various sedges (*Carex* spp.), including uptight sedge, which are particularly abundant in emergent wetlands and occur in shrub/scrub and forested wetlands onsite. Adult food consists of any flower nectar. Flowering plants occur abundantly in wetland and upland habitats onsite (Ecology III 1995-TN1782). Because the mulberry wing is most likely to use moist areas, wetlands, and particularly emergent wetlands, containing host plants are considered the most important habitats for the species onsite.

Silver Bordered Fritillary (*Boloria selene myrina*) – State Vulnerable (S3). The silver bordered frittilary is a butterfly that inhabits a variety of open, natural and unnatural, marshy or boggy areas with violets (*Viola* spp.) (NatureServe 2014-TN3855), which serve as caterpillar food plants (Lotts and Naberhaus 2014-TN3857). Adults feed on the nectar of composite flowers (Lotts and Naberhaus 2014-TN3857). Violets and composite flowers occur on the BBNPP site (Normandeau 2011-TN489). The species was observed during recent surveys of the BBNPP site in marsh habitat, but numbers of individuals were not recorded (Normandeau 2011-TN490).

Important Terrestrial Habitats

Important habitats include those identified by Federal or State agencies as unique, rare, or of priority for protection, such as sanctuaries, refuges, preserves, and Federally designated critical habitats. Critical habitats are those that are designated to support Federally listed threatened or endangered species (NRC 2000-TN614). Important habitats include ecological associations that have a State rank indicating rarity and conservation concern, such as critically imperiled (S1; having 5 or fewer occurrences in the State), imperiled (S2; having 6 to 20 occurrences in the State), or vulnerable (S3; rare, having 21 to 100 occurrences in the State). Important habitats include lands that have been set aside by nongovernmental conservation organizations. Important habitats also include wetlands and floodplains (NRC 2000-TN614), which are discussed in Section 2.4.1.1.

Federally Designated Critical Habitat

No areas designated by FWS as critical habitat for the Federally endangered Indiana bat exist in the vicinity of the BBNPP site (FWS 2007-TN934). No critical habitat is proposed for the northern long-eared myotis. No critical habitat for any other Federally listed threatened or endangered species is known to occur in the vicinity of the BBNPP site.

State-Ranked Ecological Associations

State-ranked ecological associations with occurrences within 21 mi of the center of the BBNPP site (PNHP 2013-TN3900) are listed in Table 2-16. These are discussed below.

Herbaceous Vernal Pools – State Vulnerable/Apparently Secure (S3S4). Vernal pools may be broadly categorized as ephemeral wetlands that are created and desiccated by seasonally fluctuating water levels (Zedler 2003-TN3821). Thus, vernal pools may dry out completely in summer. Substrate is mineral soil with or without a layer of muck. Plant species composition is variable between sites, as well as annually and seasonally, and may range from being unvegetated (e.g., some small, well shaded pools) to dominantly herbaceous with shrubs and small trees present. Vernal pools, because of their transitional nature, lack mature fish populations and, therefore, can provide critical breeding habitat for amphibians. They are also an important habitat resource for many species of birds, mammals, reptiles, and invertebrates (PNHP 2014-TN3885).

The Wetlands Natural Area (described below) contains vernal pools (PPL Bell Bend 2013-TN3377). The vernal pools are likely fed by fluctuations in the North Branch of the Susquehanna River and, thus, are connected to the river only during times of high water. These vernal pools have not been delineated, therefore their number and aerial extent are unknown.

Red maple (*Acer rubrum*) – Black Gum (*Nyssa sylvatica*) Palustrine Forest – State Vulnerable/Apparently Secure (S3S4). Much of the palustrine forested wetland on the BBNPP site is representative of the red maple–black gum palustrine forest community type, one of the naturally occurring broadleaf palustrine forest types in Pennsylvania (Eichelberger 2011-TN3862; Fike 1999-TN3816). Palustrine forested wetland is described in Section 2.4.1.1. PDCNR considers this community type to be of concern in the State because of long-term declines (Eichelberger 2011-TN3862).

Wildlife Sanctuaries, Refuges, and Preserves

Pennsylvania State Game Lands. There are two State Game Lands in the 6-mi vicinity of the BBNPP site. Pennsylvania State Game Lands No. 55 covers 2,470 ac in Columbia County just east of the BBNPP site, and State Game Lands No. 260 covers 3,087 ac in Luzerne County just east of the BBNPP site (PPL Nuclear Development 2011-TN3866). Pennsylvania State Game Lands are managed by the PGC for hunting, trapping, and fishing.

Susquehanna Riverlands Important Bird Area No. 72. The IBA program is an international effort to identify, conserve, and monitor a network of sites that provide essential migratory, breeding, and overwintering habitat for birds (Wells et al. 2005-TN133). IBAs are designated by the Audubon Society across the United States to conserve critical sites for bird conservation. IBAs are known to have exceptional concentrations or diversity of birdlife, substantial populations of State or Federally listed species, significant populations of one or more State Species of Special Concern, unique habitats and associated species, or sites associated with long-term avian research or monitoring (PFBC 2011-TN3834). IBAs may include public or private lands and may be protected or unprotected; however, the designation does not confer regulatory or other protection (PLTA 2014-TN3977). Pennsylvania developed the first statewide IBA program in the United States in 1996. There are more than 80 IBA sites encompassing more than two million acres of Pennsylvania's public and private land, one of which is the Susquehanna Riverlands IBA No. 72 (Audubon 2014-TN3581).

Susquehanna Riverlands IBA No. 72 is the only IBA site on the main stem or either branch of the Susquehanna River north of Harrisburg, Pennsylvania (Audubon 2014-TN3581). IBA No. 72 (Figure 2-27) is jointly owned and managed by PPL and Allegheny Electric Cooperative for recreation and environmental education and is open to the general public (PPL Corporation 2014-TN3976). It consists of 2,111 ac both on the BBNPP project area and on other PPL land on the east and west sides of the North Branch of the Susquehanna River

(Figure 2-27). It encompasses nearly all of the SREP (described below), including the Wetlands Natural Area (described below), Gould Island, and the Susquehanna River (Figure 2-27) (PPL Bell Bend 2013-TN3377). Elevation on IBA No. 72 ranges from 500 ft above msl along the Susquehanna River to 1,200 ft above msl on Council Cup bluff on the east side of the river. Along US 11, there are cultivated fields, hedgerows, lawns, picnic areas, and a fishing pond.

The river shoreline is dominated by bottomland hardwood forest, with silver maple, sycamore (*Platanus occidentalis*), tuliptree (*Liriodendron tulipifera*), American basswood (*Tilia americana*), red oak, red maple, river birch, and hackberry (*Celtis occidentalis*). Large specimens of some of these species occur on Gould Island located in the Susquehanna River, part of the IBA No. 72. Upland forests are typically Appalachian oak forest similar to that which was described previously in Section 2.4.1.1 and which is suitable for forest interior birds. Old-fields in the IBA No. 72 support a combination of tree saplings, shrubs, herbs, and grasses that are suitable for early successional forest and thicket birds. The east side of IBA No. 72 encompasses hundreds of acres of forest and shrubland (Gross 2004-TN3982).

Of the 27 species of neotropical migratory birds that are considered forest interior breeders in the northeastern United States (Therres 1993-TN1790), 26 of them are known to occur in the project area. A total of 19 of the 26 species likely nest in IBA No. 72 based on observations in the project area during the breeding season (PPL 1978-TN4036; Audubon and Cornell 2014-TN3582; Ecology III 1995-TN1782; Normandeau 2011-TN490; Wilson et al. 2012-TN3833). IBA No. 72 harbors high numbers of forest and thicket bird species. Most notable among these were the high numbers of nesting forest interior species referenced by Gross (2004-TN3982) (e.g., scarlet tanager approximately 100 breeding pairs, yellow-throated vireo approximately 20 pairs, ovenbird approximately 55 pairs, wood thrush approximately 24 pairs, worm-eating warbler approximately 15 pairs). Thus, IBA No. 72 appears to be an important nesting area for forest interior birds.

A total of 39 of the current State-listed/State-ranked bird species statewide (not including those also considered to be extirpated) (PNHP 2014-TN3978) are known to occur in the BBNPP project area (Table 2-17). However, most of the 39 species occur only as migrants, and only 8 are currently likely to nest there (Table 2-17). Thus, the IBA No. 72 appears to be an important stopover location that provides food and cover resources to these species along their migration to breeding areas located further north. Based on the information presented in Table 2-17 and the associated text, IBA No. 72 appears to be relatively unimportant as breeding habitat for most State-listed/State-ranked bird species.

Susquehanna Riverlands Environmental Preserve. The 1200-ac SREP is encompassed almost entirely within IBA No. 72 (Figure 2-27). The SREP encompasses a wide variety of upland and wetland habitats along both sides of the Susquehanna River, as described above for IBA No. 72. On the west side of the Susquehanna River, it includes a 400-ac public recreation area and the Wetlands Natural Area, described below (PPL Bell Bend 2013-TN3377).

Wetlands Natural Area. The Wetlands Natural Area is located in the SREP on the west side of the Susquehanna River (Figure 2-27). It is a 100-ac tract that contains riverine forest, marsh, vernal pools (described above) and swamps, and part of the North Branch Canal. It has been set aside as an area for nature study and education (PPL Corporation 2014-TN3976).

Landscape-Scale Conservation Area – North Branch Susquehanna River Corridor

The functionality of site-specific wildlife preserves such as the Susquehanna Riverlands IBA No. 72 described above is to a large degree dependent on the integrity of larger scale systems such as the North Branch of the Susquehanna River Corridor and adjacent tributary corridors (PEC 2004-TN3979; PNHP 2006-TN1570). Typically, five general plant community types are found within the river corridor: floodplain forest, upland forest, abandoned field, agricultural field, and wetland, all of which are represented in the Susquehanna Riverlands IBA No. 72. Wetland plant communities include submergent, emergent, scrub/shrub, and forested wetland habitats. Floodplain forests occur along the banks of the river and its tributaries and are typically dominated by large trees such as silver maple, river birch, and red oak (PEC 2004-TN3979). The river floodplain, including wetlands contained therein, is usually an area of significantly higher biodiversity than the adjoining uplands, thus much of the region's important biodiversity occurs there (PNHP 2006-TN1570). Wetlands located outside the floodplain but within the river corridor are similarly a source of important biodiversity.

The North Branch of the Susquehanna River Corridor provides habitat for resident game and non-game species, for migrating birds on a biannual basis, especially waterbirds and neotropical passerine migrants, and for the long-term survival of plant species (PNHP 2006-TN1570). The North Branch of the Susquehanna River and its adjacent forested watersheds compose one of the major corridors for the movement of wildlife in Pennsylvania (PEC 2004-TN3979; PNHP 2006-TN1570). Large unfragmented forest blocks, such as the Susquehanna Riverlands IBA No. 72, in proximity along the river serve as natural corridors for species movement within and through Luzerne County (PNHP 2006-TN1570).

State Parks

Ricketts Glen State Park. Ricketts Glen State Park is located about 15 mi north of the BBNPP site in Luzerne, Sullivan, and Columbia Counties. The park encompasses 13,050 ac that include mature forest habitat and diverse wildlife. Common game species include white-tail deer, turkey, grouse, black bear, coyote, pheasant, and squirrel. Common furbearers include raccoon, mink, muskrat, beaver, coyote, and bobcat (PDCNR 2012-TN1199).

Nescopeck State Park. Nescopeck State Park is located about 13 mi east of the BBNPP site in Luzerne County. The park encompasses 3,550 ac that include wetlands and diverse forest habitats and diverse wildlife. Common game species include white-tailed deer, turkey, black bear, rabbit, and gray squirrel. Nescopeck State Park has traditionally been managed for the American woodcock (PDCNR 2012-TN1200).

Ecologically Important Species

Scarlet Tanager (*Piranga olivacea*)

The scarlet tanager is a common neotropical migrant species of the eastern forest interior (forest interior species are described in Section 2.4.1.1). The scarlet tanager was one of the most frequently observed forest interior bird species observed in the BBNPP project area during the late spring and summer of 2008 (PPL Bell Bend 2013-TN3377) and previously (Gross 2004-

TN3982). All of the forest interior bird species observed, including the tanager, occurred primarily in forested sections of the project area (PPL Bell Bend 2013-TN3377).

The scarlet tanager represents a whole community of forest-dwelling neotropical migratory birds that share similar habitat requirements and geographical distributions (Rosenberg et al. 1999-TN2045). For example, the red-eyed vireo and wood thrush are known to occur at more than 75 and 50 percent, respectively, of BBS plots with scarlet tanagers (Rosenberg et al. 1999-TN2045), and all three species were observed during the nesting season on the BBNPP site (Normandeau 2011-TN490). The worm-eating warbler, black-throated blue warbler, and cerulean warbler occur with tanagers on at least 20 percent of BBS plots (Rosenberg et al. 1999-TN2045), and all four species were observed on the IBA No. 72, the first two species and the tanager during the nesting season and the cerulean warbler and the tanager outside the nesting season (Normandeau 2011-TN490). Scarlet tanagers were present at 61 percent, 58 percent, and 55 percent of BBS survey plots that reported cerulean warblers, black-throated blue warblers, and Kentucky warblers, respectively (Rosenberg et al. 1999-TN2045). The Kentucky warbler was also present in the IBA No. 72 with the scarlet tanager during the breeding season (Normandeau 2011-TN490). Thus, the scarlet tanager is representative of the other forest interior dwelling bird species referred to Section 2.4.1.1, and may be considered a biological indicator of the effects on forest interior birds from forest fragmentation (Rosenberg et al. 1999-TN2045).

White-Tailed Deer (*Odocoileus virginianus*)

Overbrowsing by deer has damaged forest ecosystems in several profound ways including the widespread loss of forest structure, changes in abundance and diversity of flora and fauna, and interference with processes such as regeneration and succession. By exhausting their major food source and fostering conditions that obstruct its regrowth, deer in high numbers can cause a forest's ability to sustain a high deer population to decline, essentially reducing the local ecological carrying capacity. If there is no alternative source of food, the deer population decreases through malnutrition or reduced recruitment, but typically remains at a high enough density to keep the understory in a depauperate state essentially in perpetuity, maintaining the changes noted above (Latham et al. 2005-TN3843). For example, in many areas of Pennsylvania, especially the north-central region, sustained deer browsing has eliminated tree seedlings and saplings, leaving a grass- and fern-dominated understory. The shade created by the ferns prevents future germination of seedlings, further deterring forest regeneration. Invasion of exotic species in overbrowsed areas is also becoming apparent, as noted below, especially in southeastern and south-central Pennsylvania (Casalena 2006-TN3817). In addition, browsing by deer has been shown to have negative impacts on understory-dependent forest songbirds and rare plants, noticeably decreasing their numbers (Latham et al. 2005-TN3843; PNHP 2006-TN1570).

Commercially and Recreationally Valuable Species

White-Tailed Deer (*Odocoileus virginianus*)

The white-tailed deer is the most important wild animal economically or recreationally in Pennsylvania (PPL Bell Bend 2013-TN3377). The percentage of all hunters that hunt deer is higher (greater than 90 percent) in Pennsylvania than in any other State (FWS 2004-TN1794). Deer hunting is a very popular activity in Luzerne County and most areas near the BBNPP site (PPL Bell Bend 2013-TN3377).

The white-tailed deer is ubiquitous and abundant throughout the BBNPP project area and surrounding landscape (PPL Bell Bend 2013-TN3377) and was observed during over 90 percent of the terrestrial vertebrate surveys described in Section 2.4.1.1 (Normandeau 2011-TN490). The white-tailed deer favors fragmented brushy woods interspersed with abandoned fields and thickets, as occurs on the BBNPP site and in the surrounding areas. The white-tailed deer is highly adaptable to most environments where there is sufficient browse and cover, including suburban settings (Latham et al. 2005-TN3843).

An absence of natural predators, a decline in hunter numbers, and land-use changes that create abundant browse (abandonment of farmland and forest fragmentation due to development) have resulted in high white-tailed deer populations in Pennsylvania (Latham et al. 2005-TN3843). Because none of these conditions is likely to change substantially in the near future, white-tailed deer populations are expected to remain high in the project area.

Black Bear (*Ursus americanus*)

Signs of black bear were observed during recent wildlife field surveys of the BBNPP site (Normandeau 2011-TN490), but not during previous surveys conducted from 1972 to 1974 at SSES (PPL 1978-TN4036). In Pennsylvania, excessive hunting pressure caused declining populations before 1980. Limiting hunting and the more reliable food resources that result from increased forest maturation (see above) have enabled the bear population to dramatically increase during the past two decades. They are more abundant than at any other time since European settlement. Bears are a source of recreation for hunters, wildlife photographers, and people who enjoy viewing wildlife. Black bears prefer areas that have forest cover, primarily deciduous forest in Pennsylvania. In Pennsylvania, optimal habitat includes forest stands dominated by mature, hard-mast-producing trees interspersed with a diversity of soft-mast trees, understory shrubs, and vines, with herbaceous and grass-covered openings. Forest openings (e.g., closed roads, edges of wetlands, recent clearcuts, and agricultural fields) are important for feeding on emerging grasses and herbaceous vegetation. Black bears can survive in forested habitats that are scattered among other land uses (Ternent 2006-TN1879).

Wild Turkey (*Meleagris gallopovo*)

Wild turkeys were observed year-round during wildlife field surveys of the BBNPP site (Normandeau 2011-TN490). During the late 1800s, the wild turkey was decimated by market hunting and habitat destruction that resulted from extensive forest harvesting across the eastern United States (PPL Bell Bend 2013-TN3377). By 1900, only small flocks of turkeys inhabited only remote parts of Pennsylvania. A major factor in the resurgence of Pennsylvania's wild turkey population to present levels is the regeneration of timber stands cut during the late 1800s. Wild turkeys are habitat generalists, and landscapes offering a diversity of habitats are generally most conducive to their lifestyle. Optimum wild turkey habitat generally has a diversity of habitat types, successional stages, and plant species. Diverse habitat conditions provide for varying seasonal life requirements and offer a variety of food sources that are less susceptible to complete failure during years of overall poor natural food production. Ideal habitat conditions consist of a mosaic of various age classes, including clearcut openings (Casalena 2006-TN3817).

Terrestrial Disease Vectors

White-Nose Syndrome

White-nose syndrome is a fungal disease that affects hibernating bats. The disease was first documented in the State of New York in the winter of 2006-2007 and has since spread rapidly across much of the eastern United States and Canada. It has been detected as far west as Oklahoma (FWS 2012-TN1993). The disease is known to occur in Luzerne County, Pennsylvania, since the winter of 2008-2009 (FWS 2012-TN1993). The white fungus (*Geomyces destructans*) responsible for causing white-nose syndrome was isolated in 2009 (Gargas et al. 2009-TN1996). It appears on the muzzle and other body parts of hibernating bats. Bats with the disease exhibit uncharacteristic behavior during hibernation, including flying outside during day and clustering near the entrances of hibernacula. Bats have been found sick and dying in and around caves and mines. The disease has killed more than 5.5 million bats in the Northeast and Canada. In some hibernacula, 90 to 100 percent of bats have died (FWS 2012-TN1993). White-nose syndrome is known to affect numerous bat species, including the northern long-eared bat, tri-colored bat, little brown bat, and bat big brown bat (FWS 2012-TN1993), all four of which are known to occur on the BBNPP site (see Sections 2.4.1.1 and 2.4.1.3). White-nose syndrome is also known to affect the Indiana bat, which is known to hibernate at three locations within 10 mi of the BBNPP site (see Section 2.4.1.3) and is assumed to occur on the BBNPP site (FWS 2009-TN3868), and the eastern small-footed myotis (FWS 2012-TN1993), which is known to hibernate within 5 mi of the BBNPP site (see Section 2.4.1.3).

West Nile Virus

West Nile Virus first appeared in New York City in 1999 and since then has spread over much of the United States and Canada (McLean 2006-TN1994). West Nile Virus is known to occur in Pennsylvania, including Luzerne County (Cameron 2012-TN1995). Birds, primarily of the family corvidae (e.g., American crow and blue jays), are reservoirs (carriers) of West Nile Virus. Mosquitoes feed on infected birds, and the virus may then be transmitted from mosquitoes to mammals, including humans. West Nile Virus can, in rare instances, cause encephalitis, a brain inflammation capable of causing death. Corvid mortality is used as a sentinel for disease presence by public health surveillance programs (McLean 2006-TN1994).

Invasive Plant Species

Non-native invasive plants occur abundantly within particular upland and wetland habitats on the BBNPP site. In addition, 36 invasive plant species are known to be associated with waterbodies that are part of the CUMP, particularly the North Branch of the Susquehanna River and West Branch of the Susquehanna River (PFBC 2011-TN3834). Common invasive plant species in wetlands in Pennsylvania include reed canary grass, purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*), which are herbaceous plants that commonly colonize emergent wetland habitat (PPL Bell Bend 2013-TN3377). Upland invasive species include garlic mustard (*Allaria petiolata*), Japanese stilt grass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and bush honeysuckle (*Lonicera tartarica*) (PPL Bell Bend 2013-TN3377). These wetland and upland invasive species are discussed below. All of these wetland and upland species are also associated with the North Branch of the Susquehanna River and West Branch of the Susquehanna River (PFBC 2011-TN3834).

Reed Canary Grass

Reed canary grass is a perennial that is native to temperate regions of Europe, Asia, and North America. Both Eurasian and native ecotypes of the species likely exist in the United States, and it is uncertain from where invasive populations descend. The species produces few viable seeds, which are dispersed by wind, water, animals, and machines. However, once established in a wetland, it spreads aggressively via rhizomes (PDCNR 2014-TN2050). Reed canary grass is a dominant species throughout much of the emergent wetlands within the BBNPP site and forms near monocultures in some areas (PPL Bell Bend 2013-TN3377).

Purple Loosestrife

Purple loosestrife is a perennial herb intentionally introduced into North America in the early nineteenth century as an ornamental plant. Each purple loosestrife plant may produce two to three million seeds per year. The species can also reproduce via underground stems at a rate of one foot per year per plant. Purple loosestrife outcompetes native plants, forming dense homogeneous stands that may eventually displace entire wetlands (PDCNR 2014-TN2052). The species is moderately abundant on the BBNPP site and without control can be expected to colonize additional emergent wetland habitat over time (PPL Bell Bend 2013-TN3377).

Common Reed

Common reed is a perennial grass that is native to North America, although a more invasive genotype was also introduced from Europe in the late eighteenth or early nineteenth century. Colonization of new sites is typically via wind-dispersed seeds or fragments of rhizomes may be washed to new locations along rivers and shorelines. Once established, it spreads horizontally by rhizomes (PDCNR 2014-TN2051). Common reed is currently limited to a small area near the southeastern corner of the BBNPP site and without control can be expected to colonize additional emergent wetland habitat over time PPL Bell Bend 2013-TN3377).

Garlic Mustard

Garlic mustard is a biennial herb native to Europe that was introduced to the United States. Individual plants produce thousands of seeds that scatter nearby. The species is unpalatable to white-tailed deer which further its spread by foraging on native species and thus reducing competition from native species, as well as by exposing the soil and seedbed through trampling. Its allelopathic compounds inhibit the seed germination of other species, reducing competition and allowing the species to form monocultures. Garlic mustard is shade-tolerant, and thus can invade mature forests (PDCNR 2014-TN2053). It is common in the herbaceous layer of upland forests on the BBNPP site (PPL Bell Bend 2013-TN3377).

Japanese Stiltgrass

Japanese stiltgrass is a perennial herb that was accidentally introduced to the United States. The species reproduces only by seed, 100 to 1,000 per plant. It crowds out native plant species and after it dies back in late fall, it forms a thick layer of thatch that is slow to decompose. Because stilt grass is relatively unpalatable, it may encourage heavier deer browsing on native plant species. It is found growing in the moist ground of open woods, floodplain forests, wetlands, uplands, fields, thickets, roadsides, and ditches. It readily invades areas subject to regular disturbance (PDCNR 2014-TN2054). It is common in the herbaceous layer of upland forests on the BBNPP site (PPL Bell Bend 2013-TN3377).

Multiflora Rose

Multiflora rose is a perennial shrub that was introduced from Japan as an ornamental in the nineteenth century. Each plant may produce 1,000,000 seeds per year, and new plants can form from canes where they contact the ground. The species forms dense, impenetrable thickets that exclude native plants, and it grows prolifically in riparian areas (PDCNR 2014-TN2055). The species occurs in dense concentrations in old-field habitat and along forest edges on the BBNPP site (PPL Bell Bend 2013-TN3377).

Bush Honeysuckle

Bush honeysuckle was introduced to North America for erosion control, landscaping, and wildlife cover. The species produces large numbers of fruits that are disseminated by birds. Once established, plants spread by vegetative sprouting. The species is relatively shade-intolerant, and often occurs in disturbed woods or edges, roadsides and abandoned fields (PDCNR 2014-TN2049). The species occurs in dense concentrations in successional old-field habitat and along forest edges on the BBNPP site (PPL Bell Bend 2013-TN3377).

Mile-A-Minute Weed

Mile-a-minute weed (*Persicaria perfoliata*) is an herbaceous annual vine that spreads primarily by seeds carried by wildlife or water. It readily colonizes disturbed areas along forest margins, wetlands, stream banks, and roadsides. It can grow up to 6 in. a day and smother native vegetation, and climb into the tree canopy and restrict sunlight to underlying species

(PDCNR 2014-TN3957). Mile-a-minute weed has been observed along the Susquehanna River south of the proposed cooling-water intake location (PPL Nuclear Development 2011-TN3887).

Consumptive-Use Mitigation Areas

By letter dated January 29, 2014, the NRC requested that the FWS Field Office in State College, Pennsylvania, and PDCNR, PFBC, and PGC provide a list of Federally listed species and critical habitats; State-listed species; and State-ranked species and communities in and around the portions of the waterbodies and water courses, and the Rushton Mine expansion area, highlighted and labeled in Figure 2-10 (PNNL 2014-TN3983). On February 25, 2014, FWS provided a list of Federally listed species known to occur in the counties containing the waterbodies and water courses in Figure 2-10 (FWS 2014-TN3968). Species identified by FWS that could occur along waterbodies affected by the CUMP, based on habitat affinities, are listed in Table 2-18. In a letter dated May 23, 2014, FWS noted that the bald eagle is also known to occur in the counties containing the waterbodies and water courses in Figure 2-10 (FWS 2014-TN3967). On March 18, 2014, PGC provided a list of species of interest known to occur along the waterbodies and water courses in Figure 2-10 (Wilson et al. 2012-TN3833). In a meeting held March 17, 2014, PDCNR identified plant species and communities of interest known to occur along the waterbodies and water courses in Figure 2-10 (PDCNR 2014-TN3985). By letter dated March 17, 2014, PDCNR confirmed that no plant species and communities of interest are known to occur around Cowanesque Lake and in the Rushton Mine expansion area (PDCNR 2014-TN3985). Species and communities identified by the above agencies are listed in Table 2-18.

By letter dated December 19, 2013, the NRC requested that the New York Natural Heritage Program (NYNHP) provide a list of Federally listed species and critical habitats; State-listed species; and State-ranked species and communities in and around the portions of the waterbodies and water courses highlighted and labeled in Figure 2-10 that occur in New York State (PNNL 2013-TN3984). On January 17, 2014, NYNHP provided a list of species of interest known to occur along the waterbodies and water courses in Figure 2-10 that occur in New York State (NYNHP 2014-TN3988).

Species and natural communities noted in the above correspondence are listed along with their known areas of occurrence and their habitat affinities in Table 2-18.

2.4.1.4 Monitoring

PPL (1971-TN4038) documented some common tree and shrub species in its ER in support of the SSES construction license. PPL (1978-TN4036) conducted studies of flora, birds, mammals, reptiles, and amphibians from 1972 to 1974 in support of the SSES initial operating license ER. Ecology III (1995-TN1782) conducted surveys for avian Species of Special Concern and floristic studies related to potential effects from salt drift between 1977 and 1994 as part of the preoperational and post-operational SSES Environmental Monitoring Program. More recent studies performed in support of the BBNPP COL ER include surveys of plant communities and delineation of wetlands, both conducted from 2007 through 2011 (Normandeau 2011-TN489; Normandeau 2011-TN1224). A series of wildlife field surveys were conducted for birds, butterflies, mammals, reptiles, and amphibians in support of the BBNPP

Table 2-18. Important Species and Natural Communities Potentially Occurring along Waterbodies Affected by Consumptive-Use Mitigation

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	State Rank[(a)]	CUMP Area[(b)]	Habitat
Plants						
Ammannia coccinea	scarlet ammannia		PE	S2	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Shorelines of rivers, streams, and ponds. Flowers July−September.[(c)] Temporarily flood-tolerant.[(d)]
Boechera dentata	toothed rock-cress		NYT	S2	Chemung River in New York	Bluffs and rocky ledges, wooded slopes, and floodplains. Flowers April−June.[(e)] Historic population (1887), present status uncertain.[(f)]
Boltonia asteroides	aster-like boltonia		PE	S1	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Open rocky shores and exposed river bed outcrops, particularly where annual scouring occurs. Flowers July−October.[(c)] Temporarily flood-tolerant.[(d)]
Carex shortiana	sedge			S3	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Wet meadow, swamps, rich woods, and streams, particularly characteristic of bottomlands.[(c,e)] Sets fruit May through late July.[(e)]
Chaerophyllum procumbens	spreading chervil		NYE	S1	Chemung River in New York	Rich floodplain forests.[(g)] Historic population (1882), present status uncertain.[(f)]
Eleocharis compressa	flat-stemmed spike rish		PE	S1	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	River shorelines and riverbed rock outcrops, which are subject to annual scouring.[(c)] Temporarily flood-tolerant.[(d)]
Ludwigia decurrens	upright primrose-willow		PE	S1	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Shoreline Areas of the Susquehanna River. Flowers July−September.[(c)] Temporarily flood-tolerant.[(d)]
Magnolia tripetala	umbrella magnolia		PT	S2	Main-stem Susquehanna River from Sunbury to Harrisburg	Rich wooded slopes, wooded streambanks, and in moist ravines. Flowers in May.[(c)]
Phyllanthus caroliniensis	Carolina leaf-flower		PE	S1	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Damp to wet open habitats, especially on the shorelines of rivers, streams, and ponds. Flowers July−September.[(c)]

Table 2-18. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	CUMP Area[b]	Habitat
Rotala ramosior	tooth-cup		PR	S3	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Exposed shorelines, stream margins, streambed outcrops, and other damp, open places, especially along the Susquehanna River. Flowers July−September.[c] Temporarily flood-tolerant.[d]
Scirpus ancistrochaetus	northeastern bulrush	FE	PE	S3	Centre, Clinton, Columbia, Dauphin, Lackawanna, Lycoming, Tioga Counties (all CUMP waterbodies in Pennsylvania)	Edges of seasonal pools, wet depressions, beaver ponds, wetlands, and small ponds.[c]
Sida hermaphrodita	sida		PE	S2	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	Streambanks and bottomlands. Restricted to the Juaniata River and lower Susquehanna River. Flowers July−October.[c]
Sisyrinchium mucronatum	Michaux' blue-eyed-grass		NYE		Chemung River in New York	Prairies, roadsides, moist open woods, and rocky and sandy open shores. Flowers spring to early summer.[e] Historic population (1946), present status uncertain.[f]
Birds						
Ardea alba	great egret		PE	S1B	Main-stem Susquehanna River from Sunbury to Harrisburg	See Table 2-17
Ardea herodias	great blue heron			S3S4B, S4N	Cowanesque Lake and Cowanesque River. Rookery located on the Cowanesque River about 4,000 ft below Cowanesque Lake Dam.[h]	See Table 2-17
Falco peregrinus	peregrine falcon		PE	S1B, S1N	North Branch Susquehanna River from New York to Bell Bend; main-stem Susquehanna River from Harrisburg to Holtwood Dam; West Branch Susquehanna River from Moshanon Creek confluence to North Branch Susquehanna River confluence	See Table 2-17
Haliaeetus leucocephalus	bald eagle			S3B	All CUMP waterbodies in Pennsylvania; Chemung River in New York	See Table 2-17
Nycticorax nycticorax	black-crowned night-heron		PE	S1B	Main-stem Susquehanna River from Sunbury to Harrisburg	See Table 2-17
Nyctanassa violacea	yellow-crowned night-heron		PE	S1B	Main-stem Susquehanna River from Sunbury to Harrisburg	Nests singly or in small groups along the lower Susquehanna River. Nesting may start as early as April with young fledged by mid-summer. Crayfish are a major part of their diet. Feeds mainly along small, shallow

Table 2-18. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	CUMP Area[b]	Habitat
						streams. Nests in brush or trees, usually sycamores, found on islands or along streams.
Pandion haliaetus	osprey		PT	S3B	Cowanesque Lake and Cowanesque River; main-stem Susquehanna River from Harrisburg to Holtwood Dam	See Table 2-17
Protonotaria citrea	prothonotary warbler			S2S3B	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	See Table 2-17
Tyto alba	barn owl			S2S3B, S2S3N	Main-stem Susquehanna River from Sunbury to Harrisburg	See Table 2-17
Amphibians and Reptiles						
Eurycea longicauda longicauda	longtail salamander		NYSC	?	0.2 mi from the Tioga River along a tributary stream	Wet shale banks and other seep areas, often under stones or logs or along clear, flowing woodland streams. Diet consists of insects.[i]
Glyptemys muhlenbergii	bog turtle	FT	PE	S2	Lancaster County (main-stem Susquehanna River from Harrisburg to Holtwood Dam)	Open, early successional wetland habitats with deep mucky soils fed by groundwater seeps, dominated by tussock sedge and grasses, with modest amounts of open water.[c]
Mammals						
Lasionycteris noctivagans	silver-haired bat			SU	North Branch Susquehanna River from New York to Bell Bend	Forested areas near water. Summer roosts and nursery sites in tree foliage, cavities, or under loose bark, sometimes in buildings.[d]
Myotis leibii	eastern small-footed myotis		PT	S1B, S1N	Main-stem Susquehanna River from Harrisburg to Holtwood Dam	See Table 2-16 and Section 2.4.1.3 text.
Myotis septentrionalis	northern myotis	PFE		S1	Moshanon Creek from Ruston Mine to West Branch Susquehanna River; main-stem Susquehanna River from Sunbury to Harrisburg	See Table 2-16 and Section 2.4.1.3 text.
Myotis sodalis	Indiana bat	FE	PE	SUB, S1N	Potential summer habitat statewide (all CUMP waterbodies in Pennsylvania)	See Table 2-16 and Section 2.4.1.3 text.
Neotoma magister	Alleghany woodrat		PT	S3	Moshanon Creek from Ruston Mine to the West Brance of the Susquehanna River; West Branch Susquehanna River from Moshanon Creek confluence to North Branch of the Susquehanna River confluence; main-stem Susquehanna River from Sunbury to Harrisburg	Extensive expanses of surface rock surrounded by unfragmented de-ciduous, coniferous or mixed forest. Outcrops, cliffs, ledges, boulder fields, and caves providing nest locations and food caches. Mast-producing trees are important.[c]

Table 2-18. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	State Rank[a]	CUMP Area[b]	Habitat
Sorex palustris albibarbis	northern water shrew			S3	Cowanesque Lake and Cowanesque River.[j]	Along streams and lake edges, in boulders and sphagnum moss. Forages under water[c] on aquatic invertebrates.[k] Active year-round.[k]
Natural Communities						
Andropogon gerardii – Sorghastrum nutans	big bluestem – Indian grass river grassland			S3	North Branch Susquehanna River from New York to Bell Bend	Sand/gravel deposits and cobble/boulder shores along the banks of large rivers. May also occur on islands within the active channel. Sites subject to high-intensity flooding and ice scour that restrict the establishment of trees.[c]
	riverside ice scour			S1S2	North Branch Susquehanna River from New York to Bell Bend	Along the banks of major rivers, where rock outcrops are subject to winter ice scour and high-velocity flooding. Sparse to dense vegetation growing amidst exposed bedrock, boulders, or cobble.[c]

(a) Federal status: FE = Federally endangered, PFE = proposed Federally endangered, FT = Federally threatened; State status: PE = Pennsylvania endangered, PT = Pennsylvania threatened, PR = Pennsylvania rare (PNHP 2014-TN3975); NYE = New York endangered, NYT = New York threatened, NYSC = New York Special Concern (NYDEC 2014-TN3980); NatureServe rank: S1 = critically imperiled (five or fewer populations, especially vulnerable to extirpation), S2 = imperiled (20 or fewer populations, very vulnerable to extirpation), S3 = vulnerable (80 or fewer occurrences, vulnerable to extirpation), S4 = apparently secure (uncommon but not rare, some cause for long-term concern) (PNHP 2014-TN3975).

(b) CUMP (area reported for plants by PDCNR (2014-TN3985), FWS (2014-TN3967), and New York State Department of Environmental Conservation (NYDEC 2014-TN3981); for amphibians and reptiles by NYDEC (2014-TN3980); for birds and mammals by Wilson et al. (2012-TN3833) and FWS (2014-TN3967), unless otherwise indicated.

(c) Pennsylvania Natural Heritage Program (PNHP). 2014. Species of Special Concern Lists. Available at http://www.naturalheritage.state.pa.us/species.aspx.

(d) PDCNR 2014-TN3985.

(e) Flora of North America 1993-TN3960.

(f) NYNHP 2014-TN3988.

(g) Weldy et al. 2014-TN3959.

(h) USACE 2011-TN3965.

(i) Ohio Department of Natural Resources 2014-TN3958.

(j) USACE 2002-TN3966.

(k) EPA-TN3859.

COL ER from 2007 through 2008 and during 2010 and 2013 (Normandeau 2011-TN490; Normandeau 2014-TN3828). In connection with bat surveys conducted in 2008 and 2013, potential roost tree surveys for the Federally endangered Indiana bat were performed in 2010 and 2011 in areas of the BBNPP site that would be affected by construction of the BBNPP (Normandeau 2011-TN493).

The NRC staff reviewed the available information relative to the terrestrial ecological monitoring program and the data collected by the program. The NRC staff concludes that the program provides adequate data to characterize and track impacts on the terrestrial ecological environment for the BBNPP site in support of the acceptance criteria outlined in NRC's Environmental Standard Review Plan (NRC 2000-TN614) and recent updates.

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota on and near the BBNPP site that are likely to be affected by the building, operating, or maintaining of the proposed new unit. This section describes the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages that the proposed action could affect. This section also identifies important aquatic resources, as defined in NUREG-1555 (NRC 2000-TN614), and the location of natural preserves that might be affected by the proposed action. The surface-water hydrology and water quality that support these aquatic resources in the vicinity of the BBNNP site are described in Section 2.3.

2.4.2.1 Aquatic Resources – Site and Vicinity

Major aquatic environments within or near the BBNPP project boundary include the North Branch of the Susquehanna River, Walker Run, small onsite streams (Unnamed Tributaries 1, 2, 3, 4, and 5, North Branch Canal), small onsite ponds (Johnson Pond, West Building Pond, Unnamed Ponds 1 and 2, Farm Pond), and Lake Took-A-While (Figure 2-17). The North Branch of the Susquehanna River is the largest waterbody near the site. Three tributaries of the North Branch of the Susquehanna River (Salem, Big Wapwallopen, and Nescopeck creeks) are nearby and downstream of the proposed BBNPP site but are not within the project boundary. The closest natural preserve with aquatic habitats is the Susquehanna Riverlands Nature Preserve, a 1,200-ac preserve owned by PPL located on the northeast portion of the BBNPP project area, which includes Lake Took-A-While and part of the North Branch Canal (PPL Corporation Environmental Preserves 2012-TN695).

North Branch of the Susquehanna River

The proposed BBNPP site is located along the west bank of North Branch of the Susquehanna River, extending from approximately the tip of Gould Island (owned by PPL) to a location roughly opposite the community of Wapwallopen (on the eastern shore of the river). This part of the river and its tributaries are within the Middle Susquehanna Sub-basin (Sub-basin 3) of the Susquehanna River Basin (SRBC 2008-TN699). The protected use designation for this stretch of the river to its confluence with the West Branch of the Susquehanna River is for warm-water fish (PA Code 25-93-TN611). Water flows in the North Branch of the Susquehanna River vary considerably throughout the year, with the lowest flows typically in late summer and early fall and the highest flows in early spring (PPL Nuclear Development 2011-TN1824).

The North Branch of the Susquehanna River forms a relatively large, deep pool in the Bell Bend area. The pool starts about 0.2 mi upstream from the proposed BBNPP intake location and extends about 0.7 mi downriver (PPL Nuclear Development 2011-TN1824). Water depths in the deepest parts of the pool are about 16 to 18 ft (PPL Bell Bend 2013-TN3377) with relatively slow water flow (Normandeau et al. 2010-TN1825). Downstream of the pool, from approximately the mouth of Unnamed Tributary 3 to just downstream of the mouth of Walker Run, the river is a run/glide mesohabitat where waters are shallow and fast-moving. The run/glide mesohabitat transitions to a riffle mesohabitat that extent to near the mouth of Nescopeck Creek, which is about 6 to 7 mi downriver from the proposed BBNPP site, and the substrate is mainly gravel, cobble, and boulder. Several islands occur in this stretch of the river. Hess Island is near the shore at the upstream extend of the riffle area, and Rocky Island is nearby but in the middle of the river. Heron and Swan Islands are farther downriver near Berwick. Beyond Nescopeck Creek, the river channel narrows and deepens and river flow is swift. PPL sponsored a limited water-quality (pH only) survey in this reach to examine potential abandoned mine drainage effects (PPL Bell Bend 2013-TN3377).

The PFBC (2012-TN1625), citing concerns about the increasing effects of disease on Smallmouth Bass (*Micropterus dolomieu*) populations, requested that the PADEP include the Susquehanna River from Sunbury to the Holtwood Dam on the 303(d) list of impaired waterbodies. Arway and Smith (2013-TN2914) described the decline of the Smallmouth Bass fishery in the river that has occurred since about 2005. The PADEP (2012-TN1626) declined to list the river as 303(d) impaired primarily because Smallmouth Bass disease could not be linked to specific stressors, and other data do not support listing the river under the Federal guidelines. The PADEP emphasized that the river would continue to be studied without the need for the designation.

The SRBC has been involved with a long-term study of the nutrient and suspended sediment loads in the Susquehanna River since the 1980s. Composited core samples collected from the North Branch of the Susquehanna River near the BBNPP site showed that sediments within the proposed intake areas were primarily sandy silt with some gravel, and were of high quality (AECOM 2011-TN504).

Shenk (2011-TN698) concluded that water quality in the stretch of the river that includes BBNPP was relatively good, and surface-water quality is discussed in more detail in Section 2.3.3.1 and Table 2-11. Sampling conducted in 2010 near SSES and BBNPP found that values for all water-quality parameters, for which there are published criteria, were within those water-quality limits (Ecology III 2011-TN1175).

Historical sampling from 1968 to 1977 showed that water temperature in the Susquehanna River ranged from approximately 0 to 29°C (32 to 84°F) (PPL Bell Bend 2013-TN3377). Mangan (2012-TN1352) examined long-term temperature trends in the river at the SSES Environmental Laboratory (0.2 mi upstream of the BBNPP site) by using data collected from 1974 to 2010. The data showed a statistically significant increasing trend in the average annual water temperature from about 11 to 13°C (52 to 55°F) during that period. The analysis predicted the rate of annual increase as about 0.038°C (0.068°F). This trend was similar to that observed for other major river systems in the northeastern United States (Kaushal et al. 2010-TN1571). Dissolved oxygen concentrations fluctuate throughout the year, typically being higher when the water is cold and lower when the water is warm. For example, dissolved oxygen at one station in the North Branch of the Susquehanna River near the proposed BBNPP site was 7.1 mg/L during July 2008 and 21.3 mg/L during February 2008 (PPL Bell Bend 2013-TN3377).

Abandoned Mine Drainage

The drainage of acidic water from abandoned coal mines is probably one of the most important stressors on streams in the Susquehanna River Basin (SRBC 2013-TN2942). This abandoned mine drainage, which also is called acid mine drainage, results because of the exposure of pyrite to air and groundwater during the mining process (USGS 1998-TN1644). This combination produces sulfuric acid, which dissolves metals including aluminum, iron, and manganese. The production of this acidic waste can continue long after a mine has been abandoned. The key water-quality issues from abandoned mine drainage are low pH, high metals concentrations, and iron-hydroxide deposition that coats streambeds (Cravotta and Kirby 2004-TN609). Some of the effects of abandoned mine drainage, such as iron-hydroxide deposition, increased algal growth, and severely reduced macroinvertebrate communities, are most noticeable locally. Bott et al. (2012-TN2915) reported that remediation of streams affected by abandoned mine drainage improved conditions in the streams, although remediated streams had not yet reached reference stream conditions for water chemistry, macroinvertebrate communities, or stream ecological functions.

Discharges from four anthracite coal fields affect streams that discharge into the North Branch of the Susquehanna River and the main stem of the Susquehanna River (SRBC 2011-TN1646). The BBNPP area of the North Branch of the Susquehanna River is affected by abandoned mine drainage from the Northern and Eastern-Middle Anthracite Coal Fields via discharges upstream and downstream of the BBNPP site. These discharges contribute primarily to iron, manganese, aluminum, and acidity loading in the river (SRBC 2011-TN1646). During a field survey conducted between May 21 and October 29, 2010, Normandeau (Normandeau 2012-TN1605) reported that pH at the mouth of Nescopeck Creek was lower than the minimum State standard (6.0) on 8 of the 10 sampling dates, with the lowest value (4.9) occurring August 13, 2010. The farthest downstream effect of the low pH discharge from Nescopeck Creek was 0.6 mi (August 13, 2010), and the creek's influence typically was lost within 0.2 mi of the mouth of the creek.

Global Climate Change

A significant issue facing all waterbodies and their ecology in the Susquehanna River Basin is global climate change. The projected climate changes are predicted to affect the Susquehanna River Basin primarily through changes in the timing and amount of precipitation that may provide episodic rain events, or periods of extended drought (GCRP 2014-TN3472). Changes in the timing, seasonality, and magnitude of precipitation would strongly affect aquatic systems. Predicted increases in severe storm events and longer dry periods would significantly change stream flow patterns by reducing or eliminating flow pulses and causing important channel morphology and aquatic habitat changes (Ross et al. 2013-TN3485). Major flooding occurs in the Susquehanna River Basin about once every 14 years, although some flooding can occur every year (SRBC 2013-TN2942). The principal ecological effect of droughts on rivers and streams is a reduction in water levels that contributes to the loss of aquatic habitats and connectivity among streams (Lake 2003-TN2926). Secondary effects include food supply changes, alterations in species interactions, and reduced water quality. Fish and invertebrates may survive seasonal drought-related conditions by using refugia, such as deep pools and sediments in the stream or river. However, the benefits of using such refugia during extended or severe drought are not known (Lake 2003-TN2926). Droughts within the Susquehanna River Basin occur relatively often. The SRBC (2013-TN2942) reported that 28 drought warnings or emergencies (the most serious drought condition) occurred within counties in the basin from 1990 to 2011.

Fish Community

Snyder (2005-TN2934) provided a general overview of the fish assemblages in the Susquehanna River based on data from various surveys conducted since the 1800s. Approximately 60 of the 115 living species Snyder compiled from historical surveys are native, approximately 33 are non-native, and another 22 species are diadromous or euryhaline (Snyder 2005-TN2934). The fish fauna in the river is characterized primarily by minnows (family Cyprinidae) and sunfish (family Centrarchidae). Most of the non-native species are predators of other fish, whereas most of the native species feed on invertebrates. Many of the more well-known fish of the Susquehanna River (e.g., Smallmouth Bass, Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Northern Pike (*Esox lucius*), and Muskellunge (*E. masquinongy*) are non-native species that were introduced into the system to enhance recreational fishing.

Since the late 1970s, Ecology III has used electrofishing and seining techniques during its ongoing fish sampling program in the North Branch of the Susquehanna River near Bell Bend. The most recent complete data set is from sampling that occurred in May, June, July, August, and October 2010 (Ecology III 2011-TN1175). Ecology III (2012-TN2236) also sampled the fish community in 2011, but high water levels in the river limited sampling to June and July (electrofishing) and August (seining). The fish community diversity from the 2010 study is provided in Table 2-19. The sample locations in the North Branch of the Susquehanna River included the east and west banks of the river both upriver of the SSES intake structure (SSES location) and downriver of the SSES intake structure (Bell Bend location), in the general area where the discharge diffuser for the cooling-water system for the proposed BBNPP unit would be located.

Walleye (*Sander vitreus*) and Smallmouth Bass were the most abundant of the 1,594 fish representing 19 species collected by electrofishing during 2010 (Ecology III 2011-TN1175). Walleye were relatively abundant during the mid-summer to early-fall samplings, accounting for about 29 percent to 52 percent of the total abundance at the SSES location and about 11 percent to 43 percent at the Bell Bend location during that time. Smallmouth Bass relative abundance at the SSES location was highest in late spring, about 36 percent, and ranged from about 11 to 23 percent of the total abundance from mid-summer to early fall. Smallmouth Bass relative abundance ranged from 12 percent to 40 percent at the Bell Bend location during the study. The only other species that accounted for more than 10 percent of the total abundance during any of the five sampling events at the SSES location were the Northern Hog Sucker

1 **Table 2-19. Fish Species Collected in Waterbodies on or Near the Proposed BBNPP Site**

Common Name	Species Name	North Branch of the Susquehanna River [a]	Walker Run and Unnamed Tributary 1[b]	North Branch Canal[c]
Unidentified spp.		58		
Rock Bass	*Ambloplites rupestris*	189		
Yellow Bullhead	*Ameiurus natalis*			3
Brown Bullhead	*Ameiurus nebulosus*			2
Quillback	*Carpiodes cyprinus*	114		
Sucker spp.	Catostomidae spp.	3		
White Sucker	*Catostomus commersonii*	8	459	25
Brook Stickleback	*Culaea inconstans*			1
Spotfin Shiner	*Cyprinella spiloptera*	190		1
Common Carp	*Cyprinus carpio*	34		1
Gizzard Shad	*Dorosoma cepedianum*	1		
Northern Pike	*Esox lucius*	1		
Muskellunge	*Esox masquinongy*	9		
Chain Pickerel	*Esox niger*			1
Pike spp.	*Esox* spp.	5		
Tessellated Darter	*Etheostoma olmstedi*	18	150	
Banded Killifish	*Fundulus diaphanus*	5		
Northern Hog Sucker	*Hypentelium nigricans*	133		
Channel Catfish	*Ictalurus punctatus*	25		
Redbreast Sunfish	*Lepomis auritus*	3		
Green Sunfish	*Lepomis cyanellus*	33	56	43
Pumpkinseed	*Lepomis gibbosus*	51		13
Bluegill	*Lepomis macrochirus*	13	4	68
Sunfish hybrid	*Lepomis* sp.	29	1	1
Smallmouth Bass	*Micropterus dolomieu*	314		
Largemouth Bass	*Micropterus salmoides*		1	4
Shorthead Redhorse	*Moxostoma macrolepidotum*	13		
River Chub	*Nocomis micropogon*	1		
Golden Shiner	*Notemigonus crysoleucas*			43
Comley Shiner	*Notropis amoenus*	1		
Spottail Shiner	*Notropis hudsonius*	186		
Yellow Perch	*Perca flavescens*	27		
Bluntnose Minnow	*Pimephales notatus*	45		8
Fathead Minnow	*Pimephales promelas*			2
Black Crappie	*Pomoxis nigromaculatus*			1
Blacknose Dace	*Rhinichthys atratulus*		594	
Longnose Dace	*Rhinichthys cataractae*		30	
Brown Trout	*Salmo trutta*		24	
Walleye	*Sander vitreus*	559		
Creek Chub	*Semotilus atromaculatus*		416	2
Fallfish	*Semotilus corporalis*	34	42	

(a) Electrofishing and seining at Bell Bend and SSES locations in 2010 (Ecology III 2011-TN1175).
(b) Fish collected from Walker Run and Unnamed Tributary 1 in 2008 (Normandeau 2011-TN1226).
(c) Fish collected in North Branch Canal and Outlet in 2010 (Normandeau 2011-TN1226).

(*Hypentelium nigricans*) in early summer (45 percent), Quillback (*Carpiodes cyprinus*) in early fall (11 percent), and Rock Bass (*Ambloplites rupestris*) in late spring to late summer (11 to 17 percent). Only Quillback in early summer (19 percent) and Rock Bass in mid- and late summer (18 and 17 percent, respectively) accounted for more than 10 percent of the total abundance during any of the five sampling events at the Bell Bend location in 2010.

The limited June and July 2011 electrofishing sampling identified Smallmouth Bass (19 percent), Northern Hog Sucker (19 percent), and Rock Bass (15 percent) as the most abundant species at the SSES location and Smallmouth Bass (18 percent), Rock Bass (17 percent), and Northern Hog Sucker (16 percent) as the most abundant species at the Bell Bend location (Ecology III 2012-TN2236). Walleye accounted for about 4 percent and 9 percent of the total abundance in 2011 at the SSES and Bell Bend locations, respectively. The difference in Walleye abundance in 2011 versus 2010 may be explained by the lack of 2011 sampling later in August and October, when Walleye often are more abundant.

Spotfin Shiner (*Cyprinella spiloptera*), Spottail Shiner (*Notropis hudsonius*), and Bluntnose Minnow (*Pimephales notatus*) were the three most abundant of the 575 fish belonging to 15 species collected by seining in June and August 2010 (Ecology III 2011-TN1175). Spotfin Shiner and Spottail Shiner were very abundant in June at the Bell Bend location, accounting for about 92 percent of the fish caught. The only other species that accounted for more than 10 percent of the total abundance during either sampling event at the SSES location were Tessellated Darter (*Etheostoma olmstedi*) in June (18 percent) and Pumpkinseed (*Lepomis gibbosus*) and Green Sunfish (*L. cyanellus*) in August (28 and 17 percent, respectively). Tessellated Darter (21 percent) and White Sucker (*Catostomus commersonii*; 11 percent) were the only other species that accounted for more than 10 percent of the total abundance during either sampling event at the Bell Bend location.

Seining during 2011 was limited to late August. Spotfin Shiner and Spottail Shiner were the most abundant fish caught at either location (Ecology III 2012-TN2236). However, Spotfin Shiner accounted for a larger proportion of the fish community in the river at Bell Bend (87 percent) than at SSES (55 percent), and Spottail Shiner had higher relative abundance at SSES (33 percent) than at Bell Bend (7 percent). No other species accounted for more than 4 percent of the total number of fish caught by seining in 2011.

In each of its annual reports since the early 1990s, Ecology III has included an analysis of the fish community data collected before and after the startup of the SSES. The analyses of the 1976 to 2010 electrofishing data set, which included all months sampled each year, suggested that seven fish species had significant population level changes at the Bell Bend location (downstream from the SSES plant) versus the SSES location (Ecology III 2011-TN1175). Quillback, Northern Hog Sucker, Shorthead Redhorse (*Moxostoma macrolepidotum*), Muskellunge, Rock Bass, and Smallmouth Bass populations decreased at the Bell Bend location from 1976 to 2010, whereas Brown Bullhead (*Ameiurus nebulosus*) populations increased (Ecology III 2011-TN1175). The results were similar when the analyses were restricted to data from June to October each year. A similar comparison of the 1978 to 2010 seining data sets showed slightly significant increases in populations of Spotfin Shiner and Spottail Shiner and decreases of Rock Bass populations at the Bell Bend location (Ecology III 2011-TN1175).

Invertebrate Community

Ecology III conducted an invertebrate survey in the North Branch of the Susquehanna River in August 2007 (Ecology III 2008-TN391) and in June 2008 (Ecology III 2009-TN1572) at sites that were collocated with the fish surveys and corresponded to sites that Ecology III last sampled for invertebrates in 1994. Both of these studies reported that invertebrate densities determined in 2007 and 2008 generally were similar to those estimated during the earlier studies in the river (Ecology III 2008-TN391; Ecology III 2009-TN1572). Total invertebrate abundances at the stations upriver of the SSES intake area (SSES location) and in the Bell Bend stretch of the river (Bell Bend location) were similar in 2007. However, invertebrate abundance was much greater at the SSES location than at the Bell Bend location in 2008 because of higher abundances of caddisfly larvae (Trichoptera) and riffle beetle (*Stenelmis* spp.) larvae at SSES (Ecology III 2009-TN1572). Riffle beetle, yellow mayfly (*Anthopotamus* spp.), and midge larvae (Chironomidae) generally were the most abundant insect larvae in both years. Fingernail clams (*Musculium* spp.) represented about 16 and 12 percent of the invertebrates collected from the river in 2007 and 2008, respectively. The 2007 samples differed from previous collections by having higher abundances of the amphipod (*Gammarus* spp.) and triclad flatworms (Tricladida). Amphipod and triclad abundances were lower in 2008 than in 2007. Both study results indicated that the invertebrate community at the SSES and BBNPP locations was representative of relatively good quality habitat (PPL Bell Bend 2013-TN3377).

Several mussel studies were conducted near and downriver of BBNPP. Normandeau (2010-TN492) found four freshwater mussel species during a qualitative survey of five areas of the North Branch of the Susquehanna River near Bell Bend in October 2007. All four species occurred at four of the stations; mussels were not found at the station located approximately 1.25 mi upriver of the SSES cooling-water system intake system. Normandeau (2010-TN492) collected many individuals of eastern floater (*Pyganodon cataracta*), elktoe (*Alasmidonta marginata*), triangle floater (*A.undulata*), and yellow lampmussel (*Lampsilis cariosa*).

Normandeau (2012-TN1607) conducted a survey in June 2012 to investigate the occurrence of the brook floater (*A.varicosa*) and green floater (*Lasmigona subviridis*) in the run/glide and riffle areas of the North Branch of the Susquehanna River downriver from the proposed BBNPP site. Normandeau (2012-TN1607) did not find any brook floater individuals in the study area near Swan Island, Heron Island, Hess Island, Rocky Island, and Goose Island. During the timed, semi-quantitative survey involving all five islands, Normandeau (2012-TN1607) found that the yellow lampmussel was the most common of the seven species identified, accounting for about 45 percent of the 264 mussels observed. Also common were elktoe and eastern floater, which when combined, accounted for about 37 percent of the mussels observed. The green floater was found in only one location – the channel between Heron and Swam Islands. During a quantitative survey conducted between Heron and Swan Islands, Normandeau (2012-TN1607) found elktoe, triangle floater, and yellow lampmussel. Elktoe, which was the most abundant of the three species, occurred at an estimated density of 0.32 individuals/m^2.

Kleinschmidt et al. (2012-TN1608) studied river flow conditions and mussel occurrence in the North Branch of the Susquehanna River around Heron and Swan Islands (downriver of the proposed BBNPP site) and in the small channel between the two islands in August and September 2012. The purpose of the study was to evaluate the potential effects of low river flows on mussel populations, particularly those of the green floater, in the area. A semi-quantitative survey that focused on areas around the perimeters of the islands found yellow lampmussel, elktoe, and triangle floater were the predominant mussels; they accounted for about 91 percent of the mussels observed. Kleinschmidt et al. (2012-TN1608) found that yellow lampmussel, green floater, and elktoe were the most abundant mussels within the small channel between the two islands, accounting for about 81 percent of the total mussel abundance in the channel. Green floaters only occurred within the channel. Kleinschmidt et al. (2012-TN1608) estimated that the yellow lampmussel and green floater populations in the channel were about 1,277 and 613 individuals, respectively. Green floaters occurred mainly in nearshore waters that were shallow (mean depth = 14 cm [5.5 in]), slowly flowing (mean velocity = 0.3 fps), and had moderately abundant algal cover (21 percent cover).

Aquatic Plants

Ecology III (2012-TN1645) identified 10 aquatic plant species during its August 2012 survey of submerged aquatic vegetation in the North Branch of the Susquehanna River from about the location of the SSES intake to the Nescopeck Bridge, a distance of about 6 mi. The two most abundant species were water star-grass (*Heteranthera dubia*) and curly pondweed (*Potamogeton crispus*). Ecology III (2012-TN1645) identified the Bell Bend East Bed, which is located on the east shore of the river adjacent to the community of Wapwallopen, as the largest of the five aquatic plant beds observed. Water star-grass and unidentified algal species were the most widespread aquatic plant taxa, each occurring in all five beds. Curly pondweed and Eurasian watermilfoil (*Myriophyllum spicatum*), both non-native species, occurred in three of the five plant beds.

Walker Run

Walker Run is a second order, low- to moderate-gradient stream that flows from Lee Mountain north of the BBNPP project area to its confluence with the North Branch of the Susquehanna River near the community of Beach Haven, Pennsylvania. Walker Run is about 3.6 mi long (PFBC 2009-TN503) and flows south through the western portion of the BBNPP site (Figure 2-17). The protected use designation for Walker Run is for cold-water fish (PA Code 25-93-TN611) and the PFBC added Walker Run to the State list of wild trout streams in December 2009 (Austen 2009-TN1573). Walker Run stream width at the ordinary high-water mark gradually increases or varies considerably during its course through the BBNPP project area. Upstream from its confluence with Unnamed Tributary 1, the Walker Run stream width ranges from about 6 to 41 ft; downstream from the confluence, its width varies from about 6 to 20 ft. Its water depth ranges from about 1 to 3 ft, and its bottom substrate varies from silt and clay to large cobble mixed with fine material (PPL Nuclear Development 2011-TN1905).

Historical agricultural and industrial practices have strongly affected the Walker Run watershed. Stream banks along the stretch of Walker Run downstream from Beach Grove Road to Market Street are 3 to 5 ft high, and the stream flows through a wooded area consisting of shallowly rooted trees that is very susceptible to erosion (LandStudies 2009-TN499) (Figure 2-28). Downstream from Market Street, Walker Run is incised and flows through a long backwater pool with a flat streambed consisting of silt and sand. Walker Run continues to be significantly incised farther downstream to the crossing of an old farm road (a proposed BBNPP access road) at the BBNPP site and has lost its connection to the floodplain. Farmers channelized the stream in this area and moved it to the east to meet agricultural needs. Downstream of the old farm road, Walker Run flows into an area that was affected by a beaver dam that PPL removed in April 2010 (LandStudies 2010-TN1901). Downstream of the former beaver dam, Walker Run is incised and flows through a forested area where the stream level has degraded to match that at a culvert under a private road farther downstream (LandStudies 2009-TN499). The culvert interferes with normal flood flow and keeps sediment from moving downstream. After flowing through the culvert, Walker Run enters a flat area characterized by long pools and riffles. Walker Run eventually flows under Market Street again, passing an earthen berm and a residential area. Many parts of the stream in this downstream stretch are straightened or channelized and are no longer connected to the floodplain. Walker Run then flows along a steeper gradient before flowing through the community of Beach Haven, eventually reaching the North Branch of the Susquehanna River.

Figure 2-28. Walker Run Stretches Between Beach Grove Road and Market Street (top) and North of Old Farm Road (bottom)

The fish community in Walker Run has been the subject of several surveys conducted since the summer of 2006. Normandeau (2011-TN1226) studied the fish community in Walker Run in November 2007, April 2008, and July 2008; results are summarized in Table 2-19. Normandeau (2011-TN1226) found that Blacknose Dace (*Rhinichthys atratulus*), Creek Chub (*Semotilus atromaculatus*), and White Sucker were the most abundant fish in Walker Run regardless of season. The three species accounted for about 78 percent of the fish collected in July 2008 and 86 percent of those collected in November 2007 and April 2008. LandStudies (2009-TN500) studied habitat quality and fish populations at six locations in Walker Run that were chosen to represent relatively high-quality habitat (upstream section) and relatively low-quality habitat (midstream and downstream sections). LandStudies (2009-TN500) found the same dominant three species described in the Normandeau study (Normandeau 2011-TN1226) − Creek Chub, White Sucker, and Blacknose Dace − accounting for about 75 percent of the 1,140 fish captured during the survey. Brown Trout also occurred in all six reaches but were least abundant in the most downstream reach. Fallfish (*Semotilus corporalis*), Tessellated Darter, and Pumpkinseed were unique to the most downstream reach. The Walker Run fish assemblage is generally typical for a cool-water stream in eastern Pennsylvania (Fairchild et al. 1998-TN1611; Walsh et al. 2007-TN1612) with some warm-water fish (e.g., Creek Chub) present.

Normandeau (2011-TN1226) studied the invertebrate community in the midstream section of Walker Run in November 2007 and April and July 2008 in conjunction with fish community surveys. The upstream station showed little variation in the number of individuals collected (1,233 to 1,510) and in the number of taxa present (36 to 46 taxa) each season. Fly larvae (Diptera), primarily non-biting midge larvae (Chironomidae), dominated the collections numerically each season. However, the fly larvae relative abundance decreased from 73 percent in November 2007 to 65 percent in April 2008 and to 49 percent in July 2008. The number of individuals collected at the downstream station increased from 1,161 individuals in November 2007 to 3,765 individuals in April 2008 and declined to 689 individuals in July 2008. Mayfly larvae (Ephemeroptera) and beetle larvae (Coleoptera) were the most common taxa collected in November 2007, accounting for about 34 and 31 percent of the total invertebrates collected, respectively. Fly larvae were predominant at this station in April and July 2008, accounting for 60 and 42 percent of the collections, respectively. Blackfly larvae (*Prosimulium* spp.) accounted for about 54 percent of the invertebrates collected in April 2008. Midge larvae returned to prominence in July 2008, accounting for about 40 percent of the invertebrate catch. Two stations added to the 2008 surveys were located on the main-stem Walker Run about 0.5 mi and 0.75 mi downstream from the BBNPP site. Fly larvae numerically dominated the invertebrate collections at both stations in April 2008, accounting for about 73 and 89 percent of the organisms, respectively. Normandeau (2011-TN1226) concluded that the invertebrate community present in Walker Run was typical for a small cold stream in eastern Pennsylvania.

LandStudies (2009-TN500) collected additional invertebrates in Walker Run in spring 2009 in conjunction with its fish community survey. Blackfly larvae accounted for 41 percent of the individuals collected and were abundant at all stations except the most downstream station. Midge larvae accounted for about 19 percent of the invertebrates collected and were at least three times more abundant at the three stations downstream of Beach Grove Road than they were at the three stations upstream of the road. LandStudies (2009-TN500) concluded that the invertebrate community reflected very good water quality at the four most upstream stations (upstream of Market Street) and good to fair water quality at the two downstream stations (near Unnamed Tributary 1 and near the southern portion of Market Street).

Unnamed Tributaries and North Branch Canal

Unnamed Tributary 1 flows west through the center of the proposed BBNPP site, under an unpaved farm road via a small culvert that occasionally causes an upstream backup of water during periods of high flow and meets Walker Run near Market Street (PPL Bell Bend 2013-TN3377) (Figure 2-17; Figure 2-29). Unnamed Tributary 1 is about 2.1 mi long and drains about a 0.68-mi^2 area (PPL Bell Bend 2013-TN3377). Normandeau (2011-TN1226) sampled the tributary for fish, but not invertebrates, in November 2007 and April and July 2008 (Table 2-19). The EPA Rapid Bioassessment Protocol habitat scores for most of the 10 parameters measured for the tributary were suboptimal or marginal.

Figure 2-29. Unnamed Tributary 1 Upstream of Road Culvert

Fish abundances in the tributary generally were less than those for the other areas sampled within the Walker Run watershed during that period (Table 2-19). Creek Chub was the most abundant species in the tributary in 2007 and April 2008, accounting for about 32 to 70 percent, respectively, of the fish caught. Blacknose Dace was the most abundant species in July 2008, accounting for about 59 percent of the fish caught. Other relatively common species were Green Sunfish and White Sucker. In fall 2009, LandStudies (2010-TN498) sampled invertebrates at two sites upstream from the stream's confluence with Unnamed Tributary 2 and two sites downstream. The study collected 4,652 individuals belonging to 49 taxa. Pill clams (*Pisidium* spp.), amphipods (*Hyalella* spp.), freshwater worms (Oligochaeta), and midge larvae accounted for about 70 percent of the invertebrate community in the tributary. Based on the substrate and invertebrate community data, LandStudies (2010-TN498) concluded that habitat in the tributary was marginal to poor and that water quality was fair to poor.

Unnamed Tributary 2 originates in a forested area within the BBNPP project area near the "teardrop" wetland located east of the proposed BBNPP power block site (Figure 2-17). The perennial stream flows freely upstream of the field and for a short distance before entering

Unnamed Tributary 1, although most of its flow is carried underneath an agricultural field via a 567-ft-long by 8-in.-diameter polyvinyl chloride pipe and tile drainage system (PPL Nuclear Development 2011-TN1906) (Figure 2-30). LandStudies (2010-TN498) evaluated habitat and collected invertebrates from Unnamed Tributary 2 in the fall of 2009.

The fish community within the stream has not been studied. The invertebrate samples collected in fall 2009 from Unnamed Tributary 2, at one station upstream of the agricultural field and one downstream of the field, yielded 2,290 individuals belonging to 25 taxa. The community was characterized by non-biting midge larvae and pill clams, which accounted for about 82 percent of the invertebrates found in the stream. Based on the substrate and invertebrate community data, LandStudies (2010-TN498) concluded that habitat in the tributary was marginal to poor and that water quality was fair to poor.

Figure 2-30. Unnamed Tributary 2 View of Discharge from Polyvinyl Chloride Pipe Toward Unnamed Tributary 1

Unnamed Tributary 3 is a small perennial stream that drains south of the BBNPP project area to the North Branch of the Susquehanna River (Figure 2-17), but is not a part of the Walker Run watershed. Normandeau (2011-TN1226) could not sample the stream effectively for fish during the July 2008 survey because it was too overgrown by plants. Normandeau did not see any fish during visual observations made at the time. Normandeau (2011-TN1226) found 444 invertebrate individuals belonging to 17 taxa in the stream in July 2008. Fly larvae (Diptera) accounted for about 73 percent of the individuals collected, with those in the family Chironomidae (midges) contributing about 52 percent to the total number of fly larvae (Normandeau 2011-TN1226).

Unnamed Tributary 4 is a small intermittent stream that flows from the southeastern corner of the BBNPP project area directly to the North Branch of the Susquehanna River (Figure 2-17). It is not within the BBNPP project area. The stream, which is usually less than 5 ft wide, was dry during the summer sampling in 2008 (PPL Bell Bend 2013-TN3377). No water-quality sampling or biological sampling has occurred recently in the stream.

Unnamed Tributary 5 originates in the south-central part of the SSES site, flows east, and eventually enters the southern tip of Lake Took-A-While (Figure 2-17). It is within the BBNPP project area. Normandeau (2011-TN1226) attempted to sample the biota in the stream in July 2008, but was not successful because the tributary was too overgrown with vegetation. Normandeau (2011-TN1226) did not see any fish during visual observations made at the time. Invertebrate sampling in Unnamed Tributary 5 yielded 8,161 organisms belonging to 16 taxa. An amphipod (*Gammarus* spp.) was the predominant taxon, accounting for about 96 percent of the organisms collected (Normandeau 2011-TN1226). No water-quality sampling has occurred recently in the stream.

North Branch Canal and North Branch Canal Outlet

The North Branch Canal (Figure 2-17), which was built in 1834 as part of the Pennsylvania Canal System, was used to convey barge traffic around a stretch of the North Branch of the Susquehanna River until 1901 (PPL Bell Bend 2013-TN3377; LandStudies 2010-TN1908). The canal is hydrologically connected to Lake Took-A-While to the north (Mangan 2000-TN392), and outflow to the North Branch of the Susquehanna River and Riverlands Area is controlled by a weir known as the North Branch Canal Outlet (LandStudies 2010-TN1908) (Figure 2-31).

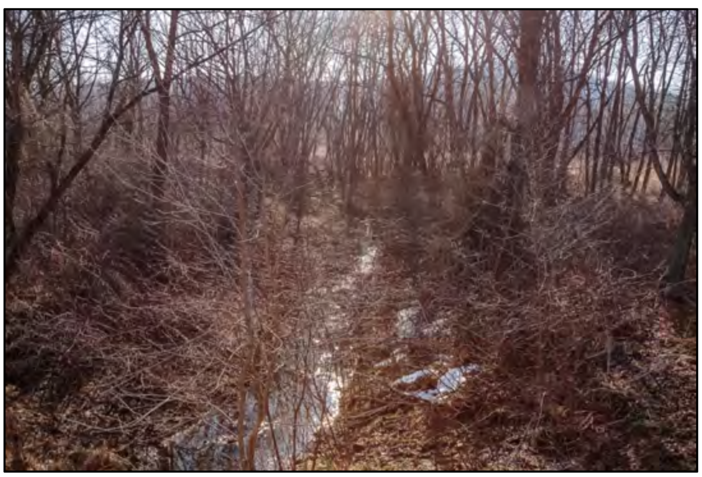

Figure 2-31. North Branch Canal Outlet (view downstream toward Susquehanna River)

Normandeau (2011-TN1226) sampled the North Branch Canal and the North Branch Canal Outlet for fish in April 2010 (Table 2-19). The study found that the fish community within the canal included seven species and was characterized primarily by Bluegill and Green Sunfish, which accounted for about 58 and 15 percent, respectively, of the 59 fish caught. The study collected 159 fish belonging to 12 species from the Canal Outlet. Golden Shiner (*Notemigonus crysoleucas*; 27 percent), Bluegill and Green Sunfish (each 21 percent), and White Sucker (16 percent) were the most abundant species. The fish community in both parts of the canal system represented a typical Pennsylvania warm-water fish community. Normandeau (2011-TN1226) collected an individual Brook Stickleback (*Culaea inconstans*), a PFBC candidate species that usually occurs in vegetated, spring-fed waters that contain a substantial plant community (PNHP 2007-TN1619), from the Canal Outlet. The Brook Stickleback is not otherwise known in Luzerne County, and it is assumed to be a human-directed release (PPL Bell Bend 2013-TN3377).

Normandeau (2011-TN1226) sampled the North Branch Canal for invertebrates in July 2008. The survey found that midge larvae were the predominant invertebrates, and that dragonfly and damselfly (Odonata) larvae, true bug (Hemiptera) larvae, aquatic snails (Gastropoda), and oligochaete worms were common. No mussels were observed in or collected from the canal. LandStudies (2010-TN497) sampled invertebrates in two parts of the Canal Outlet in the fall of 2009. The study collected 1,322 individuals belonging to 28 taxa. Sow bugs (*Caecidotea* spp.), moth larvae (*Neocataclysta* spp.), midge larvae, and flatworms (*Phagocata* spp.) accounted for about 71 percent of the invertebrate community in the Canal Outlet. LandStudies (2010-TN497) stated that this community pattern usually indicates fair to poor water-quality conditions.

Onsite Ponds

Several small ponds occur within the BBNPP project area (Figure 2-17). Spring-fed Johnson's Pond, located just west of Unnamed Tributary 1 in the northwest part of the proposed BBNPP site, is the largest pond; its water depths range as deep as 5 ft (PPL Nuclear Development 2011-TN1824; PPL Bell Bend 2013-TN3377). Johnson's Pond discharges into Unnamed Tributary 1. West Building Pond, Unnamed Pond 1, and Unnamed Pond 2 are three very small, shallow (depths less than 1 ft) ponds located near the center of the BBNPP project area. Farm Pond is a small pond located near the confluence of Unnamed Tributary 1 and Walker Run. Farm Pond is spring-fed by water from the Glacial Outwash aquifer. The aquifer discharge is warm, allowing Farm Pond to remain ice-free in many winters and to have continuous discharge all year, even during dry periods (PPL Bell Bend 2013-TN3377).

Normandeau (2011-TN1226) sampled the fish communities in Johnson's Pond, West Building Pond, Unnamed Pond 1, and Farm Pond in November 2007 and July 2008. Normandeau also made visual observations for fish in Unnamed Pond 2 in July 2008 because the water depth was too shallow for quantitative sampling methods. The study did not find fish in Unnamed Pond 1 or West Building Pond in 2007 or 2008 and did not record any fish in Unnamed Pond 2 in 2008.

The November 2007 sampling in Johnson's Pond yielded 89 fish, mostly Bluegill (96 percent). One fish (Creek Chub) was collected from Farm Pond. The July 2008 sampling produced fish only from Johnson's Pond and Farm Pond. Sampling in Johnson's Pond in 2008 yielded 240 fish, predominantly Bluegill (86 percent). A few Largemouth Bass (10 percent) were caught. Farm Pond sampling produced 52 fish in 2008, predominantly Creek Chub (83 percent) and Blacknose Dace (8 percent). The fish community in Johnson's Pond was fairly typical of those found in warm-water ponds in Pennsylvania (PPL Bell Bend 2013-TN3377) and included species often stocked in ponds. The fish collected from Farm Pond typically do not occur in ponds but inhabit streams and rivers. The reason for their occurrence in the pond is likely human introduction (PPL Bell Bend 2013-TN3377).

Normandeau (2011-TN1226) sampled the invertebrate communities in Johnson's Pond and Unnamed Pond 1 during July 2008. Midge larvae were the predominant invertebrates; dragonfly and damselfly larvae, true bug larvae, aquatic snails, and oligochaete worms were common. No mussels were observed in the ponds.

Lake Took-A-While

Lake Took-A-While is a 30-ac lake that was built in 1979 by connecting and enlarging a wetland and two ponds that were in the site (Mangan 2000-TN392; PPL Nuclear Development 2011-TN1824). All of the lake is included within the BBNPP project area (PPL Bell Bend 2013-TN3377). The lake consists of three basins and is located within the Susquehanna Riverlands Preserve (Figure 2-17). Several small streams, including Unnamed Tributary 5, feed the lake, which discharges into the North Branch Canal. Water depths are typically less than about 5 ft, and water levels are primarily influenced by rainfall. The PFBC stocks Lake Took-A-While with trout annually during its early-season trout-stocking program (PFBC 2014-TN3471). The taxa stocked into the lake have included Brown, Rainbow (*Oncorhynchus mykiss*), and golden rainbow trout (*O. mykiss* hybrid) (PPL Corporation 2010-TN1916), although only Rainbow Trout are listed for the 2014 stocking. Mangan (2000-TN392) studied the fish community in the lake in April 2000. The sampling program caught 722 fish belonging to at least 9 species. Most of the fish were Bluegill (46 percent), Gizzard Shad (*Dorosoma cepedianum*; 24 percent), and Carp (*Cyprinus carpio*; 10 percent) (Mangan 2000-TN392).

2.4.2.2 Aquatic Resources – Offsite Areas

Offsite Streams – Consumptive-Use Mitigation Areas

Offsite areas affected by PPL's CUMP for the proposed BBNPP unit are described in Sections 2.2.2 and 2.3.1.1. Release of water from Cowanesque Lake and from Rushton Mine would be required under SRBC-regulated flow conditions, and would directly affect Cowanesque Lake and River, and Moshannon Creek downriver from the Rushton Mine (SRBC 2012-TN3565). The Cowanesque River is about 40 mi long and flows eastward from Potter County, Pennsylvania, through Tioga County, Pennsylvania, eventually joining the Tioga River just across the New York State border in Steuben County. The river was dammed in 1980, approximately 2.2 mi upstream from its confluence with the Tioga River in Tioga County, forming Cowanesque Lake (USACE 2013-TN3383).

Cowanesque Lake, located in Tioga County, is a 1,050-ac, 5-mi-long lake that is owned and operated by the USACE (USACE 2013-TN3383). The maximum depth of the lake, which occurs near the dam, is approximately 75 ft. The PADEP (2014-TN3450) lists Cowanesque Lake as a Category 2 waterbody because the lake meets its designated aquatic life and potable waterbody uses. However, PADEP (2014-TN3450) also lists the lake as a Category 5 waterbody because atmospheric deposition contributes to fish tissue mercury concentrations that exceed State advisory limits for consumption. The PFBC (2014-TN3422) issued an advisory regarding consuming Largemouth Bass from the lake because of mercury contamination. The most recent PFBC biologist trap-net and electrofishing survey collected 15 species in the lake, the most abundant of which were Alewife (*Alosa pseudoharengus*), Black Crappie (*Pomoxis nigromaculatus*), and Bluegill (Wnuk 2010-TN3417). These three species accounted for about 91 percent of the 2,750 fish caught during the survey. A survey conducted in the late 1990s documented an additional nine species occurring in the lake (EA 2012-TN3371). Wnuk (2010-TN3417) also reported that although Largemouth Bass and Smallmouth Bass densities were relatively low, large bass were available. Most of the fish species in

Cowanesque Lake spawn from April to July. However, Alewife, Carp, Golden Shiner, Green Sunfish, and Pumpkinseed extend the breeding period into August (EA 2012-TN3371).

The lake has about 178 ac of shallow-water habitat that occurs at depths of 0 to 7 ft at various locations, with the largest area of shallow-water habitat being near the head of the lake (EA 2012-TN3371). EA Engineering surveyed submerged aquatic vegetation in the shallow-water habitats in 2011 and reported that about 73 ac had 100 percent cover or otherwise were considered to have high densities of submerged aquatic vegetation. These high-density beds were scattered mainly along the north and south shores, but not at the head of the lake. The primary submerged aquatic vegetation species is the Eurasian watermilfoil, a non-native species. Other submerged aquatic vegetation species were not reported.

Shallow-water submerged aquatic vegetation beds provide valuable habitat for many of the lake's fish species, including Largemouth Bass (and other sunfish), Yellow Bullhead (*Ameiurus natalis*), carp, and Yellow Perch (*Perca flavescens*) (EA 2012-TN3371). Walleye and Smallmouth Bass use shallow-water boulder and gravel habitats. The USACE, in conjunction with the PFBC and FWS, has provided many artificial habitats for fish, including porcupine cribs, root wads, black bass (Smallmouth Bass and Largemouth Bass) nesting structures, short vertical planks, and rock rubble piles in shallow (less than 7 ft) to moderate (to approximately 30 ft) waters along the north and south shores of the lake (PFBC 2013-TN3423). Information about the macroinvertebrate communities in the lake is not available.

The Cowanesque River downstream of the dam at Cowanesque Lake is a fifth order stream, which has a protected use designation for warm-water fish (Figure 2-32) (PA Code 25-93-TN611). The PADEP (2014-TN3450) lists the river as not being supportive of aquatic life because of siltation, thermal modifications, and organic enrichment/low dissolved oxygen. The PFBC (2014-TN3422) issued an advisory for the stretch of the river below the dam limiting consumption of Black Crappie to two meals per month because of mercury contamination.

Figure 2-32. Cowanesque River (view downstream from Cowanesque Dam)

Brightbill and Bilger (1999-TN3379) studied the fish community in the downstream reach of the river relatively near its confluence with the Tioga River in 1998. This fish community included

22 species, 14 of which were not found at another station upstream of the lake. The predominant species downstream of the dam were the Tessellated Darter, White Sucker, Bluntnose Minnow, and Shield Darter (*Percina peltata*). These four species accounted for about 62 percent of the fish caught. Bleech (1999-TN3425) reported that 20-lb Channel Catfish (*Ictalurus punctatus*), which are not usually found in small creeks, have been caught by fishers in the tailwaters just below the Cowanesque Dam. Based on a series of biological metrics, Brightbill and Bilger (1999-TN3379) concluded that the fish community here was fair.

The SRBC reported on the habitat and macroinvertebrate community at two stations in the river downstream of the dam from 2007 to 2011. One station (COWN 2.2) is located just downstream from the Cowanesque Dam and is affected by flood-control releases from the dam (Henning 2012-TN3387). The other station (COWN 1.0) is located about 1.2 mi downstream of the dam and is considered a recovery zone from the water released by the dam during flood-control operations. The SRBC report described the channel as being heavily modified and the streambed as having no cover. During the most recent assessment (2011), habitat at COWN 2.2 was described as “supporting” (i.e., scores for habitat metrics were about 75 to 89 percent of those at a reference stream), which is the second highest rating category. Water quality at the station is categorized via use of a water-quality index, with values ranging from 1 to 100, and high scores describing poor water quality. The water-quality scores measured in 2011 at COWN 2.2 ranged from about 40 to 65, with manganese concentrations reported to be greater than the accepted limits.

Biological condition is estimated by a complex combination of seven macroinvertebrate indicators mostly based on the EPA Rapid Bioassessment Protocol. The biological condition at COWN 2.2 from 2007 to 2010 was rated as moderately impaired but was rated as severely impaired in 2011. The 2011 score was the lowest biological condition score of any stream monitored by the SRBC that year. At the station (COWN 1.0) in the recovery zone, the stream bank is affected by a nearby road; however, habitat at this station in 2011 was described as “supporting” (Henning 2012-TN3387). Water-quality scores at the station ranged from about 30 to 60, with the concentrations of all measured parameters being within acceptable limits. The biological condition at the station ranged from slightly to moderately impaired from 2007 to 2009 and was classified as nonimpaired in 2010 and 2011.

Moshannon Creek

Treated effluent from Rushton Mine flows into Moshannon Creek, which flows from about the Centre/Blair County boundary northeast to its confluence with the West Branch of the Susquehanna River near Karthaus, Pennsylvania. Much of the watershed is affected by abandoned mine drainage, which has contributed to high concentrations of metals in the stream. The PADEP (2014-TN3450) lists Moshannon Creek as impaired because of siltation from abandoned mine drainage and residential runoff and lists a target date of 2017 for the development of total maximum daily loads. Despite the effects of abandoned mine drainage, the protected-use designation for the stretch of Moshannon Creek downstream of Osceola Mills, past the Rushton Mine, to its confluence with the Susquehanna is for trout-stocking and migratory fish (PA Code 25-93-TN611). No additional information about the aquatic resources in the creek is available.

2.4.2.3 Important Aquatic Species and Habitats

Important species include those that are commercially or recreationally important species; Federally listed threatened, endangered, or candidate species; and those species listed by the Commonwealth of Pennsylvania as threatened or endangered, or identified as a candidate species by the PFBC that could be affected by building or operating the proposed unit on the BBNPP site. Species essential to the maintenance or survival of the above species, species of historical importance, or non-native or nuisance species are also included. Important aquatic habitats include wildlife sanctuaries, refuges and preserves, and critical habitats for listed species.

Recreationally Important Species – Site and Vicinity

There are no commercial fisheries or commercial bait operations listed for this area of the North Branch of the Susquehanna River (PPL Bell Bend 2013-TN3377; PDA Undated-TN688). There is recreational fishing in the North Branch of the Susquehanna River near the proposed BBNPP site that is directed primarily to Smallmouth Bass, Muskellunge, Channel Catfish, and Walleye. The Susquehanna River Smallmouth Bass fishery has been an economically important factor in the region but has been declining river-wide since about 2005 (Arway and Smith 2013-TN2914). The fishery is catch-and-release only from about Sunbury to the Holtwood Dam (PFBC 2014-TN3403). The Walleye fishery in the North Branch of the Susquehanna River is self-sustaining (PFBC 2011-TN2930). Other species that are fished recreationally include Northern Pike, Yellow Perch, and Bluegill (PPL Bell Bend 2013-TN3377). These species are regulated by the PFBC. Trout, including Brown Trout, are important recreational fish in cold-water streams in the region. Only Brown Trout, which is found in Walker Run, occurs on the BBNPP site. The distribution, habitat, and life-history characteristics of these fish species are provided in Table 2-20.

Smallmouth Bass and Walleye generally were the most commonly collected species during surveys conducted in the Bell Bend section of the North Branch of the Susquehanna River from 2004 to 2010. Smallmouth Bass accounted for about 19 to 50 percent and Walleye about 7 to 39 percent of the electrofishing catch at Bell Bend during that time (Ecology III 2009-TN1572; Ecology III 2010-TN1174; Ecology III 2011-TN1175; PPL Bell Bend 2013-TN3377). Smallmouth Bass are affected by columnaris, an infection caused by the bacterium *Flavobacterium columnare,* which is commonly found in soil and water. Columnaris primarily affects young-of-the-year Smallmouth Bass that encounter environmental or nutritional stresses (PFBC 2009-TN1814). Diseased bass were observed in Susquehanna River and Juniata River in 2005 and 2007 (PFBC 2009-TN1814). Unusually high temperatures coupled with low dissolved oxygen levels in the water are believed to have played a major role in the outbreaks in 2005 and 2007. The disease was again observed in the Susquehanna River Basin in 2008, including at a site downriver from the proposed BBNPP site near the Luzerne-Columbia County line (Chaplin et al. 2011-TN1818). The probable cause of the disease was low river flow and high water temperatures that led to low dissolved oxygen in Smallmouth Bass young-of-the-year habitat (Chaplin et al. 2011-TN1818). The disease has been found in the West Branch of the Susquehanna River, the Lower Susquehanna River, and the North Branch of the Susquehanna River in Bradford County (Crawford 2009-TN1819), which is well upriver from Bell Bend. Field staff observed the disease in Smallmouth Bass in the Bell Bend area in 2005 and 2010, both years of low flow and relatively high water temperatures (Normandeau et al. 2012-TN1945).

Table 2-20. Distribution, Habitat, and Life-History Characteristics of Recreational Fish Species in the BBNPP Area[a]

Common Name	Scientific Name	Pennsylvania Distribution	Habitat	Spawning	Diet	Onsite Occurrence/Notes[b]
Channel Catfish	*Ictalurus punctatus*	Statewide; often introduced	Clean sand, gravel, or rock-rubble bottoms in moderately large to large rivers; deep pools	Spring; 80°F; nest is hole or depression in an undercut bank, burrow under logs or rocks; egg mass adhesive, guarded by male	Young − mayfly nymphs, caddisfly larvae, midge larvae; adults − fish, crayfish, mollusks	Entrained (very common), impinged (common); not abundant in Susquehanna River surveys
Muskellunge	*Esox masquinongy*	Northwest PA, Lake Erie, Ohio River watersheds; not native to Susquehanna River	Cool, shallow water; slow pools, quiet backwaters with aquatic weeds; rocky shoals	Live to 20 yr; spawn in spring; ~60°F; shallow-water stumps/logs; adhesive eggs; fry attach to sunken debris, mortality high; mature at 3 yr, 20 in.	Mainly fish; also snakes, frogs, muskrats, mice, waterbirds	Not entrained or impinged; not abundant in Susquehanna River surveys
Northern Pike	*Esox lucius*	Native Ohio, Allegheny River watersheds, Lake Erie; stocked elsewhere	Rivers and large streams, in pools and backwaters, with weeds; clear and cool-water fish; shallow parts of lakes, ponds	Live to 25 yr; early spring; 40–50°F; eggs adhesive, broadcast randomly over plants, organic debris; fry attach to plants	Young – newly hatched suckers, other fish; adults–fish, frogs, tadpoles, birds, muskrats, mice, crayfish, leeches, large aquatic insects	Not entrained or impinged; not abundant in Susquehanna River surveys

Table 2-20. (contd)

Common Name	Scientific Name	Pennsylvania Distribution	Habitat	Spawning	Diet	Onsite Occurrence/Notes[(b)]
Brown Trout	*Salmo trutta*	Not native; naturalized, widespread	Cold or cool streams, rivers, lakes, ponds; water 50–60°F; relatively tolerant of siltation, high temperatures, low pH	Live 10–12 yr; fall; 40–45°F; shallow depression in gravel; eggs hatch in spring	Aquatic, terrestrial insects, crayfish, other crustaceans, fish. Larger fish may eat small mammals, salamanders, frogs, turtles	Not entrained, impinged (rare); not collected in Susquehanna River surveys; reproducing population occurs in Walker Run
Bluegill	*Lepomis macrochirus*	Statewide; not native	Slower parts of warm-water streams, rivers; lakes, small farm ponds; weeds	May to August; minimum 67°F; small depressions in sand, gravel; males guard nests	Aquatic insects, crustaceans, minnows, plants	Possibly entrained (genus recorded), impinged (common); eastern floater glochidial host
Smallmouth Bass	*Micropterus dolomieu*	Statewide; not native	Rivers, lakes, rocky, deep, fast-water river stretches; gravel or boulders riffles in streams; summer water temperature 60–80°F	May to June; 60–70°F; circular depression in gravel, sand; shallow water; defended by males	Young – small crustaceans; larger fish – insect larvae, crayfish, fish	Entrained (common); impinged (rare); abundant in Susquehanna River surveys
Walleye	*Sander vitreus*	Statewide; introduced to Susquehanna, Delaware River watersheds	Large streams, rivers; large lakes; cool (<85°F), clear, deep water; gravel, sand, rocky bottoms	Early spring; 45–50°F; adhesive, eggs deposited in spaces between rocks, gravel; flowing water transports young out of nursery area	Young – zooplankton; adult – fish, frogs, crayfish, large insect larvae	Entrained (uncommon), impinged (rare); abundant in Susquehanna River; schooling fish

Table 2-20. (contd)

Common Name	Scientific Name	Pennsylvania Distribution	Habitat	Spawning	Diet	Onsite Occurrence/Notes[(b)]
Yellow Perch	*Perca flavescens*	Statewide	Shallow waters in warm or cool lakes, ponds, slow-moving streams; sand, gravel bottom, submerged plants	April to May; 45–55°F; eggs in long, sticky, semibuoyant gelatinous mass	Young – zooplankton, small aquatic insects; adult – small fish, aquatic insects, crustaceans	Entrained (common), impinged (rare); not abundant in Susquehanna River surveys; yellow lampmussel, eastern elliptio, eastern floater glochidial host; schooling fish

(a) Sources: Ecology III 2011-TN1175; Johnson and Dropkin 1993-TN2924; Kneeland and Rhymer 2008-TN1658; Normandeau 2010-TN491; Normandeau 2011-TN1226; PNHP 2012-TN647; Steiner 2000-TN1918.
(b) Entrainment or impingement refers to studies conducted of the SSES intake system (Normandeau 2010-TN491).

Channel Catfish and larger predators, such as Northern Pike and Muskellunge, were caught each year, but were not abundant. Bluegill occurrence in the North Branch of the Susquehanna River at Bell Bend from 2004 to 2010 was sporadic. Bluegill abundance was highest in seine samples collected in 2005, 2007, and 2008 at the SSES (Ecology III 2009-TN1572; PPL Bell Bend 2013-TN3377). The PFBC stocked the stretch of the North Branch of the Susquehanna River between Pittston and Wapwallopen Creek with about 750 to 2,800 Muskellunge fingerlings every year from 2004 to 2013 (PFBC 2014-TN3468). The PFBC (Austen 2009-TN1573) designated Walker Run as a Wild Trout Stream but does not stock the stream (PFBC 2014-TN3471). The PFBC issued a fish consumption advisory in 2014 that included the general caution to eat no more than one meal (one-half pound) per week of sport fish (including stocked trout) caught in the waterways of the Commonwealth (PFBC 2014-TN3422). The advisory for the North Branch of the Susquehanna River in Luzerne County cautions people to consume no more than two meals per month of Smallmouth Bass (mercury contamination) or more than one meal per month of Channel Catfish, Quillback, Carp, or Walleye (because of polychlorinated biphenyl [PCB] contamination) and not to eat any sucker species (PCB contamination) (PFBC 2014-TN3422).

Consumptive-Use Mitigation Areas

There are no commercial fisheries in Cowanesque Lake, Cowanesque River, and Moshannon Creek (PDA Undated-TN688). Cowanesque Lake is a popular recreational fishing area. The primary game fish caught in the lake are Smallmouth Bass, Largemouth Bass, Black Crappie, Muskellunge, and tiger muskellunge (Muskellunge *Esox masquinongy* x Northern Pike E. *lucius*) (USACE 2013-TN3383). Other recreational fish include Yellow Perch, Brown Bullhead, Yellow Bullhead, and various sunfish species. Cowanesque Lake hosts several fishing tournaments each year (EA 2012-TN3371). The PFBC has historically stocked Cowanesque Lake with Walleye, Muskellunge, tiger muskellunge, Largemouth Bass, Rainbow Trout, Lake Trout (*Salvelinus namaycush*), Black Crappie, White Crappie (*Pomoxis annularis*), Striped Bass (*Morone saxatilis*), and Channel Catfish (USACE 2011-TN3424; PFBC 2014-TN3421). There are no recreational fishing reports available for the Cowanesque River below the dam, or for Moshannon Creek.

Species of Historic Interest.

Two migratory species that have historical ties to the BBNPP section of the North Branch of the Susquehanna River are the American Shad (*Alosa sapidissima*) and the American Eel (*Anguilla rostrata*). The American Shad is an anadromous fish species that enters freshwater to spawn after spending much of its life in ocean waters. The shad fishery was prominent on the northeast U.S. coast from the mid-1700s until its decline because of overfishing and loss of important spawning habitat (Murdy et al. 1997-TN1938). Shad once constituted an important fishery along the Susquehanna River and its tributaries (PFBC 2007-TN1700). The shad fishery in the North Branch of the Susquehanna River was particularly important, accounting for hundreds of thousands of fish per year. The fishery began to decline after 1830 when dams were built on the river to support the Pennsylvania Canals System (PFBC 2007-TN1700). Some of these dams were abandoned in the late 1800s and the shad runs returned upriver of those former dam sites for a brief period until being eliminated from most of the upriver habitats by the construction of four hydroelectric power dams on the lower river in the early 1900s. Restoration efforts began in the 1950s and have continued with the building of fish passages across the dams and the stocking of hatchery-raised fish (SRAFRC 2010-TN1701). The number of shad passing each dam decreases upstream such that the number passing York Haven Dam (farthest upstream) annually typically is about 1 to 2 percent of those passing Conowingo Dam (farthest downstream). In 2013, 12,733 shad passed Conowingo, 2,503 passed Holtwood, 1,927 passed Safe Harbor, and only 202 passed York Haven (PFBC 2013-TN2931). American Shad are not present in the North Branch of the Susquehanna River near BBNPP (PPL Bell Bend 2013-TN3377). The PFBC stocked American Shad fry both well upriver and downriver of the BBNPP site in the North Branch of the Susquehanna River from 2000 to 2013 (PFBC 2014-TN3468).

The American Eel is a catadromous fish species that spends most of its life in freshwater and returns to the ocean (Sargasso Sea) to spawn. A large commercial eel fishery existed in the Susquehanna River until the early 1900s when dam construction blocked eel passage (Steiner 2000-TN1918). Efforts are under way to restore eels to the Susquehanna River above the Conowingo Dam (Minkkinen and Park 2011-TN1719). Few American Eels are present in North Branch of the Susquehanna River near BBNPP (PPL Bell Bend 2013-TN3377), although the PFBC has stocked American Eel fingerlings in recent years in various portions of the Susquehanna River and some tributaries (PFBC 2014-TN3468). No American Eels were captured recently during the electrofishing surveys conducted at the Bell Bend location in 2010 and 2011 (Ecology III 2010-TN1174; Ecology III 2011-TN1175).

Non-Native, Nuisance, and Pest Species

One taxon that is considered a nuisance or pest, the non-native Asian clam (*Corbicula fluminea*), is known to occur in the BBNPP section of the North Branch of the Susquehanna River (Ecology III 2008-TN391; Ecology III 2009-TN1572). Blackflies (*Simulium* spp. and *Prosimulium* spp.) were found in Walker Run and Unnamed Tributary 2 (PPL Bell Bend 2013-TN3377), but it is not known whether any were the species targeted for suppression by the PADEP. Several other nuisance taxa, including two plant species, occur or have the potential to occur at the site and are discussed in this section.

Asian clam (*Corbicula fluminea*)

The Asian (also known as Asiatic) clam, which was first introduced to the U.S. Pacific Coast in 1938, is characterized by fast growth and a high reproduction rate. Juvenile clams are small, which facilitates their colonization of piping systems, such as those found at power plants. The species probably entered Pennsylvania by 1973 and was documented below Conowingo Dam in 1980 (Nichols and Domermuth 1981-TN1950). Asian clams likely reached the confluence of the West Branch of the Susquehanna River and North Branch of the Susquehanna River by 1990 and reached Bloomsburg by 2001 (Mangan 2002-TN1705). The clam has since become established in the North Branch of the Susquehanna River at the proposed BBNPP site. Asian clams were found in the SSES engineered safeguard service water spray pond in July 2005 (72 FR 68598-TN1706) and the pond was treated with an approved molluscicide (NRC 2009-TN1725). Ecology III collected 438 individuals at the Bell Bend location in 2007 but collected only 4 individuals at the Bell Bend location in 2008 (Ecology III 2008-TN391; Ecology III 2009-TN1572). The 2007 sampling study found that *Corbicula* densities in the river were 871 to 1,816 clams/m^2 at the Bell Bend location (Ecology III 2008-TN391), and were much greater than they were at a location upriver of the SSES intake (25 to 49 clams/m^2).

Black flies (*Simulium* and *Prosimulium* spp.)

Black flies are pest species that have aquatic larval stages and cause problems primarily for humans (bites at times cause severe reactions) and domestic animals but also may affect wildlife. Black fly outbreaks have caused deaths in domestic animals and wildlife (PADEP 2013-TN1707). Black flies may contribute to nestling raptor mortality by harassing nestlings causing them to fall or jump from the nests, by transmitting a protozoan infection, or by blood loss and dehydration (Smith et al. 1998-TN1708). Pennsylvania has a black fly suppression program that aerially sprays *Bacillus thuringiensis israelensis* (Bti), a naturally occurring soil bacterium, onto rivers during the spring and summer (PADEP 2013-TN1709). Luzerne County and several counties in the proposed CUMP area are among the 33 participating counties (PADEP 2013-TN1709). Black flies belonging to two genera were found in waterbodies on the BBNPP site. *Simulium* spp. were found in Unnamed Tributary 2 (n=9) and Walker Run (n = 5 to 26) in July 2008 (PPL Bell Bend 2013-TN3377). The other genus, *Prosimulium*, was abundant at three stations in Walker Run in April 2008, accounting for about 11 to 84 percent of the macroinvertebrates collected (PPL Bell Bend 2013-TN3377). The high abundance may have reflected a short-term seasonal bloom that often occurs (Normandeau 2011-TN1226). Black flies for either genus were not found in the North Branch of the Susquehanna River sampling conducted in 2007 (Ecology III 2008-TN391), but *Simulium* sp. was found at a location upriver of the SSES intake (n=6) during sampling conducted in 2008 (Ecology III 2009-TN1572).

Zebra mussels (*Dreissena polymorpha*)

Zebra mussels first occurred in North America in 1988 (Strayer 2009-TN1710). Since then, the species has spread over much of the United States. Zebra mussels affect aquatic ecosystems principally by changing the trophic dynamics from a water-column-based to a benthic-based food web by removing large quantities of plankton from the water column (Strayer 2009-TN1710; Higgins and Vander Zanden 2010-TN1711). Zebra mussels also colonize hard substrates within power plants, including intake pipes and onsite storage ponds (Connelly et al. 2007-TN1712). Removing mussels from power plant structures can be costly and may involve physical or chemical methods or replacement of fouled structures (Connelly et al. 2007-TN1712).

The presence of zebra mussels in the Susquehanna River Basin has been documented for several widespread locations. The USGS database has zebra mussel records (and date of first record) in Pennsylvania for Cowanesque Lake (2007) and several locations near Hallstead, Pennsylvania (2007), both on the upper region of the North Branch of the Susquehanna River (USGS 2014-TN3410). The database also has one record for the Susquehanna River main stem at Selinsgrove, Pennsylvania (2013), and one in the lower part of the main stem at the Muddy Run Reservoir (2008). Zebra mussels are also recorded from the Conowingo Dam area in the Maryland part of the Lower Susquehanna River (Venesky 2009-TN650; USGS 2014-TN3410). Records for the New York part of the Susquehanna River include Windsor (2007), which is upriver from Hallstead, and several locations between Conklin (2007) and Apalachin (2007) (USGS 2014-TN3410).

There are no records in the USGS database for the BBNPP region of the North Branch of the Susquehanna River (USGS 2014-TN3410). However, seven zebra mussels were found attached to pump screens in the pump forebays of the SSES emergency service spray ponds in August 2011 (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2013-TN3377), although no mussels were seen in the main body of the pond. The size of the mussels in the spray pond suggested that they had survived molluscicide treatments.

Rusty crayfish (*Orconectes rusticus*)

Non-native crayfish can disrupt aquatic ecosystems by reducing the abundance of aquatic plants, invertebrates (particularly snails), and other crayfish (Lodge et al. 2000-TN1714). The rusty crayfish is native to the Ohio River drainage and was first discovered in Pennsylvania in 1976 in the Lower Susquehanna River (Sea Grant Pennsylvania 2012-TN1715). The rusty crayfish has increased in abundance in the river and has been found in the main stem of the Susquehanna River near Sunbury (Mangan 2010-TN635; Mangan and Bilger 2012-TN1568). It occurs in the upper Susquehanna River (New York) and could be replacing native or established crayfish (Kuhlmann and Hazelton 2007-TN1716). Data from several regions suggest that rusty crayfish occur at higher densities than the native crayfish in streams where they co-occur (Kuhlmann and Hazelton 2007-TN1716; Bobeldyk and Lamberti 2010-TN1802; Mangan 2010-TN635). Rusty crayfish consume greater amounts of prey than native species of similar size (Kuhlmann and Hazelton 2007-TN1716) and are less susceptible to predation, especially by Smallmouth Bass (Kuhlmann and Hazelton 2007-TN1716).

Flathead Catfish (*Pylodictis olivaris*)

The Flathead Catfish in the Susquehanna River drainage currently occurs only downriver from Danville, Pennsylvania, to the Conowingo Dam (Brown et al. 2005-TN1804). However, fish passages around dams, such as those provided as part of the shad restoration efforts, may provide access to more than 600 mi of river. This catfish species is a large piscivorous fish that is also prized as a food and sport fish and can weigh more than 110 lb. Flathead Catfish inhabit deeper, sluggish pools in large rivers, such as the Susquehanna River. The main concern is that Flathead Catfish will compete with native fish populations and may eliminate native catfish (Sea Grant Pennsylvania 2012-TN1813) or adversely affect Smallmouth Bass populations (PFBC 2009-TN1814). There is some evidence of naturally reproducing Flathead Catfish populations in the Lower Susquehanna River near Brunner Island (Brown et al. 2005-TN1804).

Curly pondweed (*Potamogeton crispus*)

Curly pondweed occurs in the North Branch of the Susquehanna River near the Bell Bend site. Ecology III (2012-TN1645) found the species in the Bell Bend pool and off Goose and Hess Islands, which are about 3 to 4 mi downriver from the Bell Bend site. Curly pondweed was the second-most abundant aquatic plant found during the qualitative survey. Curly pondweed can grow rapidly to a length of about 6 ft and can crowd out native species (PSU 2009-TN696). The plant often dies back during late summer but can persist through winter. The late summer dieback can contribute to water-quality issues.

Eurasian watermilfoil (*Myriophyllum spicatum*)

The Eurasian watermilfoil occurs in the Bell Bend region of the North Branch of the Susquehanna River. Ecology III (2012-TN1645) found the species in the Bell Bend pool and off Goose and Hess Islands. Eurasian watermilfoil has long stems with four to five whorls of featherlike leaves that often form a thick canopy on the water surface that may limit light reaching native plants (PSU 2008-TN1815). Although the species provides food for some animals and habitat for others, it grows rapidly to levels that can create water-quality issues.

Didymo (*Didymosphenia geminata*)

Didymo, also called "rock snot", is an invasive diatom species (a type of single-celled algae) that forms large colonies on river-bottom rocks and plants (Sea Grant Pennsylvania 2013-TN2938). Didymo tolerates a variety of water-flow and nutrient conditions. When didymo forms large colonies, it can cover river bottoms, reducing available benthic habitat and smothering indigenous plants and animals. These effects can translate into effects on tourism, fishing, and hydropower generation. Didymo was first documented in the Susquehanna River Basin in 2013, and its occurrence is currently limited to the main stem (Lycoming County) and the West Branch (Potter County) of Pine Creek (SRBC 2013-TN2944).

Federally and State-Listed Species – Site and Vicinity

There are no Federally protected species inhabiting the freshwater habitats onsite or in the North Branch of the Susquehanna River near the proposed BBNPP unit (FWS 2013-TN3847). The brook floater, which may occur in the North Branch of the Susquehanna River, is listed as Pennsylvania endangered, and the Eastern Mudminnow (*Umbra pygmaea*) is identified as a PFBC candidate species for Luzerne County, but it is not likely to occur on the site.(Table 2-21).

Table 2-21. Aquatic Animal Species in Luzerne County, Pennsylvania, that Are State-Listed or Identified by PFBC as a Candidate Species

Common Name	Scientific Name	State Status[a]	Occurrence on Site[b, c]
Fish			
Eastern Mudminnow	*Umbra pygmaea*	PC	NR/NL; slow-moving, muddy streams, ponds with much plant growth
Mussel			
Brook floater	*Alasmidonta varicosa*	PE	NR/P; riffle areas in rivers, streams; glochidial hosts known from site

(a) PC = PFBC candidate species; PE = Pennsylvania endangered.
(b) P = possibly occurs on site, habitat exists on site; NL = not likely to occur onsite, appropriate habitat not present; NR = not recorded during any onsite faunal surveys.
(c) Habitat information from PNHP (2013-TN1777) and PPL (PPL Bell Bend 2013-TN3377).

Eastern Mudminnow (*Umbra pygmaea*)

The Eastern Mudminnow is a PFBC candidate species. This species usually is smaller than 6 in. long and lives in slow-moving, muddy streams and ponds where there is considerable plant growth (PNHP 2012-TN694). Eastern Mudminnows were not collected during the aquatic surveys conducted on the site in 2007 and 2008 (Normandeau 2011-TN1226) or in surveys of the North Branch of the Susquehanna River at the Bell Bend location (Ecology III 2008-TN391; Ecology III 2010-TN1174; Ecology III 2011-TN1175).

Brook floater (*Alasmidonta varicosa*)

The brook floater reaches a length of about 2.8 in. (PNHP 2012-TN647). The species occurs in 12 Pennsylvania counties located primarily in the middle of the Commonwealth, from New York to Maryland. Brook floaters live in gravel or sand and gravel substrates in riffle areas of rivers and streams. Males fertilize eggs in July and August, and females brood the eggs from August through April, releasing glochidial larvae from April through June (DePhilip and Moberg 2010-TN1652). Glochidial larval hosts include Blacknose Dace, Longnose Dace (*Rhinichthys cataractae*), Golden Shiner, Pumpkinseed, Slimy Sculpin (*Cottus cognatus*), Yellow Perch, and Margined Madtom (*Noturus insignis*). There are no historical or current records of brook floater from Luzerne County (NatureServe 2014-TN3969), and Normandeau (2012-TN1607) and Kleinschmidt et al. (2012-TN1608) did not find the species during their surveys of the North Branch of the Susquehanna River downriver from the site of proposed BBNPP unit in 2012. However, the glochidial host species do occur near the BBNPP site, and there is habitat in the area that would support this species.

Aquatic Plants

Pennsylvania lists eight threatened or endangered aquatic plant species for Luzerne County (Table 2-22). State-endangered species listed for Luzerne County are small-floating manna-grass (*Glyceria borealis*), Beck's water-marigold (*Megalodonta beckii*), broad-leaved watermilfoil (*Myriophyllum heterophyllum*), grassy pondweed (*Potamogeton gramineus*), and Vasey's pondweed (*P. vaseyi*) (PNHP 2014-TN3971). Beck's water-marigold and grassy pondweed are not likely to occur on the site because of the lack of suitable habitat on the site. Habitat for Vasey's pondweed is vaguely described to include ponds, and the species' occurrence on the site cannot be excluded. Habitat for small-floating manna-grass and broad-leaved watermilfoil is vaguely described as shallow lakes, streams, or ponds, and the species' occurrence on the site is unlikely but cannot be excluded. Three State-threatened species listed for Luzerne County—Tuckerman's pondweed (*P. confervoides*), bushy naiad (*Najas gracillima*), and flat-leaved bladderwort (*Utricularia intermedia*)—are not likely to occur on the site because of the lack of suitable habitat on the site (NatureServe 2013-TN2928). Ecology III (2012-TN1645) did not find any State-listed aquatic plant species during its August 2012 survey of submerged aquatic vegetation in the North Branch of the Susquehanna River.

Important Species – Consumptive-Use Mitigation Areas

To determine the important aquatic species in aquatic areas within the proposed CUMP, the NRC team obtained lists of protected species from the PNHP for each county in which a potentially affected aquatic resource exists, and from NYNHP for Steuben County in New York (NYNHP 2014-TN3988). The species listed for each county were evaluated only for occurrence within the proposed CUMP for Cowanesque Lake (Tioga County, PA) Cowanesque River (Tioga County, PA, and Steuben County, NY), and Moshannon Creek (Centre County, PA).

There are no Federally protected aquatic species listed for Tioga and Centre Counties (FWS 2014-TN3967). In addition to the already described Pennsylvania endangered brook floater, three Pennsylvania endangered aquatic plant species are listed as possibly occurring in counties included within CUMP area, and the State of New York lists the brook floater and the green floater as threatened for Steuben County, New York (Table 2-23).

Table 2-22. Aquatic Plant Species in Luzerne County, Pennsylvania, that are State-Listed as Threatened or Endangered

Common Name	Scientific Name	State Status[a]	Occurrence Onsite[b,c]
Small-floating manna-grass	*Glyceria borealis*	PE[d]	NL?; shallow waters in lakes, streams
Beck's water-marigold	*Megalodonta beckii*	PE	NL; calcareous lakes, swamps
Broad-leaved watermilfoil	*Myriophyllum heterophyllum*	PE	P?; ponds, lakes
Bushy naiad	*Najas gracillima*	PT[d]	NL; very clear, softwater lakes and ponds; streams; muddy, sandy, or peaty substrates.
Tuckerman's pondweed	*Potamogeton confervoides*	PT	NL; glacial lakes and boggy ponds
Grassy pondweed	*Potamogeton gramineus*	PE	NL; lakes, deep streams
Vasey's pondweed	*Potamogeton vaseyi*	PE	P?; ponds, lagoons, slow flows
Flat-leaved bladderwort	*Utricularia intermedia*	PT	NL; lakes, floating bog mats

(a) PE = Pennsylvania Endangered; PT = Pennsylvania Threatened.
(b) P = possibly occurs on site, habitat exists on site; NL = not likely to occur on site, appropriate habitat not present; ? = uncertain, no definitive distribution data, habitat descriptions differ, too general.
(c) Habitat information from PNHP (2014-TN3971); PPL (PPL Bell Bend 2013-TN3377); UC Berkeley (2012-TN1663); NatureServe (2013-TN2928).
(d) Recommended for removal from the Pennsylvania State list of endangered and threatened species because they are more abundant than previously realized (Morris Arboretum 2012-TN1665).

Table 2-23. Aquatic Species that Are Pennsylvania/NewYork State-Listed and Their Potential for Occurrence in Consumptive-Use Mitigation Areas

Common Name	Scientific Name	State Status[a]	County[b]	Occurrence in Area[c]
Mussels				
Brook floater	*Alasmidonta varicosa*	PE/NYT	T, S	P; small streams, large rivers with good, clean water flow
Green floater	*Lasmigona subviridis*	NYT	S	P, small streams, large rivers with good, clean water flow
Plants				
Northern water-plantain	*Alisma triviale*	PE	T	NL?; stream, ditch, lake margins
Small-floating manna-grass	*Glyceria borealis*	PE[d]	Ce	NL; shallow waters in lakes, streams
Grassy pondweed	*Potamogeton gramineus*	PE	Ce	NL; lakes, deep streams

(a) PE = Pennsylvania Endangered; NYT = New York Threatened.
(b) Ce = Centre; S = Steuben; T = Tioga.
(c) P = possibly occurs within consumptive-use mitigation area, habitat exists within area; NL = not likely to occur within consumptive-use mitigation area, appropriate habitat not present; ? = uncertain, no definitive distribution data, habitat descriptions differ, too general.
(d) Recommended for removal from the Penssylvania State list of endangered and threatened species because it is more abundant than previously realized (Morris Arboretum 2012-TN1665).

Sources: PPL Bell Bend 2013-TN3377; NatureServe 2014-TN3969; NYNHP 2014-TN3988; PNHP 2014-TN3972; PNHP 2014-TN3973

Aquatic Plants

Pennsylvania lists three aquatic endangered plant species for the counties included within the proposed CUMP area, the northern water-plantain (*Alisma triviale*), small-floating manna-grass, and grassy pondweed (Table 2-23). However, it is unlikely that these aquatic plants are present in the CUMP waterbodies because of lack of preferred habitat (PNHP 2014-TN3972; PNHP 2014-TN3973).

2.4.2.4 Aquatic Monitoring

Extensive biological monitoring data exist to characterize the fish and macroinvertebrate communities in the North Branch of the Susquehanna River in the Bell Bend area. Biological sampling studies have occurred since 1971 in conjunction with the operation of the SSES. Preoperational monitoring (1971–1982) and post-operational monitoring (since 1983) has been conducted by Ichthyological Associates (prior to 1986) and Ecology III (since 1986) (Ecology III 2012-TN2236) at two locations in the river, one upriver from the SSES intake area and one downriver in the Bell Bend area. More recent surveys of aquatic biota were performed to support the assessment of the impacts of building and operating the proposed plant on the BBNPP site (PPL Bell Bend 2013-TN3377).

2.5 Socioeconomics

This section describes the baseline socioeconomic characteristics area surrounding the BBNPP site. These characteristics include demographics, economics, and community characteristics that form the basis of the NRC review team's assessment of the potential social and economic impacts from the construction and operation of the BBNPP, which would be operated by PPL at a site located to the west of and adjacent to the existing SSES.

Baseline data also are presented for recreational sites affected by the SRBC requirement that PPL provide an upstream water source to compensate for consumptive use at the BBNPP. The affected recreational sites all are located on or near the supplemental water sources proposed by PPL in its CUMP: Cowanesque Lake, Holtwood Reservoir, and Rushton Mine (PPL Bell Bend 2013-TN3541).

The team examined the PPL BBNPP ER and verified the data sources used in its preparation by examining cited references and by independently confirming data in discussions with community members and public officials. The team requested clarification and additional information from PPL as needed to verify data in the ER. Unless otherwise specified in the remainder of this section, the team has drawn upon verified data from PPL (PPL Bell Bend 2013-TN3377). Where the team used different analytical methods or additional information for its own analysis, the sections below include explanatory discussions and citations for additional sources.

With the exception of the recreational sites affected by supplemental water withdrawals, the baseline discussion considers the entire region within a 50-mi radius of the BBNPP site, with a focus on Columbia and Luzerne Counties, which, for socioeconomic purposes is deemed the "economic impact area." The 50-mi radius centered on the BBNPP site includes all or portions of 22 counties in Pennsylvania and, for socioeconomic and environmental justice purposes, is deemed the "50-mi region."

The review team examined the possibility that significant numbers of in-migrating workers may choose to live in a county within 50 mi of the proposed BBNPP but outside the two-county economic impact area, and that in-migrating workers would locate in the economic impact area in the same proportion as the current operations and maintenance workforce employed at SSES Units 1 and 2. As shown in Table 2-24, 87.1 percent of all SSES workers reside in Columbia and Luzerne Counties (PPL Bell Bend 2013-TN3377). Therefore, the review team considers Luzerne County, the host county for the BBNPP, and adjacent Columbia County to be the economic impact area for socioeconomic analysis. The review team also expects the other counties in the 50-mi region would receive 12.9 percent of the in-migrating workers. Therefore, much of the discussion in this section concentrates on the economic impact area because not only would the building and operations workforces (local residents and in-migrants) reside primarily in these two counties, the two counties also would receive the majority of any benefits or any strains on community services from the addition of in-migrating workers.

Table 2-24. Distribution of Current SSES Workforce between Counties within 80 km (50 mi) of the Proposed BBNPP Site

		Number of Current SSES Units 1 and 2 Residents	
County	**State**	**Number**	**%**
Berks	PA	1	0.1
Bradford	PA		
Carbon	PA	13	1.0
Columbia	PA	559	44.8
Dauphin	PA		
Lackawanna	PA	5	0.4
Lebanon	PA	1	0.1
Lehigh	PA	5	0.4
Luzerne	PA	528	42.3
Lycoming	PA	8	0.6
Monroe	PA	1	0.1
Montour	PA	27	2.2
Northampton	PA	2	0.2
Northumberland	PA	47	3.8
Pike	PA		
Schuylkill	PA	35	2.8
Snyder	PA	2	0.2
Sullivan	PA		
Susquehanna	PA		
Union	PA	3	0.2
Wayne	PA	1	0.1
Wyoming	PA		
Other		9	0.7
Totals		1,247	100.0

Source: PPL Bell Bend 2013-TN3377

2.5.1 Demographics

The review team evaluated the demographic characteristics of resident and transient populations living within the 50-mi region of the BBNPP. The team also has presented these data by county for the economic impact area. For definitional purposes, “residents” live permanently in the area, while “transients” may temporarily live in the area but have permanent residences elsewhere. Transients are not fully characterized by the U.S. Census, which generally captures only individuals residing in the area at the time of the census. Data used in this section were derived from the ER; the 2010 American Community Survey (ACS) 5-Year Summary Files (2006 through 2010); the 2010 Census; and the Commonwealth of Pennsylvania.[1]

2.5.1.1 Resident Population

Table 2-25 presents population estimates for all counties located within the 50-mi region from 2000 through 2070. County-level population data for 2000 and 2010 were obtained from the Pennsylvania Data Center (PASDC 2013-TN2018). The review team also used population forecasts through 2030 prepared by the Pennsylvania Data Center as part of its *Pennsylvania Population Projections Background Report (*PASDC 2010-TN1895). The Pennsylvania Data Center, which uses a cohort-component demographic projection model, forecast population growth by county through 2030. The 2020 to 2030 average annual growth rate for each county was extended over the last 50 years of the forecast to extend the population estimates to 2070.

Table 2-26 provides more detailed population totals for Columbia and Luzerne Counties and the Commonwealth of Pennsylvania from 1970 through 2010, and population projections for these areas through 2080. Population estimates for 1970 through 2000 were reported by PPL in the ER (PPL Bell Bend 2013-TN3377). Population estimates for 2010 were obtained from the Pennsylvania Data Center (PASDC 2013-TN2018). Population forecasts from 2010 through 2030 were obtained from the Pennsylvania Data Center through its *Pennsylvania Population Projections Background Report* (PASDC 2010-TN1895). Population projections for the 2030 through 2070 time periods were prepared by the team using the average annual percent growth for the 2010 to 2030 time period forecast by the Pennsylvania Data Center.

In Luzerne County, where the BBNPP site would be located, the population decreased from 343,079 in 1980 to 320,918 in 2010. The Luzerne County population grew slightly between 2000 and 2010. The longer term trend of population decline is forecast to continue with population decreasing by 0.3 percent annually from 2020 through 2070, reaching 267,873 in 2070. In 2010, the population in Luzerne County was concentrated in and around the communities of Back Mountain and Wilkes-Barre to the northeast and Hazelton to the southeast of the BBNPP site.

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[1] The U.S. Census Bureau (USCB) data used in this section were obtained from American Community Survey (ACS) results released in 2011. During preparation of this EIS, the results of the 2012 ACS were released in topical and regional data sets. The review team has examined the latest ACS data, and is not aware of any information that appears to be inconsistent with the 2011 ACS data.

Table 2-25. Population Projections by County from 2000 to 2070

Area	2000[a]	2010[a]	2020[b]	2030[b]	2040[c]	2050[c]	2060[c]	2070[c]
Berks	373,638	411,442	450,050	491,185	536,079	585,077	638,554	696,918
Bradford	62,761	62,622	61,275	60,574	59,881	59,196	58,519	57,850
Carbon	58,802	65,249	69,043	71,372	73,780	76,269	78,842	81,502
Columbia	64,151	67,296	70,010	72,841	75,787	78,853	82,042	85,360
Dauphin	251,798	268,100	274,884	282,533	290,394	298,473	306,778	315,313
Lackawanna	213,295	214,437	208,818	204,130	199,546	195,066	190,686	186,405
Lebanon	120,327	133,568	137,562	143,071	148,801	154,760	160,958	167,405
Lehigh	312,090	349,497	375,747	396,851	419,142	442,684	467,548	493,809
Luzerne	319,250	320,918	310,747	301,655	292,830	284,263	275,947	267,873
Lycoming	120,044	116,111	113,344	110,202	107,146	104,175	101,287	98,479
Monroe	138,687	169,842	203,922	234,961	270,726	311,934	359,414	414,122
Montour	18,236	18,267	17,952	18,016	18,081	18,146	18,211	18,277
Northampton	267,066	297,735	323,517	349,266	377,064	407,075	439,474	474,451
Northumberland	94,556	94,528	94,187	93,499	92,815	92,136	91,462	90,794
Pike	46,302	57,369	72,808	85,076	99,411	116,162	135,736	158,607
Schuylkill	150,336	148,289	147,769	147,387	147,006	146,625	146,246	145,867
Snyder	37,546	39,702	40,460	40,387	40,315	40,243	40,170	40,098
Sullivan	6,556	6,428	6,403	6,376	6,350	6,324	6,298	6,272
Susquehanna	42,238	43,356	55,067	69,274	87,146	109,629	137,913	173,493
Union	41,624	44,947	48,437	50,628	52,917	55,310	57,812	60,426
Wayne	47,722	52,822	60,980	67,610	74,962	83,113	92,150	102,170
Wyoming	28,080	28,276	25,264	21,639	18,535	15,875	13,597	11,646
Economic Impact Area	383,401	388,214	380,756	374,497	368,617	363,116	357,988	353,233

(a) PASDC 2013-TN2018.
(b) PASDC 2010-TN1895.
(c) Population projections for 2030 through 2070 were built using the average annual percent growth from the forecast prepared by the Pennsylvania State Data Center over the 2020 through 2030 time period.

Sources: PASDC 2013-TN2018; PASDC 2010-TN1895

Table 2-26. Population Growth in Luzerne and Columbia Counties (1970 to 2070)

	Columbia County		Luzerne County		Economic Impact Area		Pennsylvania	
Year	Pop	Annual Percent Growth[a]	Pop	Annual Percent Growth[a]	Pop	Annual Percent Growth[a]	Pop	Annual Percent Growth[a]
1970[b]	55,114	--	342,301	--	397,415	--	11,793,909	--
1980[b]	61,967	1.18%	343,079	0.02%	405,046	0.19%	11,863,895	0.06%
1990[b]	63,202	0.20%	328,149	-0.44%	391,351	-0.34%	11,881,643	0.01%
2000[b]	64,151	0.15%	319,250	-0.27%	383,401	-0.21%	12,281,054	0.33%
2010[c]	67,296	0.48%	320,918	0.05%	388,214	0.12%	12,702,379	0.34%
2015 (est.)[d]	68,639	0.40%	315,791	-0.32%	384,431	-0.20%	12,868,973	0.26%
2020 (est.)[d]	70,010	0.40%	310,747	-0.32%	380,756	-0.19%	13,037,752	0.26%
2025 (est.)[d]	71,411	0.40%	306,167	-0.30%	377,579	-0.17%	13,198,108	0.24%
2030 (est.)[d]	72,841	0.40%	301,655	-0.30%	374,497	-0.16%	13,360,436	0.24%
2040 (est.)[d]	75,787	0.40%	292,830	-0.30%	368,617	-0.16%	13,691,106	0.24%
2050 (est.)[d]	78,853	0.40%	284,263	-0.30%	363,116	-0.15%	13,691,106	0.24%
2060 (est.)[d]	82,042	0.40%	275,947	-0.30%	357,988	-0.14%	14,029,960	0.24%
2070 (est.)[d]	85,360	0.40%	267,873	-0.30%	353,233	-0.13%	14,377,201	0.24%

(a) Average annual growth rate from previously noted year (e.g., 1.18 percent annual change in Columbia County from 1970 to 1980).
(b) PPL Bell Bend 2013-TN3377.
(c) PASDC 2013-TN2018.
(d) Population projections for 2010 through 2070 were built using the average annual percent growth from the forecast prepared by the Pennsylvania State Data Center (PASDC 2010-TN1895). The 2020 through 2030 average annual growth rate for each county was extended over the last 50 years of the forecast to extend the population estimates to 2070.

Sources: PPL Bell Bend 2013-TN3377; PASDC 2013-TN2018; PASDC 2010-TN1895

Columbia County has experienced slow but steady population growth over the past 40 years. From 2000 to 2010, the population grew at an average annual rate of 0.48 percent. The Pennsylvania Data Center, which uses a cohort-component demographic projection model, forecast 0.4 percent average annual growth over the next 20 years, with the population of Columbia County forecast to reach 72,841 by 2030 (PASDC 2010-TN1895). Extending this forecast growth rate forward results in a 2070 Columbia County population of 85,360. While the population of Columbia County reached 67,296 in 2010, it remains roughly one-fifth the population of adjacent Luzerne County. Population in Columbia County is concentrated in and around the communities of Berwick and Bloomsburg, which are located about 4 and 16 mi, respectively, to the west of the BBNPP site.

Table 2-27 provides the age and gender distribution of the resident population within the economic impact area. Both counties exhibit a slightly higher female population and a school-aged population of 14 to 15 percent. In Columbia County, 69.2 percent of the total population comprises adults 22 years old or older, 15.8 percent of the total population is over the age of 65. In Luzerne County, 73.9 percent of the residents are 22 years of age or older, and 18.1 percent are over the age of 65 (USCB 2011-TN2068). When compared to the Commonwealth of Pennsylvania and the broader U.S. population, a higher share of residents in the economic impact area is over the age of 65 and a lower share is between 5 and 17 years of age.

Table 2-27. Age and Gender Distribution within the Economic Impact Area (2010 ACS 5-year estimate)

	Columbia	Luzerne	Economic Impact Area	Pennsylvania	United States
Total Population	66,642	319,120	385,762	12,612,705	303,965,272
Male	31,872	155,600	187,472	6,138,935	149,398,724
Under 5 years	1,632	8,342	9,974	371,755	10,286,150
5 to 17 years	4,975	24,867	29,842	1,073,247	27,604,352
18 and 19 years	1,543	4,776	6,319	195,819	4,608,216
20 to 21 years	1,610	4,981	6,591	188,431	4,600,457
22 to 29 years	3,173	14,506	17,679	625,749	16,673,143
30 to 39 years	3,654	18,364	22,018	756,560	20,029,504
40 to 49 years	4,491	24,800	29,291	916,678	21,966,991
50 to 64 years	6,354	32,126	38,480	1,210,184	27,066,774
65 and older	4,440	22,838	27,278	800,512	16,563,137
Female	34,770	163,520	198,290	6,473,770	154,566,548
Under 5 years	1,582	8,076	9,658	355,520	9,845,270
5 to 17 years	4,582	23,633	28,215	1,021,120	26,297,345
18 and 19 years	2,220	4,450	6,670	192,824	4,383,162
20 to 21 years	2,400	4,247	6,647	186,071	4,349,074
22 to 29 years	2,911	13,917	16,828	613,774	16,304,393
30 to 39 years	3,830	18,354	22,184	764,446	20,077,662
40 to 49 years	4,488	23,138	27,626	940,217	22,380,554
50 to 64 years	6,643	32,928	39,571	1,273,453	28,742,812
65 and older	6,114	34,777	40,891	1,126,345	22,186,276

Source: USCB 2011-TN2068

Table 2-28 presents the racial and ethnic distribution of residents within the economic impact area. In Columbia County, African-American residents make up 1.4 percent of the population, and Hispanic residents compose 1.9 percent of the total population. In Luzerne County, African-American residents are 3.3 percent of the population, and 5.4 percent of the residents are Hispanic. White residents are the most prominent race in both counties, composing more than 90 percent of the population in each county (USCB 2011-TN2070). The counties in the economic impact area have a higher proportion of white residents (93.5 percent) than the U.S. population (74.0 percent) or the Commonwealth of Pennsylvania (82.9 percent).

Table 2-28. Percent Racial and Ethnic Distribution within the Economic Impact Area (2010 ACS 5-year estimate)

	Columbia	Luzerne	Economic Impact Area	Pennsylvania	United States
White	96.3%	93.0%	93.5%	82.9%	74.0%
Black or African-American	1.4%	3.3%	2.9%	10.7%	12.5%
American Indian and Alaskan Native	0.2%	0.1%	0.1%	0.1%	0.8%
Asian	0.9%	0.9%	0.9%	2.6%	4.7%
Native Hawaiian/ Other Pacific Islander	0.0%	0.0%	0.0%	0.0%	0.2%
Some other race	0.4%	1.6%	1.4%	2.0%	5.5%
Two or more races	0.9%	1.1%	1.1%	1.6%	2.4%
Not Hispanic or Latino	98.1%	93.8%	94.6%	94.8%	84.3%
Hispanic or Latino	1.9%	5.4%	4.8%	5.2%	15.7%
Aggregate minority	5.2%	10.1%	9.3%	19.7%	35.3%

Source: USCB 2011-TN2070

Table 2-29 provides household income distribution data for Columbia and Luzerne Counties. The percentage of residents living below the poverty level in the Commonwealth of Pennsylvania is 12.4 percent, which is 1.4 percent lower than the national average of 13.8 percent (USCB 2011-TN2071). The poverty levels in Columbia and Luzerne Counties are both measured at 13.7 percent, placing the counties in the economic impact area near the national poverty rate but higher than the State level (USCB 2011-TN2071).

Table 2-29. Household Income Distribution within the Economic Impact Area (2010 ACS 5-Year Estimate)

	Columbia	Luzerne	Economic Impact Area	Pennsylvania	United States
Total	25,884	130,855	156,739	4,940,581	114,235,996
Less than $10,000	8.6%	8.2%	8.2%	7.3%	7.2%
$10,000 to $14,999	6.8%	7.9%	7.7%	5.9%	5.5%
$15,000 to $24,999	12.5%	13.9%	13.7%	11.3%	10.8%
$25,000 to $34,999	12.4%	12.7%	12.6%	10.9%	10.5%
$35,000 to $49,999	18.0%	14.6%	15.2%	14.3%	14.1%
$50,000 to $74,999	19.8%	19.2%	19.3%	19.0%	18.6%
$75,000 to $99,999	10.6%	11.1%	11.1%	12.4%	12.3%
$100,000 to $149,999	8.0%	8.6%	8.5%	11.7%	12.3%
$150,000 to $199,999	1.8%	2.0%	1.9%	3.8%	4.4%
$200,000 or more	1.5%	1.8%	1.7%	3.5%	4.2%

Source: USCB 2011-TN2071

2.5.1.2 Transient Population

Transient populations include seasonal or daily workers or visitors to large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, and at recreational areas or special events. PPL estimated transient populations within the 50-mi radius at 47,740 (PPL Bell Bend 2013-TN3377). Transient population estimates were equal to 2.9 percent of the resident population in the 50-mi region (PPL Bell Bend 2013-TN3377). PPL estimates were based on an assessment of the workers/college students who live outside the area but commute into the area on a regular basis, the number of hotels/motels, golf course attendance, available fishing and hunting, campground capacity, and seasonal housing, and the number of farms located in each county with migrant farm labor. The review team has examined the approach used by PPL and found it reasonable because the populations covered were relevant and sources of information supporting the analysis credible. Therefore, it was used as the basis for estimating transient populations within the four counties examined in Table 2-30. These four counties were identified because they contain campgrounds and recreational vehicle (RV) parks within 30 mi of Berwick, Pennsylvania, which is the nearest community to the BBNPP site with a population in excess of 5,000.

Table 2-30. Baseline Transient Population by County (2010 ACS 5-Year Estimate)

	Luzerne County	Columbia County	Northumberland County	Schuylkill County
Total population[(a)]	320,918	67,296	94,517	148,289
Transient population[(b)]	9,307	1,952	2,660	4,180
Seasonal population	9,087	1,296	2,130	3,650
Hotel/motel units[(c)]	2,353	1,321	N/A	5
Recreational area sites[(c)]	1,389	1,509	720	448

(a) USCB 2011-TN1875.
(b) Transient population estimates were equal to 2.9 percent of the resident population (PPL Bell Bend 2013-TN3377).
(c) PPL Bell Bend 2013-TN3377.

Sources: PPL Bell Bend 2013-TN3377; USDA 2007-TN1697

Within the 50-mi radius, the review team expects short-term visitors would include those who travel to the area for two National Association for Stock Car Auto Racing Sprint Cup races and one Camping World Truck Series race held at the Pocono Raceway in Long Pond, Pennsylvania, in June and August, respectively (Pocono Raceway 2012-TN1896). Travelers also visit the Susquehanna River for fishing tournaments and recreational fishing opportunities (McDowell 2014-TN3492). Williamsport hosts the Little League World Series in two stadiums: Lamade and Volunteer. Attendance capacity at Lamade Stadium is approximately 40,000, which can be accommodated in 10,000 seats with additional space on the grass berm surrounding the stadium for 30,000 spectators. Volunteer stadium, which was built in 2001 when the Little League World Series expanded to 16 teams, has a capacity of 5,000 (LLIBS 2012-TN1717).

2.5.1.3 Migrant Labor

The United States Census Bureau (USCB) defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from his or her permanent place of residence. The 2012 Census of Agriculture provides information about farms, workers, and use of migrant workers by farms in the two-county economic impact area. It does not, however, estimate the number of migrant farm laborers in the economic impact area. In 2012, there were 59,309 farms operating in Pennsylvania, 944 farms reported in Columbia County, and 556 in Luzerne County (USDA 2012-TN3634). In 2012, there were 16 farms in Columbia County that hired migrant farm labor and 4 farms in Luzerne County. Another potential indicator of a migrant or seasonal workforce is the number of farm laborers employed fewer than 150 days per year on farms in the economic impact area. In 2012, there were 108 farms in Columbia County that employed 656 laborers fewer than 150 days. In Luzerne County, 67 farms employed 220 farm laborers fewer than 150 days (USDA 2014-TN3620).

2.5.2 Community Characteristics

This section characterizes the communities that may be affected by construction and operations activities at the BBNPP site. Seven sections evaluate community characteristics in terms of economy, taxes, transportation, aesthetics and recreation, housing, public services, and education. The review team drew information for this characterization from analysis of the ER and its sources; responses from PPL in response to NRC requests for additional information; interviews with local officials, agency staff, and residents; Federal and State published reports and data; and other sources as cited throughout this section.

The remainder of this section addresses community characteristics, including the regional economy, transportation networks and infrastructure, taxes, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.5.2.1 Economy

The principal economic centers in the economic impact area include Back Mountain, Berwick, Bloomsburg, Hazleton, Kingston, Mountain Top, Nanticoke, and Wilkes-Barre. The USCB reports that the top five industries in terms of employment in the economic impact area in 2010 were educational, health, and social services (24.2 percent); manufacturing (14.7 percent); retail trade (13.5 percent); arts, entertainment, recreation, accommodation, and food services (8.1 percent); and professional, scientific, management, administrative, and waste services (7.1 percent) (see Table 2-31). Together, these five industries composed 67 percent of the employment in the economic impact area in 2006. The construction industry accounts for 5.8 percent of the employment in the 50-mi region (USCB 2011-TN2071).

Although no single employer dominates the region, PPL Susquehanna, LLC is one of the largest employers in Luzerne County with more than 1,000 employees. Other large employers in Luzerne County include the U.S. Government, Pennsylvania State Government, Wyoming Valley Health Care System, Luzerne County Government, OneSource, Inc., and the Hazleton Area School District. In Columbia County, the largest employer is the State System of Higher

Table 2-31. Employment by Industry Sectors in the Economic Impact Area (2000 and 2010)

Two-Digit NAICS Industry Sector	Luzerne County				Columbia County				Total Economic Impact Area			
	2000		2010		2000		2010		2000		2010	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total, All Industries	143,492	100%	147,286	100%	30,006	100%	31,370	100%	173,498	100%	178,656	100%
Agriculture, Forestry, Fishing and Hunting, and Mining	1,057	0.7%	901	0.6%	561	1.9%	422	1.3%	1,618	0.9%	1,323	0.7%
Construction	8,515	5.9%	8,148	5.5%	1,624	5.4%	1,900	6.1%	10,139	5.8%	10,048	5.6%
Manufacturing	23,754	16.6%	20,108	13.7%	7,233	24.1%	6,090	19.4%	30,987	17.9%	26,198	14.7%
Wholesale Trade	6,075	4.2%	5,563	3.8%	790	2.6%	635	2.0%	6,865	4.0%	6,198	3.5%
Retail Trade	18,595	13.0%	20,153	13.7%	3,609	12.0%	3,970	12.7%	22,204	12.8%	24,123	13.5%
Transportation and Warehousing, Utilities	8,260	5.8%	8,660	5.9%	1,571	5.2%	1,682	5.4%	9,831	5.7%	10,342	5.8%
Information	4,916	3.4%	3,887	2.6%	513	1.7%	493	1.6%	5,429	3.1%	4,380	2.5%
Finance, Insurance, Real Estate and Rental and Leasing	8,322	5.8%	8,310	5.6%	969	3.2%	1,150	3.7%	9,291	5.4%	9,460	5.3%
Professional, Scientific, Management, Administrative, and Waste Services	8,963	6.2%	10,845	7.4%	1,438	4.8%	1,865	5.9%	10,401	6.0%	12,710	7.1%
Educational, Health, and Social Services	30,882	21.5%	34,934	23.7%	7,170	23.9%	8,220	26.2%	38,052	21.9%	43,154	24.2%
Arts, Entertainment, Recreation, Accommodation and Food Services	9,988	7.0%	11,815	8.0%	2,355	7.8%	2,649	8.4%	12,343	7.1%	14,464	8.1%
Other Services (except public administration)	6,369	4.4%	6,041	4.1%	1,185	3.9%	1,178	3.8%	7,554	4.4%	7,219	4.0%
Public Administration	7,796	5.4%	7,921	5.4%	988	3.3%	1,116	3.6%	8,784	5.1%	9,037	5.1%

NAICS = North American Industry Classification System
Sources: PPL Bell Bend 2013-TN3377; USCB 2011-TN2071

Education because of the presence of Bloomsburg University in Bloomsburg. Other employers of significance in Columbia County include Wise Foods, Inc., Community Health Systems, Inc. – Berwick Hospital Corporation, Magee Rieter Automotive Systems, Del Monte Corporation, and the Berwick Area School District (PPL Bell Bend 2013-TN3377).

Table 2-32 shows the number of workers employed and the unemployment rates for Columbia and Luzerne Counties, the Commonwealth of Pennsylvania, and the United States for 2000, 2006, and 2010, respectively. These data show the number of employed workers in Columbia County increased between 2000 and 2006 at a slow average annual rate of 0.4 percent but that the unemployment rate declined from 7.3 percent to 5.5 percent during the same time frame. The average annual growth in workers over the 2000 to 2006 time frame in Luzerne County also was slow at 0.5 percent. The unemployment rate in Luzerne County in 2006 was close to that in Columbia County at 5.6 percent, which was lower than the statewide unemployment rate of 6.2 percent and nationwide unemployment rate of 6.4 percent (PPL Bell Bend 2012-TN1173).

The two-county economic impact area has not been immune to the effects of the recent nationwide economic downturn. From 2006 to 2010, the unemployment rate in Luzerne County grew sharply from 5.6 percent to 10.5 percent. During the same time, the unemployment rate in Columbia County grew marginally from 5.5 percent to 6.0 percent. The unemployment rate in the two-county economic impact area was close to that for the Commonwealth of Pennsylvania in 2010 (9.8 percent in the economic impact area vs. 9.6 percent in Pennsylvania). Unemployment rates in both the economic impact area and the Commonwealth of Pennsylvania were lower than the national average rate of 10.8 percent in 2010 (PPL Bell Bend 2012-TN1173).

Heavy-construction trade categories that might support nuclear power plant construction include supervisors; boilermakers; brick and block masons; carpenters; construction laborers; electricians; line workers; insulation workers; ironworkers; millwrights; operating engineers and other construction equipment operators; paving, surfacing and tamping equipment operators; plumbers; pipefitters and steamfitters; and welders, cutters, and brazers. In 2006, at least 49,179 construction workers were employed within the 50-mi radius of the BBNPP site. Of these workers engaged in construction activities, 12,735 were employed in the construction of buildings, 4,404 were involved in heavy and civil engineering construction, and 31,347 were specialty trade contractors. Among the local unions located in the 50-mi radius around the BBNPP site that provided data to PPL as of 2009, there were a reported 4,698 union members. Of these union members, there were 3,383 electricians and line workers, 600 pipefitters and plumbers, and 715 iron workers. As of 2009, there were 1,374 unemployed union workers (29 percent of the total union workforce) reported by unions operating in the 50-mi radius around the BBNPP site (PPL Bell Bend 2013-TN3377).

Table 2-32. Employment Characteristics in Economic Impact Area, Pennsylvania, and the United States

Labor Force	Luzerne County	Columbia County	Pennsylvania	United States
Individuals in Labor Force (2000)	151,869	32,403	6,000,512	138,820,935
Civilian Labor Force	151,748	32,376	5,992,886	137,668,798
Employed	143,492	30,006	5,653,500	129,721,512
Unemployed	8,256	2,370	339,386	7,947,286
Unemployed (%)	5.4%	7.3%	5.7%	5.8%
Individuals not in Labor Force	108,543	20,096	3,692,528	78,347,142
Individuals in Labor Force (2006)	156,404	33,251	6,277,605	152,193,214
Civilian Labor Force	156,352	33,211	6,269,806	151,203,992
Employed	147,674	31,398	5,881,115	141,501,434
Unemployed	8,678	1,813	388,691	9,702,558
Unemployed (%)	5.6%	5.5%	6.2%	6.4%
Individuals not in Labor Force	101,710	21,194	3,710,321	82,050,749
Individuals in Labor Force (2010)	159,375	32,790	6,470,008	156,966,769
Civilian Labor Force	159,305	32,741	6,463,490	155,917,013
Employed	142,502	30,787	5,842,790	139,033,928
Unemployed	16,803	1,954	620,700	16,883,085
Unemployed (%)	10.5%	6.0%	9.6%	10.8%
Individuals not in Labor Force	105,592	23,601	3,803,556	86,866,154

Source: PPL Bell Bend 2012-TN1173, which derived data from the U.S. Census Bureau 2000 and 2010 Censuses; and the 2006 to 2010 American Community Survey.

Table 2-33 shows trends in per capita income in the economic impact area, Commonwealth of Pennsylvania, and the United States between 2000 and 2010. The economic impact area generally followed the overall regional trends of an increase in per capita income in nominal terms. During the 2000 to 2010 time period, per capita income in Pennsylvania increased by 26.3 percent, which exceeded the national growth rate of 20.7 percent. Growth in per capita income in both Luzerne and Columbia Counties exceeded State and national averages, growing at 27.1 and 32.7 percent, respectively. In 2010, per capita income in both counties located within the economic impact area ($23,176 in Luzerne County and $22,531 in Columbia County) continued to lag behind income levels in the Commonwealth of Pennsylvania, which reached $26,374 in 2010, and the nationwide level of $26,059.

Table 2-33. Regional Per Capita Personal Income (nominal dollars)

County/Nation	2000 $	2006 $	2010 $	Percent Change (2000−2010) %
Luzerne	18,228	21,346	23,176	27.1
Columbia	16,973	18,715	22,531	32.7
Pennsylvania	20,880	24,694	26,374	26.3
United States	21,587	25,267	26,059	20.7

Sources: PPL Bell Bend 2013-TN3377; USCB 2010-TN1718

2.5.2.2 Taxes

This section identifies and examines the tax systems that would be potentially affected by building and operating the proposed BBNPP. It evaluates the State tax structure and those in the two-county economic impact area. It also presents an overview of the sources and uses of funds for Columbia and Luzerne Counties.

The Commonwealth of Pennsylvania imposes a 3.07 percent tax against the taxable income of resident and nonresident individuals, S corporations, business trusts, limited liability companies that are not taxed by the Federal Government as corporations, and estates and trusts (PDR 2012-TN2020). In State fiscal year (SFY) 2012, Pennsylvania collected $10.8 billion in personal income taxes (PDR 2012-TN2021). In 2010, taxable income in the two-county economic impact area ($7.1 billion) composed 2.3 percent of the statewide total ($310.4 billion) (PDR 2012-TN2021). Pennsylvania also imposes a realty transfer tax of 1 percent of real estate value. In SFY 2012, realty transfer tax remittances totaled $342.4 million in Pennsylvania, of which $7.1 million (2.1 percent) were collected on transactions in the two-county economic impact area (PDR 2012-TN2021). Pennsylvania levies an inheritance and estate tax on transfers to direct descendants (4.5 percent), siblings (12 percent), and other heirs except charitable organizations and other exempt institutions (15 percent). Surviving spouses and children aged 21 years or younger are exempt from estate taxes in Pennsylvania (PDR 2012-TN2020). In SFY 2012, inheritance tax remittances totaled $820.4 million of which $24.6 million (3.0 percent) were collected in the economic impact area (PDR 2012-TN2021).

Pennsylvania also imposes several forms of corporate taxes. It levies a 9.99 percent corporate net income tax. It also imposes a 1.89 mill capital stock/foreign franchise tax. The capital stock tax is based on the capital stock value of a domestic company as derived from a formula based on average net income and a company's net worth. Net worth is defined as the consolidated net stockholders' equity as of the current tax year unless that net worth is more than twice or less than half the net worth as calculated at the beginning of the year. A foreign franchise tax based on the capital stock value attributable to Pennsylvania is imposed on foreign corporations (PDR 2012-TN2020). There are several gross receipts taxes in Pennsylvania with varying rates, including 50 mills on telephone, telegraph, and mobile telecommunications companies; 59 mills on electric suppliers; and 50 mills on transportation companies (PDR 2012-TN2020). On all forms of corporate taxation, Pennsylvania collected $5.0 billion in SFY 2012 (PDR 2012-TN2021).

Pennsylvania levies a 6 percent sales, use, and hotel occupancy tax. It also imposes a $1.60 cigarette excise tax per pack of 20 cigarettes/small cigars, an 18 percent liquor excise tax, and a 2 percent vehicle rental tax (PDR 2012-TN2020). Total sales and use tax remittances in Pennsylvania totaled $8.8 billion in SFY 2012 with $112.9 million or 1.3 percent collected in the two-county economic impact area (PDR 2012-TN2021).

Columbia and Luzerne Counties both impose property taxes with amounts based on the assessed value of the property and the millage rates for the local school district, as well as the county and municipality in which the property is located. A millage rate is the amount per $1,000 in assessed value used to calculate taxes on the property. Millage rates for several communities located near the BBNPP site are presented in Table 2-34. Berwick and

Bloomsburg are located in Columbia County and all other communities are located in Luzerne County. The BBNPP site is located in Salem Township. At a millage rate of 16.544 in Salem Township, the annual tax on a property with an assessed value of $1 million would be $16,544.

Table 2-34. 2012 Property Tax Millage Rates for Communities Located Near the BBNPP Site

Municipality	County	Municipal	School	Total
Berwick Borough	10.491	14.1	45	69.591
Bloomsburg	10.491	9.821	38.9	59.212
Conyngham Borough	5.32	2.83	9.1956	17.3456
Hazle Township	5.32	0.75	9.1956	15.2656
Nanticoke City	5.32	4.0594	10.1777	19.5571
Nescopeck Borough	5.32	1.377	11	17.697
Salem Township	5.32	0.224	11	16.544
Shickshinny Borough	5.32	1.1329	9.1986	15.6515

Sources: Luzerne County 2013-TN2026; Columbia County 2013-TN2027

PPL property tax payments to Luzerne County, Salem Township, and the Berwick Area School District for the SSES are approximately $4 million annually, of which $2.4 million is allocated to the Berwick Area School District (PPL Bell Bend 2012-TN1348). This amount represents approximately 4.4 percent of the Berwick Area School District's annual budget of $54.7 million (Berwick Area School District 2011-TN1676).

At the local level in Pennsylvania, several jurisdictions also impose earned income taxes (EITs) on both residents and nonresidents. Salem Township imposes a 1.0 percent EIT on both residents and nonresidents, with half of the proceeds from the resident EIT allocated to the Berwick Area School District (PDCED 2014-TN3915). Nonresidents working in Salem Township would be subject to the local nonresident EIT unless the resident rate they pay to their local jurisdiction equals or exceeds the nonresident rate in Salem Township. Workers at the BBNPP would also be subject to a $52 annual local services tax, which would be paid to Salem Township. Salem Township would transfer $5 of each local services tax payment to the Berwick Area School District. In 2012, Salem Township EIT and local services tax collections were $417,726 and $106,844, respectively (PDCED 2012-TN3916). Collectively, proceeds from these two taxes represented 27.5 percent of total collections in 2012 for Salem Township.

Table 2-35 and Table 2-36 present tax revenues and expenditure for Columbia and Luzerne Counties. In FY 2012, Columbia County collected approximately $21.3 million. The real estate tax was the largest source of non-grant revenue, generating $7.3 million. The hotel tax raised an additional $280,000. The largest expenditure items included the county prison ($4.6 million) and children and youth services ($4.1 million). In FY 2012, Luzerne County collected approximately $122.6 million, most of which ($97.6 million) came from real estate taxes (Luzerne County 2012-TN2028). Major expenditure items include fixed overhead ($33.8 million or 27.6 percent), prisons ($26.9 million or 22.0 percent), and judicial services ($23.7 million or 19.3 percent). The 2012 adopted budget for Luzerne County includes $4.5 million for emergency medical services and 911 operations, and $259,304 for emergency management (PPL Bell Bend 2012-TN1346).

Table 2-35. Revenue Sources and Expenditures per Department for the 2012 Adopted Columbia County General Fund Budget

Revenue Source	Amount	Expenditure Item/Department	Amount
Real Estate Tax	$7,329,153	Council/Commissioners	$786,523
Per Capita Tax	170,000	County Buildings	675,614
Hotel Tax	280,000	Human Services Department	872,403
Court Costs and Fines	200,000	Tax Assessment	362,988
Interest/Rental Income	219,013	Family Center Department	485,259
Federal Grants	661,304	Sheriff	406,945
State Grants	7,401,154	Domestic Relations	592,950
Payments in Lieu of Tax	80,448	District Attorney	404,808
Departmental Earnings	4,675,253	Courts and Jury Commissioners	1,125,532
Other Revenues/Transfers	287,556	Probation and Parole	950,326
Total Revenues	$21,303,883	County Prison	4,556,365
		Children and Youth Services	4,089,283
		911 Center	989,105
		Contributions to Other Agencies	2,096,311
		Other Items	2,722,073
		Total Expenditures	$21,129,667

Source: Columbia County 2013-TN2029

Table 2-36. Revenue Sources and Expenditures per Department for the 2012 Adopted Luzerne County General Fund Budget

Revenue Source	Amount	Expenditure Item/Department	Amount
Real Estate Tax	$97,645,709	Fixed Overhead	$33,873,371
Hotel Room Tax	41,000	Council/Commissioners	151,356
Licenses Permit Fees	9,902,554	County Manager	198,085
Court Costs and Fines	496,200	Central Law	653,964
Interest	89,360	Administrative Services	2,148,973
Rent and Lease Rev.	877,309	Budget and Financial Services	2,858,573
Federal Grants	1,138,971	Prison	26,922,802
State Grants	2,431,367	Human Services	8,504,481
Other Income	878,731	Judicial Services	5,339,864
Reimbursements	9,048,997	Operational Services	10,945,970
Operating Transfers	80,392	Public Defenders	2,496,171
Total Revenues	$122,630,590	Controllers	319,600
		Judicial	23,696,918
		District Attorney	4,520,463
		Total Expenditures	$122,630,591

Sources: Luzerne County 2012-TN2028; PPL Bell Bend 2012-TN1346

2.5.2.3 Transportation

The transportation network surrounding the BBNPP site includes State and Federal highways, county roads, city streets, railroad networks, and several airports. The remainder of this section characterizes the local transportation network by mode.

Airports

The Wilkes-Barre/Scranton International Airport (AVP), the largest airport in the 50-mi geographic region, is located in Wilkes-Barre, Pennsylvania. It serves four major airlines (Allegiant, Delta, United, and U.S. Airways) that provide daily flights to and from seven major U.S. cities: Atlanta, Charlotte, Chicago, Detroit, Newark, Orlando, and Philadelphia (Wilkes-Barre/Scranton International Airport 2013-TN2035). In 2011, 228,367 people boarded planes at AVP, which was a 7.0 percent increase over 2010 levels (213,422) (FAA 2012-TN2036). In terms of total boardings, AVP ranked 170th in the United States in 2011. In addition to AVP, both Luzerne and Columbia Counties have several municipal airports, including the Bloomsburg Municipal Airport, Hazleton Municipal Airport, and Wilkes-Barre-Wyoming Valley Airport (PPL Bell Bend 2013-TN3377).

Bus

Public transportation around the BBNPP site is operated by the Luzerne County Transportation Authority and the City of Hazleton Department of Public Services. The Luzerne County Transportation Authority network offers service to Wilkes-Barre and its surrounding communities along 16 fixed routes (PPL Bell Bend 2013-TN3377). The City of Hazleton operates bus service along 12 routes near Hazleton and in the surrounding boroughs, with limited service on weekends (Hazleton Public Transit 2013-TN2057). Intercity bus service in Luzerne County is offered by Martz Trailways, Susquehanna Trailways, and Greyhound to destination points throughout the region, including Philadelphia, Atlantic City, and New York City.

Roads/Highways

Vehicles access the BBNPP site via U.S. Route 11 (US 11), which is a two-lane paved road that runs northeast-southwest. All employees traveling to and from the BBNPP site traverse US 11 along the Susquehanna River. US 11 intersects State Route (SR) 239 (northwest-southeast orientation) 4 mi north of the BBNPP site. SR 239 intersects SR 93 (northwest-southeast orientation) south of the BBNPP site. East of this intersection, SR 93 intersects SR 339 (northeast-southwest orientation). SR 93 and SR 339 intersect with Interstate 80 (east-west orientation) 5 to 10 mi south of the BBNPP.

In Luzerne County between Shickshinny to the north of the BBNPP site and East Berwick to the west, traffic counts on US 11, as expressed in terms of average annual daily traffic, registered between 5,600 vehicles north of the BBNPP site and 8,900 vehicles near East Berwick. The segment of US 11 nearest the BBNPP site registered an average annual daily traffic of 7,400 vehicles (PennDOT 2012-TN2040). In Columbia County, segments of US 11 near Berwick registered average annual daily traffic ranging from 2,400 to 17,000 vehicles (PennDOT 2012-TN2041).

In 2011, KLD Engineering, P.C. (KLD) completed a traffic impact study to evaluate the impact of constructing and operating the BBNPP on the road network in the vicinity of the BBNPP site. During the operations phase, KLD assumed that the in-migrating workers would disperse in a pattern identical to the current SSES operations workforce. During the construction phase, workers were allocated to communities located within 40 mi of the site proportionally based on current populations. KLD estimated that the peak construction workforce would generate 3,039 daily auto trips to the BBNPP (KLD 2011-TN1228).

KLD examined 23 key intersections near the BBNPP site. If the construction workforce added 100 daily trips to traffic volumes through an intersection, it became a candidate for inclusion in the study. Intersections selected for the analysis were identified in Berwick, Briar Creek, Nanticoke, Nescopeck, Salem Township, Shickshinny, and South Centre. Table 2-37 presents the future no-build levels of service (LOS) estimated for the 23 key intersections. The LOS designation is an ordinal scale with “A” (free flow) being the best LOS and “F” (forced or breakdown flow) being the worst. The study evaluated the LOS for each interchange during both the A.M. and P.M. peak periods and indicates in the future no-build scenario, most intersections would operate at an LOS of “A” (free flow) or “B” (reasonably free flow). One intersection (US 11 [Front Street] and Poplar Street) located in Berwick would operate at an LOS of “D” (approaching unstable flow) during the PM peak period. In Nanticoke, there are two intersections that would operate at an LOS of “D”: US 11 and County Bridge intersection during the AM peak and SR 11 (E. Poplar Street) and SR 29 during the afternoon peak traffic period (KLD 2011-TN1228). These LOS values collectively served as the reference case that was used to determine if future build conditions would trigger required mitigation strategies due to a change in vehicle delays exceeding 10 seconds per vehicle.

There are two planned enhancements to the existing highway network that KLD built into its future no-build scenario: (1) planned upgrades to the SSES driveways and (2) a traffic signal installed at the intersection of US 11 and SR 29 (Mill Street) in Nanticoke (KLD 2011-TN1228). In addition to these projects, the Pennsylvania Department of Transportation plans to complete seven bridge projects in the Berwick area by 2016, including a $50-million U.S. Interstate 80 (I-80) bridge project near Mifflinville, Pennsylvania. These bridge construction activities could coincide with BBNPP construction activities, resulting in delays along the I-80 corridor and US 11 in and around Berwick, Pennsylvania (PennDOT 2011-TN1221), and are considered in greater detail in Chapter 7, Cumulative Impacts.

In a meeting with members of the review team, representatives of the Borough of Berwick indicated that US 11 is heavily congested during SSES outage periods, and congestion would be expected to worsen during the BBNPP construction period. Representatives of Salem Township also expressed concern, arguing that the traffic impact study did not account for recent growth in the area driven by the addition of a new business—Western International Gas and Cylinders—and the expansion of Tech Packaging. Further, Salem Township staff noted that the traffic impact study did not (1) adequately address the impact of traffic diversion during congested periods onto secondary routes located within the township, or (2) properly address the impact of the proposed Confers Lane closure on traffic flows and emergency planning and response times (NRC 2012-TN1694).

Table 2-37. Projected Level of Service at Intersections near the BBNPP Site: Future No-Build Conditions (2021)

Int. No.	County	Municipality	Intersection	AM LOS Delay (sec/veh)	PM LOS Delay (sec/veh)
1	Columbia	South Center	US 11 and SR 2028	B (14.2)	B (19.4)
2	Columbia	Briar Creek	US 11 and Briar Creek Plaza	A (6.6)	B (14.2)
3	Columbia	Berwick	US 11 (Front Street) and Eaton Street	A (1.1)	A (1.8)
4	Columbia	Berwick	US 11 (Front Street) and Poplar Street	C (20)	D (38.9)
5	Columbia	Berwick	US 11 (Front Street) and Orchard Street	A (6.5)	B (15.1)
6	Columbia	Berwick	US 11 (Front Street) and SR 93 (Orange Street)	A (5.8)	A (9.9)
7	Columbia	Berwick	US 11 (Second Street) and LaSalle Street	B (11.7)	B (13.6)
8	Columbia	Berwick	US 11 (Second Street) and Oak Street	A (6.2)	A (8)
9	Columbia	Berwick	US 11 (Second Street) and Mulberry Street	A (4.8)	A (5.7)
10	Columbia	Berwick	US 11 (Front Street) and Mulberry Street	A (6)	A (7.9)
11	Columbia	Berwick	S.R. 1020 (Market Street) and Third Street	A (9.6)	B (12.9)
12	Columbia	Berwick	US 11 (Second Street) and Market Street	A (9.5)	B (11.6)
13	Columbia	Berwick	US 11 (Front Street) and Market Street	B (13.7)	B (15.3)
14	Columbia	Berwick	US 11 (Second Street) and Pine Street	A (6)	A (8.7)
15	Luzerne	Nescopeck	S.R. 93 (Third Street) and SR 339 (Broad Street)	B (13.9)	B (12.2)
16	Luzerne	Nescopeck	S.R. 93 (Third Street) and Dewey Street	A (4.6)	A (3.7)
17	Luzerne	Salem Township	US 11 and Bell Bend Site Entrance	--	--
18	Luzerne	Salem Township	US 11 and SSES Site Entrance	A (4.4)	A (3.8)
19	Luzerne	Shickshinny	US 11 (S. Main Street) and SR 239	A (8.1)	A (9.1)
20	Luzerne	Shickshinny	US 11 (Main Street) and SR 239 (Union Street)	B (13.6)	B (15.3)
21	Luzerne	Nanticoke	US 11 and SR 29 (Mill Street)	C (23.4)	C (25.8)
22	Luzerne	Nanticoke	US 11 and County Bridge	D (48.9)	C (23.6)
23	Luzerne	Nanticoke	US 11 (E. Poplar Street) and SR 29	A (2.7)	D (27.7)

Notes: A = free flow, B = reasonably free flow, C = stable flow, D = approaching unstable flow, E = unstable flow, and F = forced or breakdown flow; sec/veh = seconds per vehicle.

Source: KLD 2011-TN1228

To address these concerns, PPL commissioned a supplemental traffic study prepared by KLD. The study employed a dynamic traffic assignment model to estimate diversion during congested periods onto the local road system. The results of the analysis suggest that few motorists would divert onto local roads in Salem Township even under congested conditions because the alternative routes are longer and experience lower speeds than US 11. KLD posted an automatic traffic recorder on Confers Lane during morning and afternoon peak periods, and counted seven to 13 vehicles per hour. Thus, the closure of Confers Lane was expected to have very little impact on local traffic flow.

The supplemental traffic study did, however, note that mitigation may be required in the form of adding one full-size school bus with driver, and a van or a shorter school bus to mitigate traffic conflicts between the BBNPP workforce and local school buses on US 11. The traffic study also recommended that a plan be developed in consultation with the Berwick Area School District and Salem Township, to remove scheduled stops from US 11 for four identified school bus routes when construction peak traffic overlaps with bus trips. Finally, the KLD traffic impact study identified a need to revise the 2008 Salem Township Radiological Emergency Response Plan and alter police deployment strategies or add a police unit or extend hours of service to mitigate the effects of the Confers Lane closure (KLD 2013-TN2841).

The review team has reviewed each of the traffic studies prepared by KLD in support of the ER and found them to be reasonable. Therefore, the review team largely relied on these studies for assessing the traffic impacts of building and operating the BBNPP.

Railroad

A number of railroads operate in Columbia and Luzerne Counties, including the Canadian Pacific Railway, Luzerne and Susquehanna Railroad Company, Norfolk Southern Railway Company, Reading Blue Mountain and Northern Railroad, the North Shore Railroad, and Steamtown USA (tourist). Non-operator lines include the Luzerne County Redevelopment Authority, National Park Service, and the Pennsylvania Northeast Regional Railroad Authority. The North Shore Railroad operates a line along US 11 near the BBNPP site. The line runs from the Norfolk Southern Railroad Line in Northumberland through Berwick and Bloomsburg to Beach Haven, Pennsylvania. PPL plans to extend the existing rail spur at the SSES plant to the BBNPP (PPL Bell Bend 2013-TN3377).

2.5.2.4 Aesthetics and Recreation

The BBNPP is located in the southwestern corner of Luzerne County, and is characterized by forested rolling terrain. The land in the immediate vicinity of the plant includes forested, undeveloped, mined, open, and developed land. The land is located adjacent to the Susquehanna River and the SSES. PPL owns 2,355 ac on both sides of the Susquehanna River. Situated on this site are the SSES, the BBNPP site, and the Riverlands Recreation Area, which is a strip of land between the SSES power-generating facilities and the Susquehanna River. This recreation area includes the Riverlands Nature Center, Riverlands Recreation Area, Lake Took-A-While, and the Wetlands Nature Area (PPL Bell Bend 2013-TN3377).

Within the region, there are 17 State parks, 6 State forests, 67 State game lands, and three Federal recreation sites (see Table 2-38). Within 50 mi of the BBNPP site, there are 44,992 ac of State parks, 301,573 ac of State forests, 452,029 ac of State game lands, and 2,105 ac of Federal recreational areas (ESRI 2008-TN2227; PASDA 2011-TN2230; PASDA 2013-TN2234). These recreation areas encompass more than 800,000 ac of land.

1 **Table 2-38. Recreational Areas within 50 Mi of the BBNPP Site**

Area	Acreage	Approximate Distance to the BBNPP Site (mi)	Party Days/Nights[(a)]
State Parks[(b)]			
Nescopeck State Park	973	12.3	37,434
Ricketts Glen State Park	12,691	14.8	127,921
Tuscarora State Park	1,504	20.5	61,653
Locust Lake State Park	717	20.7	57,246
Frances Slocum State Park	934	21.6	228,529
Hickory Run State Park	13,613	22.1	115,278
Beltzville State Park	2,022	31.4	223,047
Worlds End State Park	723	32.7	71,737
Gouldsboro State Park	2,515	36.0	62,163
Shikellamy State Park	51	36.2	161,688
Milton State Park	147	36.3	72,159
Tobyhanna State Park	4,966	38.5	116,548
Lackawanna State Park	1,485	39.6	124,887
Big Pocono State Park	1,094	41.7	58,848
Archibald Pothole State Park	346	42.4	14,465
Susquehanna State Park	51	46.8	NA
Jacobsburg State Park	1,158	48.7	75,934
State Park Subtotal	44,992		1,609,537
State Forests[(c)]			
Bald Eagle	82,459	37.2	
Delaware	9,716	33.0	
Lackawanna	29,603	11.3	
Loyalsock	114,532	28.5	
Tiadaghton	37,266	35.8	
Weiser	27,997	16.5	
State Forest Subtotal	301,573		
State Game Lands[(d)]			
State Game Lands Subtotal	44,992	1.9	
Federal Lands[(b)]			
Blue Marsh Lake	1,795	46.3	
Nay Aug gorge	251	34.3	
Steamtown National Historic Site	60	33.7	
Federal Lands Subtotal	2,105		
Total All Areas	800,700		

(a) Mowen et al. 2012-TN2222.
(b) ESRI 2008-TN2227.
(c) Pennsylvania Spatial Data Access (PASDA 2013-TN2234).
(d) PASDA 2011-TN2230.
NA = Data not available

Sources: Mowen et al. 2012-TN2222; ESRI 2008-TN2227; PASDA 2011-TN2230; PASDA 2013-TN2234

Visitors to State parks located within the 50-mi region surrounding the BBNPP site spent more than 1.6 million days/nights at these sites in 2010 (Mowen et al. 2012-TN2222). Figure 2-33 shows the location of the recreation areas within the 50-mi region (ESRI 2008-TN2227; PASDA 2011-TN2230; PASDA 2013-TN2234).

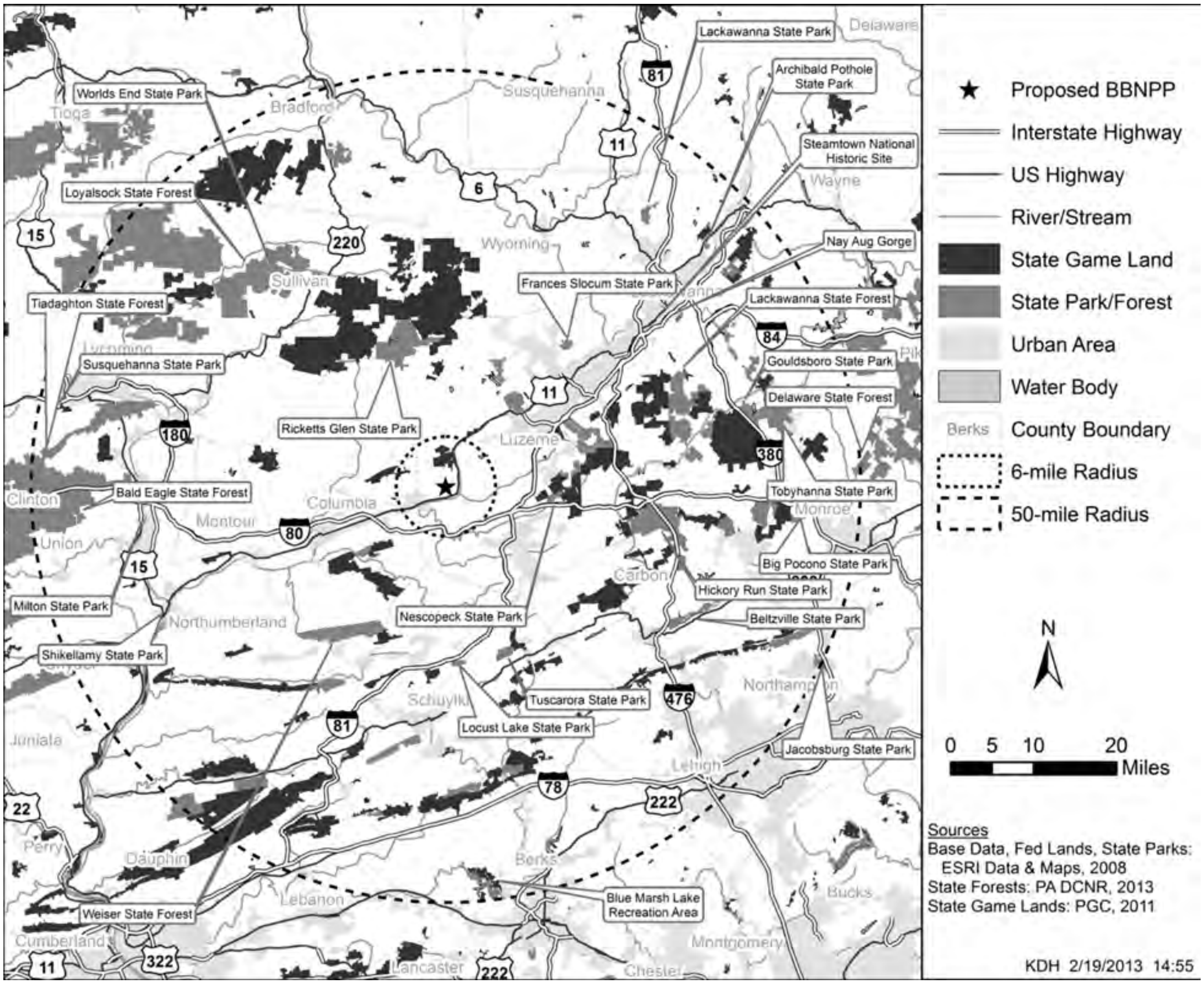

Figure 2-33. Regional Parks and Recreational Areas

Within the two-county economic impact area, there are four State parks, which include the Lehigh Gorge, Frances Slocum, Ricketts Glen, and Nescopeck Parks. There are a total of nine State game lands, one State forest area (the Lackawanna State Forest), and five county parks (Moon Lake Park, Luzerne County Sports Complex, Tubs Nature Area, Bloomsburg Town Park and Twin Bridges Park) (PPL Bell Bend 2013-TN3377).

Within 50 mi of the BBNPP site, there are about 1,100 mi of recreational trails and 363 mi of water trails (see Table 2-39 and Figure 2-34). Land trails within the economic impact area are 153 mi or 13.9 percent of all recreational trails in the 50-mi region. Water trails in the economic impact area cover 63.5 mi or 17.5 percent of all water trails in the 50-mi region.

Table 2-39. Total Trail Distances within 50 Mi of the BBNPP

County	Trail Distances (mi)	
	Land Trails	Water Trails
Berks	104.75	25.02
Bradford	44.25	29.65
Carbon	158.10	43.48
Columbia	18.87	18.86
Lackawanna	104.82	2.13
Lebanon	44.47	12.47
Lehigh	59.72	5.70
Luzerne	134.23	44.65
Lycoming	84.89	23.43
Monroe	55.17	--
Montour	20.46	7.49
Northampton	51.67	13.50
Northumberland	35.22	39.93
Pike	3.07	--
Schuylkill	32.67	46.21
Snyder	27.72	2.89
Sullivan	53.52	
Union	25.56	8.60
Wayne	8.70	
Wyoming	31.03	39.20
Total	1,098.90	363.21

Sources: PASDA 2009-TN2232; PASDA 2012-TN2233

There are 28 campgrounds in Luzerne and Columbia Counties and an additional 3 campgrounds in Schuylkill County and 2 campgrounds in Northumberland County. Within the economic impact area, there are nearly 3,000 campsites and 16 boat launch sites on ponds, lakes, and nearby rivers, providing water recreational opportunities to residents and tourists. Table 2-40 presents an overview of the campgrounds located within the economic impact area (PPL Bell Bend 2013-TN3377) and in adjacent Schuylkill and Northumberland Counties.

Other recreational opportunities within the 50-mi region include a variety of outdoor activities within the areas identified above. These activities include hiking, walking, running, golfing, biking, trail biking, picnicking, wildlife watching, horseback riding, fishing, hunting, swimming, boating, canoeing, kayaking, whitewater rafting, camping, organized group tenting, and cabins, and sledding, ice skating, ice climbing, cross-country skiing, and snowmobiling during the winter.

Local hunting activities are focused on white-tail deer, turkey, and waterfowl. In 2002, 21,600 turkeys were harvested in the economic impact area. In 2003, 17,600 deer and 145 black bear were harvested in the two-county economic impact area (PPL Bell Bend 2013-TN3377). Other hunting focuses on beavers, pheasants, and various species of waterfowl.

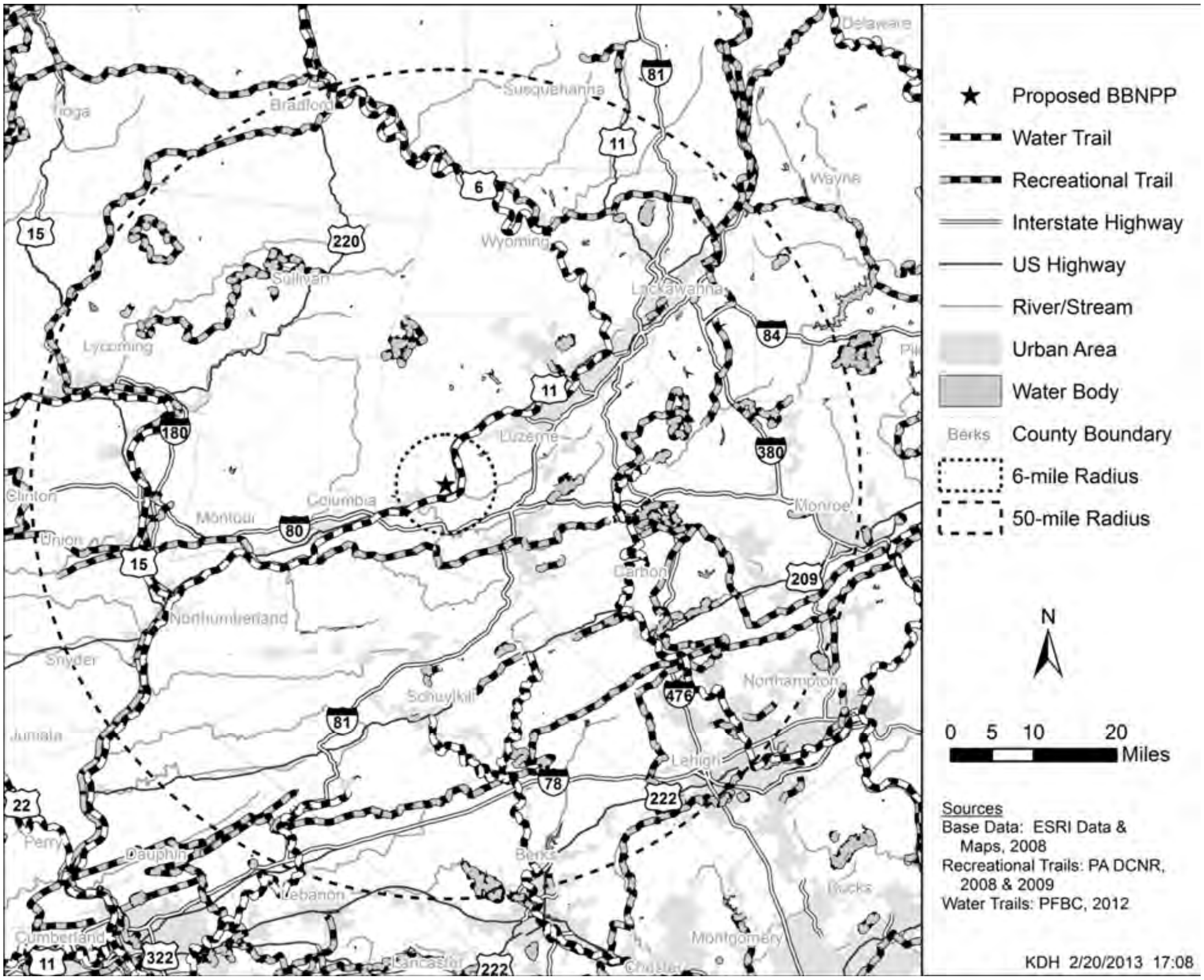

Figure 2-34. Regional Recreational and Water Trails

The primary bodies of water that are fished within the economic impact area include Harris Pond, Lily Lake, Mountain Springs Lake, Frances Slocum Lake, Frances E. Walter Reservoir, Moon Lake, Lake Frances, Nescopeck Creek, Lake Jean, Briar Creek Lake, and the Susquehanna River (PPL Bell Bend 2013-TN3377). Fish species harvested in these waterbodies include American Shad, Black Crappie, Bluegill, Brown Bullhead, carp, catfish, Chain Pickerel (*Esox niger*), herring, Largemouth Bass, Muskellunge, Native Brook Trout (*Salvelinus fontinalis*), Northern Pike, panfish, Rainbow Trout, Smallmouth Bass, Striped Bass, Sunfish, Walleye, Yellow Bullhead, and Yellow Perch (PPL Bell Bend 2013-TN3377). A more detailed discussion of these sport species can be found in Section 2.4 of this EIS.

Table 2-40. Campgrounds and RV Parks Located within 30 Mi of Berwick, Pennsylvania

County/Campsite/RV	City/Location	Distance from Berwick (mi)	Distance from Berwick (km)	Total No. of Sites
Luzerne County				
Paradise Campground Resort	Nescopeck	5.2	8.4	NA
Council Cup Campground	Wapwallopen	9.1	14.6	165
Moyers Grove Campground	Wapwallopen	12.8	20.6	170
Whispering Pines Camping Estates	Stillwater	13.8	22.2	60
Hazleton/Wilkes-Barre KOA	Drums	15.8	25.4	100
Hidden New Lake Campground	Shickshinny	17.4	28.0	NA
81-80 RV Park and Campground	Drums	17.5	28.2	87
Nesco Manor	Drums	17.9	28.8	NA
Moon Lake Park	Hunlock Creek	22.6	36.4	63
Lehigh Gorge Campground	White Haven	28.8	46.3	150
Sandy Valley Campground	White Haven	30.9	49.7	113
Frances Slocum State Park	Wyoming	32.9	52.9	100
Hickory Run State Park	White Haven	33.0	53.1	381
Number of Facilities: 13				**Number of Sites: 1,389**
Columbia County:				
Diehl's Camping Resort	Bloomsburg	11.5	18.5	200
Indian Head Campground	Bloomsburg	14.6	23.5	225
Turner's High View Camping	Bloomsburg	15.9	25.6	92
Red Rock Mountain Campground	Benton	20.0	32.2	NA
Mt. Zion Family Campground	Catawissa	20.0	32.2	NA
Shady Rest Campgrounds	Millville	20.4	32.8	100
Springbrook Camp Grounds	Catawissa	20.5	33.0	150
Ideal Park	Catawissa	21.1	34.0	NA
Lake Glory Campground	Catawissa	21.2	34.1	150
J&D Campgrounds	Catawissa	21.7	34.9	245
Mill Race Golf & Camping Resort	Benton	24.8	39.9	NA
Ricketts Glen State Park	Benton	25.4	40.9	120
Grassmere Park Campgrounds	Benton	27.5	44.3	65
Acorn Acres	Benton	28.4	45.7	100
Good's Campground	Benton	29.3	47.2	62
Number of Facilities: 15				**Number of Sites: 1,509**
Schuylkill County				
Red Ridge Lake Campgrounds	Zion Grove	25.4	40.9	160
Tuscarora State Park	Barnesville	29.0	46.7	6
Locust Lake State Park	Barnesville	33.3	53.6	282
Number of Facilities: 3				**Number of Sites: 448**
Northumberland County				
Knoebels Campground	Elysburg	25.5	41.0	500
Splash Magic Campground	Northumberland	33.7	54.2	220
Number of Facilities: 2				**Number of Sites: 720**
Total Facilities: 33				**Total Sites: 4,066**

NA = not applicable.

Source: PPL Bell Bend 2013-TN3377

Pennsylvania Fish and Boat Commission representatives indicated that the Susquehanna River is a world-class bass fishery and that approximately 50 bass tournaments occur in the area each year, with an average of between 15 and 20 vessels in each tournament (McDowell 2014-TN3492). The scope of the local area referenced in this case was limited to Union Access (above Shickshinny) downstream to the Pennsylvania Fish and Boat Commission Bloomsburg Access. The Pennsylvania Fish and Boat Commission also shared an economic analysis of angling on the Middle and Lower Susquehanna, and Lower Juniata Rivers. From north to south, the study area reached from Port Royal on the Juniata River and Sunbury on the Middle Susquehanna River to Holtwood on the Lower Susquehanna River. The study estimated that in 2007, this 136-mi stretch of river was the destination for 126,201 angler trips, and that those trips generated $2.7 million in direct expenditures ($21.67 per trip per day). With multiplier effects included in the analysis, these expenditures resulted in a total of $3.4 million in annual output and $1.4 million in labor income supporting 59 local jobs (Shields 2010-TN3362).

In addition to the recreational effects experienced near the BBNPP site, there also could be impacts on sites located at or downstream of Cowanesque Lake, Holtwood Reservoir, and Rushton Mine. These sites would be affected by the SRBC requirement that upstream water sources be used to compensate for BBNPP consumptive use. PPL has proposed a CUMP for addressing the SRBC requirement, as described in Section 2.2.2 of this EIS. There are a number of recreational sites in the area surrounding Cowanesque Lake. These sites offer recreational opportunities for boating, water skiing, fishing, swimming, picnicking, and camping. The recreation sites and facilities of interest at Cowanesque Lake are presented in Table 2-41 and described below.

Thompkins Campground covers 223.5 ac and accommodates campers with tents and RVs. The campground has 106 campsites in four camping loops, 16 primitive campsites for hikers, mooring docks, a boat launch, and beach area that includes a concrete pad for swimming. In 2009, 103,715 campers visited the camping loops and 5,768 hikers visited the hike-in campground (EA 2012-TN3371).

The South Shore Day-Use Area covers 51.6 ac and provides opportunities for boating, fishing, swimming, and picnicking. There are two boat launches, an accessible fishing pier at the site, and a concrete pad for swimming. In 2009, the South Shore Day-Use Area attracted 57,089 visitors (EA 2012-TN3371).

Other areas of interest include the Lawrence Picnic Area, North and South Tailrace Access Areas, and the Overlooks at Cowanesque Lake. The Lawrence Picnic Area includes a picnic pavilion that attracted 24,856 visitors in 2009. The North and South Tailrace Access Areas provide shoreline access for fishing and picnicking. In 2009, 6,688 people visited these areas. The Overlooks at Cowanesque Lake provide scenic views of Cowanesque Lake and Cowanesque Dam. In 2009, these overlooks attracted 12,684 visitors (EA 2012-TN3371).

Table 2-41. Cowanesque Lake Recreation Areas

Facility	Parking Area	Boat Launch	Boat Mooring Docks	Shoreline Fishing Area	Accessible Fishing Pier	Swimming Area	Picnic Tables	Picnic Pavilion	Hiking Trail	Biking Trail	Interpretive Trail	Amphitheatre	Playground	Ball Field	Horseshoe Pits	Ranger Station	Barbecue Pits	Osprey Sites	Campsites	Vault Toilet	Flush Toilets	Potable Water Spigot	Potable Water at Sites	Electricity at Sites	Sanitary Hook-up at Sites	Showers	Sanitary Dumping Station	Camp Store/Concession
Thompkins Campground																												
Entrance Area	X																										X	
Knoll Camp	X			X			X					X	X		X				33		X		X	X	X	X		
Cover Camp	X						X								X				31		X		X	X		X		
Bench Camp	X		19	X			X						X		X				18		X		X	X	X			
Meadow Camp	X						X	X	X					X	X				24	X		2						
Hike-in Campground	X			X			X												16	X								
Boat Launch and Beach Area	X	1	15	X		X																						
South Shore Day-use Area	X	2		X	X	X	X	3	X				X		X	X	X	X		X	2					X		X
Lawrence Picnic Area	X			X			X	1							X		X			X								
North Tail-race Access Area	X			X			X													X								
South Tail-race Access Area	X			X														X										
North Overlook	X																											
South Overlook	X																	X										
Moccasin Trail	X								X	X	X																	

Source: Modified from EA 2012-TN3371

The USACE collects visitor data using traffic counters, counts of registered visitors at Tompkins Campgrounds, and visitor surveys. Table 2-42 presents Cowanesque Lake visitors by month. Of the 926,183 visitor hours spent at Cowanesque Lake in 2009, 96.7 percent visited in the May−September time frame (EA 2012-TN3371).

Table 2-42. Monthly Cowanesque Lake Visitor Hours by Month (2009)

Month	Hours	% by Month
January	1,920	0.2
February	2,065	0.2
March	3,083	0.3
April	6,477	0.7
May	103,610	11.2
June	168,788	18.2
July	272,972	29.5
August	241,143	26.0
September	109,547	11.8
October	8,517	0.9
November	4,483	0.5
December	3,578	0.4
Totals	926,183	100.0

Source: EA 2012-TN3371

As the water resources stored in the lake are accessed during low-flow conditions, lake elevations would fall. As the elevation of the lake falls below certain thresholds, some recreational facilities could face closure. Table 2-43 presents a summary of elevation impacts on Cowanesque Lake recreation facilities. The target operating elevation for the lake is 1,080 ft. When lake elevations drop 2 to 3 ft below the target elevation, several sites are affected, including the Boat Launch Concrete Pad and Beach Swimming Concrete Pad at Thompkins Campground and the Beach Swimming Concrete Pad and Americans with Disabilities Act-compliant Fishing Pier at the South Shore Day-Use Area. When elevations drop below 1,075 ft, most sites identified in Table 2-43 would be closed for recreational use. Baseline lake elevations and drawdowns are presented in Section 2.3 of this EIS.

Visitors to Cowanesque Lake provide a significant benefit to the local economy. In 2006, spending by visitors to Cowanesque Lake generated $2.16 million in direct sales and $1.1 million in value added (wages and salaries, payroll benefits, profits and rents, and indirect business taxes) to the local economy. This impact supported 34 jobs in the communities surrounding the lake (Shields 2010-TN3448).

Section 2.3 also indicates that the proposed action may affect Moshannon Creek, which is 52 mi long and is the fifth largest tributary to the West Branch of the Susquehanna River. The creek is designated as a Trout Stocked Fishery and a Migratory Fishery in 25 Pennsylvania Code Chapter 93.91 (PA Code 25-93 -TN611). It is an impaired stream because of pollution from abandoned mine drainage that results in elevated levels of iron, aluminum, and manganese. Because of the presence of acid mine drainage, the creek has not sustained fish populations.

Table 2-43. Summary of Elevation Impacts on Cowanesque Lake Recreation Facilities

Recreation Facility	Drawdown Closure
Tompkins Campground	
Boat Launch Concrete Pad	Fully operational from 1,080–1,078 ft.
Boat Launch Dock Concrete Bulkhead	Fully operational from 1,080–1,975 ft.
Beach Concrete Pad	A drawdown of any kind would affect the area available for swimming. Complete closure at 1,074 ft.
Floating Mooring Slips at Boat Launch and Campground	Majority are operational from 1,080–1,076 ft.
South Shore Day-use Area	
East Boat Launch Concrete Pad	Fully operational from 1,080–1,070 ft.
West Boat Launch Concrete Pad	Fully operational from 1,080–1,070 ft.
East Boat Launch Dock Concrete Bulkhead	Fully operational from 1,080–1,075 ft.
West Boat Launch Dock Concrete Bulkhead	Fully operational from 1,080–1,075 ft.
Beach Concrete Pad	A drawdown of any kind would affect the area available for swimming. Complete closure at 1,074 ft.
Americans with Disabilities Act-Compliant Fishing Pier	Fully operational from 1,080–1,077 ft.

Source: EA 2012-TN3371

Moshannon Creek is a popular destination for kayakers and canoers, and it serves as the site of an annual kayak and canoe race that has taken place since 1967. The Red Moshannon Downriver Race or "Red Mo" race runs 7.5 mi in length, starting at Peal Bridge near the town of Grassflat and ending at the Route 53 Bridge near the town of Moshannon. In 2013, the Red Mo race attracted more than 100 participants from throughout the region.

PPL operates the Holtwood Environmental Preserve, which is home to several recreational sites. The 2,400-ac Lake Aldred, which is located to the north of Holtwood Dam, is a popular boating destination and is home to the Pequea and York Furnace Boat Ramps and two marinas. It also is a popular fishing spot that is home to several species, including Walleye, bass, catfish, panfish, and Muskellunge. Within the broader preserve, there are camping and hiking opportunities. The Otter Creek Campground and Pequea Creek Campground have a total of 150 campsites. Amenities at these campsites include flush toilets, hot showers, and electricity. The Holtwood Environmental Preserve also is home to the Pinnacle and Face Rock Overlooks, the Lock 12 Historic Area, the Holtwood Recreation Area/Arboretum, the Shenk's Ferry Wildflower Preserve, Indian Steps Museum, and several hiking trails (Urey Overlook Trail, Otter Creek Nature Trail, Mason-Dixon Trail, Kelly's Run, Conestoga Trail, and Pequea Creek Nature Trail).

2.5.2.5 Housing

Housing patterns near the BBNPP site follow development patterns within the 50-mi region, with residential housing clustering around town and city limits and along transportation corridors. Rental property and housing are limited in the rural areas of the region but are available in the larger municipalities, including Berwick, Bloomsburg, Hazleton, Nanticoke, and Wilkes-Barre. In the near vicinity of the BBNPP site, housing structures are generally isolated, single-family homes. Newer residential areas are primarily associated with the larger towns and cities located in the economic impact area.

Table 2-44 presents an overview of the housing markets for counties located in the economic impact area, and for Northumberland and Schuylkill Counties. These counties were selected because approximately 87.1 percent of the current SSES workforce resides in Columbia County (44.8 percent) and Luzerne County (42.3 percent), while an additional 3.8 percent resides in Northumberland County to the west of the BBNPP site and 2.8 percent resides in Schuylkill County to the south. The final 6.3 percent of the workforce is distributed across at least 18 other counties (see Table 2.5-1 of the ER).

Table 2-44. Regional Housing Stock in 2010

County	Total Housing Units	Number Vacant	Percent Vacant	Number Owner-Occupied	Number Renter-Occupied	Percent Renter-Occupied
Columbia	29,291	3,407	11.6	18,515	7,369	28.5
Luzerne	148,515	17,660	11.9	91,484	39,371	30.1
Northumberland	44,910	5,676	12.6	28,404	10,830	27.6
Schuylkill	69,271	8,924	12.9	46,595	13,752	22.8
Total	291,987	35,667	12.2	184,998	71,322	27.8

Source: USCB 2011-TN2072

In 2010, there were a total of 291,987 housing units available in the four counties included in Table 2-44, 177,806 of which were located in the economic impact area (USCB 2011-TN2072). Within the economic impact area, there were 21,067 vacant housing units representing 11.8 percent of total housing units. Vacancy rates in the counties located in the economic impact area were lower than those found in Northumberland County (12.6 percent) and Schuylkill County (12.9 percent). The renter occupation rate in the economic impact area (29.8 percent) is higher than those registered in Northumberland County (27.6 percent) and Schuylkill County (22.8 percent) (USCB 2011-TN2072).

Despite the apparent availability of housing indicated by the data presented in Table 2-44, discussions with representatives of the Borough of Berwick indicated that the current availability of vacant new and rental homes near the BBNPP site may be much more limited. Borough staff expressed concern regarding housing during the BBNPP construction period because during the construction of the SSES, houses were purchased, divided into multiple family dwellings, rented at a high price during the construction period, and then left to fall into disrepair in the years that followed. Berwick staff shared the concern that this pattern would recur with the construction of the BBNPP. Berwick staff noted that there is very little room for growth in Berwick and that local ordinances would limit the number of trailer and RV parks that could be added to the Berwick area. Thus, Berwick staff concluded that there is limited capacity to accommodate additional housing demands placed upon Berwick during the BBNPP construction period (NRC 2012-TN1694).

The review team examined USCB ACS data to assess the capacity for local communities to provide housing to in-migrating workers and their families. In 2010, vacancy rates were lower in Berwick (430 units or 9.6 percent of the housing stock) compared to other surrounding communities. In Bloomsburg, there were 584 vacant housing units (11.3 percent) among 5,152 total units in 2010. The number of vacant units in Wilkes-Barre was 2,851 (14.6 percent) in 2010. In Nanticoke, there were 5,312 housing units in 2010, and 622 (11.7 percent) were vacant. In Hazleton, there were 11,936 housing units, and 1,891 (15.8 percent) stood vacant (USCB 2011-TN2072).

In 2010, the median value of owner-occupied housing was $118,800 in Columbia County and $113,300 in Luzerne County (USCB 2011-TN2072). Median gross monthly rent in the four-county area examined in this section ranged from a low of $524 in Northumberland County to a high of $619 in Columbia County. The median rent in Luzerne County was $599 in 2010 (USCB 2011-TN2072).

In addition to the vacant housing units identified in Table 2-44, there are 96 hotels, motels, and bed and breakfasts with a total of 3,674 units located in the two-county economic impact area (PPL Bell Bend 2013-TN3377). In addition, there are a total of 28 campgrounds located in the economic impact area within a 30-mi radius of Berwick with nearly 3,000 sites that could accommodate members of the construction workforce (see Table 2-40).

2.5.2.6 Public Services

This section provides information regarding public health and safety services available to residents of the economic impact area. The systems examined in this section include water and wastewater, police services, fire-protection services, emergency management, and healthcare. The review team reviewed the ER for the proposed BBNPP site and obtained additional information as needed for each of the service areas discussed below.

Water Supply

Water supplied in Luzerne and Columbia Counties comes from both groundwater and surface-water sources. On average, 41.4 million gallons are produced by the 12 largest water systems operating in the economic impact area (PADEP 2013-TN2218). A large water system is defined as any system serving a population in excess of 4,500.

The team obtained information regarding the potable water supply in the two-county economic impact area from the Pennsylvania Drinking Water Reporting System maintained by the PADEP. The Drinking Water Reporting System provides information about public water systems throughout Pennsylvania, including monitoring requirements, water-quality sample results, production information, design capacity, and other inventory information. The data set did not include maximum production values for the PAWC systems operating in Luzerne and Columbia Counties. Those values were obtained through direct contact with the PAWC (Pennsylvania American Water 2013-TN2223). Table 2-45 presents water system information, including the population served, water source, water system name, average and maximum production, and design capacity for large water systems in the economic impact area. Figure 2-35 maps the location of each community water system within Luzerne and Columbia Counties (PADEP 2014-TN3462). The water system located nearest to the BBNPP is the 19070 – PA American Water Company, Berwick District.

Table 2-45. Water Supply and Capacity by Major Water-Supply Systems in Columbia and Luzerne Counties

System Name	Population Served[(a)]	Primary Water Source[(a)]	Average Production (gpd)[(a)]	Maximum Production (gpd)[(a, b, c)]	Design Capacity (gpd)[(a)]
Columbia County					
United Water Pennsylvania-Bloomsburg	21,500	GW	2,581,000	3,479,000	4,147,200
Pennsylvania American Water Company-Berwick	16,000	GW	1,500,000	2,477,000	4,600,000
County Subtotal			4,081,000	5,956,000	8,747,200
Luzerne County					
Freeland Borough Municipal Water Authority	4,610	GW	430,438	709,000	1,613,200
United Water Pennsylvania – Dallas	5,113	GW	462,000	891,270	1,566,000
Humboldt Industrial Park	8,000	GW	500,000	1,706,000	1,375,200
Glen Summit Springs Water	5,500	GW	12,500	15,000	96,000
Pennsylvania American Water Company-Crystal Lake	9,535	SW	2,500,000	4,000,000	4,920,000
HCA Roan Filter Plant	40,620	SW	5,394,000	7,700,000	10,000,000
Pennsylvania American Water Company-Ceasetown	63,198	SW	8,700,000	10,300,000	16,000,000
Pennsylvania American Water Company-Nesbitt	58,278	SW	7,800,000	8,800,000	10,400,000
Pennsylvania American Water Company-Watres	58,000	SW	9,000,000	11,500,000	16,000,000
Pennsylvania American Water Company-Huntsville	10,800	SW	2,500,000	3,600,000	4,500,000
County Subtotal			37,298,938	49,221,270	66,470,400
Total			41,379,938	55,177,270	75,217,600

(a) PADEP 2013-TN2218.
(b) Maximum production is defined as the maximum volume of water in gallons produced for any one day during a calendar year.
(c) Maximum production data for the Pennsylvania American Water Company systems in Luzerne County obtained from Pennsylvania American Water 2013-TN2223.
gpd = gallons per day, GW = groundwater, SW = surface water

Sources: PADEP 2013-TN2218; Pennsylvania American Water 2013-TN2223

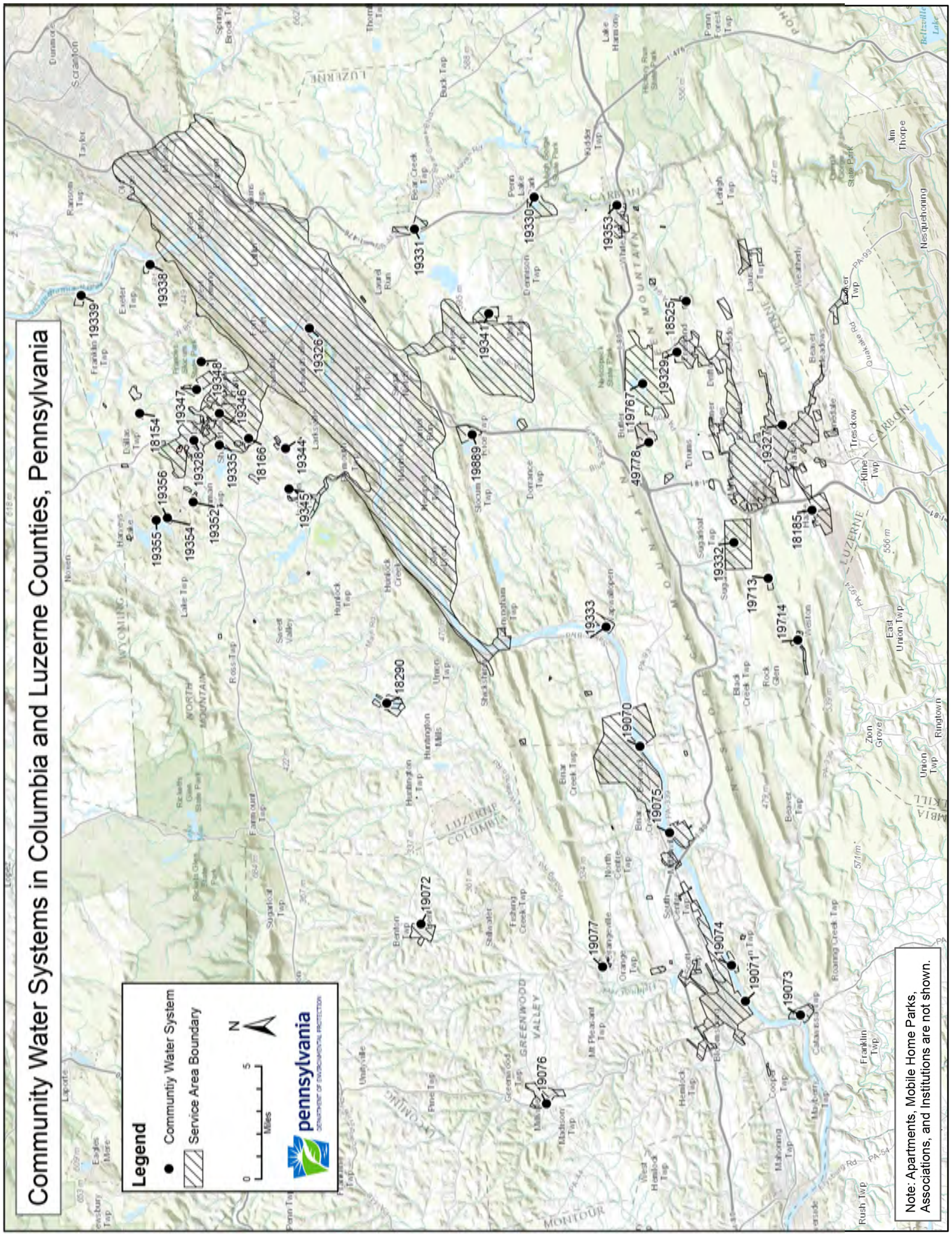

Figure 2-35. Community Water Systems in Luzerne and Columbia Counties

With the exception of the Humboldt Industrial Park, which is operating at 124.1 percent of design capacity during maximum production periods, all systems are well under design capacity. For large systems in Columbia County, average and maximum production levels are at 46.7 and 68.1 percent of design capacity, respectively. Large systems in Luzerne County are operating nearer to design capacities. The PAWC–Nesbitt system is operating at 84.6 percent of capacity and the PAWC–Crystal Lake system is operating at 81.3 percent of capacity. In total, large systems located in Luzerne County are operating at 73.4 percent of design capacity (PADEP 2013-TN2218 and Pennsylvania American Water 2013-TN2223).

The review team used the population estimates presented in Table 2-26, and assumed constant per capita water consumption rates over time, to project water demand for large systems operating in Columbia and Luzerne Counties out to 2030 (see Table 2-46). Even when using a conservative no-growth assumption for system design capacity, water systems in both counties demonstrate the ability to absorb additional demand. Note that the Luzerne County population has been forecasted to decline over the time period from 2011 to 2030, thus reducing strain on the county's water systems.

Table 2-46. Historic and Projected Water Demand for Columbia and Luzerne Counties from 2011 to 2030

Year	Average Production (gpd)	Maximum Production (gpd)	Design Capacity (gpd)
Columbia County			
2011	4,081,000	5,956,000	8,747,200
2015	4,146,044	6,050,929	
2020	4,228,809	6,171,720	
2025	4,313,480	6,295,292	
2030	4,399,846	6,421,339	
Luzerne County			
2011	37,298,938	49,221,270	66,470,400
2015	36,821,495	48,591,215	
2020	36,233,275	47,814,976	
2025	35,699,317	47,110,342	
2030	35,173,228	46,416,092	

gpd = gallons per day

Source: PADEP 2013-TN2218

Wastewater Treatment

A total of 22 wastewater-treatment facilities are located within the economic impact area: 13 are located in Columbia County and 9 in Luzerne County. Table 2-47 identifies the sewer systems located in Columbia and Luzerne Counties, and presents capacity and utilization data. The data presented in Table 2-47, which represent 5-year average and 3-month maximum loads from 2007 to 2011, were developed by representatives of the PADEP from Chapter 94 reports prepared by individual sewer districts (PADEP 2013-TN3464; PADEP 2013-TN3465). Chapter 94 reports are municipal waste load management reports filed annually with PADEP by all municipal sewer districts in the Commonwealth of Pennsylvania. Note that 2011 maximum loadings are abnormally high because of record precipitation that raised the Susquehanna River to flood levels.

Table 2-48 shows that several sewer authorities are either near or exceeding capacity during peak periods. The two largest sewer authorities in Columbia County are the Berwick Area Joint Sewer Authority (average loading of 1.85 Mgd and the Bloomsburg Municipal Authority with an average loading of 3.09 Mgd. From 2007 to 2011, the county's sewers were at 63 percent of capacity during average periods and 96 percent of capacity during peak periods. Average loadings in Luzerne County were proportionally higher than those in Columbia County at 78 percent of capacity; however, maximum loadings were much higher at 123 percent of design capacity.

The review team used the population estimates presented in Table 2-26, and assumed constant per capita wastewater generation rates over time, to project wastewater-treatment levels for municipal sewage systems operating in Columbia and Luzerne Counties out to 2030 (see Table 2-48). Columbia County maximum production is forecast to exceed design capacity in 2025, while average production levels are forecast to remain at least 3 Mgd below design capacity. Note that the Luzerne County population is forecast to decline over the 2011 to 2030 time period, thus reducing strain on the county's water systems.

Police Services

Law enforcement within the economic impact area is provided by the Pennsylvania Department of State Police, the Luzerne County Sheriff's Office, Columbia County Sheriff's Office, and local city, town, township, and borough police departments. Within the economic impact area, there are 781 law enforcement employees and 698 law enforcement officers. Officer rates per 1,000 people in Columbia and Luzerne Counties are 1.9 and 1.8, respectively (Pennsylvania State Police 2010-TN1868).

Police departments located near the BBNPP site include the Salem Township Police Department (BBNPP is located within Salem Township) and the Berwick Police Department, which is located 4.27 mi from the BBNPP site. The Salem Township Police Department is staffed with three full-time and four part-time officers. The department, which operates on a shortened schedule, handled 2,536 calls in 2007 (PPL Bell Bend 2013-TN3377). The Berwick Police Department includes a Police Chief, an Assistant Chief, a total of 13 officers, a parking attendant, and 3 clerks/dispatchers (Berwick Borough 2013-TN2004). In 2007, the department handled 5,694 calls (PPL Bell Bend 2013-TN3377). A representative of the Borough of Berwick indicated that the borough's police force was working at capacity and that it could be difficult to accommodate additional activity generated by the BBNPP construction workforce (Balducci 2009-TN4027).

Table 2-47. Hydraulic Loading and Design Capacity for Sewer Districts/Systems in Columbia and Luzerne Counties (5-year average and 3-month maximum load: 2007 to 2011)

System Name	Average Loading (Mgd)[a,b]	Maximum Loading (Mgd)[a,b]	Design Capacity (Mgd)[a,b,c]
Columbia County			
Berwick Area Joint Sewer Authority	1.851	3.422	3.640
Catawissa Borough Sewer Authority	0.145	0.186	0.200
Millville Borough Sewer Authority	0.193	0.292	0.300
Bloomsburg Municipal Authority	3.090	4.160	4.290
Greenwood Township Municipal Authority	0.006	0.007	0.008
Orange Township Sewer Authority	0.005	0.010	0.013
Hemlock Township Municipal Sewer Coop	0.020	0.362	0.300
Madison Township Municipal Authority	0.014	0.021	0.020
Benton Borough Municipal Water and Sewer Authority	0.073	0.104	0.132
Orangeville Borough Water Authority	0.026	0.032	0.070
Montour Township Authority	0.061	0.073	0.100
Locust Township Municipal Authority	0.033	0.056	0.050
County Subtotal – 13 Facilities	5.516	8.724	9.123
Luzerne County			
Wyoming Valley Sanitary Authority	25.008	39.900	32.000
Greater Hazleton Joint Sewer Authority	9.180	14.400	8.900
Mountaintop Area Joint Sewer Authority	3.232	4.820	4.160
Lower Lackawanna Valley Sanitary Authority	3.588	4.720	6.000
Shickshinny Sewer Authority	0.352	0.725	0.450
Conyngham Borough Authority	0.429	0.716	0.350
Nescopeck Sewer Authority	0.124	0.232	0.110
Freeland Sewer Authority	0.504	0.693	0.750
Butler Township Sewer Authority	0.584	1.294	2.200
County Subtotal – 9 Facilities	43.001	67.500	54.920
Total	48.517	76.224	64.043

(a) PADEP 2013-TN3465
(b) PADEP 2013-TN3464
(c) PPL Bell Bend 2013-TN3377
(d) Butler Township 2014-TN3463

Sources: PPL Bell Bend 2013-TN3377; PADEP 2013-TN3465; PADEP 2013-TN3464; Butler Township 2014-TN3463

Table 2-48. Historic and Projected Wastewater-Treatment Facility Capacities for Columbia and Luzerne Counties from 2010 to 2030

	Average Production (Mgd)	Maximum Production (Mgd)	Design Capacity (Mgd)
Columbia County			
2010	5.52	8.7	9.1
2015	5.63	8.9	
2020	5.74	9.1	
2025	5.85	9.3	
2030	5.97	9.4	
Luzerne County			
2011	43.0	67.5	54.9
2015	42.3	66.4	
2020	41.6	65.4	
2025	41.0	64.4	
2030	40.4	63.4	

Sources: PPL Bell Bend 2013-TN3377; PADEP 2013-TN3465; PADEP 2013-TN3464; Butler Township 2014-TN3463.

The Columbia County Sheriff's Office employs six full-time and six part-time deputies (NRC 2012-TN1694). The primary functions of the office include transporting prisoners, courtroom security, clearing bench warrants, serving and administering Protection from Abuse orders, and assisting in civil judgments including evictions. In 2012, the Columbia County Sheriff's Office cleared 990 bench warrants and transported prisoners over 80,000 mi (Chamberlain 2012-TN2005). In 2011, the Columbia County Jail housed an average of 170.7 inmates, which is 78.3 percent of its 218 prisoner capacity. In 2011, the jail's budget was $4.7 million, which funded 55 full-time and 20 part-time security staff, three full-time administrative staff, three full-time and two part-time treatment staff, and four full-time support staff (PDOC 2012-TN2007).

The Luzerne County Sheriff's Office employed 36 deputies and 5 office staff in 2012. A representative of the agency indicated that the office lost 11 staff members from 2010 to 2012 due to budget cuts, and further cuts were expected in the near future (NRC 2012-TN1694). The Luzerne County Sherriff's Office is the enforcement arm of the county court system providing prisoner transportation, clearing warrants, and assisting in civil judgments including evictions. In 2011, the Luzerne County Jail housed an average of 600 inmates, which is 114 percent of its 525 prisoner capacity. The county currently houses an average daily inmate population of 94.6 prisoners in other local county jails. In 2011, the jail's budget was $29.0 million, which funded 291 full-time security staff, 9 full-time administrative staff, 25 full-time and 13 part-time treatment staff, and 13 full-time support staff (PDOC 2012-TN2007).

Fire Department Services

Firefighting services within the economic impact area are provided by 90 fire departments operating 117 fire stations with 3,225 active firefighters (see Table 2-49). In Columbia County, 23 fire departments operate 27 fire stations with 751 volunteer and 150 paid per call firefighters.

In Luzerne County, 67 fire departments operate 90 fire stations with 180 career, 2,014 volunteer, and 130 paid per call firefighters (USFA 2013-TN1867). There are 7.2 firefighters per 1,000 people in Luzerne County and 13.3 per 1,000 people in Columbia County. In 2011, the national average rate of firefighters per 1,000 people was 3.5 (Karter and Stein 2012-TN1871).

The Salem Township Fire Department and Berwick Fire Department are closest to the BBNPP site. The BBNPP site is located in Salem Township 4.27 mi away from Berwick, Pennsylvania. The Berwick Fire Department is composed of five companies. In 2010, the department responded to 410 calls that required a response, 123 of which were to communities located outside of Berwick (Berwick Borough 2013-TN2008). While meeting with staff and elected officials in the Borough of Berwick, the review team did not receive any information to suggest that the borough's fire department was operating at or near capacity. In Salem Township, however, township staff noted that investments were needed for local fire and emergency response systems to accommodate the BBNPP (NRC 2012-TN1694).

Table 2-49. Economic Impact Area Fire-Protection Resources

County	Fire Departments	Fire Stations	Active Firefighters			
			Career	Volunteer	Paid per Call	Total
Columbia	23	27	0	751	150	901
Luzerne	67	90	180	2,014	130	2,324
Economic Impact Area	90	117	180	2,765	280	3,225
Pennsylvania	1,794	2,368	5,435	58,431	1,043	64,909

Source: USFA 2013-TN1867

Emergency Management

The Luzerne County Emergency Management Agency (EMA) coordinates the response to natural disasters and other emergencies with 67 fire departments (including volunteer stations), 31 police or sheriff departments, and 9 hospitals located within the county. In a meeting with the review team, a representative of the Luzerne County EMA indicated that the agency was responsible for coordinating the offsite emergency response to a radiological incident at the SSES, and that it worked closely with 22 local municipalities, 15 of which are located in Luzerne County and 7 of which are in Columbia County (Balducci 2009-TN4027). The Luzerne County EMA's Radiological Emergency Response Plan indicates that in the event of a radiological incident at the SSES, the agency also would communicate with, or coordinate the response of, the Pennsylvania Emergency Management Agency, ambulance companies, county emergency operations center staff, at-risk school districts and colleges, healthcare organizations, prisons, monitoring/decontamination teams, and local chapters of the American Red Cross (PPL Bell Bend 2008-TN398).

A representative of the Luzerne County EMA also indicated that emergency response drills involving nuclear incidents are carried out annually and that no deficiencies were found during the most recent drill. The Luzerne County EMA keeps a list of special-needs individuals (e.g., elderly, disabled, low-income) who would require public transportation in the event of an incident at the existing SSES. That contact information, along with a notification system that includes 75 sirens posted throughout the region, would be used to notify these special-needs groups in event of an emergency. Finally, the Luzerne County EMA representative noted that the County had built an emergency operations center where Federal, State, local, and private agencies could coordinate a response in the event of a radiological event at the SSES (Balducci 2009-TN4027).

A representative of the Berwick Hospital Center indicated that the hospital was a first-responder site where contaminated workers would be directed in the event of an incident at the SSES. The representative further noted there was an emergency response plan in place, and that part of that plan includes converting emergency room space at the hospital into a decontamination unit (Balducci 2009-TN4027).

The Columbia County EMA employs three full-time employees and several volunteers, and is the primary emergency management agency coordinating the response to emergencies of 33 municipalities, 23 fire departments, 9 police or sheriff departments, and 2 hospitals located within the county. Primary emergencies targeted for response include floods, droughts, lightning strikes, wind, tornadoes, winter weather, pandemics, hazardous material releases, and radiological events at nuclear power plants (CCEMA 2013-TN2216). The Columbia County EMA also would participate in the response to radiological incidents at the SSES, and has established a system of sirens, emergency alert systems, transportation systems, evacuation routes, and emergency reception centers to respond to such an event.

Healthcare Services

Ten hospitals are located within the economic impact area. The Berwick Hospital Center and Bloomsburg Hospital are located in Columbia County. The other eight hospitals (Geisinger Wyoming Valley Medical Center, Hazleton General Hospital, Wilkes-Barre General Hospital, First Hospital Wyoming Valley, John Heinz Institute of Rehabilitation, Kindred Hospital – Wyoming Valley, Mercy Special Care Hospital, and the Veterans Administration Medical Center) are located in Luzerne County. Table 2-50 presents use and personnel data for hospitals located within the economic impact area.

During 2010 to 2011, there were 1,007 staffed beds and 804 physicians at Luzerne County hospitals. Luzerne County hospitals provided 253,873 patient days over the same time period. Luzerne County hospitals were operating at 70.4 percent capacity in 2010 to 2011 (PADOH 2012-TN2224). In addition to these hospitals, 26 nursing homes are located in Luzerne County with 2,912 licensed/approved beds (PPL Bell Bend 2013-TN3377). Wilkes-Barre General is the largest hospital in the county with 17,065 admissions and 375 staffed beds during the 2010 to 2011 time period. In Luzerne County there were 3.0 beds and 2.4 physicians at acute care, specialty, and Federal hospitals per 1,000 people (2010 to 2011). In Pennsylvania, there were 3.5 beds and 4.7 physicians per 1,000 people over the same time period (PADOH 2012-TN2224). The U.S. average was 2.7 hospital beds per 1,000 people in 2007 (PPL Bell Bend 2009-TN1872). While the Luzerne County ratios are below the State ratio, county hospitals are operating at 70.4 percent capacity.

Table 2-50. Hospital Data for Columbia and Luzerne Counties

Facility Name	Staffed Beds[a]	Admissions[a]	Patient Days of Care[a]	Bed Days Available[a]	Occupancy Rate	Personnel		No. of Physicians	
						FT	PT	Board Certified	Other
Columbia County									
Berwick Hospital Center	101	3,190	14,046	36,865	38.1%	257	83	45	9
Bloomsburg Hospital	72	2,807	11,534	26,280	43.9%	267	178	49	20
County Subtotal	173	5,997	25,580	63,145	40.5%	524	261	94	29
Luzerne County									
Geisinger Wyoming Valley Medical Center	201	12,868	60,221	73,365	82.1%	2,701	749	129	14
Hazleton General Hospital	150	6,781	33,970	54,750	62.0%	472	219	112	23
Wilkes-Barre General Hospital	375	17,065	80,714	130,175	62.0%	1,586	692	315	44
First Hospital Wyoming Valley	107	3,617	33,580	39,055	86.0%	161	107	10	0
John Heinz Institute of Rehabilitation	71	1,813	21,194	25,915	81.8%	329	160	10	0
Kindred Hospital – Wyoming Valley	36	337	8,444	13,140	64.3%	95	5	71	24
Mercy Special Care Hospital	67	615	15,750	24,455	64.4%	109	74	47	5
VA Medical Center – Wilkes-Barre	NA	NA	NA	NA	NA	NA	NA	NA	NA
County Subtotal	1,007	43,096	253,873	360,855	70.4%	5,453	2,006	694	110
Total All Counties	1,180	49,093	279,453	424,000		5,977	2,267	788	139

(a) Total during a recent 12-month period from July 2010 to June 2011.
(b) Hospital personnel list does not include doctors that serve patients in the hospital but are not employed by the hospital. It does include contract staff.
NA = Data not available.

Source: PADOH 2012-TN2224

In Columbia County, there are two hospitals (Berwick Hospital Center and Bloomsburg Hospital) with 173 staffed beds and 123 physicians (PADOH 2012-TN2224). There also are five nursing homes with 685 licensed/approved beds (PPL Bell Bend 2013-TN3377). The Berwick Hospital Center is the largest hospital in the county with 101 acute care beds. During 2010 to 2011, there were 3,190 patients admitted who received 14,046 patient days of care at the hospital. The Berwick Hospital Center employed 54 full-time physicians and has a total hospital staff of 340. During 2010 to 2011, there were 2.6 beds and 1.8 physicians per 1,000 people in Luzerne County. The Columbia County ratios are lower than those for Pennsylvania and the United States; however, Columbia County hospitals are currently operating at 40.5 percent of capacity (PADOH 2012-TN2224).

2.5.2.7 Education

A number of local school districts would be affected by in-migrating families during construction and operation of the BBNPP. There are 117 primary and secondary schools in 23 districts within the economic impact area (Columbia and Luzerne Counties). The total student enrollment at these schools for the 2010–2011 school year was approximately 57,000 (NCES 2013-TN4026) and 3,923 teachers. During the 2010–2011 school year, the student-to-teacher ratio for all schools in the economic impact area was 14.5, and was 12.6 and 15.0 in Columbia and Luzerne Counties, respectively. As shown in Table 2-51, the student-to-teacher ratio in Columbia County falls below the statewide average of 13.8, while the Luzerne County ratio is above the statewide average (NCES 2013-TN4026).

Table 2-51. Education Resources in Economic Impact Area

Resources	Columbia	Luzerne
School Districts[(a)]	7	16
Schools[(b)]		
Elementary	10	37
Elementary-Middle	1	19
Middle	3	6
Elementary-Middle-High	3	5
Middle-High	4	9
High	6	10
Other	0	12
Total	27	98
Teachers-Students[(b)]		
Total Number of Students	9,923	47,107
Total Number of Teachers	785	3,138
Student-to-Teacher Ratio	12.6	15.0
Statewide Average	13.8	13.8

(a) PPL Bell Bend 2009-TN1872
(b) NCES 2013-TN4026 (includes public and private schools)
E = elementary school, M = middle school, and H = high school

Sources: PPL Bell Bend 2009-TN1872; NCES 2013-TN4026

The Pennsylvania Code for Academic Standards requires that, for every 20 students enrolled in pre-kindergarten programs, there must be one teacher and one teacher aide. These standards do not extend to the primary and secondary school systems in Pennsylvania, and there are no State laws governing LOS capacity requirements.

A number of school districts are likely to be affected by in-migrating families during construction and subsequent operation of the BBNPP; principal among these are the Berwick Area School District (Luzerne and Columbia Counties), Hazleton Area School District (Carbon, Luzerne, and Schuylkill Counties), Crestwood School District (Luzerne County), and the Greater Nanticoke Area School District (Luzerne County). Other school districts potentially affected by in-migrating families are the Wilkes-Barre and Bloomsburg Area School districts.

The Berwick Area School District serves the boroughs of Berwick, Briar Creek, and Nescopeck, and the townships of Salem, Briar Creek, Nescopeck, and Hollenback. The Berwick Area School District encompasses most of the area in the immediate vicinity of the BBNPP site and is located in both Columbia and Luzerne Counties. There are six schools in the Berwick Area School District, and the district's student-to-teacher ratio was 13.1 for the 2010–2011 school year (NCES 2013-TN4026). In discussions with the review team, a representative of the Berwick Area School District indicated that the student-to-teacher ratio would likely increase to above 15.0 as a result of recent staff layoffs (NRC 2012-TN1890).

Table 2-52 demonstrates that schools within the Berwick Area School District could absorb additional students, with capacities ranging from 66.5 percent to 91.3 percent; however, a representative of the Berwick Area School District noted that most of its buildings were aging; three elementary school buildings—Orange, Nescopec, and 14th Street—were built prior to 1935. These elementary school buildings need to be upgraded or replaced. If there is no influx of students, the district may consider closing one elementary school in the near future. If an influx of students associated with BBNPP construction occurs, the district would receive more real estate taxes and State funding because its apportionment is based in part on enrollment (Balducci 2009-TN4027).

The Hazleton Area School District is located to the southeast of the BBNPP site, and is a large district that encompasses communities in Carbon, Luzerne, and Schuylkill Counties. The district serves the municipalities of Freeland, Jeddo, Foster Township, Butler Township, Conyngham, West Hazleton, Hazle Township, Sugarloaf Township, Black Creek Township, Kline Township, North Union Township, East Union Township, McAdoo, Beaver Meadows, and Banks Township. In the Hazleton Area School District, student-to teacher-ratios exceed the statewide average. The student-to-teacher ratio for Hazleton High School is 15.9, and ratios in the Hazleton School District reach as high as 17.6 at Drums Elementary/Middle School (NCES 2013-TN4026). In addition, several schools are currently operating above their capacities. Among these schools, Hazleton Area High School, which includes the Hazleton Area Career Center, is operating at nearly 50 percent over capacity (PPL Bell Bend 2009-TN1872).

Table 2-52. Capacity and Enrollment by School for Districts Located near BBNPP

District/School	Capacity[a]	Enrollment[b] (2010–2011)	% Capacity
Berwick Area School District[c]			
Berwick High School	1,037	915	88.2
Berwick Middle School	1,140	758	66.5
Fourteenth St. Elementary	240	219	91.3
Orange Street Elementary	484	384	79.3
Nescopeck Elementary	352	283	80.4
Salem Elementary	462	455	98.5
Mulberry St. Elementary[d]	154	No data	
Hazleton Area School District			
Arthur Street Elementary	350	428	122.3
McAdoo/Kelayres	450	431	95.8
Drums Elementary/Middle	689	834	121.0
Heights Terrace	1,071	1,055	98.5
Valley	1,047	1,122	107.2
West Hazleton	789	1,011	128.1
Freeland Elementary/Middle	961	861	89.6
The Castle	1,039	1,087	104.6
Hazle Building	725	836	115.3
Hazleton Area High School	1,637	2,420	147.8
Crestwood School District			
Crestwood High School Crestwood Middle School	1,424	1,513	106.3
Fairview Elementary School Rice Elementary School	1,600	1,516	94.8
Greater Nanticoke Area School District			100.0

(a) PPL Bell Bend 2009-TN1872.
(b) NCES 2013-TN4026.
(c) Hayes Large 2012-TN2152.
(d) The building that formerly housed Mulberry Street Elementary has been leased to the New Story School, which is a special education magnet school.

Sources: PPL Bell Bend 2009-TN1872; NCES 2013-TN4026; Hayes Large 2012-TN2152

The Crestwood School District is located to the east of the BBNPP site and to the north of the Hazleton Area School District. The Crestwood School District includes four schools serving the boroughs of Nuangola, Penn Lake Park, and White Haven, and the townships of Dennison, Dorrance, Fairview, Rice, Slocum, and Wright in Luzerne County. The student-to-teacher ratio in the Crestwood School District is 18.25, which is above the statewide average of 13.8 (NCES 2013-TN4026). In addition, the schools in the district are currently operating above or near full capacity (PPL Bell Bend 2009-TN1872).

The Greater Nanticoke Area School District is located to the north of the BBNPP site and east of the Berwick Area School District. The school district serves the borough of Nanticoke and the townships of Conyngham, Newport, and Plymouth. It includes five schools and is operating at a student-to-teacher ratio of 17.0, which is above the statewide average of 13.8 (NCES 2013-TN4026). PPL contacted the Director of Buildings for the Greater Nanticoke Area School District who informed PPL that all schools were operating at capacity (PPL Bell Bend 2009-TN1872).

Six 4-year universities and one community college are located within the two-county economic impact area, but none is located within 10 mi of the BBNPP site. These schools include Bloomsburg University, King's College, Luzerne County Community College, Misericordia University, Penn State Hazleton Campus, Penn State Wilkes-Barre Campus, and Wilkes University.

2.6 Environmental Justice

Environmental justice refers to a Federal policy established by Executive Order 12898 (59 FR 7629 -TN1450) under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.(2) The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997-TN452). Although it is not subject to the Executive Order, the NRC has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the NRC issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040-TN1009).

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the region surrounding the site. The characterization in this section forms the analytical baseline from which the review team made assessments of potential environmental justice effects during building and operations of the proposed BBNPP.

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and in this discussion, the total population minus those who self-identified as "White, not Latino or Hispanic" constitutes the aggregate racial minority population. Persons of Hispanic/Latino origins are considered an ethnic minority and may be of any race.

Unless specified in the sections below, the review team used data from the 2006 to 2010 USCB ACS for all poverty and racial/ethnic data (USCB 2011-TN2009).(3) When the review team used different analytical methods or additional information for its analysis, the sections below include explanatory discussions and citations for additional sources.

(2) Minority categories are defined as American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black races, or Hispanic ethnicity; "other" may be considered a separate minority category. Low income refers to individuals living in households meeting the official poverty measure.

(3) The USCB data used in this section were obtained from ACS results released in 2011. During the preparation of this EIS, the results of the 2012 ACS were released in topical and regional data sets. The review team has examined the latest ACS data, and is not aware of any information that appears to be inconsistent with the earlier information sets and those sets projected from the earlier survey.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the BBNPP site using ArcGIS® software and the USCB data sets noted above to identify minority and low-income populations. The team then verified its analysis by conducting field inquiries of numerous agencies and groups (NRC 2012-TN1694; Balducci 2009-TN4027).

The first step in the review team's environmental justice methodology is to examine each census block group that is fully or partially included within the 50-mi region to determine for each minority or low-income population whether it should be considered a population of interest. If either of the following two criteria is met by a census block group for an environmental justice population, that group is considered a population of interest:

- A demographic group exceeds 50 percent of the total population for the census block group.
- A demographic group is 20 percentage points (or more) greater than the same population's percentage in the census block group's state.

The identification of census block groups that meet the above criteria is not sufficient for the review team to conclude that a disproportionately high and adverse impact exists. Likewise, the lack of census block groups meeting the above criteria cannot be construed as evidence of no disproportionate and adverse impacts. The review team must also conduct an active public outreach and onsite investigation in the region of the proposed project to determine whether minority and low-income populations may exist that were not identified in the census mapping analysis. To reach an environmental justice conclusion, starting with the identification of populations of interest, the review team must investigate all populations of interest in greater detail to reveal key pathways that may have disproportionately high and adverse impacts on any unique characteristics or practices associated with a minority or low-income population. To determine whether disproportionately high and adverse effects may be present, the review team considers the following:

- Heath Considerations
    1. Are the radiological or other health effects significant or above generally accepted norms?
    2. Is the risk or rate of hazard significant and appreciably in excess of the general population?
    3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?
- Environmental Considerations
    1. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
    2. Are there any significant adverse impacts on a group that appreciably exceed or are likely to appreciably exceed those on the general population?
    3. Do the environment effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard?

If this investigation in greater detail does not yield any pathways that could lead to adverse impacts on populations of interest, the review team may conclude that there are no disproportionately high and adverse effects. If, however, the review team finds any potentially adverse impacts on populations of interest, the review team should fully characterize the nature and extent of the impact and consider possible mitigation measures that may be used to lessen the impact. The remainder of this section discusses the results of the search for potentially affected populations of interest.

2.6.2 Analysis

Drawing on the USCB 2006 and 2010 ACS for all poverty and racial/ethnic data, this section presents the demographics of the minority and low-income populations that reside within a 50-mi radius of the BBNPP site, including Luzerne and Columbia Counties, which compose the economic impact area. The consideration of a 50-mi comparative geographic area surrounding the BBNPP site, which includes all or portions of 22 counties, is based on the guidance provided by the NRC in Standard Review Plans for *Environmental Reviews of Nuclear Power Plants: Environmental Standard Review Plan for New Site/Plant Applications* (NRC 2000-TN614).

2.6.2.1 Location of Minority and Low-Income Populations

The review team performed its analysis of the locations of minority and low-income populations within a 50-mi radius of the BBNPP site using the Environmental Systems Research Institute ArcGIS software and USCB data and Topologically Integrated Geographic Encoding and Referencing census block group boundaries from 2010. The entire census block group was included in the analysis if any part of the block group was inside the 50-mi radius. The ArcGIS software and census data were then used to determine the minority and low-income characteristics by census block group within 50 mi of the BBNPP site.

There are 1,448 census block groups wholly or partially within a 50-mi radius of the center-point at latitude 41.089227 and longitude −76.165930 (USCB 2011-TN2009).

2.6.2.2 Minority Populations

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and in this discussion, the difference between total population and those who self-identified as “White, Not Hispanic or Latino” represents the aggregate racial minority population. Persons of Hispanic/Latino origin are considered as being an ethnic minority and may be of any race including any one of the identified racial populations (USCB 2011-TN2009).

USCB data (USCB 2011-TN2009) present the Pennsylvania population as containing the following:

- <1.0 percent American Indian or Alaskan Native
- 2.6 percent Asian
- <1.0 percent Native Hawaiian or other Pacific Islander
- 10.7 percent Black or African-American
- 2.0 percent other single race
- 1.6 percent multi-racial

- 19.7 percent aggregate of minority races[(4)]
- 5.0 percent Hispanic ethnicity.

This provides the following threshold values for the second (20-percent) criterion:

- 20.1 percent American Indian or Alaskan Native
- 22.6 percent Asian
- 20.0 percent Native Hawaiian or other Pacific Islander
- 30.7 percent Black or African-American
- 22.0 percent other single race
- 21.5 percent multi-racial
- 39.7 percent aggregate of minority races
- 25.0 percent Hispanic ethnicity.

The review team identified a total of 1,448 census block groups within a 50-mi radius of the BBNPP site, 102 of which were classified as having aggregate minority populations. Of these minority populations, 17 are located in Luzerne County and two are located in adjacent Schuylkill County. The nearest aggregate minority group is located near Nanticoke (7.48 mi from the BBNPP site) in Luzerne County. There are no aggregate minority populations located in adjacent Carbon or Columbia Counties. Nine of the 17 census block groups with aggregate minority populations in Luzerne County are located in Hazleton, Pennsylvania, and 6 are located in Wilkes-Barre, Pennsylvania. The highest concentrations of aggregate minority populations within the 50-mi region are located in Lehigh (58 census block groups) County (USCB 2011-TN2009).

Within the 50-mi radius surrounding the BBNPP site, there are 26 census block groups the review team identified as meeting at least one of the two significance criteria for black populations outlined in Section 2.6. Two census block groups met the criteria for Asian populations and 88 met the criteria for Hispanic ethnicity. Figure 2-36 shows the block groups within the 50-mi radius in which aggregate minority census block groups were identified.

2.6.2.3 Low-Income Populations

For the purposes of this analysis, the NRC identifies a census block as a low-income population if either of the following criteria were met:

- The percentage of low-income households exceeds 50 percent of the total number of households for the census block group.
- The percentage of low-income households is 20 percentage points (or more) greater than percentage of households in the census block group's state.

The Commonwealth of Pennsylvania average for individuals below the poverty level was 12.4 percent (USCB 2011-TN2009). This provides 32.4 percent as the threshold value for the second criterion (USCB 2011-TN2009).

[(4)] Aggregate minority race is calculated by subtracting the percentage of reported white race from the total population.

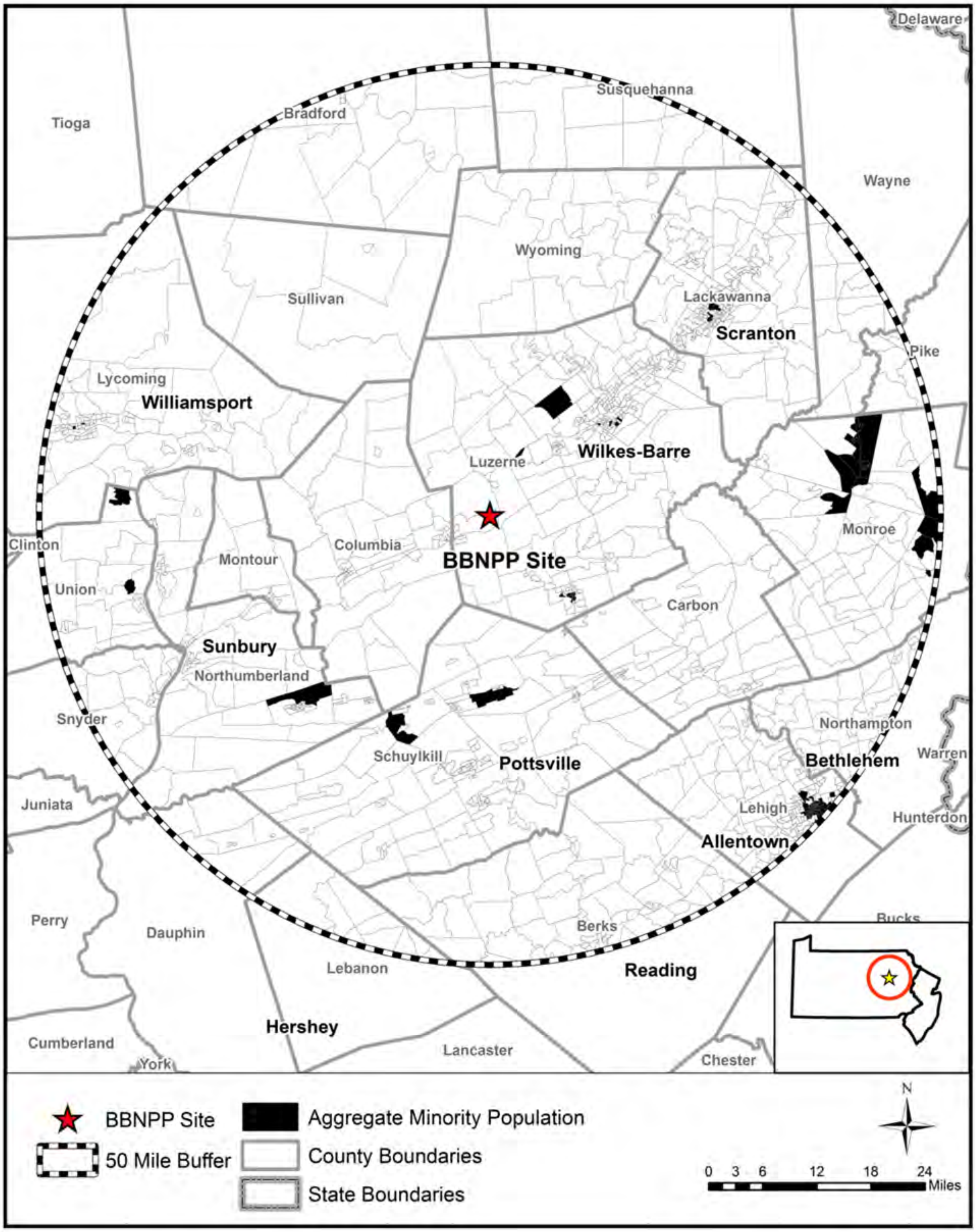

Figure 2-36. Regional Aggregate Minority Population (USCB 2011-TN2009)

Figure 2-37 shows the location of low-income populations within the 50-mi region surrounding the BBNPP site. Within the 50-mi radius of the site, the review team identified 94 census block groups with low-income populations of interest. The nearest low-income populations of interest are located near Nanticoke (11 mi from the BBNPP site), Hazleton (13 mi from the BBNPP site), Bloomsburg (16 mi from the BBNPP site), and Wilkes-Barre (18 mi from the BBNPP site). Of the 94 census block groups with low-income populations, 4 are located in Columbia County, 21 in Luzerne County, and 6 in Schuylkill County. The most significant concentration of low-income census blocks (13 census blocks) in Luzerne County was identified in Wilkes-Barre, Pennsylvania (USCB 2011-TN2009).

2.6.2.4 Communities with Unique Characteristics

The NRC's environmental justice methodology includes an assessment of high-density communities and populations with unique characteristics. High-density communities are minority or low-income "pockets" of populations that are not discerned by the census but might suffer a disproportionately high and adverse impact from building or operation of a project. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, proximity to a source of impacts, or dependence on subsistence resources; but such unique characteristics need to be demonstrably present in the population and relevant to the potential environmental impacts of the plant. If the impacts from the proposed action appear to affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then the review team makes a determination as to whether or not the impact is disproportionate when compared to the general population.

High-Density Communities

The review team met with community members and public officials and made field observations to investigate whether there were such high-density communities within the vicinity of the BBNPP site. The investigations indicated that there are residents living near the proposed plant site; and the income and racial characteristics of those located near the site are not different from those away from it. Based on this information, the review team concluded that there are no minority or low-income pockets that were not captured by the census block group analysis.

Subsistence

Common subsistence behaviors include gardening, gathering plants, fishing, and hunting. Natural resources may be used to supplement store-bought foodstuffs or medications for budgetary purposes, or for ceremonial and traditional cultural purposes. Subsistence information is often site-specific and it can be difficult to differentiate between subsistence and recreational uses of natural resources. In this section, the review team presents subsistence information based on anecdotal information and data acquired through the BBNPP ER prepared by PPL.

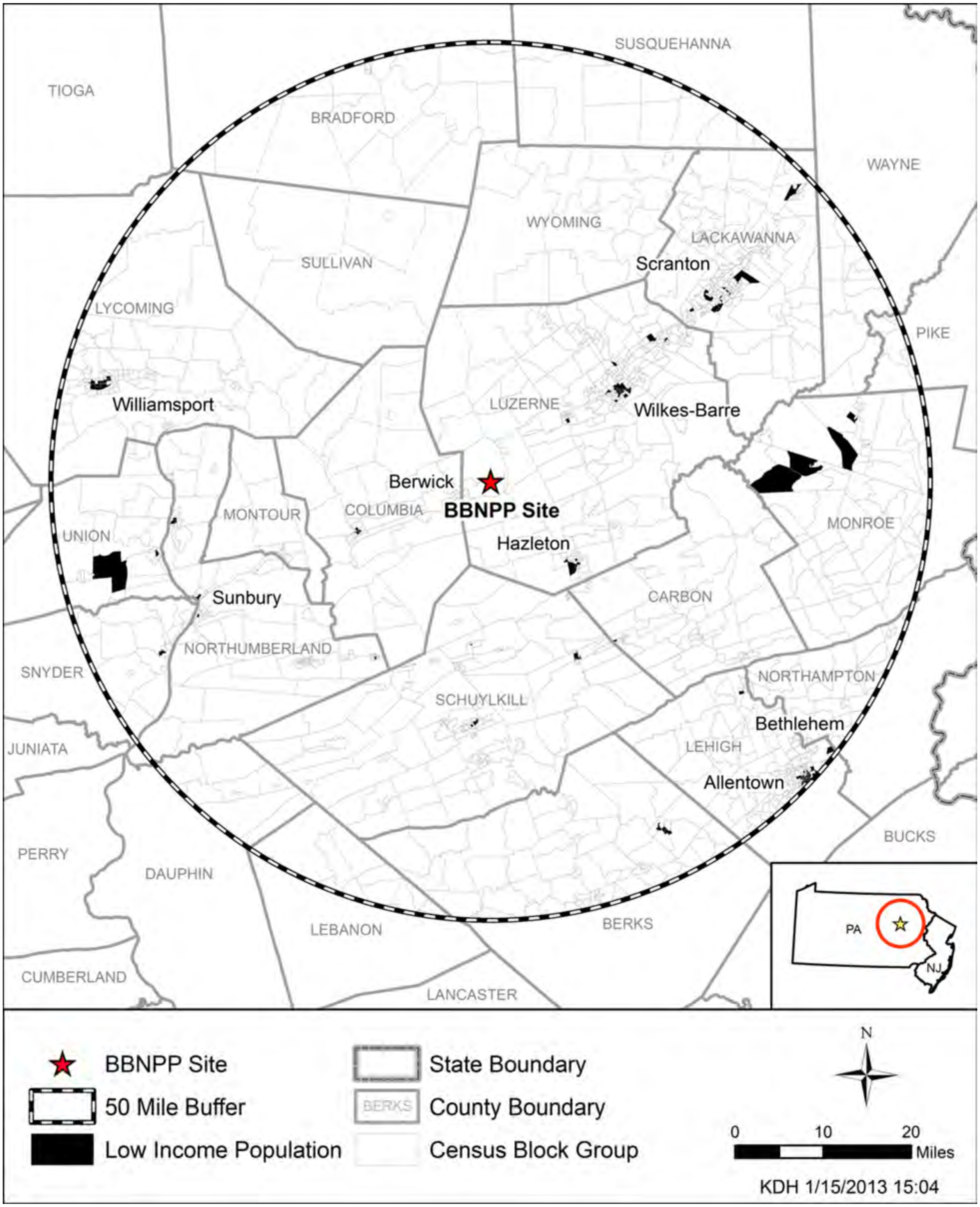

Figure 2-37. Regional Low-Income Population (USCB 2011-TN2009)

The review team conducted interviews with local officials and staff of the Berwick Hospital, Columbia County Housing Authority, Columbia County Redevelopment Authority, Luzerne County Commission on Economic Development (CED), and school districts situated near the site. None of these entities track subsistence users quantitatively, nor did any have information specific to the site (Balducci 2009-TN4027). The CED works with low-income and otherwise disadvantaged populations on employment, energy, nutrition, and housing issues. The CED noted that there had been recent manufacturing plant closings locally that, along with poor local economic conditions, had contributed to a 30 percent increase in demand for its services. Further, the CED noted that approximately 15 percent of the area's population fell below the poverty line and that low-income populations were distributed throughout the region.

The Columbia County Housing Authority and Columbia County Redevelopment Authority also noted the presence of low-income and otherwise disadvantaged populations in the area, indicating that while assistance was provided to 413 families, 250 remained on the waiting list. Families on the waiting list can expect a 1.5- to 2-year wait for assistance (Balducci 2009-TN4027). The Columbia County Housing Authority was unaware of distinctive communities (e.g., Native American, Amish) within the county. While the local officials indicated that hunting of deer, turkey, and waterfowl on local lands takes place, they were not able to supply the review team with an estimated level of subsistence use.

Subsistence use in the area consists of plant gathering, hunting, fishing, and farming. No information was found on plant gathering but that does not preclude the possibility of it occurring within the two-county economic impact area. Hunting in the area is focused on white-tail deer, turkey, and waterfowl. In 2002, 21,600 turkeys were harvested in the two-county economic impact area. In 2003, deer (17,600) and black bear (145) also were harvested in the two-county economic impact area (PPL Bell Bend 2013-TN3377). Other subsistence hunting focuses on beavers, pheasants, and various species of waterfowl.

The primary bodies of water where subsistence fishing could occur in the two-county economic impact area include Harris Pond, Lily Lake, Mountain Springs Lake, Frances Slocum Lake, Frances E. Walter Reservoir, Moon Lake, Lake Frances, Nescopeck Creek, Lake Jean, Briar Creek Lake, and the Susquehanna River (PPL Bell Bend 2013-TN3377). Fish species harvested in these waterbodies include American Shad, Black Crappie, Bluegill, Brown Bullhead, carp, catfish, Chain Pickerel, herring, largemouth Bass, Muskellunge, Native Brook Trout, Northern Pike, panfish, Rainbow Trout, Smallmouth Bass, Striped Bass, Sunfish, Walleye, Yellow Bullhead, and Yellow Perch (PPL Bell Bend 2013-TN3377).

Subsistence farming or gardening is the harvesting of crops for personal consumption rather than for commerce. The review team found no local-area data on subsistence farming, or the presence of low-income farm operators.

Through its review of PPL's ER and its own outreach and research, the review team identified no communities with unique characteristics that would make them susceptible to disproportionately high and adverse impacts.

2.6.3 Scoping and Outreach

During the development of its ER, PPL interviewed community leaders of the minority populations within the two-county economic impact area. The review team built upon this base by interviewing local and county officials, business leaders, and interested members of communities within the two-county economic impact area and assessed the potential for disproportionately high and adverse environmental effects on minority and low-income communities (NRC 2012-TN1694; Balducci 2009-TN4027). In general, the information was consistent with data mapped using USCB information. Representatives from the Columbia County Housing Authority noted that while the majority of the area's population was white, there was a growing Hispanic population in the area, particularly in the Hazelton area. Local school district officials did not identify large minority or low-income populations in the region, but did report that 41 to 42 percent of the students in the Berwick Area School District qualified for free or reduced lunch programs. Eligibility for these programs is based on household income.

The interviews and research conducted by the review team did not identify any additional groups of minority or low-income persons not already identified in the geographic information system analysis of census data.

2.6.4 Migrant Populations

The USCB defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from his or her permanent place of residence. The 2012 Census of Agriculture provides information about farms, workers, and use of migrant workers by farms in the two-county economic impact area. It does not, however, estimate the number of migrant farm laborers in the economic impact area. In 2012, there were 59,309 farms operating in Pennsylvania, 944 farms reported in Columbia County, and 556 in Luzerne County (USDA 2012-TN3634). In 2012, there were 16 farms in Columbia County that hired migrant farm labor, and 4 farms in Luzerne County did so. Another potential indicator of a migrant or seasonal workforce is the number of farm laborers employed fewer than 150 days per year on farms in the economic impact area. In 2012, there were 108 farms in Columbia County that employed 656 laborers fewer than 150 days. In Luzerne County, 67 farms employed 220 farm laborers fewer than 150 days (USDA 2014-TN3620).

2.6.5 Environmental Justice Summary

The review team found low-income, African-American, Hispanic, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses. The review team performed additional analyses to identify any potential communities with unique characteristics or practices that could lead to an environmental justice impact from the proposed site. The review team found limited evidence of dependence on subsistence activities, and this was the only such unique characteristic. As a result of these findings, the review team performed further analysis before making a final environmental justice determination. These analyses can be found in Section 4.5 for building-related impacts and in Section 5.5 for operational impacts.

2.7 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c) (TN513), the NRC and the USACE have elected to use the National Environmental Policy Act of 1969, as amended (NEPA; 42 USC 4321 et seq.-TN661) process to comply with the obligations found under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA; 54 USC 300101 et seq. -TN4157). NUREG-1555 (NRC 2000-TN614) and NRC Staff Memorandum (NRC 2014-TN3767) provide additional guidance to staff on historic and cultural resource analysis in its environmental reviews.

As a cooperating agency, the USACE is part of the NRC review team, involved in all aspects of the environmental review. Assuming a Department of the Army permit is granted, the USACE is the primary Federal agency that will review and permit the site-preparation activities related to working in wetlands and streams. The NRC will determine whether to issue a COL for the proposed BBNPP. For the purposes of NHPA Section 106, the USACE is the lead Federal agency consulting with the Pennsylvania Historical and Museum Commission (PHMC), Bureau for Historic Preservation, and State Historic Preservation Office (SHPO).

This section discusses the historic and cultural background of the BBNPP region. It also details the efforts that have been taken to identify cultural resources within the Areas of Potential Effect (APEs) and describes the resources that were identified during this review. A description of the consultation efforts accomplished to date is also provided. Assessments of effects on historic and cultural resources from the proposed building and operation are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

This section provides an overview and summary of the cultural history of the BBNPP site and region. The discussion of precontact history is from cultural resources investigations completed for the license renewal EIS for SSES Units 1 and 2 (NRC 2009-TN1725). The area in and around the BBNPP site has a rich cultural history and a substantial record of significant prehistoric and historic resources. The Susquehanna River system flows through the region and influenced settlement in the area. The cultural history of the area has been described as follows:

- Paleo-Indians occupied North America approximately 15,000 to 10,000 years ago, subsisting on hunting game and gathering wild plant foods. In the Pennsylvania area, Paleo-Indians migrated into an environment changed by retreating glacial ice. Evidence from archaeological work in the region suggests that small game and plants played a significant role in the lives of the people. The earliest occupations are identified by the Clovis point, a distinctive, fluted, lanceolate point that is widely distributed throughout North American, and in Pennsylvania they are well represented in the Susquehanna and Delaware River drainages. Regional studies indicate that there is a higher probability for Clovis points to be found in the Susquehanna River drainage. Other tools commonly found at Pennsylvania Paleo-Indian sites include scrapers; spurred end scrapers; drills; cores; bifaces; microblades; and small uniface, biface, and flake knives (NRC 2009-TN1725).
- During the Archaic period, from approximately 10,000 to 3,000 years ago, subsistence strategies underwent local changes to adapt to resources. As the glaciers retreated

northward toward Canada and larger fauna became extinct, humans adapted to exploit modern flora and smaller game animals. Archaic peoples subsisted on animals (e.g., deer, elk, rabbits, squirrels) and vegetable products of the forest. As both resource quality and the cultural means to access resources improved, the populations of Archaic people also increased. Archaeologists find evidence of larger populations developing by the end of the Archaic period, at a time when the regional climate reached its modern condition. Archaic people collected, hunted, and gathered most of what they needed for survival in their home territory. Large base camps found near major water sources provided a focal point for groups during the winter months. During other seasons, camps divided and people engaged in more mobile foraging activities (NRC 2009-TN1725).

- The Woodland culture occupied the region between 3,000 years ago until European contact around 1500 A.D. In the Woodland culture, Native Americans became regionally distinct cultural entities. Woodland people ultimately became dependent on maize agriculture, lived in villages, and introduced the bow and arrow in hunting. Major traits delineating the Woodland period is the introduction of ceramics and the construction of earthen mounds for burial of the dead (NRC 2009-TN1725).

In the 1600s, Europeans first came to the Pennsylvania area and came into contact with Late Woodland peoples known as the Delaware, Nanticoke, Shawnee, Iroquois, and Susquehannock. The BBNPP site is located on land once occupied by the Susquehannocks, an Iroquoian speaking Tribe that lived along the Susquehanna River in Pennsylvania and Maryland. During the early historic period, the Susquehannocks controlled much of the fur trade with the Europeans and prospered. Later, the Susquehannock populations were reduced by diseases brought by Europeans and by attacks from Europeans and wars with other Native American groups. By 1675, the Susquehannocks ceased to exist as a Nation (NRC 2009-TN1725).

The rise of nation states in Europe coincided with the gaining of lands in North America. War in southern Germany caused many Germans to migrate to Pennsylvania. The struggle for religious freedom in England brought Quakers, Puritans, and Catholics to Pennsylvania. Captain John Smith was the first European to explore the region. In 1608, Smith journeyed from Virginia up the Susquehanna River and made contact with the Susquehannock Indians. Between 1609 and 1681, the Dutch, Swedes, and English inhabited and fought over the region that would later become eastern Pennsylvania. Ultimately, the English prevailed and the area fell under English rule (NRC 2009-TN1725).

William Penn, a member of the Society of Friends (Quakers) in England, sought a haven in the New World for persecuted members of the Society of Friends. On March 4, 1681, his petition was granted, and was officially proclaimed on April 2, 1681. The King named the new colony in honor of William Penn's father. Although William Penn was granted all of the land in Pennsylvania by the King, he and his heirs chose not to grant or settle any part of it without first buying the claims of Native Americans who lived there. Using this recourse, most of Pennsylvania was purchased by 1768. The remaining portion was purchased by the Commonwealth by 1789 (NRC 2009-TN1725).

English Quakers were the dominant settlers, although many were Anglican. Thousands of Germans were also attracted to the colony, and by the time of the American Revolution, they composed one-third of the population. Another immigrant group, the Scotch-Irish, migrated from about 1717 until the American Revolution in a series of waves caused by hardships in Ireland. The Scotch-Irish, together with the French Huguenots, Jews, Dutch, Swede, and other groups, contributed in smaller numbers to the development of colonial Pennsylvania (NRC 2009-TN1725).

By the mid-eighteenth century, settlers began to occupy and lay claim to the Luzerne and Columbia County areas. In the years that followed, periods of unrest and war were frequent as various European pioneers and Native American groups sought possession of what would become Luzerne and Columbia Counties. Luzerne County was created on September 25, 1786, from part of Northumberland County. Wilkes-Barre, the county seat, was laid out in 1772. It was incorporated as a borough on March 17, 1806, and as a city on May 4, 1871. Columbia County was created on March 22, 1813, from part of Northumberland County. Bloomsburg, the county seat, was incorporated as a town on March 4, 1870, and is the only incorporated town in the State (NRC 2009-TN1725).

By the beginning of the twentieth century, the economic base of Luzerne and Columbia Counties had shifted for agriculture, fishing, and lumbering to mining and manufacturing centered in three urban areas: Wilkes-Barre, Hazleton, and Pittston. The North Branch Canal was created in the 1830s to provide a reliable means of transportation to markets outside the county. Later, railroads became the predominant mode of freight transportation, which resulted in the abandonment of the canals. Even with this change in transportation, the coal and lumber industries yielded to competition by the 1930s. Abandoned coal mines are numerous and spread throughout eastern Pennsylvania. Presently, Luzerne County produces about one-fourth of the anthracite coal in Pennsylvania, mostly by surface operations. Economically, the county has had heavy unemployment since World War II, although new mining machines had made mining labor-efficient long before the market diminished in the 1960s (NRC 2009-TN1725).

2.7.2 Historic and Cultural Resources at the Site and Vicinity

To identify the historic and cultural resources at the BBNPP site, the review team reviewed the following information:

- The NRC relicensing EIS at the adjacent SSES site (NRC 2009-TN1725).
- The BBNPP COL ER (PPL Bell Bend 2013-TN3377). PPL contracted with GAI Consultants, Inc., a cultural resource contractor, to identify and evaluate cultural resource sites in the area. The review team reviewed the Phase 1 and Phase 2 reports prepared by GAI Consultants, Inc., described later in this section.
- Results from the NRC onsite audits conducted in October 2009 (NRC 2009-TN1889), and May 2012 (NRC 2012-TN1890).
- Results from the NRC-ACOE cultural resources trip in August 2012 (NRC 2012-TN1888).

- Consultations between PPL and the SHPO, Tribes, local agencies, and individuals, followed by NRC consultations with the Advisory Council on Historic Preservation (ACHP), the PHMC, SHPO, the USACE, Tribes with historical ties to the area, and local individuals and organizations, as documented in Section 2.7.4.

Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on historic properties that are listed or eligible for listing in the *National Register of Historic Places* (NRHP). The NRHP is the official list of historic places that have been determined to be worthy of preservation. The list was established by the NHPA and is maintained by the National Parks Service. The eligibility of cultural resources for listing in the NRHP is assessed on four criteria including the following:

- Criterion A: Associated with events that have made a significant contribution to broad patterns of our history.
- Criterion B: Associated with the lives of persons significant in our past.
- Criterion C: Embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D: Have yielded, or are likely to yield, information important to prehistory and history.

The review team has identified direct (physical) and indirect (visual) APEs at the BBNPP and in offsite areas for the environmental review. The NRC has determined that the direct, physical APE for this COL review is the area at the BBNPP site and the immediate environs that may be affected by proposed ground-disturbing associated with building and operating the proposed BBNPP unit. It also includes the building and operation of a new transmission line, within the site boundary, that may be constructed to connect the proposed BBNPP unit with the existing electrical grid. The indirect (visual) APE is the approximately 902 ac of the proposed project footprint and a surrounding viewshed that was defined as extending at least 0.5 mi beyond the project footprint. In some areas (i.e., along the elevated riverbank) the viewshed APE was extended to include additional resources located within a clear line of sight of the project area, and in one direction (east) extended to 2.6 mi (NRC 2012-TN1738).

BBNPP's original COL applicant, UniStar, contracted with GAI Consultants, Inc. (GAI), a regional cultural resource contractor, to identify and evaluate cultural resource sites in and adjacent to the project area. UniStar worked with the SHPO to define two APEs, one based on effects of ground disturbance, and the other based on visual effects. UniStar and GAI then worked with the SHPO to establish the studies and methods that would be used to determine the effects of the proposed project on important resources.

The following approach was used by GAI to identify important resources within the APEs. First, Phase 1a (reconnaissance) studies were conducted to identify previously recorded archaeological sites and architectural/historic resources, evaluate the eligibility of architectural/historic resources within the viewshed, and assess the archaeological potential of the project area. Phase 1b surveys were then conducted in project areas determined to have moderate to high potential for archaeological resources; this work led to the discovery of additional resources and studies to assess NRHP eligibilities. Phase 2 studies were then conducted to complete determinations of NRHP eligibility for sites that either could not be avoided or for which additional archaeological information was needed. A parcel-by-parcel description of surveys conducted and resources encountered is found in the BBNPP ER (PPL Bell Bend 2013-TN3377).

A summary of the archaeological and architectural studies conducted by GAI is provided below.

The initial Phase 1 surveys were conducted in June 2007 (GAI Consultants 2008-TN479), when the project was altered to include the West Alternative. Of the combined total 1,272 ac (515 ha) surveyed, 562 ac (227 ha) were identified as having high to moderate potential for archaeological sites and requiring additional work. The remaining 65 percent of the area included 264 ac (107 ha) identified as disturbed or having no potential and 446 ac (181 ha) identified as have low potential and not requiring any additional work. This work resulted in the identification of 24 previously recorded archaeological sites, 6 of which were located in the project area.

Concurrent with the archaeological studies were architectural studies conducted within the project viewshed, defined as within a radius of approximately 0.5 mi (0.8 km) from the project footprint. The initial Phase 1a survey identified 5 previously recorded architectural resources and 52 additional resources.

GAI then conducted the Phase 1b surveys (field investigations) between May and November 2008 of the areas identified as having high to moderate potential for archaeological resources (Munford 2008-TN1726; Munford and Tuk 2008-TN477; Munford et al. 2008-TN478). The purpose was to identify any unrecorded archaeological sites, assess their eligibility, re-assess the six previously identified sites, and provide recommendations on the need for additional investigations. The acreage covered by Phase 1b archaeological studies totaled 350 ac (142 ha) (this number is smaller than the one cited above because some areas were no longer considered part of the project area). Phase 1b surveys consisted of pedestrian inspection; subsurface shovel testing to locate buried deposits; and deep testing using mechanical trenching, soil borings, and test units. In all, 5,714 shovel tests, 11 trenches, and 8 test units were excavated. This work resulted in 3 additional prehistoric sites represented by 82 artifacts; 6 historic sites, represented by 2,085 artifacts; and 25 isolated finds.

Based upon the field studies, the investigators identified 14 archaeological sites in the project APE (Table 2-53), and 10 historic buildings, 7 of which were combined into a potential NRHP Historic District (proposed as the Wapwallopen Historic District) (Table 2-54).

Table 2-53. Archaeological Sites Identified within the APE, Assessment of NRHP Eligibility, and Documentation of SHPO Concurrence

Site Number	Site Type	Eligible/Not Eligible	SHPO Concurrence	Concurrence Letter
36LU278	Prehistoric	Not Eligible	Concur	PHMC 2009-TN2892
36LU279	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU280	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU281	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU282	Prehistoric	Not Eligible	Concur	PHMC 2009-TN2892
36LU283	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU284	Historic	Not Eligible	Concur	PHMC 2009-TN2892
36LU285	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU286	Historic	Not Eligible	Concur	PHMC 2011-TN1728
36LU287	Historic	Not Eligible	Concur	PHMC 2009-TN2892
36LU288	Prehistoric	Eligible	Concur	PHMC 2011-TN1728
36LU301	Prehistoric	Not Eligible	Concur	PHMC 2012-TN1730
36LU302	Historic	Not Eligible	Concur	PHMC 2011-TN3704
36LU307	Historic	Not Eligible	Concur	PHMC 2012-TN1729

Table 2-54. Historic Buildings Identified within the Indirect APE, Assessment of NRHP Eligibility, and Documentation of SHPO Concurrence

Name	Eligible/ Not Eligible	SHPO Concurrence	Concurrence Letter
North Branch Pennsylvania Canal (141673)	Eligible	Concur	PHMC 2010-TN1756
Union Reformed and Lutheran Church (155049)	Eligible	Concur	PHMC 2010-TN3702
A.K. Harter Farm; Woodcrest Farmstead (155052)	Eligible	Concur	PHMC 2010-TN3702
House/Red Brick Studios (155064)	Not Eligible	Concur	PHMC 2011-TN1728
Wapwallopen Historic District (155070)	Not Eligible	Concur	PHMC 2011-TN1756
Stone Arch Bridge (155054)	Not Eligible	Concur	PHMC 2011-TN1728
North Market Street Bridge (155055)	Not Eligible	Concur	PHMC 2011-TN1728

2.7.2.1 Direct Areas of Potential Effect Archaeological Resources

Upon completion of the Phase 1a and 1b surveys, seven archaeological sites required additional work (Phase 2) to assess NRHP eligibility. Six were historic sites (i.e., 36LU279, 36LU280, 36LU281, 36LU283, 36LU285, 36LU286) and one was a prehistoric site (i.e., 36LU288). The Phase 2 work on the seven sites was conducted between July and November 2009 and involved archival work and the excavation of 80 test units, completion of 1,169 shovel tests, and mechanical stripping of plow zone in trenches at 4 sites. In all, 30 cultural features were recorded and 328 prehistoric artifacts and 62,841 historic artifacts were recovered (Munford et al. 2010-TN1731). GAI recommended that none of the seven sites were eligible for the NRHP; the SHPO concurred with six of the recommendations, but believed that the prehistoric site, 36LU288, was eligible for listing in the NRHP (PHMC 2011-TN1728). Pursuant to 36 CFR 800.5 (TN513), NHRP-eligible archaeological resources can be adversely affected by ground-disturbing activities that directly impact, disturb, or destroy archaeological deposits that contribute to the eligibility of the site. PPL and the SHPO have agreed on "temporary avoidance and mitigation measures" that PPL will take to protect 36LU288 (Wise 2012-TN1755). These measures include installation of geotextile fabric and fill and regular inspections throughout the period of construction. Therefore, the SHPO has agreed that there will be no adverse effect on that resource.

Following completion of this work, a Supplemental Phase 1b survey was required to address the proposed BBNPP power block relocation (Munford 2010-TN1735). This field work was conducted in April and May 2010, and involved approximately 200 ac and 1,358 shovel test pits. Two sites were recorded, one a prehistoric site represented by 15 lithic artifacts (36LU301) and one historic site represented by 246 artifacts (36LU302). Only 36LU301 required additional work to determine NRHP eligibility.

The work at 36LU301 was performed in June and July 2011. Through surface collection, shovel testing, and plow zone stripping, 212 soil anomalies, thought to be possible prehistoric cultural features, were identified; 55 of these were further tested, 47 of which were determined to be non-cultural. Of the artifacts recovered, 49 were prehistoric and 143 were historic (Munford 2011-TN1732). Based on these results, the site was determined to be not eligible for the NRHP (PHMC 2012-TN1730).

Work to determine the NRHP eligibility of historic site 36LU307 was conducted in July 2011 (Munford 2011-TN1733). The site was determined to be not eligible (PHMC 2012-TN1729).

The archaeological resources investigated within the direct APE are identified in Table 2-53. Complete descriptions of the architectural and historical resources found within the direct APEs are found in the ER (PPL Bell Bend 2013-TN3377); a portion of one eligible resource, the North Branch Pennsylvania Canal (141673/GAI-10), was located within the direct APE (PHMC 2010-TN3702).

No traditional cultural properties were identified in the direct (physical) APE by the Phase 1 work conducted by GAI. To date, no traditional cultural properties have been identified by any of the Tribes contacted.

2.7.2.2 Indirect Areas of Potential Effect

To complete an assessment of the above-ground resources in the indirect (visual) APE, GAI completed three supplemental architectural and historical surveys (Munford 2008-TN1726; Munford 2011-TN1733; GAI Consultants 2009-TN3706). PPL's ER contains a complete description of architectural and historical resources found within the indirect APE (PPL Bell Bend 2013-TN3377). Based on the results of this research and subsequent SHPO communication between PPL and the SHPO (PHMC 2010-TN3702; PHMC 2011-TN1728; PHMC 2011-TN1756), three resources were identified as eligible for the NRHP and four resources were identified as not eligible within the indirect APE. These seven resources, described in Munford et al. (2010-TN1731), include the North Branch Pennsylvania Canal (141673/GAI-10), the Union Reformed and Lutheran Church (155049/GAI-03), the Woodcrest

Farmstead (155052/GAI-04), House/Red Brick Studios (155064/GAI-26), Wapwallopen Historic District (155070/GAI-36 to GAO-45), the Stone Arch Bridge (155054/GAI-06) and the North Market Street Bridge (155055/GAI-09) (Table 2-54). No traditional cultural properties were identified in the indirect (visual) APE by the Phase 1 work conducted by GAI. To date, no traditional cultural properties have been identified by any of the Tribes contacted.

2.7.3 Historic and Cultural Resources in the Onsite Transmission Corridors

One area within the site boundary has been designated for the building of a new transmission line to connect the proposed BBNPP to the grid. GAI excavated 257 shovel test pits across a 30-ac area in 2008. No archaeological sites or isolated finds were discovered (Munford et al. 2008-TN478).

2.7.4 Consultation

The NRC initiated consultation with a letter on the proposed action with the SHPO, the ACHP, and eight Tribes in January 2009 (NRC 2009-TN1736). A letter was received from the ACHP in March 2009 outlining the process that should be followed by the NRC and explaining that in the event that the proposed project adversely affects properties listed, or eligible for listing to the NRHP, the NRC should notify the ACHP (ACHP 2009-TN1881). Consultation was put on hold when the applicant decided to move the power block.

In 2012, the NRC re-initiated consultation with a letter to the SHPO (NRC 2012-TN1738), the ACHP (NRC 2012-TN1739), 14 Tribes, 5 local organizations, and 1 individual. The 14 Tribes notified were Absentee-Shawnee of Oklahoma (NRC 2012-TN1740), Delaware Nation (NRC 2012-TN1741), Eastern Shawnee Tribe of Oklahoma (NRC 2012-TN1882), Heron Clan Cayuga Nation (NRC 2012-TN1742), Oneida Nation of Wisconsin (NRC 2012-TN1743), Onondaga Nation (NRC 2012-TN1744), Seneca-Cayuga Tribe of Oklahoma (NRC 2012-TN1883), Seneca Nation of Indians (NRC 2012-TN1884), Shawnee Tribe (NRC 2012-TN1885), the St. Regis Mohawk Tribe (NRC 2012-TN1745), Stockbridge Munsee Band of the Mohican Nation of Wisconsin (NRC 2012-TN1886), Tonawanda Seneca Nation (NRC 2012-TN1752), and the Tuscarora Nation (NRC 2012-TN1887). The local agencies notified were the Berwick County Historical Society (NRC 2012-TN1746), Luzerne County Historical Society (NRC 2012-TN1747), the Luzerne County Planning Commission (NRC 2012-TN1749), the Salem Township Board of Supervisors (NRC 2012-TN1750), the Society for Pennsylvania Archaeology (NRC 2012-TN1748), and Dr. Katie Faull, Bucknell University (NRC 2012-TN1751).

A letter was received on June 21, 2012, from the Oneida Tribe of Indians of Wisconsin indicating that they had no concerns with respect to the BBNPP COL review (Oneida Tribe 2012-TN1753). The letter also suggested that the NRC should contact the Haudenosaunee Standing Committee on Burial Rules and Regulations, Tonawanda Seneca Nation, which the NRC then did (NRC 2012-TN3703). No response was received.

During the scoping meeting, a Salem Township official had inquired about potential impacts on a reported location that was marked with a stone marker engraved with the following words: "On this Site Indians Burned the Home of Richard Dodson, 1784." Research into this question indicated that the location and marker did not appear on any list of Pennsylvania or Luzerne

County State Historical Markers and that it is located on private property, approximately 45 ft west of the PPL property line and outside the APE. Based on this review, the review team concluded that the marker is outside the APE and that no further review was required (PPL Bell Bend 2012-TN1737).

During the review, the USACE assumed the lead role responsibility for Section 106 consultation. To complete the consultation process, the USACE as the lead agency, wrote the SHPO on January 7, 2013 stating that the USACE had determined that its authorization for the proposed BBNPP unit would have no adverse effect on historic properties, and no further cultural resource investigations were necessary (USACE 2013-TN2243). The SHPO replied on February 13, 2013 concurring with the USACE's determination, stating "As a result of consultation on this project, it is our opinion that this project, as currently designed, will have no adverse effect to cultural resources" providing that "avoidance measures for 36LU288 be included as a special condition on your permit" (PHMC 2013-TN2237).

2.8 Geology

This section provides a general description of the surface and subsurface geology at the BBNPP site for the immediate purpose of defining interrelationships between the geologic factors and other environmental impact topics, including land-use impacts during construction (Section 4.1) and land-use and water-related impacts during operation (Sections 5.1 and 5.2, respectively). Groundwater and surface water are more completely described in Section 2.3.1. Further, geology, seismology, and geotechnical engineering aspects of the BBNPP site are detailed in Section 2.5 of PPL's FSAR (PPL Bell Bend 2013-TN3447). The NRC staff's description of the site and vicinity geologic features is included in the Safety Evaluation Report, along with a detailed analysis and evaluation of BBNPP site geological, seismological, and geotechnical data—as required for a site-safety assessment. The information that follows is informed by Section 2.6 of PPL's ER (PPL Bell Bend 2013-TN3377) and other direct sources as identified.

The BBNPP site is situated in the Ridge and Valley physiographic province (Fenneman and Johnson 1946-TN2882) within the Appalachian Mountains, which extend from northern New Jersey westward into Pennsylvania and southward into Maryland, West Virginia, Virginia, Tennessee, and Alabama. These mountains trace a broad arc between the Blue Ridge Mountains and the Appalachian Plateau physiographic provinces (Figure 2-38). The mountains are characterized by long, even ridges formed from folded and eroded stratigraphic sequence with valleys in between. The two great mountain ranges constituting the middle portion of the Ridge and Valley Province are the Alleghenies and the Cumberlands. The eastern head of the Ridge and Valley region is marked by the Great Appalachian Valley, which lies just west of the Blue Ridge. The western side of the Ridge and Valley province is marked by steep escarpments (e.g., the Allegheny Front, the Cumberland Mountains, and Walden Ridge).

The BBNPP site is located in Luzerne County within a subsection of the Ridge and Valley province known as the Susquehanna Lowlands located between the Anthracite Valley Section to the north and the Anthracite Upland Section to the south (Figure 2-39). Observed ridges represent the upward edges of the erosion-resistant strata, and valleys exist as the absence of the more erodible strata. Smaller streams, having little erosive power, have developed parallel

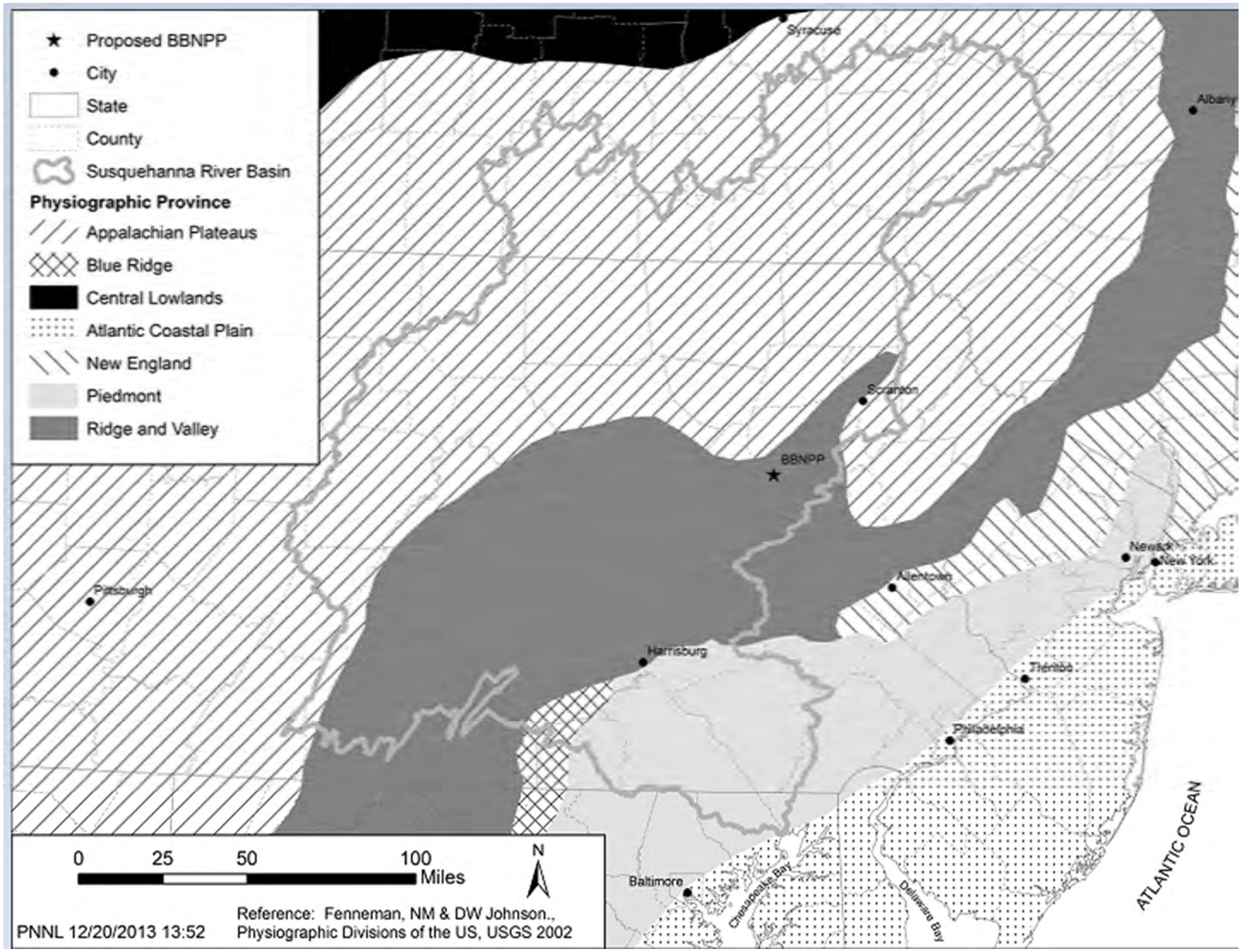

Figure 2-38. Regional Physiographic Provinces (Adapted from Fenneman and Johnson [1946-TN2882] and USGS [2002-TN2880])

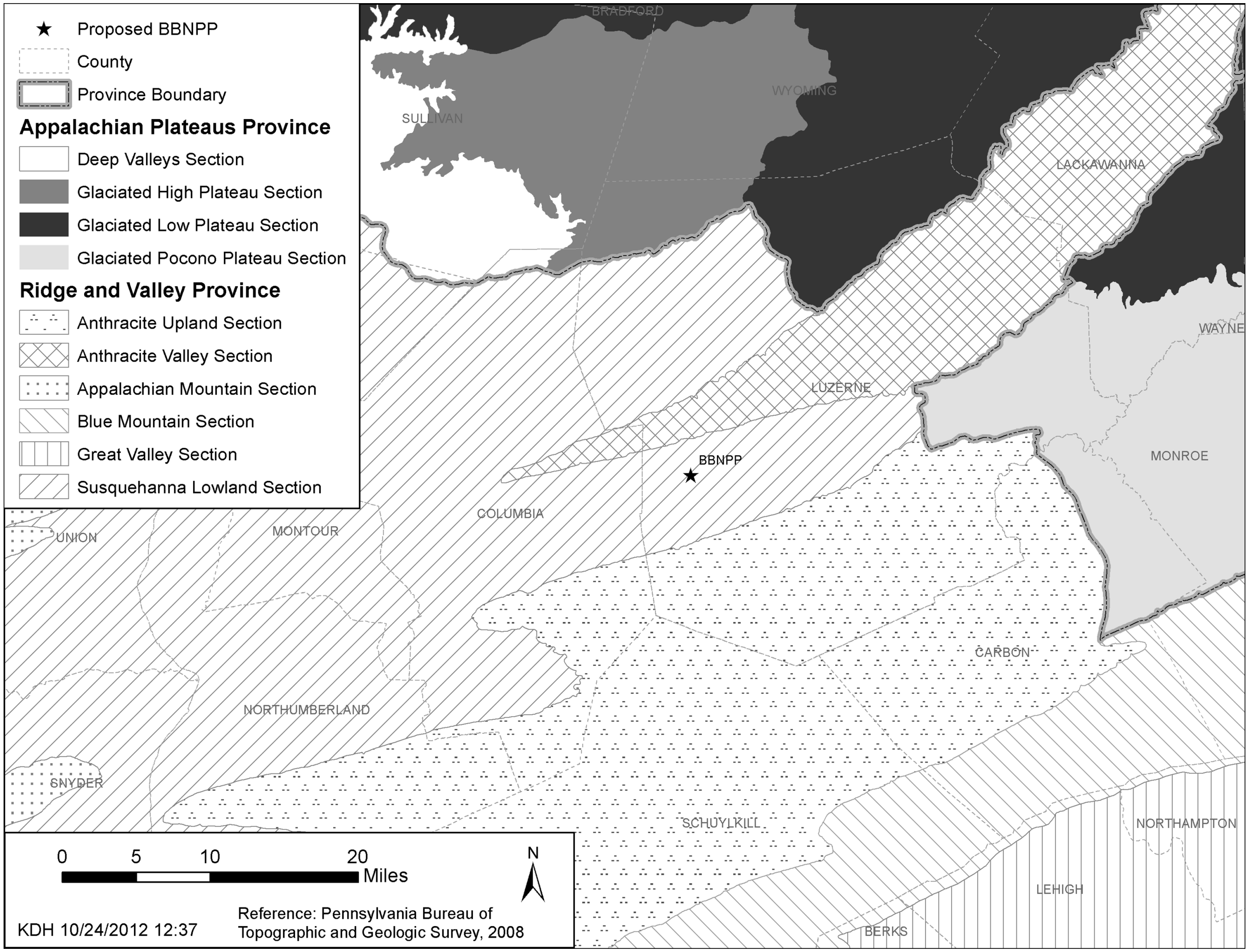

Figure 2-39. Local Physiographic Sections in the Ridge and Valley Province (Adapted from Pennsylvania Bureau of Topographic and Geologic Survey 2008-TN2881)

valleys following the confining and parallel lines of the more easily eroded strata. However, a few major ancient rivers (e.g., the Susquehanna, Delaware, and Potomac Rivers) pre-date the mountain-forming uplift of the region. These larger rivers have cut and maintained ancestral erosion gaps through and perpendicular to weather resistant strata forming the mountain ridges of the Appalachian Mountains. This evidence points to an earlier wearing down of the original mountains in the entire region to a low level with little relief. As a result, major rivers previously flowing in unconsolidated sediments that were unaffected by the underlying rock structure were able to maintain their course even as the region was uplifted slowly during the Appalachian mountain-building event. Because of these geological conditions, it appears that the rivers cut through the ridges.

The BBNPP site is located in this physiographic area at a near 90-degree bend in the Susquehanna River formed between a crosscutting water gap and a parallel folded rock structure also known as the northeast-southwest trending Berwick Anticlinorium. From a bluff overlooking the river bend, early settlers obtained a “beautiful” view—belle in French means beautiful—and subsequently created a town nearby, which was incorrectly entered into an historic map (circa 1893) with the name Belbend (Bradsby 1893-TN2891).

Locally, the BBNPP site is situated over the eroded core of the Appalachian Mountains. This core is covered by a layer of sediments carried by glaciers and deposited by water from within, and in front of, receding glaciers. These Quaternary Period glacio-fluvial deposits have remained virtually unchanged since this depositional event (Heinlen 2008-TN2871). Below these glacial sediments lies a traditional assemblage of the early to mid-Paleozoic, starting at the top Devonian strata (discussed in more detail below) (Harper 1999-TN2865; Berg 1999-TN2861) and descending through the Silurian (Laughrey 1999-TN2867), Ordovician (Thompson 1999-TN2868), and Cambrian strata, and finally, into the PreCambrian strata (Kauffman 1999-TN2866), all generally arranged within an eroded anticline structure (Figure 2-40).

Quaternary (i.e., approximately 2.6 million years ago to the present) glacial sediments make up the soil at BBNPP site. The thickness of these glacial tills varies from 12.5 to 62.0 ft (3.8 to 18.9 m) (PPL Bell Bend 2013-TN3377). With the exception of some loose sand pockets, the till consists of over-consolidated brown silty sand, or sand containing gravel and large rounded cobbles and boulders, with the presence of boulders increasing with depth. This overburdened soil is not an adequate foundation stratum for safety-related structures or facilities that will impose high-contact pressures. Figure 2-41 depicts surface soil types in the vicinity of the BBNPP site. No characteristics of these superficial soils are cause for higher than normal erosion concern.

A complete treatment of site surface and groundwater hydrology is presented in Section 2.3 of this EIS. No commercially recoverable geologic minerals reside under, or adjacent to, the BBNPP site (Shultz 1999-TN2873). No minerals of economic consequence are identified in PPL’s ER (PPL Bell Bend 2013-TN3377) or FSAR (PPL Bell Bend 2013-TN3447). The potential for future extraction of natural gas from the carbon-rich Marcellus Shale that underlies the BBNPP site is discussed below.

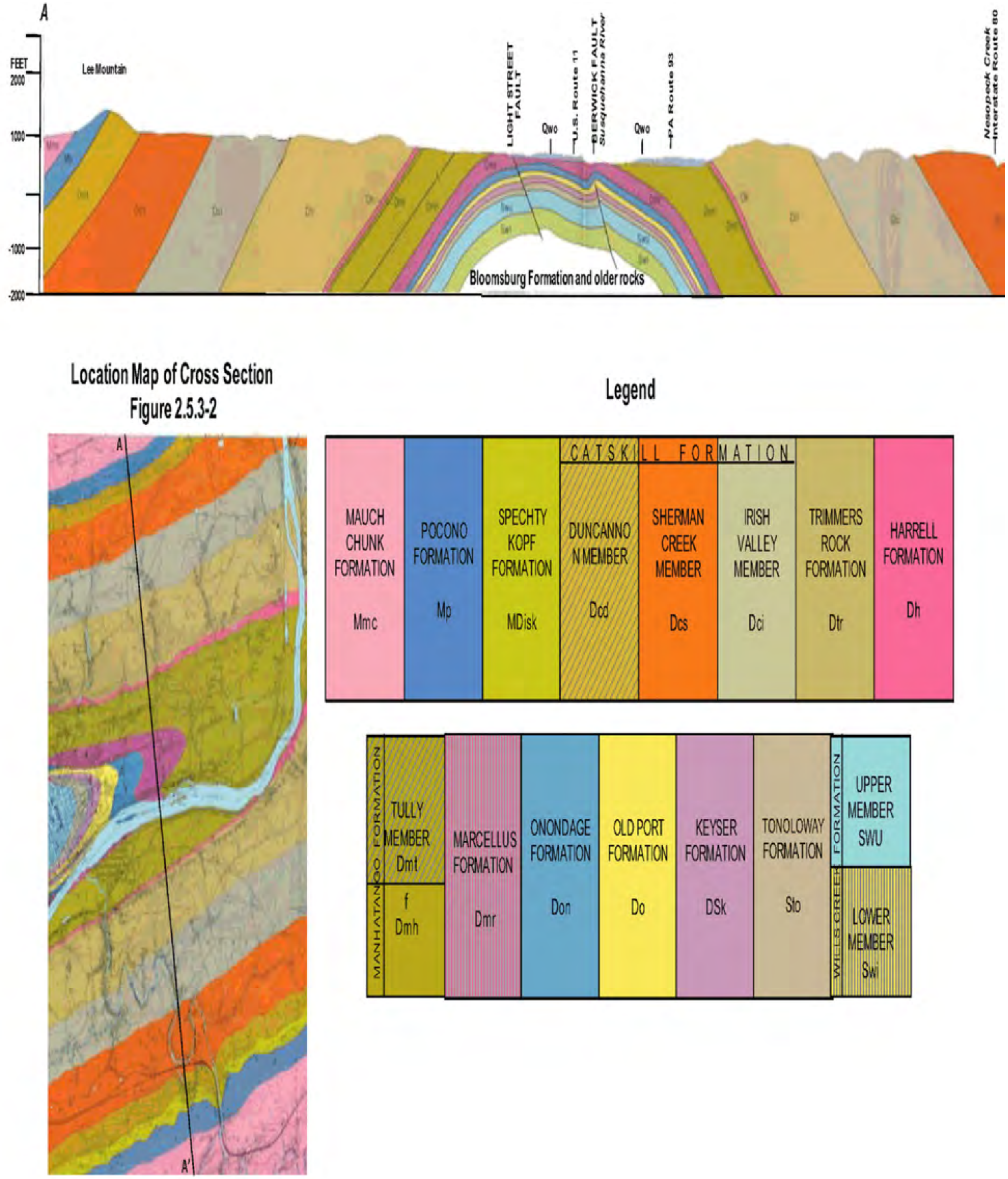

Figure 2-40. Stratigraphic Column and Geologic Anticline (PPL Bell Bend 2013-TN3447)

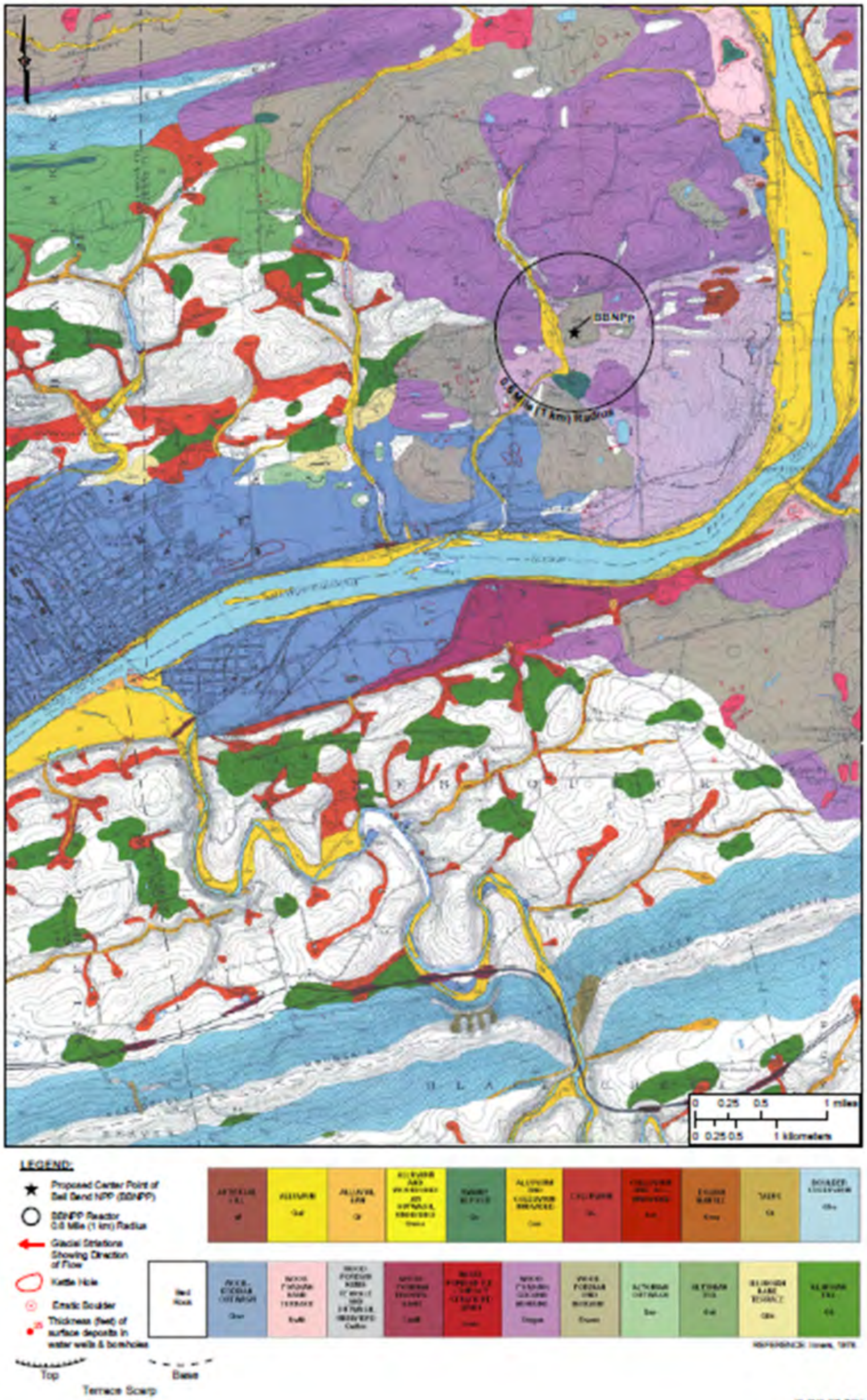

Figure 2-41. Surficial Sediments Description (PPL Bell Bend 2013-TN3447)

Pennsylvania is a major producer of oil and natural gas in the eastern United States; most of this yield is from western, northwestern, and northern Pennsylvania. Relatively recent enhanced horizontal drilling and rock-fracturing technologies have made extraction of natural gas from the Devonian Period Marcellus Shale, which underlies the BBNPP site, an economic resource. In Pennsylvania, the Devonian Period rocks (i.e., those deposited in shallow seas between 408 and 360 million years ago) represent a "westward-thinning wedge of sediments" that range in thickness from 2,400 ft in the western portion of the state, to over 12,000 ft in the east (Harper 1999-TN2865).

Within this Devonian Period sediment is the layer, or formation, described as the Marcellus Formation (also classified as the Marcellus Subgroup of the Hamilton Group, Marcellus Member of the Romney Formation, or simply the Marcellus Shale). While the Marcellus Shale underlies most of Pennsylvania (Milici and Swezey 2006-TN2872), the organic rich and natural-gas-yielding portion reaches its maximum thickness in northeastern Pennsylvania, including Luzerne County. However, this thick stratum lies under the Mahantango Formation, which is the immediate bedrock of the BBNPP site, with a thickness of approximately 1,500 ft.

Within the overall Marcellus and Utica shale resource geography, shale gas production is exceeding the most optimistic earlier expectations (Associated Press 2013-TN3707). This has the effect of driving down prices of natural gas for the foreseeable future. The Marcellus Shale resource is currently the nation's top producing natural-gas field. Its production is still rising, according to the U.S. Department of Energy, Energy Information Administration (DOE/EIA 2014-TN3779; DOE/EIA 2014-TN3780), based on production data reported from states, drilling rig counts, and existing well production. New well production is anticipated to be more than enough to offset the anticipated drop in production that results from the declining production rates of existing wells.

The geographic areas of Pennsylvania with the greatest incidence of this shale gas resource are north and northwest of the BBNPP site, outside of Columbia and Luzerne Counties (Sumi 2008-TN1628). Some of these viable resources are available in counties immediately adjacent to Luzerne County in Susquehanna, Bradford, and Wyoming Counties (Wang and Carr 2013-TN3782). The top four shale gas-producing counties in Pennsylvania are Bradford (26 percent), Susquehanna (24 percent), Lycoming (11 percent), and Tioga (10 percent); each of these counties is located between 50 and 100 mi from the BBNPP site.

At this time, oil and gas deposits immediately adjacent to and under the BBNPP site currently have no demonstrated economic value. Records from the PADEP Bureau of Oil and Gas Management show that only a few wells have been drilled in Luzerne County (Figure 2-42 and Figure 2-43). The yield of these wells was insufficient to warrant additional investigation. This is the case because the earlier deposited hydrocarbons were "baked out" during high heat and pressure metamorphic events subsequent to initial sediment deposition. The high volume of gas found elsewhere, generally causing lower prices of natural gas, coupled with its existence on the extreme eastern boundary of the known Marcellus resource, will limit future shale gas exploration in marginally viable areas such as Luzerne County.

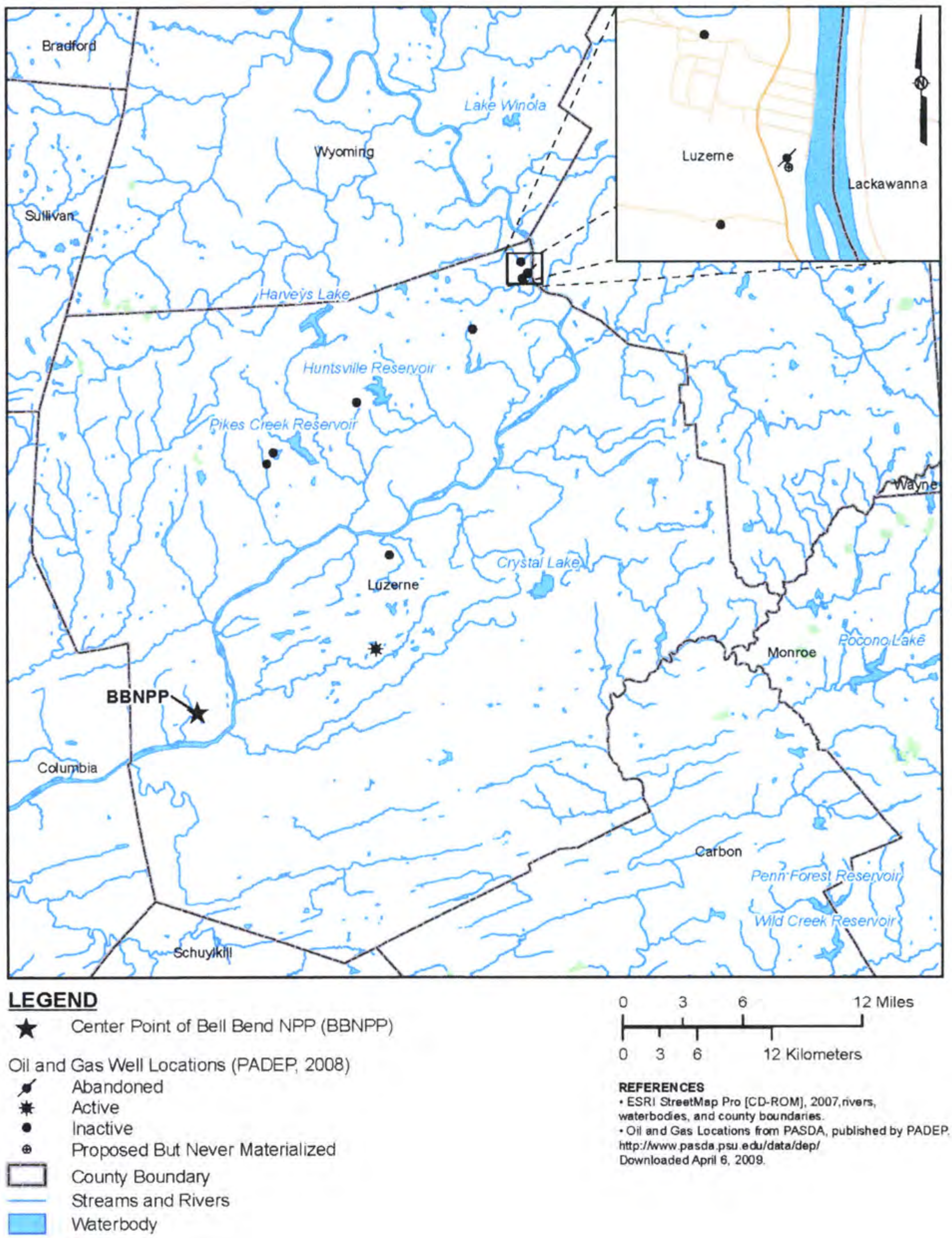

Figure 2-42. Oil and Gas Wells of Luzerne County (NRC 2009-TN2862)

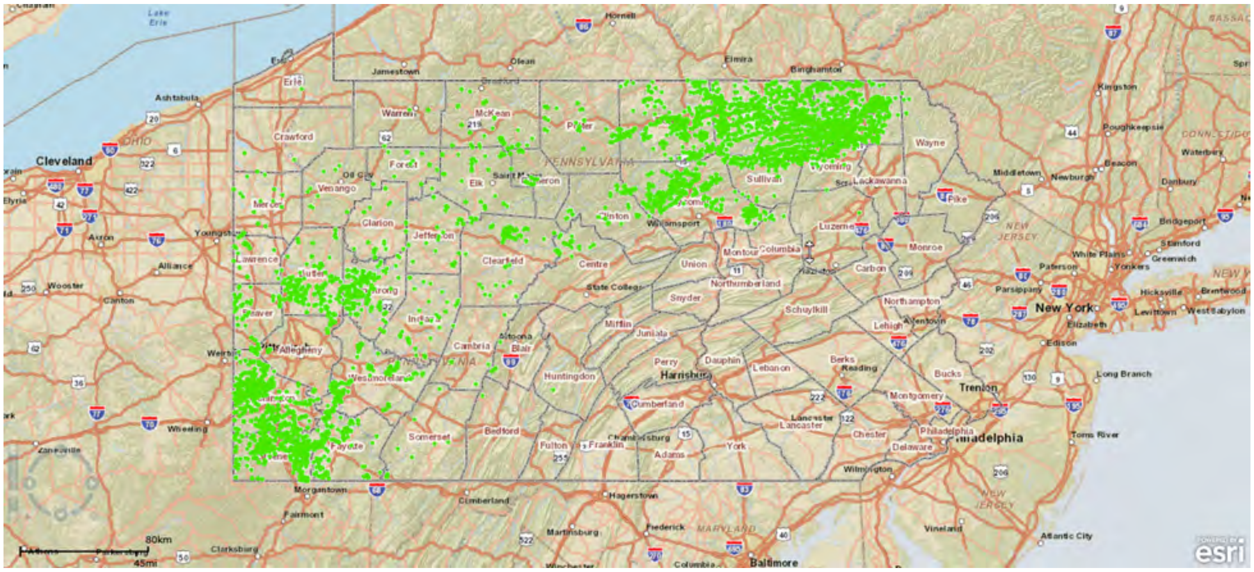

Figure 2-43. Unconventional Gas Wells in Pennsylvania (PADEP 2014-TN3970)

2.9 Meteorology and Air Quality

The following sections describe the climate and air quality of the area surrounding the BBNPP site. Section 2.9.1 describes the local and regional climate of the BBNPP site vicinity, Section 2.9.2 describes the air quality of the region, Section 2.9.3 describes atmospheric dispersion at the site, and Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The BBNPP site is located in the Susquehanna River valley of the Ridge and Valley region of east-central Pennsylvania. The topography is characterized by a series of alternating ridges and valleys that are predominately oriented in a southwest to northeast direction. The local terrain, along with the presence of the river, can influence passing weather systems and give rise to local weather phenomena, such as drainage winds and valley fog.

The region's climate is classified as continental, with cool winters and relatively warm summers. Late fall through early spring is characterized by frequent periods of cooling and warming from low-pressure systems and associated fronts passing through the area due to the repositioning of the polar jet stream. Summertime weather is generally pleasant, but anticyclonic (clockwise) winds from the Bermuda High in the western Atlantic Ocean can transport warm, moist air into the region, increasing low-level humidity and aiding in thunderstorm development. Tropical storm remnants can potentially pass through the area from late summer into fall.

The first-order weather stations closest to the BBNPP site that have long periods of record are at Wilkes-Barre Scranton, about 30 mi northeast of the site, and at Williamsport, approximately 40 mi west-northwest of the site. These stations provide a good indication of the BBNPP site's general climate (e.g., temperature and precipitation), due to their proximity to the site and similarities in vegetation. However, winds can vary at each measurement location because of the local influence of topography. The following sections compare more recent (i.e., 2001 through 2006) meteorological observations taken at the BBNPP site with longer term climatological data for Wilkes-Barre Scranton (NCDC 2012-TN2091) and Williamsport (NCDC 2012-TN2093), where observations have been taken for more than 60 years.

On a larger scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge in this area by the U.S. Global Change Research Program has been considered in preparation of this EIS; this compilation (GCRP 2014-TN3472) synthesizes the work of the Federal government on climate change. Climate-related changes include rising temperatures and sea levels; increased frequency and intensity of extreme weather (e.g., heavy downpours, floods, and droughts); earlier snowmelts and associated frequent wildfires; and reduced snow cover, glaciers, permafrost, and sea ice. The projected change in temperature in the Northeast United States is highly dependent on global emissions of greenhouse gases (GHGs), with predicted increases between 3°F to 10°F by the 2080s (GCRP 2014-TN3472). Projected precipitation changes are less certain, but increases are expected during the winter and spring seasons. However, projected precipitation changes in summer, fall, and over an entire year are generally small (GCRP 2014-TN3472).

Based on the assessments of the U.S. Global Change Research Program and the National Academy of Sciences' National Research Council, the EPA determined that potential changes in climate caused by GHG emissions endanger public health and welfare (74 FR 66496-TN245). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (e.g., respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. In CLI-09-21 (NRC 2009-TN539), the Commission provided guidance to the NRC staff to consider carbon dioxide and other GHG emissions in its NEPA reviews and directed that it should encompass emissions from constructing and operating a facility as well as from the fuel cycle. The review team characterized the affected environment and the potential GHG impacts of the proposed action and alternatives in this EIS. Consideration of GHG emissions was treated as an element of the existing air-quality assessment, which is an essential component of the NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment on other resource assessments during the period of the proposed action.

2.9.1.1 Wind

PPL provided wind roses for the BBNPP site for the years 2001 through 2006 and for other nearby first-order weather stations, including the Wilkes-Barre Scranton and Williamsport stations, for different time periods (PPL Bell Bend 2013-TN3377). The wind roses show distinct differences, particularly in wind direction, that can be attributed to the topographical influences of the Ridge and Valley region; these topographical influences can modify large-scale wind flow and also create localized winds, such as ridge-valley drainage flows.

The most frequent wind directions measured at the 10-m level of the SSES tower near the BBNPP site are from the east-northeast and southwest directions, and occur approximately 15 and 11 percent of the time, respectively (PPL Bell Bend 2013-TN3377). These winds are primarily aligned with the north-to-east bend in the valley of the nearby Susquehanna River. East-northeast winds occur during stable conditions and tend to be slower (PPL Bell Bend 2013-TN3377), suggesting that local drainage flow is occurring down the Susquehanna

River valley. Southwest winds occur during neutral to unstable atmospheric conditions and tend to be faster (PPL Bell Bend 2013-TN3377), which is more indicative of the large-scale flow for the region. Overall, the annual average wind speed at the 10-m level of the SSES tower is approximately 5.0 mph.

At Wilkes-Barre Scranton, winds are generally from the west-southwest and are aligned with the Lackawanna River valley; the annual average wind speed is 7.2 mph (NCDC 2012-TN2091). In Williamsport, winds average 6.7 mph and are generally from the west and follow the west-to-east orientation of the Susquehanna River valley in that region (NCDC 2012-TN2093). At both locations, mean wind speeds peak in the early spring (March) and trend down to a mean minimum in late summer (August).

2.9.1.2 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme based on temperature differences is set forth in Regulatory Guide (RG) 1.23, Revision 1 (NRC 2007-TN278). When the temperature decreases rapidly with height, the atmosphere is unstable, vertical mixing occurs more frequently, and atmospheric dispersion is greater. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is limited. Stability classes vary seasonally and during different times of the day. More stable conditions tend to occur during the overnight hours as the surface cools, while more unstable conditions occur during the day because of increased surface heating.

Onsite temperature measurements at the 10- and 60-m level of the SSES meteorological tower were used to determine stability classes for the BBNPP site. On an annual basis, the atmosphere at the BBNPP site is unstable, neutral, and stable approximately 13.1, 38.8, and 48.2 percent of the time, respectively (PPL Bell Bend 2013-TN3377). A larger frequency of both unstable and stable hours were reported to occur in the summer and early-fall months, and a larger frequency of neutral conditions occurred during the winter and early spring (PPL Bell Bend 2013-TN3377).

2.9.1.3 Temperature

The temperature measured at the 10-m level of the SSES meteorological tower is considered representative of the BBNPP site. Temperature data from the tower for 2001 through 2006 show that monthly average temperatures range from a low of 27.9°F in January to a high of 71.6°F in July. These temperature averages are consistent with longer term climatological means derived from the Wilkes-Barre Scranton and Williamsport stations. During this 6-year period, the absolute minimum temperature measured at the SSES was -7.0°F, and the absolute maximum temperature was 96.8°F (PPL Bell Bend 2013-TN3377). These values are bounded by an absolute minimum temperature of -21.0°F in January 1994 at the Wilkes-Barre Scranton station (NCDC 2012-TN2091) and an absolute maximum temperature of 103.0°F in July 2011 at Williamsport station (NCDC 2012-TN2093).

2.9.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways. The most common are relative humidity (or dewpoint temperature), precipitation, and fog. Dewpoint temperature and precipitation are measured at the SSES meteorological tower, and summary data for the 2001 through 2006 period are presented in the ER. Fog (visibility) is not measured onsite. Instead, PPL refers to fog observations from nearby first-order stations, including the Wilkes-Barre Scranton and Williamsport stations.

The dewpoint temperature is the temperature at which air must be cooled in order to reach saturation (i.e., 100 percent relative humidity). A higher dewpoint temperature indicates more moisture in the air. The dewpoint temperature is important for estimating potential impacts from cooling-tower plumes (e.g., visible plume length). Monthly mean dewpoint temperatures at SSES for the 2001 through 2006 period range from a low of 15.5°F in January to a high of 56.8°F in July and August (PPL Bell Bend 2013-TN3377). Similar trends are observed at the Wilkes-Barre Scranton (NCDC 2012-TN2091) and Williamsport stations (NCDC 2012-TN2093); however, the mean monthly values are approximately 3 to 5°F higher than SSES values at both locations.

Precipitation is also measured at the SSES. The annual average precipitation amount for the 2001 through 2006 period was 36.25 in. (PPL Bell Bend 2013-TN3377). Monthly mean precipitation amounts during this period ranged from a low of 1.88 in. in February to a high of 4.44 in. in October (PPL Bell Bend 2013-TN3377). June is also a wet month, with an average of 4.12 in. of precipitation observed at the SSES (PPL Bell Bend 2013-TN3377); this secondary maximum is largely due to an increase in thunderstorm activity during this month. The normal annual precipitation amounts at the Wilkes-Barre Scranton and Williamsport stations are 37.56 and 41.59 in., respectively (NCDC 2012-TN2091; NCDC 2012-TN2093). Higher amounts at Williamsport are likely due, in part, to local topographic influences. In general, monthly mean precipitation amounts at both locations follow a trend similar to the SSES.

Fog (i.e., visibility) is not a measured parameter at the SSES. However, heavy fog (i.e., visibility less than 0.25 mi) has been observed at the Wilkes-Barre Scranton and Williamsport stations. On an annual average basis, heavy fog is observed on 20 days in Wilkes-Barre Scranton (NCDC 2012-TN2091) and on 36 days in Williamsport (NCDC 2012-TN2093). On a monthly average basis, heavy fog is observed at Wilkes-Barre Scranton on 1 to 2 days each month (NCDC 2012-TN2091). At Williamsport heavy fog is observed, on average, 2 to 7 days every month; observations peak in September and October (NCDC 2012-TN2093). Differences in heavy fog observations at these locations can be attributed to local conditions (e.g., terrain and nearby waterbodies), which can affect fog formation and persistence.

2.9.1.5 Severe Weather

The BBNPP site can experience severe weather in the form of thunderstorms, ice and snow storms, hurricanes and tropical storms, and tornadoes. On an annual average basis, thunderstorms occur on 25 days at Wilkes-Barre Scranton (NCDC 2012-TN2091) and 32 days at Williamsport (NCDC 2012-TN2093). Over 90 percent of observed thunderstorms occur during April through September. Hail can accompany thunderstorms. Over a 10-year period spanning 2002 through 2011, 42 observations of hail with a diameter of 1.9 cm (0.75 in.) or greater were reported in Luzerne County (NCDC 2014-TN3999). On occasion, multiple hail observations are associated with a single storm event.

Since 1950, 17 tornadoes have been reported in Luzerne County (NCDC 2014-TN3999). Using tornado data for the period from January 1950 through August 2003, the best estimate tornado strike probability for a 1-degree box that includes the BBNPP site is 3.56×10^{-4} per year (Ramsdell and Rishel 2007-TN277).

Snowfall can occur as early as October and as late as April. Peak snowfall for the area occurs during the months of January and February. Mean annual snowfall amounts range from 47.0 in. at Wilkes-Barre Scranton (NCDC 2012-TN2091) to 40.0 in. at Williamsport (NCDC 2012-TN2093). Extreme monthly snowfall amounts include 42.3 in. in January 1994 at Wilkes-Barre Scranton (NCDC 2012-TN2091) and 40.1 in. in January 1987 at Williamsport (NCDC 2012-TN2093).

Hurricane strikes are uncommon in Pennsylvania; only one strike within 100 mi. of the BBNPP site has been recorded since 1851 (NOAA 2014-TN4000). More often, hurricane remnants pass through the area as tropical storms and depressions. The greatest danger from these storms tends to be flooding from prolonged, and sometimes intense, rainfall. The maximum 24-hour rainfall at Williamsport (i.e., 8.66 in. in June 1972) (NCDC 2012-TN2093) was from the remnants of Hurricane Agnes passing through the area.

2.9.2 Air Quality

The discussion of air quality includes the six common criteria pollutants for which EPA has set National Ambient Air Quality Standards: ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$; particulate matter with a mean aerodynamic diameter of less than or equal to 10 microns and 2.5 microns; respectively), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead. The BBNPP site is in Luzerne County, Pennsylvania, which is in the Northeast Pennsylvania-Upper Delaware Valley Interstate Air Quality Control Region (40 CFR 81.55 [TN255]). Designations of attainment or nonattainment for criteria air pollutants are made on a county-by-county basis. Luzerne County is designated as being in attainment or unclassifiable for all criteria pollutants for which the National Ambient Air Quality Standards have been established (40 CFR 81.339 [TN255]). Luzerne and several other counties in this Air Quality Control Region were redesignated as being in attainment with the 8-hour 1997 ozone standard on December 19, 2007 (72 FR 64948-TN2084), and are considered maintenance areas with respect to this standard. The EPA requires states to submit a State Implementation Plan (SIP) for maintenance areas to provide for continued attainment in the area for at least 10 years after redesignation. The EPA has approved the PADEP SIP for maintenance of the 8-hour 1997 ozone standard in Luzerne County (72 FR 64948-TN2084).

There are no mandatory Class 1 Federal Areas where visibility is an important value in Pennsylvania. The closest Class 1 Federal Area is the Brigantine Wilderness Area in New Jersey (40 CFR 81.420 [TN255]), which is approximately 150 mi south-southeast of the BBNPP site.

2.9.3 Atmospheric Dispersion

Atmospheric dispersion factors (also referred to as χ/Q values) are used to evaluate the potential consequences of routine and accidental releases. Meteorological data for the period from 2001 through 2007 have been used by PPL to develop a joint frequency distribution of wind speed, wind direction, and atmospheric stability. This distribution has been used to calculate the atmospheric dispersion factors for evaluating the consequences of normal reactor operations and potential consequences of postulated design basis accidents. PPL used the AREVA NP AEOLUS3 computer code for calculating both long-term dispersion factors for assessing the consequences of normal reactor operations and short-term dispersion factors for assessing the potential consequences of postulated design basis accidents.

Table 2-55 lists atmospheric dispersion and deposition factors for the location of the nearest residence within 5 mi in each downwind sector. Table 2-56 lists dispersion and deposition factors for the closest gardens within 5 mi. Atmospheric dispersion and deposition factors for all sectors to a distance of 50 mi listed in the ER (PPL Bell Bend 2013-TN3377) are used to estimate potential population doses from normal reactor operations discussed in Section 5.9. These factors were calculated using the methodology of RG 1.111, Revision 1 (NRC 1977-TN91), assuming a mixed-mode release and building wake.

Table 2-55. Annual Average Atmospheric Dispersion and Deposition Factors for the Nearest Residence for Evaluation of Normal Effluents

Downwind Sector	Distance (m)	Undecayed, Undepleted χ/Q (s/m^3)(a)	Decayed, Depleted χ/Q (s/m^3)(b)	Undecayed, Undepleted Gamma χ/Q (s/m^3)(c)	D/Q ($1/m^2$)(d)
N	1,254	1.30×10^{-06}	1.27×10^{-06}	5.52×10^{-07}	2.29×10^{-09}
NNE	1,266	1.42×10^{-06}	1.38×10^{-06}	6.36×10^{-07}	3.74×10^{-09}
NE	1,678	8.18×10^{-07}	7.74×10^{-07}	4.38×10^{-07}	5.40×10^{-09}
ENE	2,892	1.15×10^{-07}	1.05×10^{-07}	7.84×10^{-08}	9.75×10^{-10}
E	2,248	5.94×10^{-08}	5.32×10^{-08}	5.14×10^{-08}	7.11×10^{-10}
ESE	2,281	5.28×10^{-08}	4.74×10^{-08}	4.52×10^{-08}	6.12×10^{-10}
SE	1,271	1.21×10^{-07}	1.09×10^{-07}	9.96×10^{-08}	1.61×10^{-09}
SSE	1,620	1.33×10^{-07}	1.20×10^{-07}	1.13×10^{-07}	1.67×10^{-09}
S	1,749	1.39×10^{-07}	1.29×10^{-07}	1.27×10^{-07}	1.22×10^{-09}
SSW	1,675	2.52×10^{-07}	2.32×10^{-07}	2.67×10^{-07}	1.69×10^{-09}
SW	756	5.31×10^{-07}	4.88×10^{-07}	5.88×10^{-07}	2.55×10^{-09}
WSW	1,019	5.79×10^{-07}	5.22×10^{-07}	7.96×10^{-07}	1.45×10^{-09}
W	596	2.86×10^{-07}	2.67×10^{-07}	7.28×10^{-07}	1.25×10^{-09}
WNW	852	3.03×10^{-07}	2.92×10^{-07}	5.58×10^{-07}	1.08×10^{-09}
NW	748	2.13×10^{-07}	2.00×10^{-07}	4.37×10^{-07}	1.61×10^{-09}
NNW	1,291	3.64×10^{-07}	3.54×10^{-07}	2.81×10^{-07}	9.81×10^{-10}

(a) ER Table 2.7-133
(b) ER Table 2.7-140
(c) ER Table 2.7-147
(d) ER Table 2.7-154

Source: PPL Bell Bend 2013-TN3377

Table 2-56. Annual Average Atmospheric Dispersion and Deposition Factors for the Nearest Gardens for Evaluation of Normal Effluents

Downwind Sector	Distance (m)	Undecayed, Undepleted χ/Q (s/m^3)[(a)]	Decayed, Depleted χ/Q (s/m^3)[(b)]	Undecayed, Undepleted Gamma χ/Q (s/m^3)[(c)]	D/Q (1/m^2)[(d)]
N	833	1.29×10^{-06}	1.26×10^{-06}	7.15×10^{-07}	3.03×10^{-09}
NNE	1,395	1.23×10^{-06}	1.20×10^{-06}	5.69×10^{-07}	3.41×10^{-09}
NE	2,284	5.01×10^{-07}	4.68×10^{-07}	2.93×10^{-07}	3.28×10^{-09}
ENE	2,785	1.21×10^{-07}	1.11×10^{-07}	8.22×10^{-08}	1.04×10^{-09}
E	2,266	5.89×10^{-08}	5.28×10^{-08}	5.09×10^{-08}	7.03×10^{-10}
ESE	1,786	6.76×10^{-08}	6.08×10^{-08}	5.86×10^{-08}	8.46×10^{-10}
SE	1,467	1.03×10^{-07}	9.25×10^{-08}	8.56×10^{-08}	1.36×10^{-09}
SSE	1,619	1.33×10^{-07}	1.20×10^{-07}	1.13×10^{-07}	1.68×10^{-09}
S	811	2.58×10^{-07}	2.37×10^{-07}	2.39×10^{-07}	2.77×10^{-09}
SSW	408	1.47×10^{-06}	1.39×10^{-06}	9.18×10^{-07}	9.50×10^{-09}
SW	454	1.24×10^{-06}	1.17×10^{-06}	8.99×10^{-07}	4.89×10^{-09}
WSW	596	1.46×10^{-06}	1.36×10^{-06}	1.32×10^{-06}	3.01×10^{-09}
W	819	1.76×10^{-07}	1.62×10^{-07}	5.34×10^{-07}	8.87×10^{-10}
WNW	1,424	1.42×10^{-06}	1.41×10^{-06}	5.61×10^{-07}	1.07×10^{-09}
NW	730	2.17×10^{-07}	2.04×10^{-07}	4.48×10^{-07}	1.65×10^{-09}
NNW	1,338	3.99×10^{-07}	3.89×10^{-07}	2.81×10^{-07}	9.60×10^{-10}

(a) ER Table 2.7-134
(b) ER Table 2.7-141
(c) ER Table 2.7-148
(d) ER Table 2.7-155

Source: PPL Bell Bend 2013-TN3377

The AEOLUS3 code implements the methodology of RG 1.145, Revision 1 (NRC 1983-TN279) for calculation of atmospheric dispersion factors for evaluation of potential consequences of postulated design basis accidents. For environmental impact evaluation, realistic atmospheric dispersion factors are calculated for the exclusion area boundary and the outer boundary of the low-population zone. Realistic atmospheric dispersion factors are dispersion factors that are exceeded no more than 50 percent of the time. Table 2-57 lists the short-term dispersion factors for the BBNPP site for use in evaluating design basis accidents.

Table 2-57. Atmospheric Dispersion Factors for BBNPP Design Basis Accident Calculations

Time Period	Boundary	χ/Q (s/m^3)[(a)]
0 to 2 hours[(b)]	Exclusion Area Boundary	1.44×10^{-4}
0 to 8 hours[(c)]	Low-Population Zone	1.93×10^{-5}
8 to 24 hours[(c)]	Low-Population Zone	1.62×10^{-5}
1 to 4 days[(c)]	Low-Population Zone	1.24×10^{-5}
4 to 30 days[(c)]	Low-Population Zone	8.49×10^{-6}

(a) PPL Bell Bend 2013-TN3377
(b) Period of maximum 2-hour release to the environment
(c) Times are relative to beginning of the release to the environment

PPL provided the NRC staff with meteorological data for the 7-year period from January 2001 through December 2007 (PPL Bell Bend 2009-TN2103). The NRC staff used these data to independently estimate atmospheric dispersion factors for the site. Based on its evaluation of the meteorological data and the results of its dispersion calculations, the NRC staff accepts the PPL dispersion factors listed in Table 2-55, Table 2-56, and Table 2-57.

2.9.4 Meteorological Monitoring

Preoperational and pre-application meteorological measurements used to support the BBNPP COL application are from the meteorological tower used to support existing operations at the SSES site. The SSES meteorological tower provides measurements of wind speed, wind direction, and temperature at the 10- and 60-m levels. In addition, dewpoint temperature is measured at the 10-m level, and precipitation is measured at a nearby tipping-bucket rain gage.

The SSES meteorological tower is located approximately 6,789 ft east of the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). The meteorological tower's base elevation is estimated to be 70 ft below finished grade of the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). The SSES Unit 1 and 2 cooling towers, which are 540 ft tall and approximately 2,000 ft west of the meteorological tower, are the nearest obstructions. This distance is within the 10-times obstruction height distance that, beyond which, the wind is considered not to be affected by the obstruction (NRC 2007-TN278). The applicant performed a study to determine the effect of the cooling towers on the meteorological tower and found that the impacts were minimal and nearly non-existent (PPL Bell Bend 2013-TN3377). In addition, NRC staff conducted a site audit and concluded that the cooling towers are not in the prevailing wind direction and, therefore, are not likely to appreciably affect wind flow at the SSES meteorological tower.

Measurements from the meteorological instruments are routed to data loggers in the meteorology building for processing. Data processing includes calculation of 15-minute and hourly averages of wind speed, wind direction, and temperature. In addition, the system calculates the standard deviation of wind direction fluctuations and the temperature difference between 10 and 60 m. In case of a digital systems failure, a backup analog recording system maintains data recovery rates that have consistently been greater than 95 percent. The meteorological instruments are checked daily and calibrated semi-annually (PPL Bell Bend 2013-TN3377).

The NRC staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collected by the program. Based on that information, the NRC staff concludes that the program provides data that represent the affected environmental onsite meteorological conditions as required by 10 CFR 100.20 (TN282). In addition, the data were found to provide an acceptable basis for estimating atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34 and 10 CFR Part 50, Appendix I (TN249).

PPL intends to construct a new meteorological tower to support the operations at the BBNPP site. This tower will be located approximately 4,368 ft east-southeast of the proposed BBNPP unit, and its base elevation will be approximately 50 ft lower than the reactor building (PPL Bell Bend 2013-TN3377). The tower will be instrumented similar to the SSES tower at the 10- and

60-m levels. The NRC staff conducted a site audit and concluded that the proposed operational meteorological tower for BBNPP will be at an acceptable location.

2.10 Nonradiological Environment

This section describes aspects of the environment at the BBNPP site and in the BBNPP project vicinity associated with nonradiological human health impacts. It provides the basis for the evaluation of impacts on human health from building (Section 4.8) and operating (Section 5.8) the proposed new unit. Building activities have the potential to affect public and occupational health, create impacts from noise, and affect the health of the public and workers when transporting construction materials and personnel to the BBNPP site. Operational activities related to the proposed BBNPP that have the potential to affect the public and workers at the site include the operation of the cooling system, noise generated by operations, electromagnetic fields (EMFs) generated by transmission systems, and transportation of operations and outage workers to and from the BBNPP site.

2.10.1 Public and Occupational Health

This section describes public and occupational health impacts at the BBNPP site and in the BBNPP project vicinity that are associated with air quality, occupational injuries, and etiological agents (i.e., disease-causing microorganisms).

2.10.1.1 Air Quality

As stated in Section 2.9.2, the BBNPP site is in Luzerne County, Pennsylvania, which is in the Northeast Pennsylvania-Upper Delaware Valley Interstate Air Quality Control Region (40 CFR 81.55 [TN255]). Luzerne County is designated as being in attainment or unclassifiable for all criteria pollutants for which the National Ambient Air Quality Standards have been established (40 CFR 81.339 [TN255]). For a more detailed description of the baseline air quality for the BBNPP site, please refer to Section 2.9.2.

Public and occupational health can be affected by changes in air quality from building activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 2013-TN2654). Fugitive dust and other particulate matter (including particulate matter smaller than 10 μm and particulate matter smaller than 2.5 μm) can be released into the atmosphere during site excavations and while grading is being conducted.

Exhaust emissions during normal plant operations (including existing SSES Units 1 and 2) associated with onsite vehicles and equipment and with commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire-prevention pump engines) and other nonradiological emission-generating sources (e.g., storage tanks) or activities are not expected to be a significant source of criteria pollutant emissions. Emissions from nonradiological sources of air pollution are permitted by PADEP, as described in the Pennsylvania Code of Laws, Title 25, Subpart C, Article III, Chapter 126, Subchapter E, and any applicable Federal regulatory requirements.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities related to building and operating nuclear power plants are expected to be dominated by occupational injuries (e.g., falls, electric shock, and asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates (BLS 2012-TN3908). The U.S. Bureau of Labor Statistics provides reports that account for occupational injuries and illnesses as incidence rates, which represent the number of injuries and illnesses per 100 full-time workers. In 2011, the national incidence rate for "utility system construction" was 2.9, and the rate for "nuclear power generation" was 0.4 (BLS 2012-TN3908). The State of Pennsylvania did not start tracking annual incidence rates of injuries and illnesses for utility system construction until 2011 (BLS 2012-TN3908). These records, in addition to records from the current operating SSES plant, are used to estimate the likely number of occupational injuries and illnesses for the proposed BBNPP unit and are discussed in Chapters 4 and 5 of this EIS.

Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration safety standards, practices, and procedures to minimize worker exposures. In addition, appropriate State and local statutes, regulations, and ordinances must be considered when assessing the occupational hazards and health risks associated with the BBNPP site. PPL would implement a site-wide safety and medical program and use an industrial safety manual containing a set of work practices designed to prevent accidents (PPL Bell Bend 2013-TN3377). PPL would require all contractors and subcontractors to have and implement a health and safety program that, at a minimum, meets the same requirements as PPL's health and safety program. Further, PPL would require all contractors and subcontractors to review and comply with all safety policies and safe work practices, including all applicable Federal and State regulations (PPL Bell Bend 2013-TN3377).

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities at the BBNPP site that encourage the growth of disease-causing microorganisms (etiological agents). Thermal discharges from BBNPP into the circulating-water system and the Susquehanna River (PPL Bell Bend 2013-TN3377) have the potential to increase the growth of thermophilic microorganisms. The optimum growth temperature range for these organisms is 45 to 80°C (Madigan et al. 2003-TN3904). As stated in Section 2.3.3.1, water temperatures have been monitored daily for the Susquehanna River downstream of the proposed BBNPP discharge since November of 2010 at USGS Gage 01540500. The July–August maxium temperature recorded was 43.5°C.

The types of organisms of concern for public and occupational health include enteric pathogens (e.g., *Legionella* spp.) and free-living amoeba (e.g., *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

A review of the outbreaks of human waterborne diseases from data published in the last 10 years from Pennsylvania indicates incidences of most of the diseases mentioned above are uncommon (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557;

CDC 2011-TN558). Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1999 to 2008 (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557; CDC 2011-TN558) report 158 occurrences of waterborne outbreaks of disease from recreational water in the State of Pennsylvania; however, 143 of those were from pools and spas, not lakes or rivers. From 1999 to 2000, the U.S. Centers for Disease Control and Prevention surveillance system for waterborne-disease outbreaks documented 24 fatal cases of primary amoebic meningoencephalitis (a disease caused by *Naegleria fowleri*) in the United States; however, most of the cases occurred in southern states during the months of July and September (CDC 2002-TN2444). Outbreaks of Legionellosis, Salmonellosis, or Shigellosis from recreational water that occurred in Pennsylvania were within the range of national trends (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557; CDC 2011-TN558) in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes. There were no reportable cases in Pennsylvania from 2009 to 2010 (CDC 2014-TN4025).

Epidemiological reports from the State of Pennsylvania indicate a very low risk of outbreaks from etiologic microorganisms associated with recreational water (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557; CDC 2011-TN558; CDC 2014-TN4025). However, no water-quality monitoring stations are located along the Susquehanna River in or near recreation areas downstream of the proposed location of the BBNPP discharge structure to monitor for species indicative of the presence of other etiological agents (PPL Bell Bend 2012-TN1171). The Pennsylvania Department of Health does, however, monitor for *Escherichia coli* at State parks (PADOH 2012-TN1350). The main recreational activities associated with the Susquehanna River near the proposed BBNPP site are boating, fishing, and hunting; however, the applicant indicated limited angling and only pass-through boating in the vicinity of the discharge (PPL Bell Bend 2012-TN1171). No public swimming beaches are located along the Susquehanna River near the discharge, and signage is present to keep the public away from the intake structure (PPL Bell Bend 2012-TN1171).

2.10.2 Noise

Current sources of noise (i.e., unwanted sound) at the proposed BBNPP site are those associated with operation of existing SSES Units 1, and 2 including cooling towers, transformers and other electrical equipment, circulating-water pumps, and the public address system. Additional sources of background noise at the site include traffic noise from nearby U.S. Highway 11 (US 11) (PPL Bell Bend 2013-TN3377; Hessler Associates 2008-TN485; Hessler Associates 2010-TN1227). The closest residential receptor to the site is approximately 1,800 ft from the ESWS cooling towers (PPL Bell Bend 2013-TN3377).

Sound pressure levels are typically measured by using the logarithmic decibel (dB) scale. To assess potential noise impacts on humans, a special weighting scale was developed to account for human sensitivities to certain frequencies of sound. The A-weighted scale (dBA) is widely used in environmental noise assessments because it correlates well with a human's subjective reaction to sound (Cowan 1994-TN3905).

Human responses to noise differ depending on the time of the day (e.g., higher sensitivity to noise during nighttime hours because of lower background noise levels). Several sound descriptors have been developed to account for variations of sound with time. The equivalent continuous sound level (L_{eq}) is a sound level that, if it were continuous during a specific time period, would contain the same total energy as a time-varying sound (Cowan 1994-TN3905). It is important to note that the L_{eq} must be qualified by a time period to have meaning (e.g., $L_{eq(24)}$ is a 24-hour measurement) (Cowan 1994-TN3905). The day-night average sound level (L_{dn} or DNL) is a single 24-hour logarithmic average dBA value calculated from hourly $L_{eq(1)}$s over a 24-hour period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 A.M. to account for the greater sensitivity of most people to nighttime noise (Cowan 1994-TN3905). In addition, L_{90} is the sound level exceeded 90 percent of the time, called the residual sound level (or background level), or the fairly steady lower sound level on which discrete single sound events are superimposed.

Initial baseline noise surveys were conducted at the BBNPP site in June and March 2008, during leaf-on (summer) and leaf-off (winter) seasons, respectively, to establish background noise levels on and near the BBNPP site (Hessler Associates 2008-TN485; Hessler Associates 2010-TN1227). Continuous measurements were taken onsite and at four sensitive receptor monitoring locations surrounding the site for a total of 18 days for the leaf-on survey and 13 days for the leaf-off survey (See Figure 2-44) (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). After the initial surveys were conducted, the plant design changed slightly, resulting in an approximate 900-ft shift in the proposed location of the cooling towers northward of their original proposed position (Hessler Associates 2010-TN1227). This shift in location of the cooling towers required a supplemental noise survey to be conducted in June 2010 that included two new receptor locations north of the proposed BBNPP site (see Figure 2-45) (Hessler Associates 2010-TN1227). For comparison, this supplemental baseline study included replication of measurements from a location (i.e., Location 2) used in the initial studies (Hessler Associates 2010-TN1227).

Monitoring locations included one onsite station (i.e., Location 1) located on the proposed BBNPP site near existing SSES Units 1 and 2, the three closest residential receptors (i.e., Locations 2, 3, and 4), and two stations north and northwest of the BBNPP and the proposed cooling towers (i.e., Locations 6 and 7) (PPL Bell Bend 2013-TN3377). Results from the noise studies determined that the 24-hour logarithmic average background L_{dn} noise levels at the nearest residential receptors (Locations 2, 3, and 4) were 57, 59, and 59 dBA, respectively (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Location 5, which was located close to the highway, had L_{dn} values of 57 dBA during leaf-on measurements and 65 dBA during leaf-off measurements (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Locations 6 and 7, located north of the proposed cooling towers, had L_{dn} values of 49 dBA and 52 dBA, respectively (Hessler Associates 2010-TN1227).

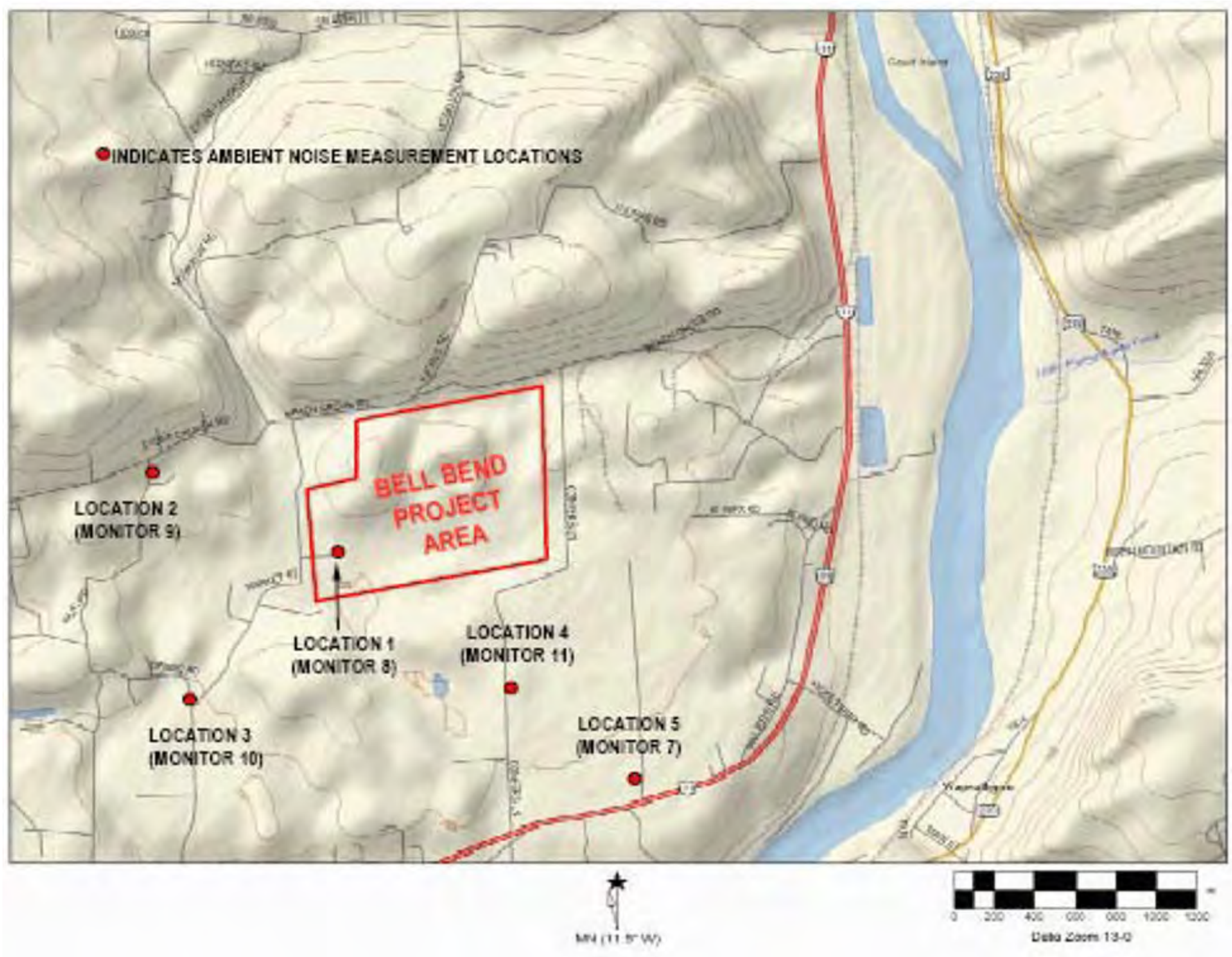

Figure 2-44. Site Map of BBNPP Showing Sound Measurement Locations

There are no known State or County noise ordinances for the proposed BBNPP. However, the EPA established guidance for noise levels to protect human health or welfare, which included an L_{dn} value of 55 dBA for residential and other outdoor areas (EPA 1974-TN3941). Consistent with U.S. Department of Housing and Urban Development regulations for exterior noise standards (24 CFR 51.101(a)(8) [TN1016]), Section 5.3.4 of NUREG-1555 (NRC 2000-TN614) states that noise levels are acceptable if the L_{dn} outside a residence is less than 65 dBA. For context, the sound level of a quiet office is 50 dBA, a normal conversation at about 3 ft is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler and Mosca 2008-TN1467). In addition, the Housing and Urban Development guidance set an L_{dn} Figurevalue of 65 dBA to be acceptable (24 CFR Part 51B [TN1016]). Regulations governing noise associated with the activities at the BBNPP site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 (TN654), *Occupational Health and Safety Standards*, and 40 CFR Part 204 (TN653), *Noise Emission Standards from Construction Equipment*. The regulations in 29 CFR Part 1910 (TN654) deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 (TN653) generally govern the noise levels of compressors.

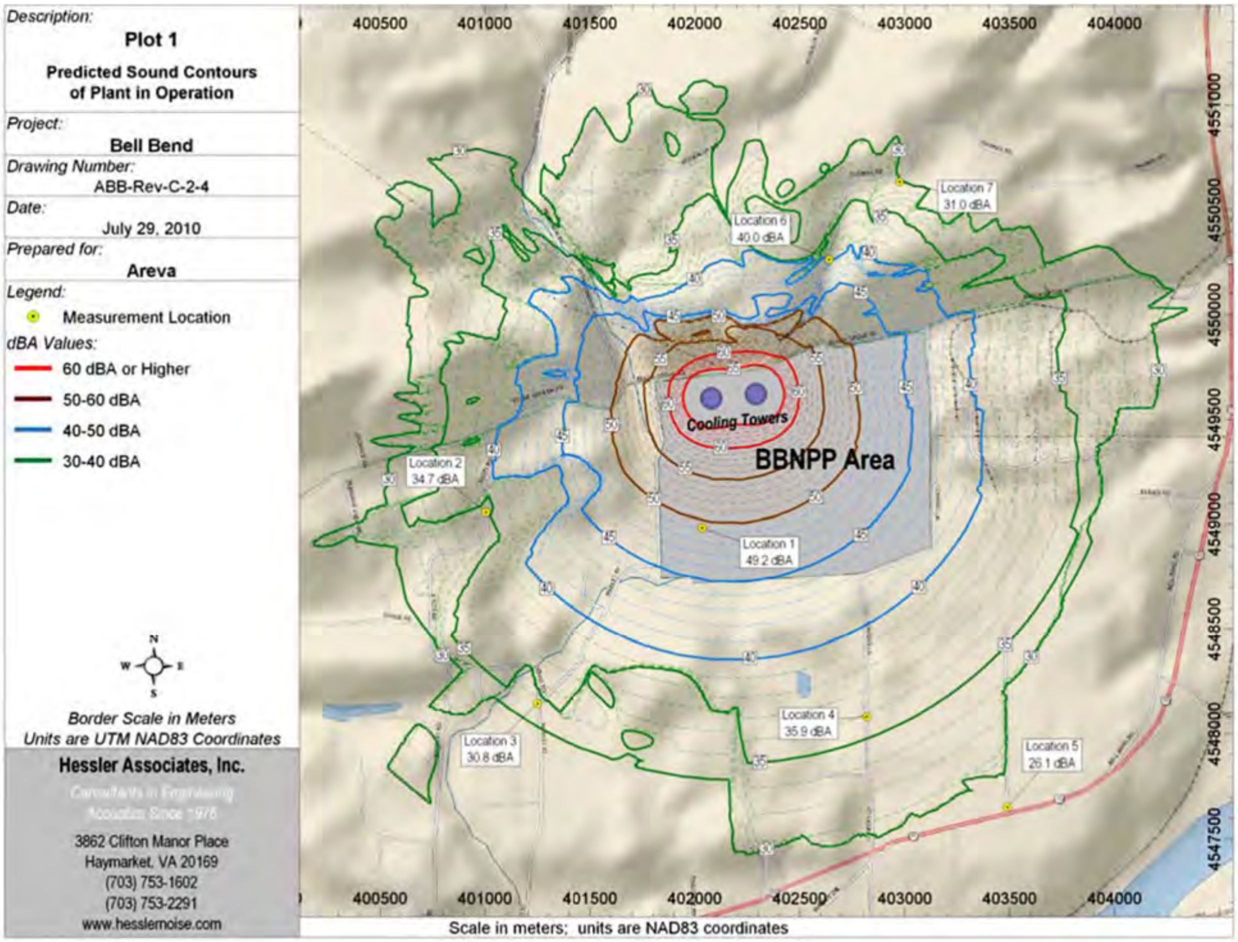

Figure 2-45. Noise Contour Plots Attributable to Natural Draft Cooling Towers

2.10.3 Transportation

The BBNPP proposed site is served by a transportation network of Federal and State highways, one primary freight rail service, and one primary commercial passenger airport. The major highway located near the BBNPP site is SR 11, which runs along the Susquehanna River east of the site. I-80 is the closest interstate highway and is located 11 mi south of the BBNPP site. I-81 is located 20 mi to the east. Major access routes to/from the BBNPP site would be the following: SR 239 and SR 11 from the northwest and north; I-81, SR 29, and SR 11 from the northeast and east; I-80, SR 93, and SR 11 from the southeast, south, and southwest; and SR 93 and SR 11 from the west (PPL Bell Bend 2013-TN3377).

Access to the site is proposed through a new intersection on SR 11, approximately 1.5 mi south of the existing entrance for SSES on SR 11. The site entrance is proposed to be located immediately east of the existing transmission-line right-of-way, which crosses SR 11 (KLD 2011-TN1228).

There are two planned changes to the existing highway network: (1) a traffic signal at SR 11 and SR 29 and (2) upgrades to the SSES driveways. No additional major highway development or improvement projects are planned within the study area that would influence the capacity of the roadway system (KLD 2011-TN1228).

The existing railroad spur will be extended from the existing SSES plant to the BBNPP site. Use of the railroad spur during construction is not expected to directly affect traffic flow on SR 11 because there are no at-grade railroad crossings along this route in the vicinity of the BBNPP and SSES sites. However, rail deliveries could create temporary congestion during SSES shift changes because the railroad spur crosses access ways that serve SSES.

2.10.4 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMFs. Public and worker health can be compromised by acute and chronic exposure to EMFs from power transmission systems, including switching stations (or substations) onsite and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 hertz (Hz) (i.e., 60 cycles per second), which is considered to be extremely low frequency. In comparison, television transmitters have frequencies of 55 to 890 megahertz (MHz), and microwaves have frequencies of 1,000 MHz and greater (NRC 2013-TN2654).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 2013-TN2654). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases; it can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, and these objects store the electric charge while they are electrically isolated from the ground. A person standing on the ground can receive an electric shock by coming into contact with such an object because of the sudden discharge of the capacitive charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code criteria.

Long-term or chronic exposure to power transmission lines has been studied for a number of years. NUREG-1437 (NRC 2013-TN2654) reviewed human health and EMFs and concluded the following:

> The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.

2.11 Radiological Environment

The two units of the SSES are located approximately 5,000 ft east of the proposed location of the BBNPP unit. An operational radiological environmental monitoring program has been conducted around the SSES site since 1982. This program measures radiation and radioactive materials from all sources, including existing SSES Units 1 and 2. The radiological environmental monitoring program is designed to monitor the following exposure pathways: direct radiation, atmospheric, aquatic (both surface and groundwater), and terrestrial. A preoperational environmental monitoring program was conducted beginning in 1972 to monitor these pathways to establish a baseline for monitoring the fluctuations of radioactivity in the environment before SSES Unit 1 began operations. After SSES Unit 1 began routine operation in 1982 and Unit 2 in 1984, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. The results of this monitoring are documented in annual reports—the *Annual Radioactive Effluent Release Report* and the *Annual Radiological Environmental Operating Report (AREOR)*—for the SSES Units 1 and 2 (PPL Susquehanna 2014-TN3747; PPL Susquehanna 2014-TN3746). NRC staff reviewed the reports from 2008 through 2013. These reports show that exposures or concentrations in air, water, and vegetation are comparable to, if not statistically indistinguishable from, preoperational levels with the following exceptions. Through 2011, PPL used thermoluminescent dosimeters (TLDs). In 2012, PPL changed to optically stimulated luminescence dosimeters. The average ambient radiation levels as measured by indicator thermoluminescent dosimeters or optically stimulated luminescence dosimeters ranged from 16.6 mR/STD quarter to 24.3 mR/STD quarter from 2008 to 2013 compared to the preoperational levels of 18.5 to 19.2 from 1978 to 1981. These values were only slightly above the control thermoluminescent dosimeter values for the same period.

The 2008 *Annual Radiological Environmental Operating Report (AREOR)* (PPL Susquehanna 2009-TN742) reported that iodine-131 was detected in 6 of 36 samples from the Susquehanna River. PPL indicated there were no detectable quantities of iodine-131 released in SSES liquid effluents in 2008 (PPL Susquehanna 2009-TN742). The iodine-131 activity is believed to result from the discharge of medical waste from sewage-treatment plants upstream of SSES. No iodine-131 activity was detected in river samples when taken from 2009 through 2013 (PPL Susquehanna 2010-TN748; PPL Susquehanna 2011-TN716; PPL Susquehanna 2012-TN1911; PPL Susquehanna 2013-TN3757; PPL Susquehanna 2014-TN3746).

Tritium was detected in various samples from the Susquehanna River from 2008 through 2013 reporting years (PPL Susquehanna 2009-TN742; PPL Susquehanna 2010-TN748; PPL Susquehanna 2011-TN716; PPL Susquehanna 2012-TN1911; PPL Susquehanna 2013-TN3757; PPL Susquehanna 2014-TN3746). PPL estimated the maximum dose from the ingestion of tritium at the nearest downriver municipal water supply (via the drinking-water pathway) and near the outfall of the SSES discharge to the Susquehanna River (via the fish pathway). Tritium was also detected at levels slightly above the minimum detectable concentration values in groundwater samples. PPL attributed the source of the tritium activity to routine airborne effluent releases from SSES Units 1 and 2 operations deposited on the ground and in surface waters from precipitation that eventually reached the groundwater.

Cesium-137 activity was detected in some soil samples from 2008 through 2013. PPL attributes the cesium-137 activity to residual fallout from atmospheric weapons testing (PPL Susquehanna 2009-TN742; PPL Susquehanna 2010-TN748; PPL Susquehanna 2011-TN716; PPL Susquehanna 2012-TN1911; PPL Susquehanna 2013-TN3757; PPL Susquehanna 2014-TN3746).

The NRC's Liquid Radioactive Release Lessons Learned Task Force Final Report (NRC 2006-TN1000) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, the Nuclear Energy Institute developed the Industry Ground Water Protection Initiative (NEI 2007-TN1913; NEI 2009-TN1277). In 2007, PPL implemented the initiative and began additional groundwater sampling in various locations that could be a source of groundwater contamination around SSES Units 1 and 2. The results of this additional groundwater sampling are summarized in the Annual Radioactive Effluent Release Report for 2013 (PPL Susquehanna 2014-TN3747). Samples were obtained from groundwater monitoring wells from 2008 through 2013. No gamma-emitting radionuclides were detected in any of the samples. Tritium values were higher than those from the control monitoring well located 5.2 mi from SSES Units 1 and 2 from 2007 through 2013. As stated in the *Annual Radiological Environmental Operating Report (AREOR)*, the reported levels were below the reporting level thresholds found in the PPL Susquehanna Technical Requirements Manual and below the reporting criteria established in response to the Nuclear Energy Institute Industry Ground Water Protection Initiative (NEI 2007-TN1913; PPL Susquehanna 2009-TN742; PPL Susquehanna 2010-TN748; PPL Susquehanna 2011-TN716; PPL Susquehanna 2012-TN1911; PPL Susquehanna 2013-TN3757; PPL Susquehanna 2014-TN3746). PPL states in Section 6.2.8 of its ER that a groundwater-protection program for BBNPP will be developed before fuel loading (PPL Bell Bend 2013-TN3377).

The PADEP also performs environmental monitoring around the SSES site. The PADEP samples airborne particulates and iodine, fish, milk, sediment, surface water, drinking water, and vegetation. In addition, it measures external radiation around the SSES site using thermoluminescent dosimetry. Results from the PADEP program in 2003 and 2004 (the most recent years available) were similar to the results from the 2006 PPL environmental monitoring program (PPL Susquehanna 2007-TN753), which were comparable to results obtained during the preoperational period before operation of SSES Unit 1.

2.12 Related Federal Projects and Consultation

The NRC staff assessed the possibility that projects or activities undertaken by the Federal government may affect the siting of the proposed BBNPP unit, the routing of transmission lines, the source or supply of plant cooling water, or alter the need for power within the service area of the proposed BBNPP unit.

2.12.1 Federal Actions Associated with Land Acquisition and/or Use

No Federal action would be required to acquire or use the proposed BBNPP site. PPL Susquehanna, LLC; PPL Bell Bend, LLC; and other PPL corporate entities currently own the land within the BBNPP project area. Federal Actions Associated with Land Acquisition for Transmission-Line Corridors

All required transmission-system upgrades for the sole purpose of supporting construction and operation of the proposed BBNPP unit would occur within the BBNPP site. No land would be acquired for offsite transmission-line corridors. Electrical power generated by the proposed BBNPP unit would be distributed to the regional grid using existing offsite transmission-line corridors and the proposed Susquehanna-to-Roseland 500-kV transmission line. The Susquehanna-to-Roseland transmission line is a PJM Regional Transmission Expansion Plan project needed to maintain regional grid reliability independent of the BBNPP project. No Federal action would be required to use the existing and proposed offsite transmission-line corridors (PPL Bell Bend 2013-TN3377).

2.12.2 Cooling-Water Source and Supply

Federal action to ensure the availability of a cooling-water source and supply is not anticipated.

2.12.3 Other Federal Actions Affecting Construction or Operation

No known, planned Federal projects or activities must be completed as a condition of construction or operation of the proposed BBNPP unit.

2.12.4 Federal Agency Plans Used to Justify the Need for Power

The need for the power generated by the proposed BBNPP unit has not been justified based on plans or commitments of any Federal agency for significant new power purchases.

2.12.5 Planned Federal Projects Contingent on Plant Construction or Operation

No known, planned Federal projects are contingent on construction and operation of the proposed BBNPP unit.

3.0 Site Layout and Plant Description

The site of proposed Bell Bend Nuclear Power Plant (BBNPP) is located on the Susquehanna River in Luzerne County, Pennsylvania, approximately 35 mi southwest of Scranton and approximately 115 mi northwest of Philadelphia. In October 2008, PPL Bell Bend, LLC (PPL) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a combined construction permit and operating license (combined license or COL) for one nuclear reactor at the BBNPP site. In addition, PPL applied for a Department of the Army permit to conduct activities that result in impacts on jurisdictional waters of the United States, including wetlands (PPL Nuclear Development 2011-TN2274; USACE 2012-TN265).

This chapter describes the key characteristics of the proposed plant that are used to assess the environmental impacts of the proposed action. Most of the information is drawn from PPL's environmental report (ER) (PPL Bell Bend 2013-TN3377), PPL's Final Safety Analysis Report (FSAR) (PPL Bell Bend 2013-TN3447), PPL's permit application to the Department of the Army (PPL Nuclear Development 2011-TN2274), supplemental PPL documentation (PPL Bell Bend 2009-TN1563; PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1347; PPL Bell Bend 2012-TN1529; PPL Bell Bend 2012-TN1532; PPL Bell Bend 2014-TN3536; PPL Bell Bend 2014-TN3625), and the U.S. Army Corps of Engineers Public Notice (USACE 2012-TN265).

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment at the proposed site and its vicinity, this chapter describes the physical aspects of the proposed nuclear plant. This chapter also describes the physical activities involved in building and operating the plant. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. The external appearance and layout of the proposed plant are described in Section 3.1. The major plant structures are described in Section 3.2, and those structures that routinely interface with the environment are distinguished from those that minimally interface with the environment, or that interface temporarily with the environment. Activities involved in building or installing each of the plant structures are described in Section 3.3. Operational activities of the plant that interface with the environment are described in Section 3.4.

3.1 External Appearance and Plant Layout

The proposed BBNPP would be located adjacent to PPL's Susquehanna Steam Electric Station (SSES) (Figure 3-1). The SSES site contains two boiling water reactors and shared infrastructure (i.e., a control room, a turbine building, a radioactive-waste building, two natural draft cooling towers, an emergency diesel generator building, an intake structure, and a blowdown discharge outfall). The SSES site also contains an Independent Spent Fuel Storage Installation and the Susquehanna 500-kV substation (PPL Bell Bend 2013-TN3377). BBNPP would be located approximately 5,000 ft west of SSES Units 1 and 2 and have a separate access road and protected area from the SSES site. BBNPP would not share any support

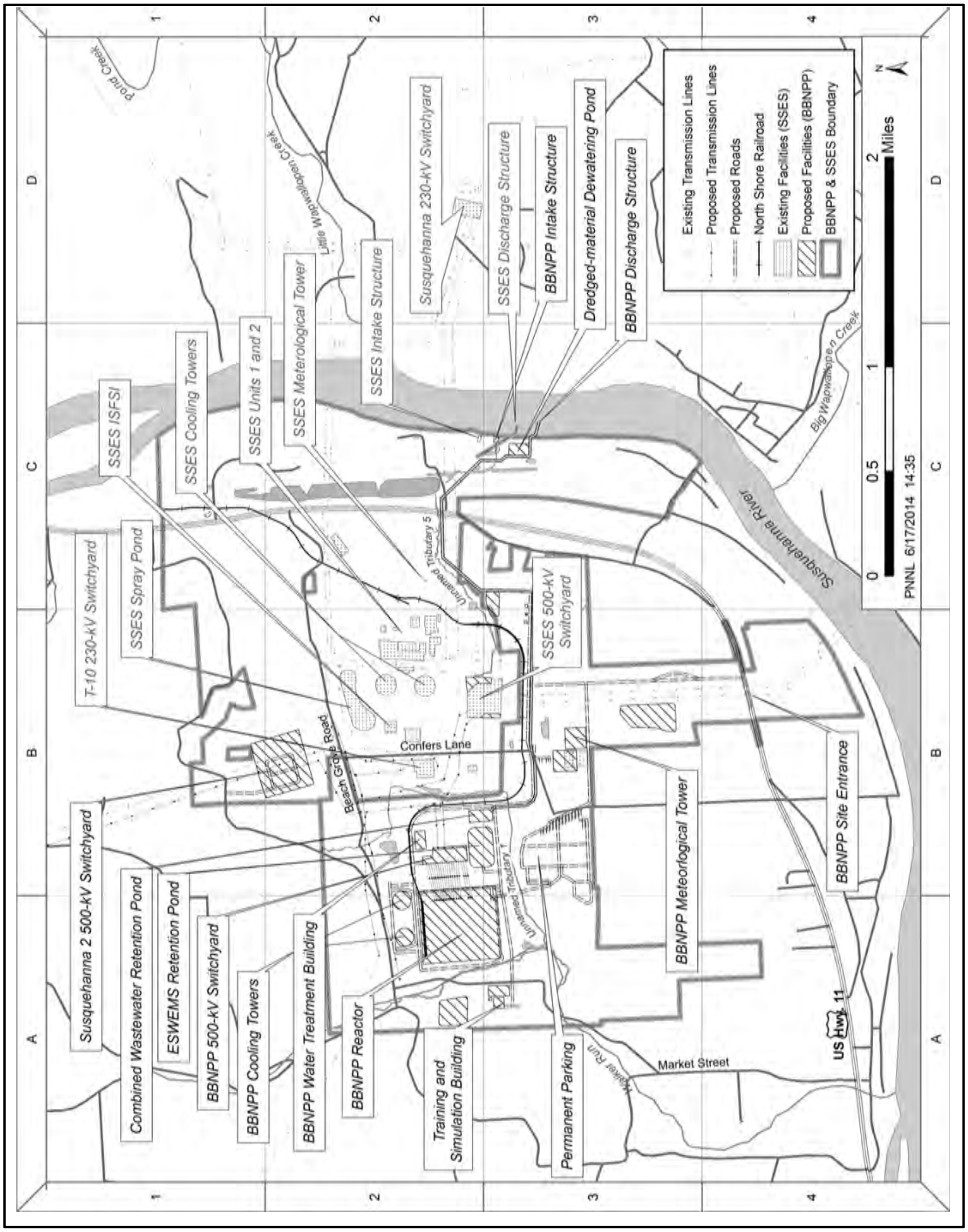

Figure 3-1. Proposed BBNPP Site and Plant Layout

facilities with SSES other than electrical connection to the offsite transmission system, the Emergency Operations Facility, and a railroad spur. The planned footprint for the proposed BBNPP facilities in relation to existing facilities is shown in Figure 3-1.

The proposed BBNPP reactor design is an AREVA U.S. Evolutionary Power Reactor (U.S. EPR), which is a pressurized water reactor. The design site grade would be 719 ft North American Vertical Datum 1988 (NAVD88). Figure 3-2 shows a view of the proposed BBNPP structures (e.g., the vent stack and two concrete cooling towers) superimposed over the current landscape and the SSES. The two cooling towers (475 ft) are the tallest structures associated with BBNPP and the vent stack (211 ft) is the tallest structure within the main BBNPP reactor unit or power block. These larger structures and cooling-tower plumes would be visible from the surrounding area; smaller structures would be less visible because of local topography and forested areas surrounding the site. The BBNPP intake structure would be visible on the west bank of the Susquehanna River. The underground discharge pipe, for cooling-tower blowdown and other plant liquid effluents, and the submerged diffuser in the river would not be visible.

Figure 3-2. The BBNPP Site with Existing SSES Units 1 and 2 at Left and Proposed BBNPP Unit Superimposed at Right (PPL Bell Bend 2013-TN3377)

3.2 Proposed Plant Structures

This section describes each of the major plant structures: the reactor power system, structures that would interface with the environment during operation, and the balance of plant structures. In Chapter 4, all plant structures required for operation are considered in the assessment of impacts of activities related to building the proposed BBNPP. Only the structures that interface with the environment are relevant to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power-Conversion System

PPL has proposed building and operating an U.S EPR pressurized water reactor at the BBNPP site. AREVA submitted the Standard Design Certification Application for the U.S. EPR to the NRC on December 11, 2007 (AREVA 2007-TN1921), and it was accepted for review on February 25, 2008 (NRC 2008-TN3793). AREVA has submitted several revisions to its application since then, including one as recently as July 2014 (AREVA 2014-TN3798). The NRC staff is performing a detailed review of that certification application; information regarding NRC's design certification review can be found at http://www.nrc.gov/reactors/new-reactors/design-cert/epr.html. The U.S. EPR design has a thermal power rating of 4,590 MW(t) and a design gross electrical output of 1,710 MW(e). The estimated station and auxiliary service load is 110 MW(e) for the proposed new unit, for a net electrical output of 1,600 MW(e) (PPL Bell Bend 2013-TN3377). Figure 3-3 is an illustration of the reactor power-conversion system.

3.2.2 Structures with a Major Environment Interface

The review team (the NRC staff, contractor staff, and U.S. Army Corps of Engineers staff who reviewed the ER and decided on impact levels) divided the plant structures into two primary groups: (1) those that interface with the environment and (2) those that are internal to the reactor and associated facilities but without environmental intakes or releases. Examples of environmental interfaces are withdrawal of surface water from the Susquehanna River, release of liquid effluents to surface water, and release of excess heat to the atmosphere. The interaction of structures with the environment are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction, and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that do not affect the environment are not discussed further in this EIS because they are not relevant to a review under National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq.-TN661). However, such internal processes are considered in the U.S. EPR design certification documentation and in NRC safety reviews of the BBNPP COL application. This section describes the structures that have a significant plant-environment interface.

The remaining structures are discussed in Section 3.2.3, to the extent that they may be relevant to the review team's consideration of construction and preconstruction impacts in Chapter 4. Figure 3-1 illustrates the BBNPP site layout with a grid overlay to reference the locations of various plant structures and activity areas as they are described in the following sections. Some of the activities would occur on the SSES site; therefore, the combined area of the BBNPP and SSES sites is referred to as the BBNPP project area.

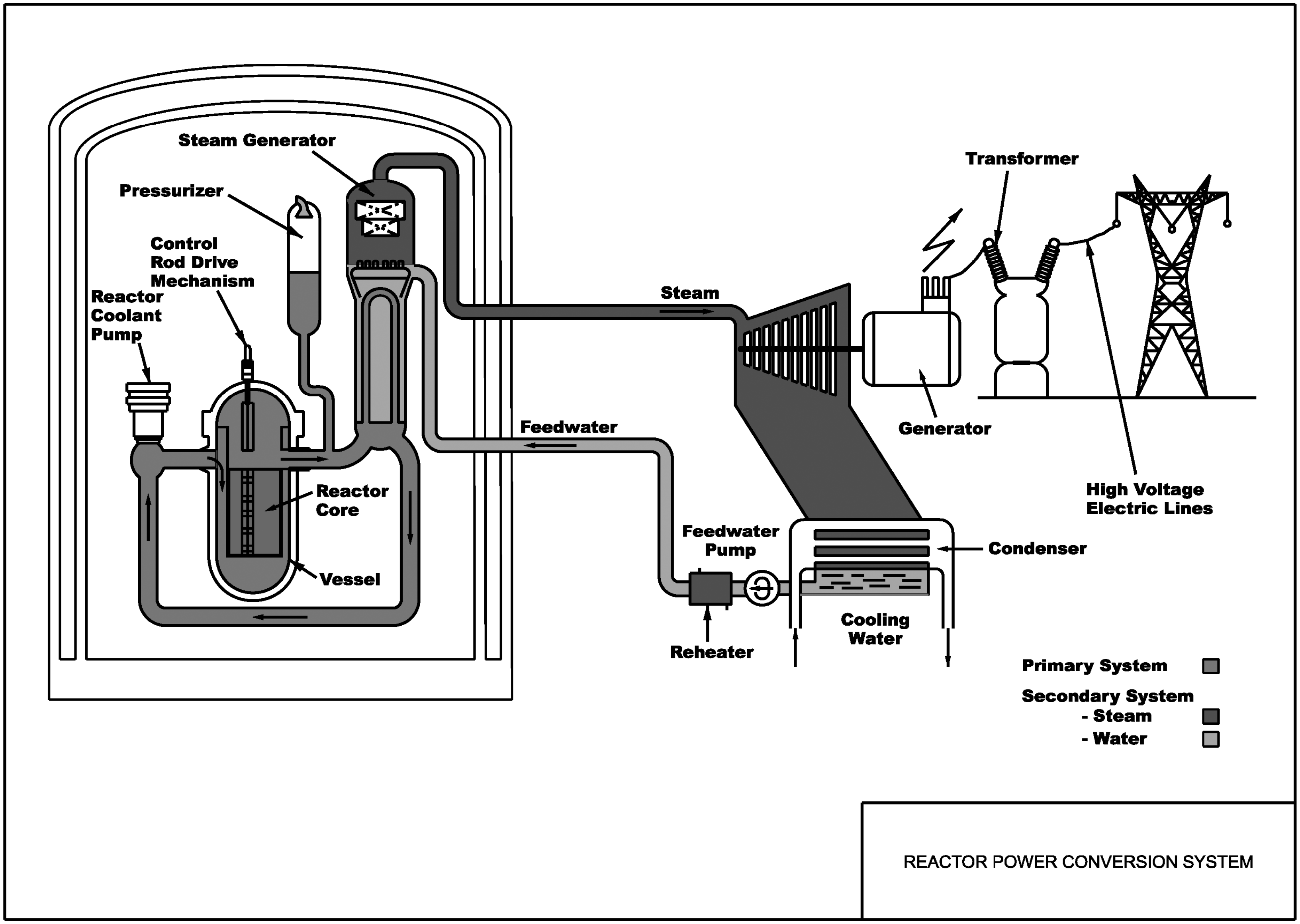

Figure 3-3. Simplified Flow Diagram of the Reactor Power-Conversion System (PPL Bell Bend 2013-TN3377)

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater-drainage system would affect both the recharge to the subsurface and the rate and location at which precipitation drains into adjacent water bodies. Impervious areas would eliminate recharge to aquifers beneath the site. Pervious areas, managed to reduce runoff and maintained free of vegetation, would experience considerably higher recharge rates than adjacent areas with local vegetation.

PPL proposes to manage surface runoff from the BBNPP project area by constructing site grading, swales, and drainage ditches to direct runoff to detention basins or infiltration beds at a number of locations around the project area. Most of the runoff would drain to underground infiltration basins that would disperse water to adjacent vegetated areas or wetlands, usually as sheet flow through a level spreader (PPL Nuclear Development 2011-TN2274). The infiltration basins would be designed to control the rate, volume, and water quality of runoff that would eventually reach surface water.

Permanent aboveground detention basins would be installed in three locations where additional runoff volume control or runoff water-quality management is needed. The largest aboveground basin would be located about 1,800 ft south of the main entrance, at the base of a steep slope near the river. Another aboveground basin would be located about 1,800 ft east of the SSES 500-kV switchyard. The third aboveground basin would be located adjacent to the main access road about 1,300 ft north of the main entrance on U.S. Highway 11 (US 11). These detention basins would also discharge to adjacent vegetated areas or wetlands (PPL Nuclear Development 2011-TN2274).

In addition, PPL proposes to modify the stream channel and floodplain of Walker Run in the reach located west of the main power block area between Beach Grove Road and the confluence of Walker Run and Unnamed Tributary 1 (Figure 3-1, grid reference A2, A3). The floodplain elevation would be lowered and about 2,200 ft of stream channel would be created or enhanced. Approximately 1,400 ft of new channel would be created in a meandering configuration. The existing flow would be relocated to the newly created channel and the old channel would be filled. Approximately 800 ft of existing channel would be enhanced by grading stream banks to floodplain level and planting native vegetation. These modifications are intended to improve the local hydrology by slowing the stream velocity and reconnecting the stream to its floodplain (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

3.2.2.2 Cooling System

In general, the cooling system represents the largest interface between a nuclear plant and the environment. Typically, cooling water is obtained from an environmental source, heat is rejected to the atmosphere, and liquid effluents are discharged to the environment. A closed-cycle wet-cooling system is proposed for BBNPP. The circulating-water system (CWS) is the main heat-dissipation system for the U.S. EPR, designed to dissipate up to 1.0 x 10^{10} Btu/hr from the main condenser during normal plant operation. An essential service-water system (ESWS) is used during normal operations and during shutdown or design basis accident conditions. The ESWS provides cooling water to the heat exchangers for the component cooling system and emergency diesel generator.

BBNPP Intake Structure

The BBNPP intake structure would be located on the west bank of the Susquehanna River, approximately 300 ft south (downstream) of the existing SSES intake (Figure 3-1, grid reference C2, and Figure 3-4). The riverbed near the shore would be deepened approximately 15 ft to form a forebay between the face of the intake and the main channel of the river; the forebay would be approximately 100 ft long by 100 ft wide. The intake structure would be 124 ft long by 90 ft wide and consist of three individual pump bays. Each pump bay would house three pumps: a CWS makeup-water pump, a raw-water supply system pump, and a small screen wash pump.

Figure 3-5 and Figure 3-6 show a plan view of the BBNPP intake structure and a cross-section view through a pump bay of the intake structure, respectively. The vertical face of the structure would be approximately 72 ft from a bottom elevation of 474 ft to the roof at 546 ft NAVD88. Pumps and electrical facilities would be located between 528 and 546 ft elevation NAVD88, which is above the high water level of record and the 100-year flood level. Water would enter the structure at elevations between 474 and 484 ft NAVD88, which is below the 100-year low-flow (single day) water level for the Susquehanna River. A bar screen would prevent large debris from entering the pump bays. In each pump bay, a dual-flow traveling screen (mesh size 0.08 in. [2 mm]) with a dedicated screen wash pump would prevent smaller debris from reaching the CWS and raw-water supply pumps. There would be no fish return system associated with the BBNPP intake structure because PPL expects other design features (e.g., the forebay depth and through-screen velocity less than 0.5 fps) to minimize impingement. Other onshore facilities associated with the BBNPP intake structure include an access road and parking lot (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

Discharge Structure

Liquid discharges from the proposed BBNPP would be transported via buried pipeline to a submerged outfall diffuser that discharges to the Susquehanna River east of the site. The BBNPP discharge structure would be located on the west bank of the Susquehanna River, about 380 ft south (downstream) of the existing SSES discharge structure (Figure 3-1, grid reference C3, and Figure 3-4). The proposed outfall pipe would extend into the river approximately 325 ft at a slight angle in the downstream direction. The outfall pipe would be either 24 in. diameter carbon steel, 24 in. diameter reinforced concrete, or 26 in. diameter high-density polyethylene material. The last 112 ft would contain 72 diffuser ports, each 4 in. in diameter, spaced 18 in. center to center. The ports would direct the effluent downstream at a 45° angle toward the water surface. The diffuser portion of the pipe would be anchored to a 7 ft-wide concrete pad. The thickness (depth) of the concrete pad would vary; it would be designed to maintain the centerline of the diffuser at a maximum elevation of 476 ft NAVD88, or 2 ft above the riverbed. Riprap would be placed on the concrete pad and part of the pipe below the diffuser ports to protect them from scour (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274). Side and cross-section views of the outfall diffuser are shown in Figure 3-7.

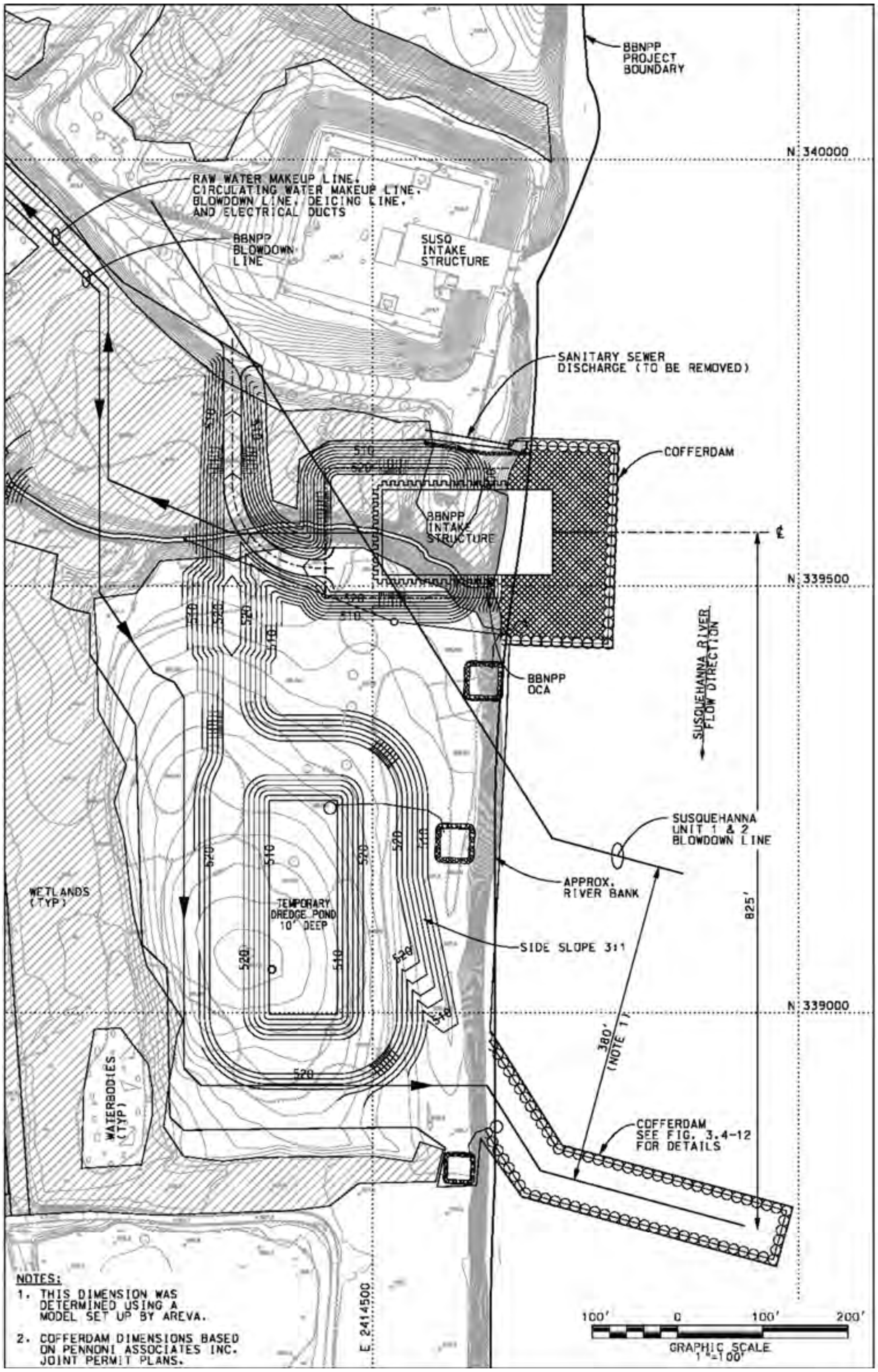

Figure 3-4. Location of BBNPP Intake and Discharge Structures Relative to SSES Intake and Discharge Structures (PPL Bell Bend 2013-TN3377)

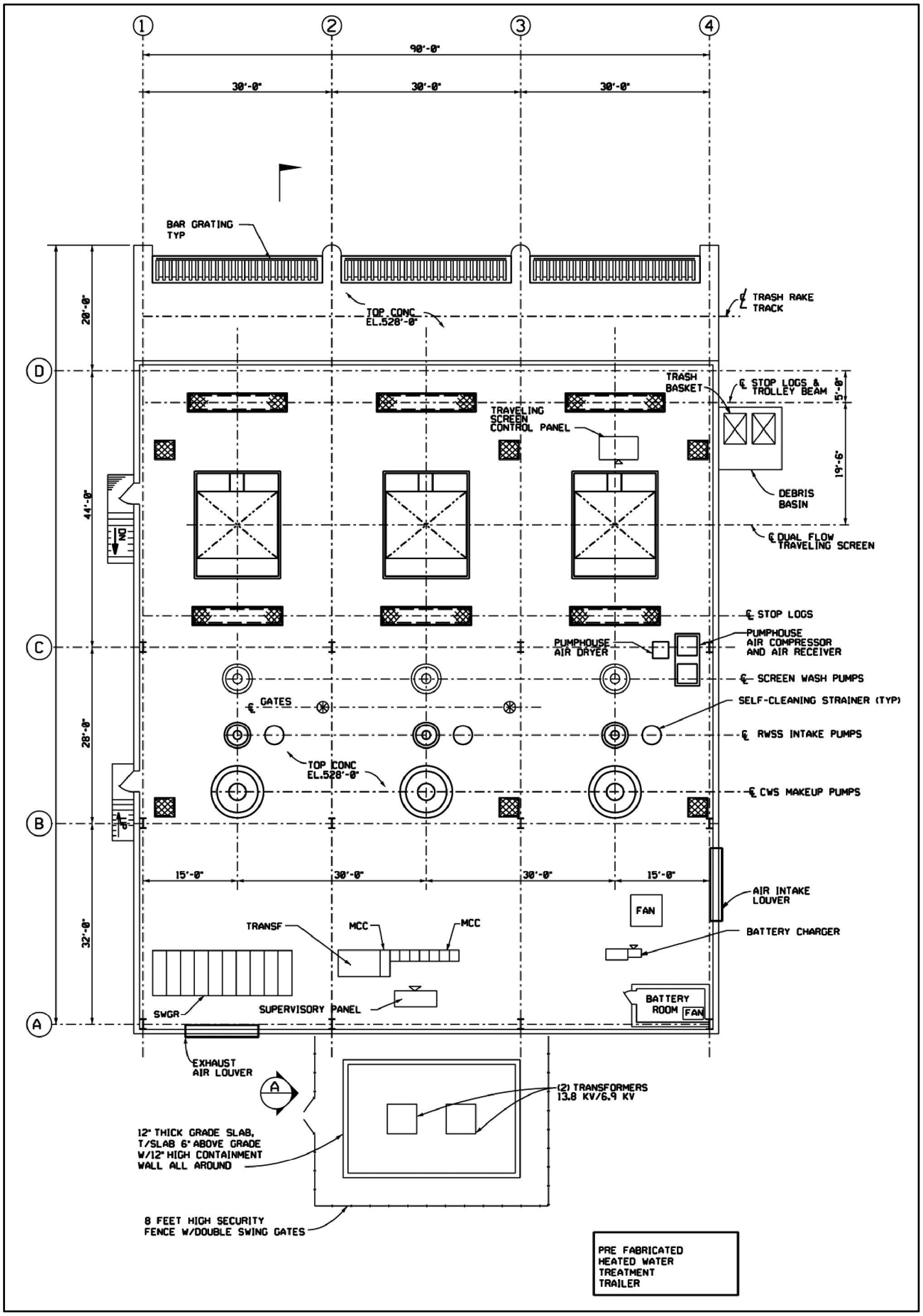

Figure 3-5. Plan View of the BBNPP Intake Structure (PPL Bell Bend 2012-TN1347)

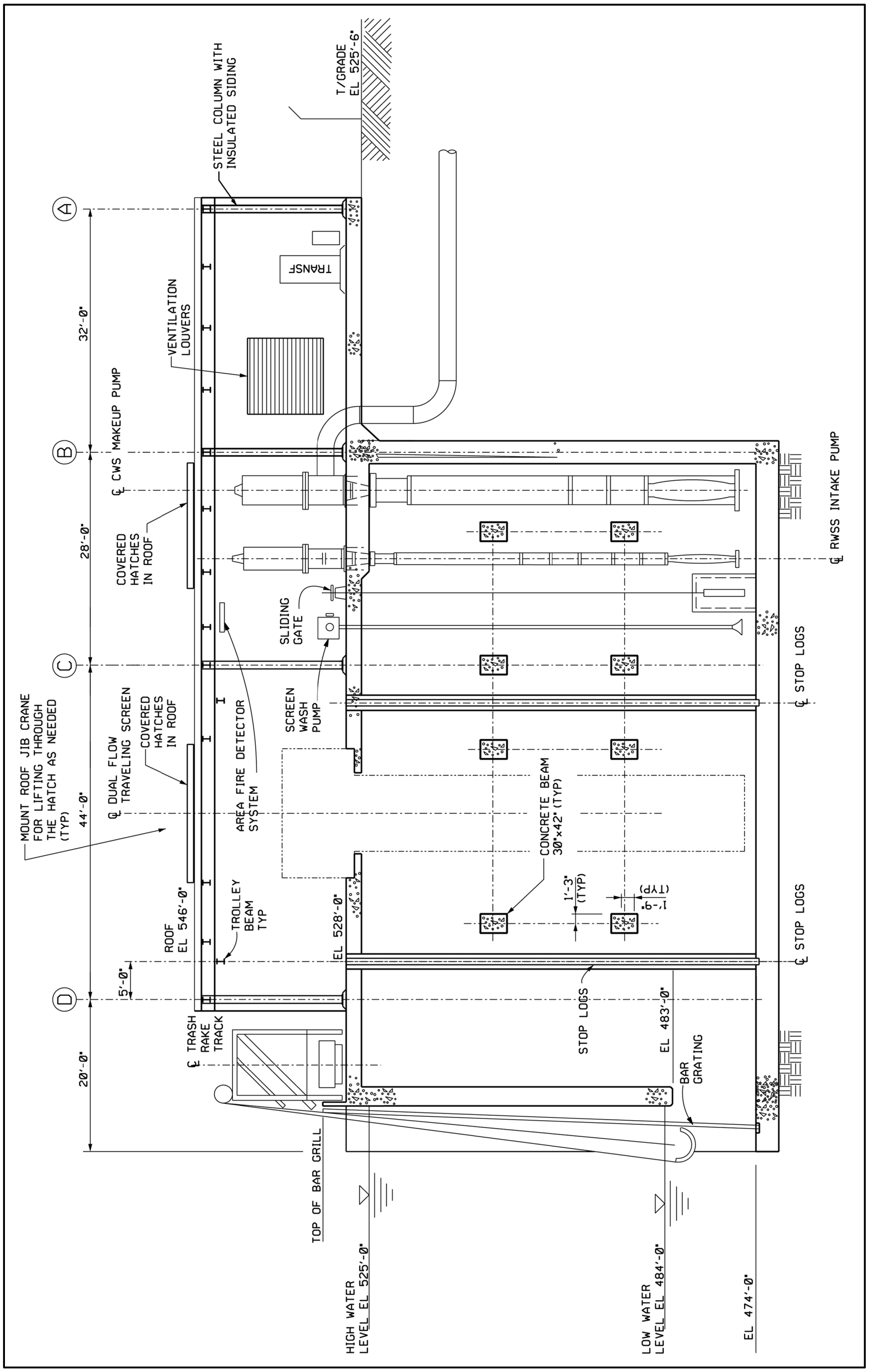

Figure 3-6. Cross-Section View of the BBNPP Intake Structure (PPL Bell Bend 2013-TN3377)

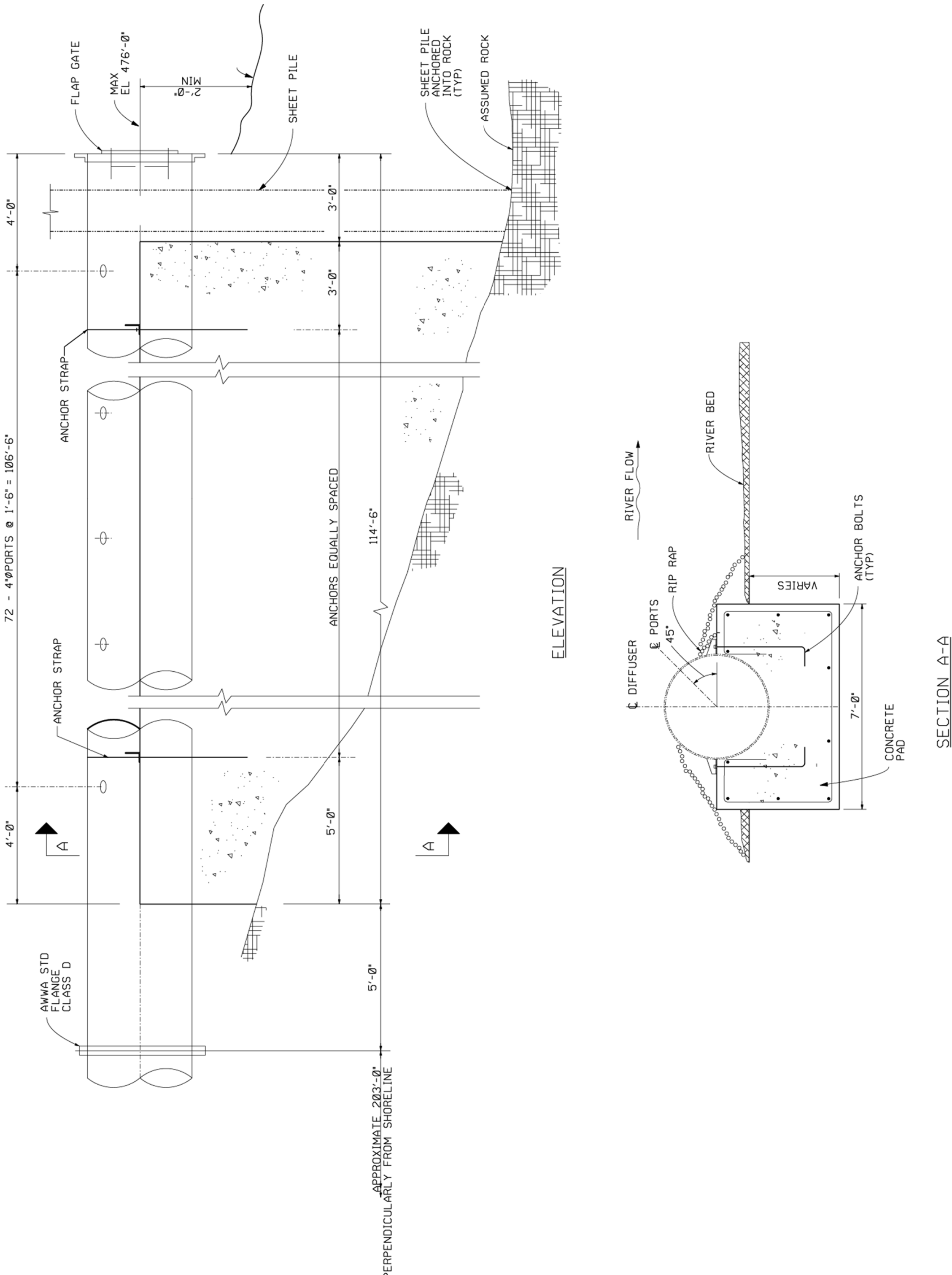

Figure 3-7. Cross-Section and Side Views of the BBNPP Discharge Structure (PPL Bell Bend 2013-TN3377)

Cooling Towers

The proposed BBNPP would use two natural draft cooling towers to dissipate heat from the CWS. These structures would be round, hyperbolic concrete cooling towers, each approximately 350 ft in diameter and 475 ft above grade. In each tower, heated CWS water would be sprayed through fine nozzles to transfer the heat to the atmosphere by evaporative cooling. Cooled CWS water would be recirculated to complete the closed-cycle cooling loop. The two CWS cooling towers would be located north of the reactor buildings (Figure 3-1, grid reference A2), and would require approximately 14 ac (PPL Bell Bend 2013-TN3377).

Heat rejected by the ESWS would be dissipated through four mechanical draft cooling towers, one associated with each of the four pressurized water reactor loops. Each ESWS cooling tower would be divided into two cells that share a cooling-tower basin. The cooling towers would be located adjacent to and north of the BBNPP reactor (Figure 3-1, grid reference A2) (PPL Bell Bend 2013-TN3377).

Essential Service-Water Emergency Makeup System Pond and Pumphouse

The essential service-water emergency makeup system (ESWEMS) is a safety-related retention pond and pumphouse designed to provide up to 30 days of makeup water to the ESWS cooling-tower basins after an accident. The ESWEMS would not be used during normal operation, when ESWS makeup water is supplied by the raw-water supply system. The ESWEMS would require approximately 11 ac and would be located adjacent to the southeast corner of the BBNPP reactor buildings (Figure 3-1, grid reference B2, B3). The ESWEMS retention pond would measure 700 by 400 ft at 700 ft NAVD88, the elevation of the top of its containment berm. It would have sides sloping 1 ft vertical to 3 ft horizontal down to a bottom elevation of 678 ft NAVD88. Its normal pool elevation would be 695 ft NAVD88, resulting in a water depth of 17 ft.

The ESWEMS pumphouse would be located at the east end of the pond and house four independent pump systems, each in its own pump bay, that would connect the pond to the ESWS cooling-tower basins. Water from the pond would enter each pump bay through an 8-ft square opening near the bottom of the pump well; the opening would be covered by a bar screen to prevent debris from reaching the pumps. The pumphouse structure would be approximately 80 ft wide by 60 ft long with the roof approximately 25 ft above the pond containment berm (PPL Bell Bend 2012-TN1529; PPL Bell Bend 2013-TN3377; PPL Bell Bend 2013-TN3447).

Combined Wastewater-Retention Pond

The combined wastewater-retention pond would be a small pond located just east of the ESWEMS pond and about 2 mi west of the BBNPP discharge structure on the Susquehanna River (Figure 3-1, grid reference B2, B3). The combined wastewater-retention pond would receive blowdown from the cooling towers and other plant wastewater (from the raw-water-treatment plant, demineralizer, and other low-volume sources—excluding sanitary wastewater) prior to discharge to the Susquehanna River. Cooling-tower blowdown accounts for 98 percent of the water entering the combined wastewater-retention pond. Liquid effluent management is discussed further in Section 3.4.4.1.

3.2.2.3 Other Structures with a Permanent Environmental Interface

Roads and buildings are the additional permanent plant-environment interfacing structures that would be built in the proposed project area.

Roads

Nearly 10 mi of new or upgraded roads would be needed to support BBNPP construction and operation. PPL proposes to build a new access road to BBNPP from US 11. It would be a three-lane road approximately 0.8 mi long, intersecting US 11 southeast of BBNPP and running north toward SSES, then turning west and north to BBNPP (Figure 3-1, grid reference B2,B3,B4). This route would be used to transport equipment, materials, or components to the site by truck. Four new bridges would be required where the roads cross waterways or wetlands on the site. The locations and dimensions of the bridges are provided in Table 3-1. In addition to the main access road to the reactor and support buildings, perimeter roads and access roads to the cooling towers and intake structure would be built (PPL Bell Bend 2013-TN3377).

Table 3-1. Proposed BBNPP Bridges and Culverts

Structure	Location (Figure 3-1 Grid Reference)	Type	Dimensions Length (ft)	Dimensions Width (ft)	Material
Bridge 1	Wetland 19; S of BBNPP site, E of Confers Lane (B3)	Vehicle	500	57	Concrete span with piers
Bridges 2 and 6	Unnamed Tributary 1, Wetland 12 (B3)	Vehicle Bridge 2 (main access road), shared structure with BBNPP water pipeline Bridge 6	410	82	Concrete span with piers
Bridge 3	Unnamed Tributary 1, Wetlands 10, 12 (A3,B3)	Vehicle (construction office access road)	408	57	Concrete span with piers
Bridge 4	Walker Run (A3)	Vehicle (construction office access road)	400	57	Concrete span with piers
Bridge 5	Unnamed Tributary 1, Wetland 12 (B3)	Railroad spur	535	25	Concrete span with piers
Bridge 7	Unnamed Tributary 1, Wetland 12; S of BBNPP (B3)	Utility pipelines (water, sewer, electrical)	340	18	Prefabricated metal truss with piers
Culvert	Unnamed Tributary 5 (B2,B3)	Railroad spur	125	4[(a)]	Reinforced concrete pipe
Culvert	North Branch Canal (C3)	Pedestrian access	40	4[(b)]	Smooth-lined corrugated polyethylene pipe
Long Pipe	Unnamed Tributary 2 (B2)	Replace existing 567-ft long, 8-in.-diameter pipe	428	3[(c)]	Reinforced concrete pipe

(a) Culvert under railroad spur would have a 4-ft diameter.
(b) Culvert for pedestrian access over North Branch Canal would have a 4-ft diameter.
(c) Unnamed Tributary 2 replacement pipe would have a 3-ft diameter.

Source: PPL Nuclear Development 2011-TN2274

Rail Lines

The North Shore Railroad runs through the SSES and BBNPP sites between US 11 and the Susquehanna River. PPL proposes to extend an existing rail spur to SSES approximately 2 mi, from its present terminus east of SSES Units 1 and 2 to the BBNPP site between the proposed reactor buildings and cooling towers (Figure 3-1, grid reference B3,B2,A2). The rail line would be routed around the SSES. The new rail line would require a 125-ft-long, 4-ft-diameter reinforced concrete pipe culvert where it crosses Unnamed Tributary 5 southeast of SSES. The culvert would have concrete end walls and would be installed on a 4.3 percent grade to convey the stream under the proposed rail line. In addition, the new rail line would require a bridge where it crosses Unnamed Tributary 1 and its associated wetland southeast of BBNPP (Table 3-1, Bridge 5). The new line would split into two parallel tracks for about 1,800 ft on the curve adjacent to the concrete batch plant and main access road (Figure 3-1, grid reference B3; Figure 3-8), and for about 1,100 ft at the new terminus between the BBNPP reactor and cooling towers (Figure 3-1, grid reference A2,B2) (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

Power Transmission System

No offsite transmission facilities are needed to connect BBNPP to the regional power grid, but some transmission facilities would be needed onsite to connect the new unit to the regional system. A new 500-kV switchyard would be built approximately 1,400 ft east of the BBNPP reactor (Figure 3-1, grid reference B2). A new 500-kV line would connect the new BBNPP switchyard with the existing SSES 500-kV switchyard (located south of the SSES cooling towers, Figure 3-1, grid reference B2,B3). The SSES 500-kV switchyard would be expanded to accommodate the additional 500-kV connection to BBNPP. Existing 500-kV transmission lines would carry power from the SSES 500-kV switchyard offsite to the south. Another new 500-kV line would connect the BBNPP substation with a new Susquehanna 2 switchyard located approximately 5,000 ft northeast of BBNPP (north-northwest of SSES), Figure 3-1, grid reference B2), which would then distribute power offsite to the northeast. The Susquehanna 2 switchyard is proposed as part of a regional transmission expansion plan for a new line between SSES and Roseland Substation in New Jersey. The SSES-Roseland line is needed for grid stability whether BBNPP is built or not; it is not part of the BBNPP project and it would be completed and operational prior to completion of BBNPP.

Although not part of the system connecting BBNPP to the regional grid, existing 230-kV transmission lines crossing the BBNPP site would be rerouted to run north of the proposed BBNPP plant area to allow adequate space for BBNPP cooling towers and other structures. The relocated 230-kV line would be about 150 ft north of Beach Grove Road (Figure 3-1, grid reference A2,B2), (PPL Bell Bend 2013-TN3377).

BBNPP switchyard structures would consist of 14 500-kV circuit breakers and associated equipment, transmission towers for the lines to the existing SSES and new Susquehanna 2 500-kV switchyards, and a control building. These structures would be erected within a level, fenced area of about 5 ac. The new Susquehanna 2 500-kV switchyard would require about 26 ac, and expanding the existing SSES 500-kV switchyard to connect new lines from BBNPP would require about 5 ac. Transmission lines would be designed using National Electric Safety

Code (NESC) guidance for clearances and spans. New transmission towers would be of tubular steel or lattice design; tower design and construction would conform to National Electric Safety Code standards (PPL Bell Bend 2013-TN3377).

3.2.2.4 Other Structures with a Temporary Environmental Interface

Temporary plant-environment-interfacing structures include a concrete batch plant and excavation dewatering systems.

Concrete Batch Plant

A concrete batch plant would occupy approximately 11 ac located approximately 8,000 ft east of BBNPP, just south of SSES Units 1 and 2 (Figure 3-8). This area would house the equipment and facilities needed for delivery, materials handling and storage, and preparation of concrete. Water for the concrete batch plant would be supplied by the Berwick District of Pennsylvania American Water Company. Wastewater and runoff from the batch plant and associated aggregate material storage would be discharged to an adjacent retention pond before draining to a vegetated area near Unnamed Tributary 5).

Dewatering Systems

The BBNPP power block, cooling towers, and ESWEMS pond and pumphouse require deep excavation so their foundations can be placed on competent bedrock. Temporary dewatering systems consisting of dewatering wells, gravity drains, sumps, and sump pumps would be used to create dry conditions for placement of structural fill in these excavations. PPL proposes to install a slurry wall around the ESWEMS pond area as a groundwater flow barrier to prevent groundwater seepage into that excavation and thereby reduce the dewatering rate. The shallow Glacial Outwash aquifer is not as thick in the vicinity of the power block and cooling towers, so flow barriers are not proposed for those excavations (PPL Nuclear Development 2011-TN2274). Dewatering pumps would discharge water to a temporary retention pond west of the ESWEMS pond excavation. Water from the temporary retention pond would be pumped to adjacent wetlands (northwest and south of the ESWEMS pond) via a temporary irrigation system (PPL Nuclear Development 2011-TN2274).

PPL expects excavation dewatering systems to be in place for about two years. Once a groundwater flow barrier is no longer needed to isolate the ESWEMS excavation, the slurry wall would be perforated or fractured to restore groundwater flow (PPL Bell Bend 2012-TN1532). Permanent dewatering systems would not be needed because the projected post-construction water table would be sufficiently below plant grade to meet U.S. EPR design criteria (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

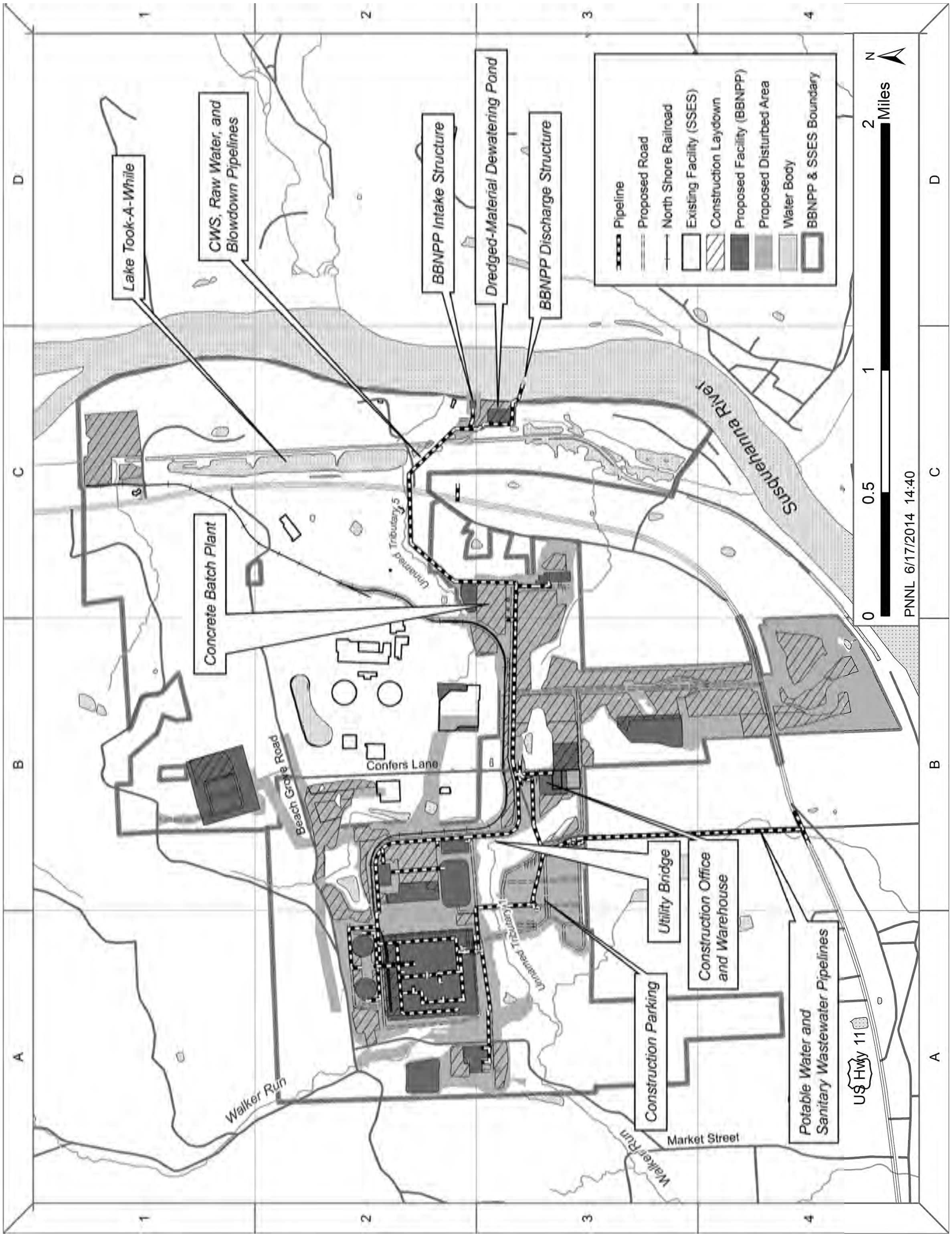

Figure 3-8. Proposed BBNPP Project Area Utilization during Construction and Preconstruction

Dredged-Material Dewatering Pond

The dredged-material dewatering pond would be a temporary facility created and used during the construction period. It would occupy 4.5 ac on the bank of the Susquehanna River between the BBNPP intake and discharge structures. The main dewatering pond would be approximately 140 by 180 ft with a depth of 10 ft (Figure 3-4, Figure 3-8).

3.2.3 Structures with a Minor Environmental Interface

The structures described in the following sections would have minimal plant-environment interface during plant operation.

3.2.3.1 BBNPP Power Block

The U.S. EPR reactor would be housed in the reactor building, an upright cylinder concrete structure capped with a spherical dome. The reactor building would be 186 ft in diameter with an overall height of 240 ft; its bottom foundation would be 35 ft below grade, so the reactor building height would be about 205 ft above grade. The reactor building would be surrounded by the turbine building, the switchgear building, the fuel building, the reactor auxiliary building, four safeguard buildings, two emergency power generating buildings, four ESWS cooling-tower structures, the radioactive-waste processing building, and the access building. The tallest reactor structure would be the vent stack at 211 ft above grade, 7 ft higher than the reactor building. Proposed BBNPP power block buildings would be concrete or steel with metal siding and exterior finishes similar to existing structures at the SSES (PPL Bell Bend 2013-TN3377).

3.2.3.2 Cranes and Footings

A crane on a concrete footing would be used to erect the BBNPP reactor building and cooling towers. Cranes on temporary footings would be used to install new bridges. Other cranes may be used for materials handling, fabrication, and component installation. A barge-mounted crane would be used to install and remove the temporary cofferdams in the river around the intake structure and discharge pipeline.

3.2.3.3 Pipelines

New pipelines would be constructed to convey raw water from the intake on the Susquehanna River to BBNPP, to convey discharge from the combined pond to the outfall diffuser, and to convey potable water from and sanitary wastewater to municipal lines along US 11 (Figure 3-8). The CWS pipeline would be a 32-in.-diameter pipe to convey water from the BBNPP intake structure to the cooling-tower basins. The raw-water supply pipeline would be a 20-in.-diameter pipe to convey water from the BBNPP intake structure to the water-treatment building. The blowdown discharge pipeline would be a 26-in.-diameter pipe connecting the combined wastewater-retention pond with the submerged BBNPP outfall diffuser. These three main water pipelines would be buried along the same route for most of their distance (PPL Bell Bend 2013-TN3377), but would be routed aboveground on a utility bridge (Bridge 6) that crosses Unnamed Tributary 1 southeast of the main plant area (Table 3-1, Figure 3-8).

3.2.3.4 *Water-Treatment Building*

The BBNPP water-treatment building would house the equipment and chemicals needed to treat raw water from the Susquehanna River for use in the essential service-water, demineralized-water, and fire-protection systems. The water-treatment building would be located east of the reactor buildings and cooling towers, just north of the proposed BBNPP 500-kV switchyard (Figure 3-1, grid reference B2). Water would come into the building via the raw-water supply pipeline from the BBNPP intake structure, and treated water would be distributed from the treatment building to the various plant systems.

3.2.3.5 *Potable and Sanitary Water Distribution System*

PPL proposes to build a potable and sanitary water distribution system for drinking water, sanitary use, and cleaning. Potable and sanitary water would be supplied by the Berwick District of Pennsylvania American Water Company via a dedicated pipeline. The system would consist mainly of water pipelines and pump stations, with a metering building located in the southeast corner of the permanent parking lot southeast of the reactor buildings (Figure 3-1, grid reference B3). Incoming water from the Pennsylvania American Water Company would be pretreated; there would be no treatment facility on the BBNPP site. Potable and sanitary wastewater generated during BBNPP operation would be discharged to a publicly owned treatment works operated by the Berwick Area Joint Sewer Authority. The BBNPP sanitary wastewater system would be independent of SSES; there would be no discharge on the BBNPP site (PPL Bell Bend 2013-TN3377). The potable-water and sanitary-wastewater pipeline routes are shown in Figure 3-8.

3.2.3.6 *Support and Laydown Areas*

Multiple construction support and laydown areas would be established to support fabrication and erection activities within the BBNPP project area (Figure 3-8). Many of the laydown areas would be located along the new main access road (south of the SSES), and one would be located in the northeast corner of the project area, where the rail line enters the project area. Laydown areas to the north and southeast of BBNPP would be used for dredged-material disposal (PPL Nuclear Development 2011-TN2274).

3.2.3.7 *Parking*

Parking areas would be created to support the construction workforce and some parking would be retained for the operating workforce once the plant is completed. Temporary parking areas would be in the vicinity of the plant, support, and laydown areas identified in Figure 3-8. The permanent parking area for the operating workforce would include approximately 2,000 spaces, located approximately 0.5 mi southeast of the reactor buildings (Figure 3-1, grid reference B3) (PPL Bell Bend 2013-TN3377).

3.2.3.8 Miscellaneous Buildings

A variety of small miscellaneous buildings would exist throughout the project area to support worker, fabrication, building, and operational needs (e.g., shop buildings, support offices, warehouses, and guard houses). Some buildings may be temporary and would be removed after the plant begins operation.

3.3 Construction and Preconstruction Activities

The NRC's authority is limited to construction activities that have "… a reasonable nexus to radiological health and safety or common defense and security" (72 FR 57416-TN260), and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction (defined at Title 10 of the *Code of Federal Regulations* Part 50, Section 10 (a) [10 CFR 50.10(a) [TN249]) activities for safety-related structures, systems, or components include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing.

Other activities related to building the plant that do not require NRC approval (but may require a Department of the Army permit) may occur before, during, or after NRC-authorized construction activities. These activities are considered to be "preconstruction" activities in 10 CFR 51.45(c) (TN250) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as site preparation (e.g., clearing, grading, erosion control, and other environmental mitigation measures); erection of fences; excavation; erection of support buildings or facilities; building service facilities (e.g., roads, parking lots, railroad lines, etc.); and procurement or fabrication of components occurring somewhere other than the final, in-place location at the proposed site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4 of this EIS.

This section describes the structures and activities associated with building proposed BBNPP. Table 3-2 provides general definitions and examples of activities that would be performed when building the new unit. This section characterizes the activities for the principal structures to provide the requisite background for the assessment of environmental impacts; it is not intended to be a complete discussion of every activity or a detailed engineering plan.

3.3.1 Major Activity Areas

Construction and preconstruction activities for the proposed BBNPP would occur within the BBNPP project area (Figure 3-8). The new main access road would enter the property from the south. The reactor buildings, cooling towers, switchyard, and most support facilities would be located in the western part of the project area; the BBNPP intake and discharge structures would be located on the east edge of the project area along the Susquehanna River. The following sections briefly describe the construction and preconstruction activities associated with the structures described in Sections 3.2.2 and 3.2.3.

1 **Table 3-2. Definitions and Examples of Activities Associated with Building BBNPP**

Activity	Definition	Examples
Clearing	Removing vegetation or existing structures from the land surface.	Cutting trees from a forested area to be used for construction laydown.
Grubbing	Removing roots and stumps by digging.	Removing stumps and roots of trees logged from the construction laydown area.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Leveling the site of the reactors and cooling towers.
Hauling	Transporting material and workforce along established roadways.	Driving on access road by construction workforce.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas, and site drainage.	Paving the parking area.
Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Preparing stormwater infiltration basins, placing pipelines, setting foundations for small buildings.
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating the reactor basemat.
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from reactor building deep excavation.
Dredging	Removing substrates and sediment from navigable waters or wetlands.	Removing sediment from the intake and discharge structure locations.
Spoils placement	Placing construction (earthwork) or dredged material in an upland location.	Stockpiling excavated material in a designated spoils placement area.
Erection	Assembling all modules into their final positions, including all connections between modules.	Using a crane to assemble reactor modules.
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing concrete for pours; laying rebar for the basemat.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining the switchyard free of vegetation.
Filling a wetland or waterbody	Discharging dredge and/or fill material into waters of the United States, including wetlands.	Placing fill material into wetlands to bring it to grade with the adjacent land surface.

3.3.1.1 Landscape and Stormwater Drainage

PPL's proposed stormwater-management plan describes measures to be taken to provide that "there will be no increase in stormwater leaving the BBNPP site as a result of the plant construction" (PPL Nuclear Development 2011-TN2274). Large portions of the project area would be cleared and graded during the construction period; therefore, drainage runoff controls would be established early in the site-preparation process. Activities related to installing site drainage would include grading, creation of berms around laydown areas, and shallow trenching for ditches, drain pipes, and culverts. Slopes, swales, ditches, and pipes would direct runoff to belowground infiltration beds or aboveground retention ponds. Establishing the infiltration beds and retention ponds would involve shallow excavation and emplacement of geotextile fabric, drain pipe, rock, cover material, and riprap. Post-construction activities would include regrading temporary retention ponds and surface stabilization by reseeding vegetation or paving (depending on use) (PPL Nuclear Development 2011-TN2274).

The proposed modifications to the Walker Run floodplain and stream channel would require shallow excavation to create new stream channel, grading to create a riffle-pool channel sequence and reduce the floodplain elevation, and installation of instream structures to direct flow and improve aquatic habitat. Logs and other woody debris would be installed, disturbed areas would be seeded with native vegetation, and native shrubs and trees would be planted to improve habitat (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

3.3.1.2 BBNPP Intake Structure

Site preparation for the BBNPP intake structure and associated access road and parking lot would involve dredging, excavation, filling, and grading. The nearshore work area would be isolated by installing a temporary cofferdam approximately 220 ft long and 120 ft out from the existing shoreline, and dewatering the area behind the cofferdam so that excavation of the shoreline and the forebay could occur in dry conditions (Figure 3-4). During dewatering, the water from the nearshore work area would be pumped to the dredged-material dewatering pond ("temporary dredge pond" in Figure 3-4). The onshore portion of the shoreline would be protected from seepage by seepage cutoff and retaining walls. Nearshore cofferdam or cutoff wall installation would involve a crane and pile driver operating from the shoreline. Cofferdam installation further offshore would require the crane and pile driver to be mounted either on the installed cofferdam or on a barge. If a barge were used, it would require a small tug or boat to maneuver it into place, and spuds or jacks to anchor it in position for installing the sheet pile. PPL proposes that if a barge were used, it could be operated from the inside (shoreward) of the area to be isolated, to minimize the area affected by anchoring the barge (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

Once the cofferdam is in place, some river bottom material would be removed to form the forebay and emplace the intake structure (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274). PPL estimated a total dredged-material volume of 17,000 to 25,000 yd^3 for the intake and discharge structures. All dredged material would be placed temporarily in the dredged-material dewatering pond and allowed to settle; dewatered dredge spoils would be disposed of on uplands within the BBNPP project area at one or more of the laydown areas to the north and southeast of the power block or on lands at the perimeter of the facility.

Fabrication of the concrete intake and pump bay structure would occur after excavation to allow placement of the base at 474 ft NAVD88. Pumps, piping, debris exclusion, screen wash, and necessary electrical systems would be installed to create an operational intake system.

3.3.1.3 BBNPP Discharge Structure

As described in Section 3.2.2.2, the 212 ft of pipe extending from the shoreline to the diffuser would be placed in a shallow trench, while the diffuser end (about 120 ft) would be supported by a concrete pad so the diffuser would discharge between 2 and 3 ft above the riverbed. To install the discharge structure, a sheet pile cofferdam extending from the riverbed to isolate a riverbed area about 375 ft long and 100 ft wide would be installed and then dewatered to allow excavation, trenching, concrete, and pipe placement work to occur in dry conditions (Figure 3-4). Activities would include dredging or excavation, dewatering and upland disposal of excavated material; installing a sheet pile wall into bedrock to support the end of the diffuser; pouring the concrete pad to support the length of the diffuser; placing the discharge pipe and diffuser; anchoring the diffuser to the concrete pad; and emplacing riprap to prevent scour. The installation of the diffuser and associated dredging within the North Branch Susquehanna River would disturb 0.46 ac of riverbed. All dredged material would be disposed of on uplands within the BBNPP project area at one or more of the laydown areas to the north and southeast of the power block or on lands at the perimeter of the facility (PPL Nuclear Development 2011-TN2274).

3.3.1.4 Power Block and Cooling Towers

Preparing the locations of the power block and CWS cooling towers would involve clearing, grading, deep excavation, excavation dewatering, placement of structural fill, large-scale fabrication, and erection activities. Various components would be hauled to the site by railroad and roads. As noted in Section 3.2.2.3, railroads and roads would be built or upgraded in the BBNPP project area.

3.3.1.5 ESWEMS Pond and Pumphouse

Installing the ESWEMS pond and pumphouse would require deep excavation (approximately 50 to 60 ft to bedrock) of approximately 11 ac, installation of a slurry wall to prevent groundwater from entering the excavation, excavation dewatering, and placement of structural fill. Excavated material would be placed in upland spoils areas on the BBNPP site. Because the ESWEMS pond and pumphouse are safety-related structures, the pond, pumphouse, and piping would all be installed on the structural fill. As noted in Section 3.2.2.4, extensive dewatering would be needed for the ESWEMS pond excavation for a period of about 2 years. The dewatering system would require shallow excavation of a temporary retention pond and installation of an irrigation system to distribute water to adjacent wetlands. Once installation of the ESWEMS was completed, the slurry wall, temporary retention pond, and irrigation system would be decommissioned and natural groundwater flow would be allowed to resume (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2012-TN1532).

3.3.1.6 Combined Wastewater-Retention Pond

Installing the combined wastewater-retention pond would require grading, shallow excavation, and connection of pipelines.

3.3.1.7 Dredged-Material Dewatering Pond and Disposal Areas

PPL estimated that disposal capacity would need to be 24,000 to 35,000 yd^3 because the dredged material would expand once it was removed from the river bottom. The temporary dredged-material dewatering pond and associated materials-handling area would require clearing, grading, and shallow excavation of about 5 ac. Dredged material from the river would be placed in the pond and allowed to settle. Overlying water would be decanted to a settling basin to further remove sediment before discharging the water back to the Susquehanna River. Once the dredged material in the dewatering pond was sufficiently dry, it would be excavated from the pond and transferred to upland spoils areas in the BBNPP project area or, if suitable, used for clean, nonstructural fill. The upland spoils storage areas, which will be located at one or more of the laydown areas to the north and southeast of the power block or near the perimeter of the project area, would be cleared and graded. Once the dredged material is dewatered and moved to permanent disposal areas, the dewatering pond area would be graded and stabilized by reseeding vegetation and emplacement of geotextile fabric as needed (PPL Nuclear Development 2011-TN2274).

3.3.1.8 Roads

Building the site-access roads would require clearing and grading of land along the proposed routes. Several bridges are proposed to span streams and wetlands. Installation of bridges would require excavation for footings and piers, fabrication of bridge components, and installation of 40- by 40-ft pads (within the bridge span) for the cranes used to set bridge components in place. Traffic controls would be installed and roadways would be paved (PPL Nuclear Development 2011-TN2274).

3.3.1.9 Rail Lines

The rail spur extension would require installation of a curved bridge over Unnamed Tributary 1 and its associated wetland southeast of the ESWEMS retention pond and the BBNPP switchyard. Bridge installation would be similar to that for road bridges: excavation for footings and piers, fabrication of bridge components, and installation of temporary pads for the cranes used to set bridge components in place. About 1 mi east of the curved bridge, a 125-ft-long, 4-ft-diameter culvert would be installed where the rail spur crosses Unnamed Tributary 5. The pipe invert would be depressed 6 in. below the streambed elevation. Riprap protection is proposed to stabilize the outfall of the culvert (USACE 2012-TN265; PPL Nuclear Development 2011-TN2274).

3.3.1.10 Pipelines

Pipeline installation would require the clearing of land along the pipeline corridor, shallow excavation (trenching), and backfilling. A new utility bridge (Bridge 6) would be installed to carry pipelines above ground and across Unnamed Tributary 1 southeast of the main plant area.

Bridge installation would be similar to that for road bridges: excavation for footings and piers, fabrication of bridge components, and installation of temporary pads for the cranes used to set bridge components in place.

3.3.1.11 Water-Treatment Plant

Building the water-treatment facility would involve shallow excavation, fabrication, and erection of the building and tanks on a cleared, graded area.

3.3.1.12 Potable and Sanitary Water Distribution System

Installing and connecting the BBNPP water distribution system to the Pennsylvania American Water Company supply line would require shallow excavation and installation of pipes, pumps, and a metering building. Installing and connecting the BBNPP sanitary sewer system to the Berwick Area Joint Sewer Authority treatment system would require shallow excavation and emplacement of pipes, pumps, and a lift station to pump sanitary waste to a sewer main that parallels US 11 (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

3.3.1.13 Concrete Batch Plant

The temporary concrete batch plant would be established on a cleared, graded area of approximately 11 ac that would be stabilized with gravel. A sedimentation basin would be created on the north side of the batch plant to capture runoff from the batch plant and adjacent areas. After construction when the concrete batch plant is no longer needed, the sedimentation basin would remain to capture runoff as part of the post-construction stormwater-management system (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

3.3.1.14 Construction Support and Laydown Areas

Establishing and preparing laydown areas would be necessary to stage activities. Prior to and during construction and preconstruction, materials would be brought to the site and stored in laydown areas. PPL expects to clear and grade laydown areas in various locations in the BBNPP project area. Erosion, sediment, and stormwater-control systems would be installed as laydown areas are prepared. Several of the stormwater infiltration basins would be located in laydown and parking areas. Support and laydown areas would be graded relatively level and covered with crushed stone or gravel. Several laydown areas could be used to stockpile material dredged from the Susquehanna River once the material is dewatered (PPL Nuclear Development 2011-TN2274). Normally only limited vegetation would be allowed in laydown areas (PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

3.3.1.15 Parking

Parking areas would be graded and paved. As with the laydown areas, erosion, sediment, and stormwater-control systems would be installed as the parking areas are prepared.

3.3.1.16 Miscellaneous Buildings

Excavating for shallow foundations would be required prior to fabrication and erection of miscellaneous buildings.

3.3.1.17 Transmission System

Clearing and grading of land would be required for the proposed switchyards. Fill material would be emplaced to raise the grade of the SSES 500-kV switchyard expansion area. Electrical switching structures would be erected and the switchyards would be fenced (PPL Bell Bend 2013-TN3377). Installation of transmission lines would require the removal of trees and shrubs along portions of the transmission-line corridor, movement of construction equipment, and shallow excavation for the foundations of the transmission-line towers. Tree removal would require the use of timber mats to cross wetlands. Stumps would remain in place and would not be cleared and grubbed (USACE 2014-TN4024).

3.3.1.18 Cranes and Crane Footings

Fabrication of concrete footings and erection of cranes would be necessary to build the larger plant structures. In addition, gravel pads and cranes would be placed in road rights-of-way to install the new bridges spanning streams and wetlands.

3.3.2 Summary of Resource Commitments during Construction and Preconstruction

Table 3-3 provides a list of the significant resource commitments associated with construction and preconstruction of the proposed BBNPP. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the construction and preconstruction impacts assessed in Chapter 4. These values were stated in the ER and the review team has confirmed that the values are reasonable.

Table 3-3. Summary of Resource Commitments Associated with Construction and Preconstruction of Proposed BBNPP

Resource Areas	Value	Parameter Description	Reference
All Resource Areas	80 months (6.7 years)	Duration of construction and preconstruction activities for one U.S. EPR unit	PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3625
Land Use, Terrestrial Ecology, Cultural and Historic Resources	669 ac	Disturbed area footprint in project area • 357 ac permanently disturbed • 306 ac temporarily disturbed for BBNPP facilities • 6 ac temporarily disturbed only for wetland mitigation	PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3536
Hydrology – Groundwater	150 ft	Maximum excavation depth	PPL Bell Bend 2013-TN3377

Table 3-3. (contd)

Resource Areas	Value	Parameter Description	Reference
Hydrology – Surface Water	• 1,200 gpm • 50 gpm	• Peak construction water use • Average construction water use (primary source would be municipal water supply)	PPL Bell Bend 2013-TN3377
Hydrology – Surface Water, Hydrology – Groundwater	490 gpm	Combined dewatering rate for power block, cooling tower, and ESWEMS retention pond excavation areas	PPL Bell Bend 2013-TN3377; S&L 2014-TN3544
Socioeconomics, Transportation	3,950 workers	Peak construction and preconstruction workforce	PPL Bell Bend 2013-TN3377
Terrestrial Ecology, Nonradiological Health, Socioeconomics	• 108 dBA • 102 dBA • 89 dBA • 72 dBA	• Peak noise at construction source (jackhammer, heavy equipment) • Peak noise level 50 ft from construction source (bulldozer) • Peak noise level 220 ft from construction source (bulldozer) • Peak construction noise level at 1,600 ft (distance to nearest permanent private residence)	PPL Bell Bend 2013-TN3377

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment, as described in Section 3.2.2. Examples of operational activities include withdrawing water for the cooling system, discharging blowdown water, and discharging waste heat to the atmosphere. Activities within the U.S. EPR unit are discussed by PPL in the FSAR portion of its application (PPL Bell Bend 2013-TN3447) and are reviewed by the NRC as part of its safety review and will be documented in its Safety Evaluation Report.

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), and the radioactive and nonradioactive waste-management systems (Sections 3.4.3 and 3.4.4). The values of resource parameters likely to be encountered during operations are summarized in Section 3.4.5.

3.4.1 Description of Operational Modes

The operational modes for the proposed BBNPP unit considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are considered the conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are considered alternative modes to normal plant operation. During these alternative modes, water intake, cooling-tower evaporation, water discharge, and radioactive releases may change from normal operating or emergency shutdown conditions.

3.4.2 Plant-Environment Interfaces during Operation

This section describes the operational activities related to structures that have an interface with the environment.

3.4.2.1 Landscape and Stormwater-Management System

PPL's proposed stormwater-management system would be designed to control stormwater flows to pre-development levels and to infiltrate the 2-year storm volume increase. Periodic inspection and maintenance would be conducted. Catch basins and inlets would be inspected and cleaned, vegetation overlying the infiltration basins would be maintained and re-vegetated as necessary, and swales would be inspected and maintained. Paved parking lots and access roads would be swept twice per year (PPL Nuclear Development 2011-TN2274).

3.4.2.2 Cooling System

Cooling-system component structures would interface with the environment continuously during operation of BBNPP. These important interfaces include withdrawal of surface water at the BBNPP intake structure, evaporation and drift from the BBNPP cooling towers, and liquid effluent discharges through the blowdown outfall diffuser. This section describes the operational activities at each of the cooling-system structures.

BBNPP Intake Structure

The BBNPP intake structure is where water would be withdrawn from the Susquehanna River for the BBNPP CWS, ESWS, fire protection, and other plant uses. As described in Section 3.2.2.2, the intake structure houses three CWS makeup-water pumps and three raw-water supply system pumps. During normal operation of the proposed BBNPP, the CWS pumps would continuously withdraw water from the Susquehanna River at a rate of 23,808 gpm and the raw-water supply pumps would withdraw water at a rate of 1921 gpm, for a combined normal withdrawal rate of 25,729 gpm (Figure 3-9). The maximum total withdrawal rate would be 28,179 gpm, which would occur during shutdown/cooldown when the ESWS cooling towers would be at their maximum evaporation and drift rates. River water would be used by the intake screen wash, but would be returned to the river at the intake location.

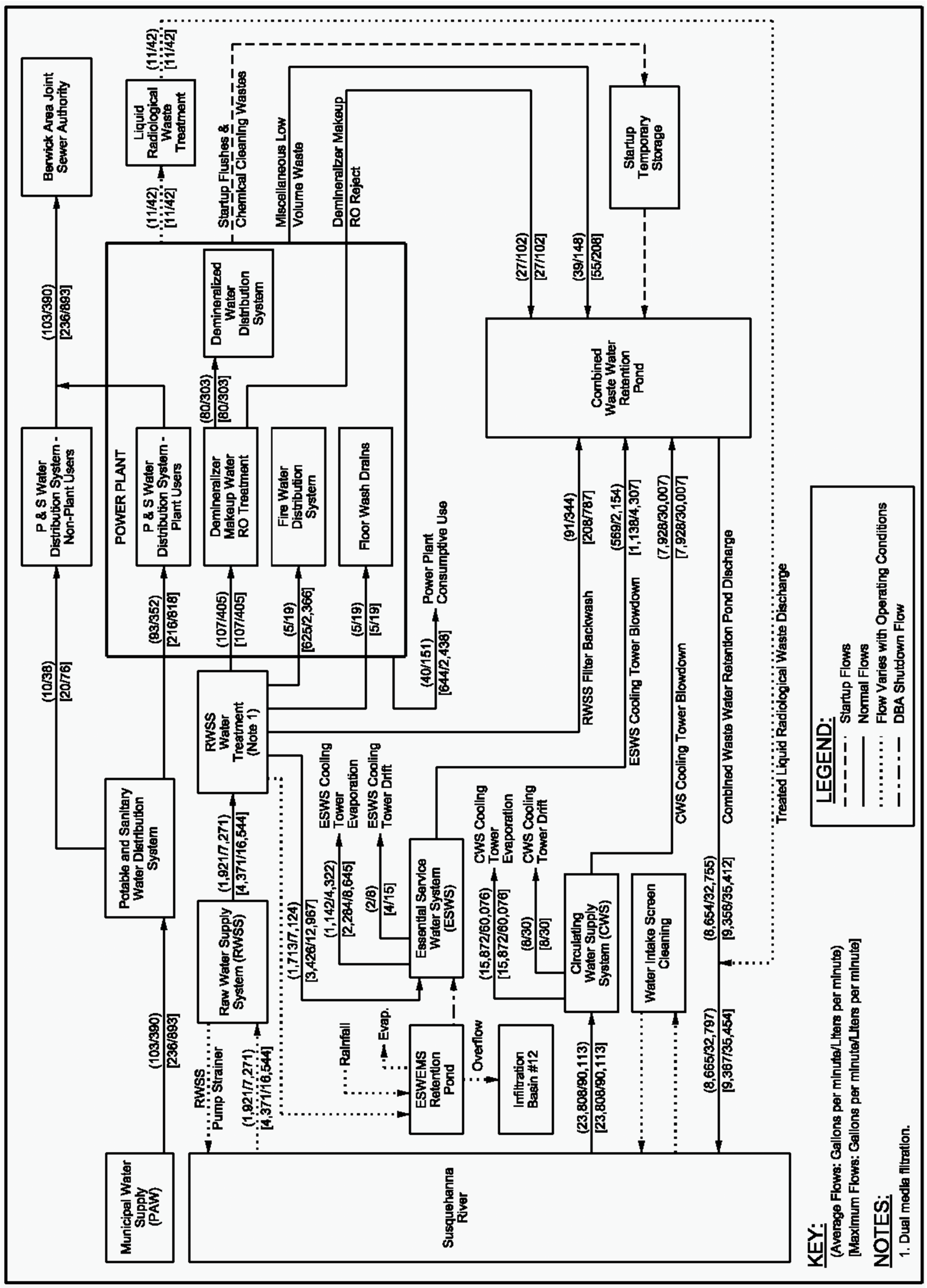

Figure 3-9. Water-Use Summary Diagram (PPL Bell Bend 2013-TN3377)

During operation of BBNPP, the forebay in front of the intake structure would be dredged periodically to maintain its depth. PPL expects the maintenance dredging would consist of mechanical dredging to remove 250 to 1,000 yd^3 of material every 5 to 10 years; the material would be stockpiled at an upland disposal area in the BBNPP project area. The intake structure pump bays would be cleaned every 18 to 36 months; up to 50 yd^3 of mud and debris would be hauled to BBNPP and placed in an appropriate upland area. Debris would be cleared regularly from the intake screens and would be disposed of as solid waste (PPL Bell Bend 2009-TN1563; PPL Bell Bend 2013-TN3377; PPL Nuclear Development 2011-TN2274).

Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. BBNPP would have two closed-cycle wet-cooling towers to dissipate heat from the CWS to the atmosphere. The CWS cooling towers are natural draft towers designed to dissipate a heat load of 1.0×10^{10} Btu/hr (PPL Bell Bend 2013-TN3377). The unit would also have four ESWS cooling towers, two on each side of the reactor. During normal operation, two of the cooling towers would be used to dissipate a heat load of 165×10^6 Btu/hr. If increased cooling capacity were needed (e.g., during plant cooldown), all four ESWS cooling towers would be used to dissipate a maximum heat load of 182×10^6 Btu/hr (PPL Bell Bend 2013-TN3377).

Excess heat in the cooling water would be transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. In addition to evaporative losses, a small percentage of cooling water would be lost in the form of droplets (drift) from the cooling towers. Water lost to evaporation and drift is considered consumptive use because the water is not available for reuse. The CWS normal and maximum evaporation rates would be 15,872 gpm. The ESWS normal and maximum evaporation rates would be 1,142 and 2,284 gpm, respectively. The normal drift rates would be 8 gpm for the CWS and 2 gpm for the ESWS; the ESWS drift rate could increase to 4 gpm when all four ESWS cooling towers are operating (PPL Bell Bend 2013-TN3377).

BBNPP Discharge Structure

Cooling water that does not evaporate or drift from the towers is known as blowdown water. Evaporation of cooling-water system water from the cooling tower increases the concentration of dissolved solids in the cooling-water system. To limit the concentration of dissolved solids, a portion of the blowdown water would be removed and replaced with makeup water. The portion that is removed would be pumped to the combined wastewater-retention pond and eventually to the Susquehanna River through the outfall diffuser. PPL plans to operate both the CWS and ESWS cooling towers at three cycles of concentration, which would maintain the chemical concentration factor of three in the blowdown. Chemical constituents in blowdown and other plant effluent are described in Section 3.4.4. The normal blowdown and maximum discharge rates from the CWS would be the same, 7,928 gpm. The normal and maximum blowdown discharge rates from the ESWS would be 569 and 1,138 gpm, respectively (PPL Bell Bend 2013-TN3377). During normal operations, 157 gpm of plant wastewater would be mixed with the blowdown in the combined wastewater-retention pond, and up to 11 gpm of effluent from the liquid radioactive-waste treatment system would be added downstream of the pond, resulting in a total liquid effluent discharge rate of 8,665 gpm (19 cfs) at the BBNPP discharge structure.

Cooling-Water Treatment Facilities

Water taken into other major systems would require treatment to meet the requirements of the end use. Water-treatment systems would be in place for the CWS, the ESWS, the demineralized-water-treatment system, and the combined wastewater system. Water-treatment chemicals would be injected into the CWS and ESWS using a chemical feed system, or added to the clarification system (housed in the water-treatment building) that supplies water to the ESWS, demineralized-water-treatment system, and fire-protection water system (labeled "RWSS Water Treatment" in Figure 3-9). These chemicals are needed to maintain optimum conditions for system piping materials and system operation; they include anti-foulants, corrosion inhibitors, anti-scalants (deposit inhibitors), dispersants, and alkalinity and pH adjustors. Blowdown and other liquid effluent treatment would depend on water chemistry, but would probably include introduction of sodium bisulfite in the combined wastewater-retention pond to reduce the residual chlorine concentration in the wastewater (PPL Bell Bend 2013-TN3377). The chemicals used in the various systems and their expected concentrations in wastewater are discussed in Section 3.4.4.1 below.

ESWEMS Pond and Pumphouse

As noted in Section 3.2.2.2, the ESWEMS pond and pumphouse are an emergency makeup-water system that would not be used during normal operation. During normal operation, ESWS makeup water is supplied by the raw-water supply system (PPL Bell Bend 2013-TN3377).

3.4.2.3 Power Transmission System

Transmission lines and corridors are considered to interface with the environment during plant operation, because there are continuing visual impacts as well as potential environmental impacts from electric fields, noise, and corridor maintenance. The PPL Electrical Utilities Corporation would use its established procedures for transmission system inspection and for maintenance of transmission-line corridors. Corridor maintenance requires controlling woody vegetation and maintaining access roads. The PPL Electrical Utilities Corporation would manage corridor vegetation on a 3-year cycle, keeping corridors cleared using both mechanical (tree trimming, mowing, hand clearing) and chemical (herbicides approved by the U.S. Environmental Protection Agency) means of vegetation control (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2012-TN1173).

3.4.3 Radiological Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as byproducts of operating the proposed BBNPP. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable before release to the environment. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50, Appendix I ("Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents") (10 CFR Part 50-TN249). The radioactive waste-management systems would not be shared between the existing SSES Units 1 and 2 and proposed BBNPP. Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in light-water reactors such as the U.S. EPR. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities could escape the fuel rods and enter the reactor coolant. Neutron activation of the primary coolant would also cause radioactive material to be present in the reactor coolant system.

The Offsite Dose Calculation Manual (ODCM) for the operating SSES was revised in 2012 (PPL Susquehanna 2012-TN1917) and attached as Appendix A to the 2013 radioactive effluent and monitoring report for the SSES (PPL Susquehanna 2012-TN1917). The ODCM describes the methods and parameters used for calculating the offsite radiological doses from liquid and gaseous effluents. The ODCM also describes the methodology for calculation of gaseous and liquid monitoring alarm/trip set points for release of the effluents from SSES Units 1 and 2. Operational limits for releasing liquids and gaseous effluents are also specified in the ODCM to ensure compliance with NRC regulations. This ODCM will be revised to include operation of the BBNPP or a similar ODCM will be developed (PPL Bell Bend 2013-TN3377).

A summary of the liquid, gaseous, and solid radioactive waste-management systems for the proposed BBNPP are presented in the following sections. A more detailed description of these systems can be found in Chapter 11 of the U.S. EPR Design Control Document (AREVA 2014-TN3722).

3.4.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system is designed to collect, store, process, and dispose of liquids containing radioactive material. PPL (PPL Bell Bend 2012-TN1169) states this will be done in a manner that ensures that any discharged liquid effluents are below concentration levels specified in 10 CFR Part 20, Appendix B, Table 2 (TN283). This is accomplished using evaporation, centrifugal separation, demineralization, and filtration in several process trains consisting of tanks, pumps, ion exchangers, and filters. The system is designed to handle both normal and anticipated operational occurrences. Normal operations include processing of (1) reactor coolant system effluents, (2) floor drain effluents and other wastes with potentially high suspended solid contents, and (3) chemical wastes. In addition, the radioactive waste-management system can handle effluent streams that typically do not contain radioactive material, but that may, on occasion, become radioactive (e.g., steam generator blowdown as a result of steam generator tube leakage). With two exceptions, liquid effluents processed through the liquid radioactive waste-management system are discharged to the environment. The exceptions are steam generator blowdown that is normally returned to the condensate system after processing and reactor coolant that can be degassed prior to reactor shutdown and returned to the reactor coolant system.

Liquid effluents are monitored upon discharge to confirm the radionuclide activity is below the release limits. The total radioactive source term for liquid effluents is listed in Table 3.5-8 of PPL's ER (PPL Bell Bend 2013-TN3377). The results from the PPL dose calculations for the maximally exposed individual and the population within 50 mi of the BBNPP are described in Section 5.9.2 of this EIS.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-treatment system would collect, process, and discharge radioactive gaseous wastes. The system is designed with an activated-carbon delay system and will be located in the Nuclear Auxiliary Building. The system is described in Section 3.5.3 of the ER (PPL Bell Bend 2013-TN3377). Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel rods during operation. Some of these gases enter the reactor cooling system through cladding defects and are released to the plant ventilation system. The gaseous radioactive treatment system uses the activated-carbon delay system to allow decay of the radionuclides with short half-lives.

All gaseous effluents from the gaseous waste-processing system, the containment ventilation purge system, the main condenser exhaust, ventilation from the radwaste building, the spent fuel building, safeguards building, the nuclear auxiliary building, the turbine building, and access-controlled areas are released via the plant stack. Gaseous effluents are monitored upon discharge to ensure release levels are not exceeded. The total gaseous radioactive effluent release values are shown in Table 3.5-8 of the ER (PPL Bell Bend 2013-TN3377). The results from the PPL dose calculations for the maximally exposed individual and population within 50 mi of BBNPP are contained in Section 5.9.2.

3.4.3.3 Solid Radioactive Waste-Management System

The proposed BBNPP solid radioactive waste-management system is described in Section 3.5.4 of the ER (PPL Bell Bend 2013-TN3377). The system functions to treat, store, package, and dispose of dry or wet solids. It includes a radioactive concentrates system, a solid waste-processing system, and the solid waste-storage system. The wet solid wastes include spent resins, centrifuge sludge, sludge from storage tank bottoms, and evaporator concentrates. The dry solid wastes include paper, cloth, wood, plastic, rubber, glass, and metal. There is currently no offsite licensed facility for the permanent disposal of solid radioactive wastes. The solid waste would be stored in the Radioactive Waste Building until an offsite licensed disposal facility becomes available. PPL states that the current Radioactive Waste Building design capacity is sufficient to store Class B and C wastes accumulated for 5 to 6 years, and with additional waste minimization and volume reduction efforts, the storage capacity could be increased to greater than 10 years (PPL Bell Bend 2013-TN3377). Building an additional storage facility is also discussed as an option in the ER.

The estimated annual solid radioactive waste volume for a U.S. EPR is estimated to be approximately 7,900 ft^3 and the expected annual activity is estimated to be 1,990 Ci with a maximum of 67,300 Ci (PPL Bell Bend 2013-TN3377).

3.4.4 Nonradioactive Waste-Management Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for BBNPP, including systems for chemical, sanitary, and other effluents. All discharges to surface waters would be regulated by a National Pollutant Discharge Elimination System (NPDES) permit that would limit the volume and constituent concentrations. The NPDES permit would be administered by the Pennsylvania Department of Environmental Protection (PADEP). In general, nonradioactive waste generated at the BBNPP would be managed in a manner similar to as wastes generated at the SSES.

3.4.4.1 Liquid Nonradioactive Waste-Management System

Liquid nonradioactive wastes generated at the BBNPP would include sanitary waste, stormwater runoff, cooling-tower blowdown, and wastewater from other plant systems. Sanitary waste from BBNPP would not discharge into an onsite effluent stream. Wastewater from sanitary- and potable-water systems would be collected and conveyed to the local municipal sewer system for offsite treatment. As noted in Sections 3.2.2.1 and 3.4.2.1, stormwater volume and quality would be managed by directing runoff to either underground infiltration basins or aboveground detention ponds, which would discharge to nearby vegetated areas. Stormwater discharges would be regulated by a NPDES permit issued by PADEP. Used oil and antifreeze would be recycled.

Cooling-tower blowdown and waste from plant systems (other than potable/sanitary waste and stormwater) would be consolidated in the combined wastewater-retention pond and then discharged to the Susquehanna River at the BBNPP outfall diffuser (discharge structure). Blowdown from the CWS and ESWS cooling towers accounts for 8,497 gpm or 98 percent of the total liquid effluent discharge. The blowdown temperature would vary depending on intake water temperature, electrical generation, and cooling-tower performance. The other 2 percent of the liquid effluent volume comes from water-treatment plant filter backwash, reverse osmosis system reject, floor drains, and treated liquid radioactive waste. The total liquid effluent discharge rate would be 8,665 gpm or 19 cfs during normal operations (PPL Bell Bend 2013-TN3377).

Chemical constituents that naturally occur in the Susquehanna River would be present in the liquid effluent, concentrated by cooling-water recirculation and losses to evaporation. The expected constituent concentrations in the effluent are provided in Table 3-4; these concentrations are calculated based on the cooling towers operating at three cycles of concentration. Liquid effluent would also contain residual concentrations of chemical additives used to treat plant water to maintain optimum operating conditions. These chemicals are injected into the CWS and ESWS using a chemical feed system, or added to the water-treatment system that supplies water to the ESWS, demineralized-water-treatment system, and fire-protection water system. Water-treatment chemicals include biocides, anti-scalants, pH adjusters, and neutralizers. PPL estimates of the water-treatment chemical additives and their byproduct concentrations in the effluent waste stream are provided in Table 3-5 (PPL Bell Bend 2013-TN3377). While some variation occurs in chemical treatment to meet particular water-use needs, plant effluents would be required to meet NPDES-permitted discharge limits (i.e., 40 CFR Part 423-TN253).

Table 3-4. Anticipated Water Quality of Combined Plant Effluent Discharged via the BBNPP Outfall Diffuser[(a)]

Parameter	Units	Maximum Concentration[(b)]	Mean Concentration[(b)]
Total alkalinity	mg/L	180	78
Total suspended solids	mg/L	447	87
Silica (silicon dioxide)	mg/L	14	8
Bicarbonate as $CaCO_3$	mg/L	279	187
Chloride	mg/L	121	83
Fluoride	mg/L	0.3	0.3
Nitrate as NO_3	mg/L	10	6
Nitrate as N	mg/L	2	1
Phosphorus as PO_4	mg/L	2	1
Sulfate	mg/L	253	186
Aluminum, total	µg/L	8,123	1,359
Barium, total	µg/L	172	97
Calcium, total	mg/L	114	78
Iron, total	mg/L	17	4
Magnesium, total	mg/L	30	18
Manganese, total	µg/L	762	331
Potassium, total	mg/L	7	5
Sodium, total	mg/L	74	43
Strontium, total	µg/L	495	299
Zinc, total	µg/L	77	45
Arsenic, total	µg/L	9	3
Lead, total	µg/L	15	15
Total dissolved solids	mg/L	713	553
Calcium hardness	mg/L	285	195
Total hardness	mg/L	388	270
Bis-(1-hydroxyethylidine) phosphonic acid (HEDP)	mg/L	5	5
Dispersant	mg/L	5	5
Free available chlorine	mg/L	<0.2	<0.2

(a) Combined plant effluent includes effluent from the combined wastewater-retention pond (CWS and ESWS cooling-tower blowdown, miscellaneous low-volume waste, reverse osmosis wastewater, and raw-water system filter backwash) and treated liquid radiological waste, which would be discharged downstream of the combined wastewater-retention pond.
(b) Concentrations are based on three cycles of concentration of Susquehanna River water.

Source: PPL Bell Bend 2013-TN3377

Table 3-5. Anticipated Waste-Stream Concentrations of Water-Treatment Chemicals from the Proposed BBNPP

Chemical	System	Frequency of Use	Byproduct Concentration in Waste Stream
Biocide (sodium hypochlorite)	CWS, ESWS	Intermittent	0.5 mg/L free available chlorine 5.0 mg/L sodium 7.7 mg/L chloride 12.7 mg/L total dissolved solids
Deposit control (HEDP, acrylate polymer)	CWS, ESWS	Continuous	5 mg/L total dissolved solids
Biofilm control (Spectrus 1500®)	CWS, ESWS	Continuous	5 mg/L total dissolved solids
Dechlorinator (sodium bisulfite)	CWS, ESWS	Continuous	0.55 mg/L sodium 2.3 mg/L sulfate 2.85 mg/L total dissolved solids
pH adjustment (sulfuric acid)	CWS, ESWS	Continuous	96 mg/L sulfate 96 mg/L total dissolved solids
Biocide (sodium hypochlorite)	Water-Treatment Plant	Intermittent	0.5 mg/L free available chlorine 1.7 mg/L sodium 2.6 mg/L chloride 4.3 mg/L total dissolved solids
Neutralizer (sulfuric acid)	Liquid Waste Processing and Storage	Intermittent	0.5 mg/L sodium 8.8 mg/L sulfate 9.3 mg/L total dissolved solids
Neutralizer (sodium hydroxide)	Liquid Waste Processing and Storage	Intermittent	
Neutralizer, ion exchange regenerator (sulfuric acid)	Demineralized Treatment	Continuous	0.5 mg/L sodium 1.0 mg/L sulfate 1.5 mg/L total dissolved solids
Neutralizer, ion exchange regenerator (sulfuric acid)	Demineralized Treatment	Continuous	

Source: PPL Bell Bend 2013-TN3377

3.4.4.2 Gaseous Nonradioactive Waste-Management System

Nonradioactive gaseous emissions would result from testing and intermittently operating BBNPP's six standby diesel generators (i.e., four emergency diesel generators and two station blackout generators). Testing and operation would be infrequent and typically of short duration (e.g., 4 hr), with longer duration tests (12 to 48 hr) occurring every 18 months to 2 years. Based on a conservative estimate of 100 operating hours per year for each generator, PPL estimated the annual emissions from these six generators to be 2,442 lb of particulates, 1,060 lb of sulfur oxides, 11,023 lb of carbon monoxide, and 35,898 lb of nitrogen oxides. These emissions, which would be permitted in accordance with PADEP and Federal regulatory requirements, would be discharged through an exhaust stack on the top of the diesel generator buildings at about 78 ft above plant grade or about an elevation of 797 ft NAVD88 (PPL Bell Bend 2013-TN3377).

3.4.4.3 Solid Nonradioactive Waste-Management System

Nonhazardous industrial waste generated at the BBNPP would be managed in accordance with Pennsylvania Code Title 25, Article IX, *Residual Waste Management*. Residual waste generators must register with PADEP, develop a source reduction strategy, and regularly report the amount and type of residual waste to PADEP (2012-TN1536). Nonradioactive solid wastes, including typical solid waste (e.g., scrap metal, wood, cardboard, paper) would be segregated and recycled to the extent possible. Recyclable materials would be collected and temporarily stored onsite prior to transfer to a recycling facility. Other typical solid wastes such as garbage; construction debris; and nonhazardous resins, filters, and sludge would be segregated and recycled to the extent practicable, with the balance disposed of in the appropriate permitted offsite disposal facilities. Debris and vegetation from intake structure trash racks and screens would be disposed as solid waste according to the applicable NPDES permit. PPL estimated that the proposed BBNPP would generate residual waste in quantity similar to SSES, or approximately 1,300 tons annually (PPL Bell Bend 2013-TN3377).

3.4.4.4 Hazardous and Mixed Waste Management

Hazardous waste generated at the BBNPP would be managed in accordance with the Resource Conservation and Recovery Act and Pennsylvania Code Title 25, Article VII, Hazardous Waste Management. PPL would develop a hazardous waste-minimization plan to reduce the amount or hazard (e.g., toxicity) of waste generated. Hazardous waste would be temporarily stored onsite for less than 90 days and then disposed offsite by a contractor at a licensed permitted facility (PPL Bell Bend 2013-TN3377). Table 3-6 lists the types and quantities shipped of hazardous wastes generated by the existing SSES, including laboratory solvents, paint wastes, and aerosol residues; PPL stated that operation of the proposed BBNPP would be expected to generate similar waste types and quantities.

Table 3-6. Types and Quantities of Hazardous Wastes Generated during SSES Operations

Hazardous Waste Type	Year	
	2005 (lb)	2007 (lb)
Waste paint, ink, lacquer, varnish	2,785	12,750
Lead debris	200	1,160
Lab packs – no acutely hazardous	355	1,713
Solvent contaminated debris	130	590
Iron oxalate hexahydrate	650	1,200
Waste paint, solvents, gasoline and oil mixture	560	640
Initiator assemblies – fire suppression system	145	15
Aerosols	40	NA
Lab packs – with acutely hazardous	10	NA
Radiological contaminated phosphoric acid filters & debris	88	NA
Concrete sealer, Tectyl 506, Spectrus CT-1300	NA	1,600
Dichlorofluoromethane, flammable aerosols	NA	61
Broken fluorescent lamps	NA	60
Radiological contaminated lead debris	947	306
Radiological contaminated paint, hydrocarbons	NA	222

Table 3-6. (contd)

Hazardous Waste Type	Year	
	2005 (lb)	2007 (lb)
Radiological contaminated debris solvents	NA	130
Radiological contaminated lab pack chemicals	NA	77
Total	**5,910**	**20,524**

NA = not applicable.

Source: PPL Bell Bend 2013-TN3377

Small amounts of mixed waste (waste containing both radioactive and nonradioactive material) would be generated during refueling, routine maintenance, radiochemical laboratory practices, and health protection activities. PPL would implement waste-minimization practices (e.g., separation of wastes) to avoid creating mixed waste. PPL estimated that the types and quantities of mixed waste generated at BBNPP would be similar to or less than those generated at SSES Units 1 and 2. Any mixed waste would be accumulated and stored in a protected area prior to being shipped to a permitted disposal facility (PPL Bell Bend 2013-TN3377).

3.4.5 Summary of Resource Commitments during Operation

Table 3-7 summarizes the operational parameters that are relevant to assessing the environmental impacts of operating the proposed BBNPP unit.

Table 3-7. Resource Commitments Associated with Operation of Proposed BBNPP

Resource(s)	Value	Description
Hydrology-Surface Water	25,729 gpm (57 cfs)	Normal water withdrawal from Susquehanna River at BBNPP Intake
	28,179 gpm (63 cfs)	Maximum water withdrawal from Susquehanna River at BBNPP Intake
Hydrology-Surface Water, Meteorology-Air Quality	15,872 gpm	Normal and maximum CWS evaporation rate
	1,142 gpm	Normal ESWS evaporation rate
	2,284 gpm	Maximum ESWS evaporation rate
Meteorology-Air Quality, Terrestrial Ecology	8 gpm	Normal and maximum CWS drift rate
	2 gpm	Normal ESWS drift rate
	4 gpm	Maximum ESWS drift rate
Hydrology-Surface Water, Hydrology-Groundwater	17,064 gpm (38 cfs)	Normal consumptive water-use rate
	18,812 gpm (42 cfs)	Maximum consumptive water-use rate
Hydrology Surface Water, Aquatic Ecology	8,665 gpm (19 cfs)	Normal discharge flow rate
	9,367 gpm (21 cfs)	Maximum discharge flow rate

Table 3-7. (contd)

Resource(s)	Value	Description
Terrestrial Ecology, Meteorology-Air Quality	475 ft	CWS cooling-tower height
Terrestrial Ecology, Socioeconomics	475 ft	Tallest structure height (cooling towers)
	212 ft	Tallest building height other than cooling towers
Socioeconomics	363 workers	Normal operating workforce for one unit
	1,000 workers	Maximum workforce during refueling outages occurring every 18 months, lasting approximately 15 days
Terrestrial Ecology, Nonradiological Health, Socioeconomics	54 dBA	CWS cooling-tower sound level at 800 ft
Uranium Fuel Cycle, Need for Power	1,710 MW(e)	Gross electrical output per unit
	110 MW(e)	Station and auxiliary service load
	1,600 MW(e)	Net electrical output per unit
	95 percent	Expected annual capacity factor

4.0 Construction Impacts at the Bell Bend Nuclear Power Plant Site

This chapter examines the environmental issues associated with the construction of a proposed new Bell Bend Nuclear Power Plant (BBNPP) adjacent to, but separate from, the existing Susquehanna Steam Electric Station (SSES) Units 1 and 2 site. This proposed action is described in the application for a combined license (COL) submitted by PPL Bell Bend, LLC (PPL). As part of its application, PPL submitted an Environmental Report (ER) (PPL Bell Bend 2013-TN3377) that discusses the environmental impacts of building, operating, and decommissioning the proposed BBNPP, and a Final Safety Analysis Report (FSAR) (PPL Bell Bend 2013-TN3447) that addresses the safety aspects of construction and operation.

In addition to the COL application, PPL has applied for a Department of Army permit from the U.S. Army Corps of Engineers (USACE) to conduct activities in or affecting waters of the United States, including wetlands. Also, PPL will be required to submit a number of other applications for permits and certifications related to construction to the Pennsylvania Department of Environmental Protection (PADEP). PPL does not plan to start preconstruction activities related to development of BBNPP or associated facilities until November 2017 (PPL Bell Bend 2014-TN3625).

As discussed in Section 3.3 of this environmental impact statement (EIS), the U.S. Nuclear Regulatory Commission's (NRC's) authority is limited to "construction activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 *Federal Register* [FR] 57416 [TN260]). Many of the activities required to build a nuclear power plant do not fall within the NRC's regulatory authority and therefore are not "construction" as defined by the NRC; such activities are referred to as "preconstruction" activities in Title 10 of *Code of Federal Regulations* (CFR) Part 51 Section 45(c) (10 CFR 51.45(c) [TN250]). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of a COL. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, erection of support buildings, etc.) are included in the evaluation of cumulative impacts.

As described in Section 1.1.3 of this EIS, the USACE is a cooperating agency on this EIS consistent with the updated Memorandum of Understanding signed with the NRC (USACE/NRC 2008-TN637). The NRC and USACE established this cooperative agreement because both agencies have concluded it is the most effective and efficient use of Federal resources in the environmental review of a proposed new nuclear power plant. The goal of this cooperative agreement is the development of one EIS that provides all of the environmental information and analyses needed for the NRC to make a license decision as well as the information needed for the USACE to perform analyses, draw conclusions, and make a permit decision in the USACE's regulatory permit decision document. In an effort to accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC/USACE team. The review team was composed of staff from the NRC, its contractor, and the USACE.

The USACE is responsible for ensuring that the information presented in this EIS is adequate, to the extent possible, to allow USACE to evaluate, in part, the proposed jurisdictional activities in accordance with USACE regulations; the Clean Water Act (CWA) Section 404(b)(1) (33 USC

1251 et seq.-TN662), "Guidelines," which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE Public Interest Review. The USACE will decide whether to issue a permit on the basis of an evaluation of the probable impact, including the cumulative impacts of the proposed activity on the public interest. In accordance with the Guidelines, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have a less adverse impact on the aquatic ecosystem, provided the alternative does not have other significant adverse environmental consequences. The USACE permit decision will reflect the national concern for both protection and use of important resources. The benefit that reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The USACE Public Interest Review factors that may be relevant to the proposal, including its cumulative effects, will be considered; among those factors are conservation, economics, aesthetics, general environmental concerns, wetlands, historic resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, bank erosion and sediment deposition, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people.

Many of the impacts that the USACE must address in its analysis result from preconstruction activities. In addition, most of the activities conducted by a COL applicant that would require a permit from the USACE would be preconstruction activities.

While both the NRC and the USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.-TN661), both agencies have mission requirements that must be met in addition to the NEPA requirements. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.-TN663). The USACE's regulatory authority as related to the proposed action is based on Section 10 of the Rivers and Harbors Appropriation Act of 1899 (RHAA) (33 USC 403 et seq.-TN660), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the USACE, and Section 404 of the Clean Water Act (33 USC 1344 et seq.-TN1019), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Therefore, the applicant must have a USACE permit before commencing preconstruction or construction activities in jurisdictional waters, including wetlands.

The USACE will make its evaluation after completion of its Public Interest Review, including full consideration of the recommendations of Federal, State, Tribal, and local resource agencies and members of the public, the 404(b)(1) Guidelines Evaluation, mitigation plan approval, and after it completes the following consultations and coordination efforts, if applicable: Section 106 of the National Historic Preservation Act (NHPA) (54 USC 300101 et seq. -TN4157), including, as appropriate, development and implementation of any Memorandum of Agreement; Section 7 of the Endangered Species Act (16 USC 1531 et seq.-TN1010); State forest conservation plans; State water-quality certifications; and State coastal zone consistency determinations. Because the USACE is a cooperating agency under the Memorandum of Understanding for this EIS, the USACE's decision about whether to issue a permit will not be made until after the final EIS is issued and its evaluation is completed.

The collaborative effort between the NRC and the USACE in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies to the extent possible. Consistent with the Memorandum of Understanding, the staffs of the NRC and the USACE collaborated in both (1) the review of the COL application and information provided in response to requests for additional information (developed by the NRC and the USACE) and (2) the development of the EIS. 10 CFR 51.45(c) (TN250) requires that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts normally presented in Chapter 7. However, because of the collaborative effort between the NRC and the USACE in the environmental review, the combined impacts of the construction and preconstruction activities that would be authorized by the NRC with its issuance of a COL are presented in this chapter. For each resource area, the NRC also provides an impact analysis solely for construction activities that meet the NRC's definition of construction in 10 CFR 50.10(a) (TN249). Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) (TN249) construction activities and the assessment of the combined impacts of construction and preconstruction are used in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

In addition to guidance provided in NUREG-1555 (NRC 2000-TN614), staff used guidance provided in the NRC Interim Staff Guidance COL/ESP-ISG-026 *Environmental Issues Associated with New Reactors* (NRC 2014-TN3767). For most environmental resource areas (e.g., aquatic ecology), the environmental impacts are not the result of either only the preconstruction activities or only the construction activities. Rather, the impacts are attributable to a combination of construction and preconstruction activities. For most resource areas, the majority of the impacts would occur as a result of preconstruction activities.

This chapter is divided into 13 sections. In Sections 4.1 through 4.10, the review team evaluates the potential impacts of building the proposed BBNPP on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological and radiological health effects, and nonradioactive waste impacts. In accordance with 10 CFR Part 51 (TN250), impacts were analyzed and an impact category level (SMALL, MODERATE, or LARGE) of potential adverse impacts was assigned for each resource area by the review team on the basis of the definitions for these terms established in Chapter 1 of this EIS. The impacts on some resource areas (e.g., the impacts on taxes under the socioeconomic resource area) may be considered beneficial and are stated as such. The review team's determination of an impact category level was based on the assumption that the mitigation measures identified in the ER or the activities planned by various State and County governments, such as infrastructure upgrades (discussed throughout this chapter), would be implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is discussed in Section 4.11. A summary of the construction and preconstruction impacts is presented in Section 4.12. A list of the references cited in this chapter is in Section 4.13. Cumulative impacts of construction and operation are discussed in Chapter 7. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10 of this EIS.

The review team's assessment of the impacts from the construction of proposed BBNPP draws on information presented in PPL's ER Revision 4 (PPL Bell Bend 2013-TN3377) and supplemental documents, as well as other government and independent sources.

4.1 Land-Use Impacts

The following sections describe land-use impacts from site preparation and building the BBNPP project.

4.1.1 The Site and Vicinity

The BBNPP site would be developed in accordance with applicable Federal, State, and local land-use requirements and environmental protections. Because of its inland location, the BBNPP site is not subject to requirements of the Coastal Zone Management Act (16 USC 1451 et seq.-TN1243). Site development activities would have to be authorized by the agencies and programs listed in Appendix H, Table H-1. No known Native American Tribal Land plans would have jurisdiction over activities proposed on or near the BBNPP site. Further, no national parks, national monuments, national forests, wild and scenic rivers, or wilderness areas are located onsite or in the BBNPP project vicinity (PPL Bell Bend 2013-TN3377).

Building the proposed BBNPP facility would disturb a total of approximately 663 ac of land. Approximately 357 ac of that land would be permanently disturbed. This includes approximately 39 ac of previously developed land associated primarily with existing SSES facilities. It also includes approximately 35 ac of land subject to permanent tree clearing only (conversion from forest to scrub/shrub vegetation to accommodate transmission lines and other overhead features). Project features that would result in permanent disturbance are listed in Table 4-1 along with their estimated acres of disturbance. Areas disturbed to build these project features would be permanently converted to structures, pavement, or intensively maintained exterior grounds (PPL Bell Bend 2013-TN3377).

Approximately 306 ac of the 663-ac total disturbance would be temporarily disturbed during construction activities (Table 4-1). This total includes 16 ac of previously developed land associated primarily with existing SSES facilities. Project features that would result in temporary disturbance are listed in Table 4-1. These include temporary laydown areas, a concrete batch plant, sedimentation ponds, dredge dewatering ponds, topsoil disposal areas, temporary offices, warehouses, temporary parking, and other temporary features that would be no longer needed once the proposed BBNPP unit is built. Water-intake and blowdown pipelines are included in the temporary disturbance totals because ground disturbance in those areas would be temporary and affected areas would be restored once the pipeline installation is complete (PPL Bell Bend 2013-TN3377).

Clearing, grubbing, grading, excavating, and the stockpiling of spoils during site-preparation and construction activities would result in the alteration of existing vegetation, topography, and site-drainage patterns. Mitigation measures proposed by the applicant to address these impacts would include soil erosion and sedimentation control, controlled access roads, and restricted construction zones. Areas of temporary disturbance would be stabilized and restored after completion of building activities, and permanently disturbed locations would be stabilized and contoured to blend with the surrounding area. Vegetation stabilization and restoration methods would comply with applicable laws, regulations, permit requirements and conditions, good engineering and construction practices, and recognized environmental Best Management Practices (BMPs) (PPL Bell Bend 2013-TN3377).

Table 4-1. Areas of Disturbance within the BBNPP Project Area

Permanent Disturbance	Acres
BBNPP power block	52.6
Essential Service Water Emergency Makeup System retention pond and pumphouse	11.0
Intake structure[a]	2.3
BBNPP switchyard	5.2
SSES switchyard expansion	5.4
Circulating-water system cooling towers	14.2
Water treatment	2.7
Combined wastewater-retention pond	2.8
Susquehanna 500-kV Switchyard 2	26.3
Roads	51.4
Railroads	24.8
Permanent buildings	21.5
Permanent parking	29.1
Stormwater-infiltration basins[b]	39.2
Plant yard and permanent laydown areas[c]	33.9
Onsite transmission-line right-of-way	35.0
Total	**357.4**
Temporary Disturbance	
Concrete batch plant	11.2
Temporary laydown areas[c]	63.4
Temporary sedimentation pond	3.9
Temporary parking	22.0
Dredge dewatering pond	4.5
Water-intake and blowdown pipeline corridor	7.1
Topsoil disposal areas	102.7
Miscellaneous construction areas	27.0
Onsite transmission-line right-of-way	63.9
Total[d]	**305.7**

(a) Total does not include areas within the Susquehanna River that will be affected either temporarily (0.8 ac) or permanently (0.2 ac) by construction activities associated with the installation of the BBNPP intake structure and discharge pipeline/diffuser and approximately 6 ac of temporary impacts associated with wetlands mitigation.
(b) Total does not include infiltration basins located in areas occupied by permanent features.
(c) Total does not include areas to be used for laydown that will be used subsequently for other site-development features.
(d) Total includes 16.0 ac of previously developed land.

Source PPL Bell Bend 2013-TN3377

Operation of the BBNPP would be consistent with applicable zoning. As described in Section 2.2.1, on February 8, 2011, the Salem Township Board of Supervisors adopted Ordinance 2011-03, which established the Special Industrial District (I-3) zoning designation. The new ordinance added electrical power generating plants (other than wind-energy facilities) as a conditional use within the I-3 zone. On the same date, the Board of Supervisors adopted Ordinance 2011-02 amending the Salem Township Zoning Ordinance and Map to zone the BBNPP site as I-3. The I-3 zone is a heavy industrial district consistent with the areas to the north and east of the BBNPP site that contain the existing SSES plant. In addition, Ordinance 2011-03 added a provision allowing intake and outfall structures on land zoned Conservation District (C-1), which includes the land within the project area located in the Riverlands Recreation Area (Cormany 2012-TN1172).

Areas that would be affected by permanent and temporary disturbance consist primarily of agricultural land and forest land typical of the surrounding landscape. Approximately 318 ac of previously undeveloped land within the BBNPP project area would be occupied by permanent structures, pavement, or intensively managed exterior grounds once construction is completed. Most of the previously undeveloped area within the BBNPP project area is forest and agricultural land, with smaller areas of wetlands and open water (PPL Bell Bend 2013-TN3377).

According to the applicant, three PPL-owned private residences and associated outbuildings would be vacated and removed or relocated during preconstruction activities. One of these three residences has since been removed. Another residence located just east of the proposed plant entrance road off of U.S. Highway 11 (US 11) was under contract for purchase by PPL in 2012. All four residences would be vacated and removed or relocated during preconstruction activities (Aarts 2012-TN3987).

Prime farmland resources are described in Section 2.2.1. Approximately 324 ac of developed and undeveloped prime farmland soils within the BBNPP project area would be affected by site grading (Figure 4-1).[(1)] This includes approximately 32 ac of prime farmland soils that have previously been graded, excavated, covered, filled, or disturbed to accommodate residential, commercial, industrial, or other non-agricultural structures and facilities. Even though approximately 292 ac of prime farmland would be affected by the project, the impact on prime farmland would be negligible for the following reasons. First, most of the undeveloped prime farmland that would be disturbed is zoned Special Industrial District (I-3) and is therefore not intended for long-term agricultural use. Second, loss of the subject farmland is not expected to substantially interfere with ongoing use of other farmland in the vicinity. A smaller portion of the affected prime farmland lies within the Riverlands Recreation Area, which is zoned Conservation (C-1); this too lies within an area zoned primarily for activities that are not agricultural (PPL Bell Bend 2013-TN3377).

[(1)] The 324 ac of prime farmland (developed and undeveloped) that would be affected is less than the approximately 440 ac identified as agricultural in Table 2-1 because not all of the acreage classified as agricultural in Table 2-1 meets the National Resources Conservation Service criteria for prime farmland (PPL Bell Bend 2013-TN3377).

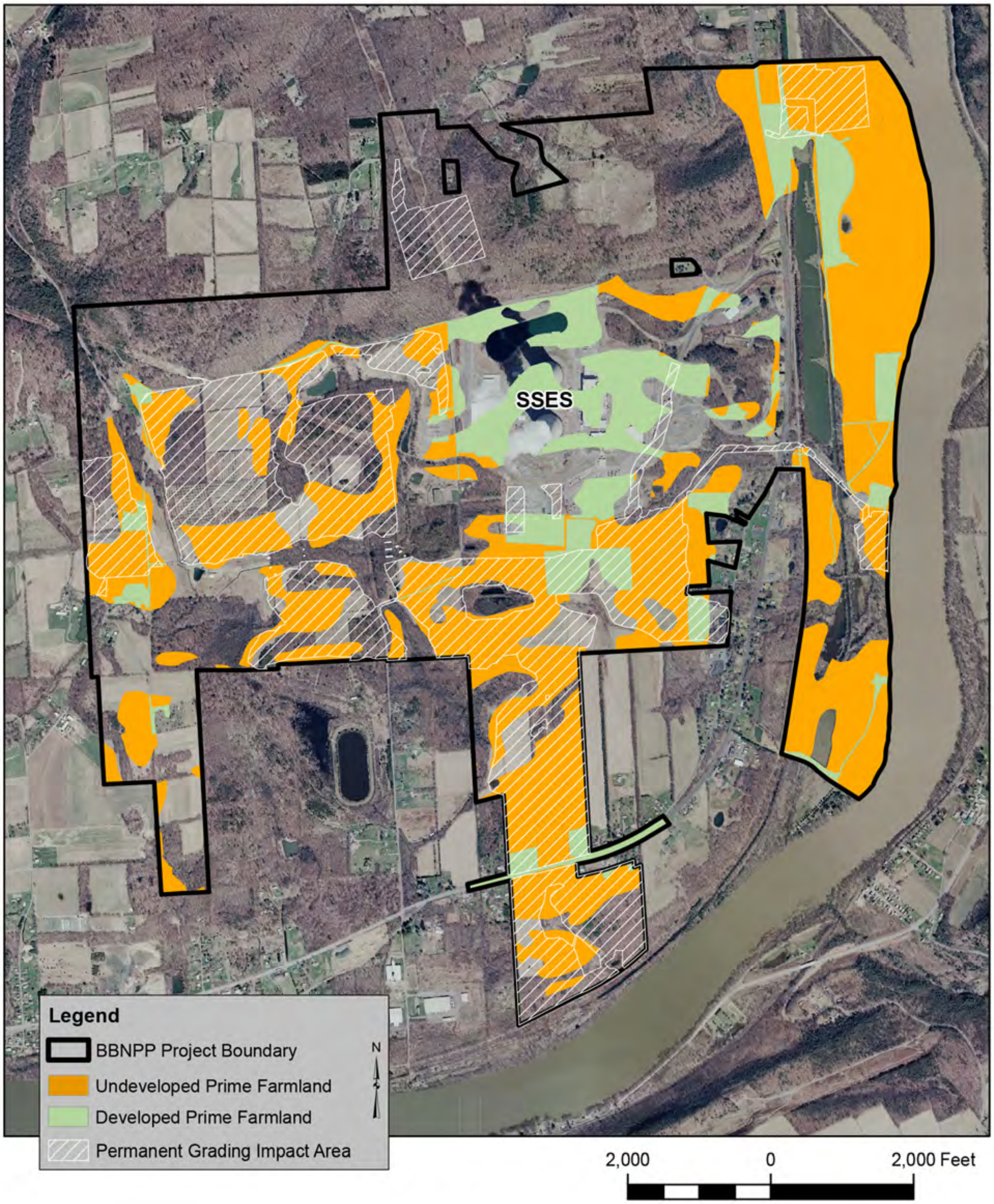

Figure 4-1. Impacts on Prime Farmland within the BBNPP Project Area (PPL Bell Bend 2013-TN3377)

Heavy equipment and reactor components would be transported to the BBNPP site by railroad and highway. A new railroad spur extending from the existing railroad line on the eastern boundary of SSES site would be extended to the modular laydown and assembly areas located north of the BBNPP power block (Figure 2-4). A new 0.8 mi onsite access road would be constructed from US 11 to the BBNPP site to avoid impeding traffic on the existing entrance road to the SSES. The new access road would not cross any existing railroads but would cross under existing transmission lines and over proposed underground utilities servicing the BBNPP project, including water and sewer lines, the raw-water makeup line, the circulating-water line, the blowdown/deicing line, and various electrical ducts. A site perimeter road system and access road around the cooling-towers area and the power block would also be built. In the area east of US 11, a new access driveway would be built to connect the proposed water-intake structure to an existing road (PPL Bell Bend 2013-TN3377).

Approximately 28.1 ac of the Susquehanna River 100-year floodplain would be disturbed by clearing and grading activities, building the proposed intake and blowdown structures, and installation of the makeup and blowdown lines. The 100-year flood elevation on the Susquehanna River in this area is approximately 513 ft National Geodetic Vertical Datum of 1929 (NGVD29). Most impacts would be temporary, except for building and operating the BBNPP intake structure, which would permanently affect approximately 1.7 ac of the 100-year floodplain (PPL Bell Bend 2013-TN3377). Access improvements and other construction activities associated with the BBNPP site would also affect approximately 0.45 ac of the 100-year floodplain of Walker Run, a small stream that flows through the western and central parts of the BBNPP site, and its tributaries. Most of the impacts in this area would be temporary, except for impacts associated with small sections of roadway, bridge abutments, and other exterior areas that would permanently affect approximately 0.3 ac of the 100-year floodplain (PPL Bell Bend 2013-TN3377). As described in greater detail in Section 4.2, the review team concludes that the extent of floodplain encroachment would not alter local flood patterns in a more than minor way.

As described in Section 2.2.1, the only minerals with the potential for being extracted at the BBNPP site are sand, gravel, and siltstone. Siltstone deposits could not be mined economically because of their substantial depth below the surface. The sand and gravel deposits along the Susquehanna River that would be occupied by permanent project features would be only a tiny fraction of the sand and gravel deposits in the flood plain within the project area (PPL Bell Bend 2013-TN3377).

Overall project impacts on wetlands would be limited to approximately 1.4 ac of fill and 7.9 ac of forested wetland conversion. Section 4.3.1.3 provides a detailed discussion of construction impacts on wetlands.

Based on information provided by PPL and the review team's independent evaluation, the review team concludes that land-use impacts of preconstruction and construction activities on the BBNPP site and within the BBNPP project vicinity would be minimal.

4.1.2 Transmission-Line Corridors and Other Offsite Areas

4.1.2.1 Transmission-Line Corridors

The BBNPP would be served by existing transmission-line corridors and not require development of any new offsite rights-of-way. Because no new offsite corridors would be required and no improvements to offsite corridors are proposed, the proposed BBNPP project would have no impact on the offsite transmission system.

As discussed in Section 2.2.2.1, the BBNPP project would require several upgrades on the BBNPP and SSES sites to the existing transmission system within the BBNPP project area. These include:

- building one new 500-kV switchyard on the BBNPP site to transmit power from the proposed BBNPP unit
- building one new 500-kV switchyard (Susquehanna 500-kV Switchyard 2) on the SSES site to transmit power to the regional grid
- expanding the existing 500-kV switchyard on the SSES site
- building two new 500-kV circuits on individual towers connecting the BBNPP substation to the existing and new 500-kV switchyards on the SSES site.

As discussed by the applicant, the BBNPP switchyard would be electrically integrated with the existing 500-kV Susquehanna switchyard, and the new Susquehanna 500-kV Switchyard 2 by installing two 500-kV 4,260 MVA circuits on individual structures. The 500-kV lines would likely be a combination of three-pole and H-Frame structures made of self-weathering steel. The poles would be rust brown and the insulators would be a dull gray. Where the new 500-kV lines would parallel existing lines within the BBNPP project area the transmission-line corridor width would be increased by 150 ft. In other areas the width of the transmission-line corridor would be 200 ft. Areas under the new and existing transmission lines would be cleared of vegetation that could pose a safety risk to the transmission system, either from arcing or by reducing the structural integrity of towers (PPL Bell Bend 2013-TN3377).

The proposed new onsite transmission lines would be routed to avoid or minimize impacts on existing wetlands and threatened and endangered species. Land-use impacts from the transmission lines and upgrades are included as part of the impacts quantified and described for the BBNPP site in Section 4.1.1. Lines routed through forested wetlands would cause a permanent disturbance due to corridor vegetation management that would preclude the presence of trees. Clearing vegetation in rights-of-way within the project area would be conducted in accordance with established PPL procedures.

The existing 230-kV transmission line that runs through the BBNPP site would be moved to the north to provide sufficient space between the transmission lines and the BBNPP circulating-water system (CWS) cooling towers and to create additional space for other plant-related structures. The width of the transmission-line corridor for the relocated line would be 150 ft.

Because there would be no new offsite transmission-line corridors or other offsite improvements, the review team concludes that there would be no additional impacts on offsite lands from the proposed BBNPP project beyond those described in Section 4.1.1.

Based on the information provided by PPL and the review team's independent evaluation, the review team concludes that the land-use impacts from the transmission-system upgrades described above, including relocation of the existing 230-kV transmission line that runs through the BBNPP site would be minimal, and additional mitigation would not be warranted.

4.1.2.2 Consumptive-Use Mitigation

The review team expects that land-use impacts from consumptive-use mitigation activities would be limited to use of a portion of PPL's Rushton Mine property to build expanded groundwater-treatment facilities. The review team assumes that building these expanded facilities would require permanent dedication of approximately 25 ac of land on the site. The Rushton Mine outfall system may require some minor re-design (i.e., rip rap repair, weir repair, resizing of settling pond discharge culverts) to accommodate higher flows (PPL Bell Bend 2014-TN3539). Because the Rushton Mine site is situated in a rural area and includes more than 60 ac of land not contemplated for other surface development, the review team concludes that the land-use impacts on the site would be minimal.

4.1.3 Summary of Land-Use Impacts

Based on information provided by PPL and the review team's independent evaluation, the review team concluded that the potential land-use impacts of preconstruction and construction activities on the BBNPP site and within the BBNPP project vicinity would be SMALL. The proposed activities would be consistent with applicable zoning, would not conflict with any land-use plans or known land-use objectives, and would have no substantial effects on agriculture or mineral development activities in the surrounding landscape. Minor encroachment into the 100-year floodplain would not substantially alter the patterns of surface-water runoff, stream flow, or flooding in the surrounding landscape. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concluded that the land-use impacts of NRC-authorized construction activities would also be SMALL. The NRC staff concludes that no mitigation measures beyond PPL's commitments outlined in its application would be warranted.

4.2 Water-Related Impacts

Water-related impacts involved in building the proposed BBNPP unit are similar to impacts that would be associated with the development of any large industrial site, and not much different than those seen while building SSES Units 1 and 2. Prior to initiating onsite activities, including any site-preparation work, PPL would be required to obtain the appropriate authorizations regulating alterations to the hydrologic environment. These authorizations would likely include, but not be limited to, the following:

- Section 404 of the Clean Water Act (33 USC 1251 et seq.-TN662). This permit would be issued by the USACE, which governs discharge of dredged and/or fill material into waters of the United States.

- Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403 et seq.-TN660) Permit. This permit would be issued by the USACE to regulate any structure or work in, over, under, or affecting waters of the United States (e.g., construction and maintenance of intake and discharge structures in navigable waters of the North Branch of the Susquehanna River [North Branch of the Susquehanna]).
- Clean Water Act Section 401 Water Quality Certification (33 USC 1251 et seq.-TN662). This certification is issued by the PADEP as part of the Water Obstruction and Encroachment Permit to ensure that the project does not conflict with State and Federal water-quality management programs.
- Clean Water Act (33 USC 1251 et seq.-TN662) Section 402(p) National Pollutant Discharge Elimination System (NPDES) Permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in the Commonwealth of Pennsylvania to the PADEP. An erosion and sediment control plan would be required as part of the NPDES permit.
- Water Obstruction and Encroachment Permit (PADEP 2013-TN3538). This permit is issued by the PADEP to authorize and specify conditions for activities covered by the Section 404 permit. This permit also constitutes approval of the Section 401 Water Quality Certification.
- Susquehanna River Basin Commission 18 CFR Part 806 (TN3811). Susquehanna River Basin Commission approval is required for groundwater withdrawal to support excavation dewatering.
- Water and sewer connection permits typically issued by a city, county, or municipal district.

Additional detail regarding the items listed above is contained in Appendix H.

Section 4.2.1 discusses the expected hydrologic alterations in surface water and groundwater related to building the proposed BBNPP unit. Sections 4.2.2.1 and 4.2.2.2 discuss water-use impacts from building activities for surface water and groundwater, respectively. Sections 4.2.3.1 and 4.2.3.2 discuss water-quality impacts from building activities for surface water and groundwater, respectively. Section 4.2.4 discusses water monitoring during plant building. These sections draw on information presented in Section 2.3 of this EIS and in PPL's ER (PPL Bell Bend 2013-TN3377).

4.2.1 Hydrologic Alterations

This section (1) identifies and describes proposed preconstruction and construction activities, including site preparation, onsite activities, and offsite activities that could result in hydrologic alterations; (2) describes and analyzes the resulting hydrologic alterations and the physical effects of these alterations; (3) analyzes the practices proposed to minimize hydrologic alterations having adverse impacts; and (4) assesses compliance with applicable standards and regulations.

Activities associated with building the proposed BBNPP are described in detail in Section 3.3. Activities that could produce hydrologic alterations include the following:

- clearing and grading at the project site and building infrastructure (e.g., roads, bridges, parking lots, and stormwater-conveyance and -retention systems)
- building new structures at the site (e.g., power block structures, cooling towers, switchyard, and subgrade piping and systems)
- building cooling-water-intake and -discharge structures on the North Branch of the Susquehanna River shoreline and dredging nearshore areas of the North Branch of the Susquehanna River for the water-intake structure forebay and the blowdown discharge line and diffuser
- excavation dewatering for construction of the power block, cooling towers, and essential service water emergency makeup system (ESWEMS) pond.

Many of these activities would affect surface waterbodies and aquifers on and near the site. Affected surface waterbodies include the Susquehanna River, Walker Run, several unnamed tributaries flowing across the site, several ponds located on the site, and a portion of the north branch of the Pennsylvania Canal located near the discharge structure. Groundwater is expected to be affected by surface modifications that alter local recharge patterns and amounts, and by excavation dewatering.

About 677 ac onsite would be disrupted during the building of the proposed BBNPP unit (PPL Bell Bend 2013-TN3377); this includes clearing land for buildings, roads, parking lots, and laydown areas. The land surface would be contoured to include surface-water drainage ditches, infiltration beds, and stormwater-retention ponds to handle stormwater flows and allow suspended solids to settle prior to discharge to the Susquehanna River or Walker Run. These land-surface modifications would alter surface-water runoff flow patterns and would alter the infiltration properties of the land surface. Runoff would be increased by replacing vegetated surfaces with buildings and relatively impervious surface materials. PPL has indicated that it would comply with NPDES permits and implement a stormwater-management plan that includes use BMPs for control of stormwater erosion and sediment transport (PPL Bell Bend 2013-TN3377).

Land-surface modifications would result in local alterations to groundwater recharge, with a reduction in recharge where vegetated surfaces are replaced by buildings and paved surfaces and an increase in recharge beneath infiltration beds. PPL has proposed to install infiltration beds at key locations to recharge the water table aquifer where building activities interrupt the natural flow of groundwater (PPL Bell Bend 2013-TN3377). Infiltration beds also would be placed around areas expected to have higher surface runoff such as laydown areas, switchyards, cooling towers, and parking areas to increase groundwater infiltration, reduce peak runoff rates, and maintain water quality. The infiltration beds also would reduce the temperature and sediment load of water discharging to adjacent wetlands and streams.

Land-surface modifications and other building activities would also affect existing wetlands on the BBNPP site. Impacts on wetlands are described in Section 4.3.

Building the BBNPP CWS intake structure will require use of a cofferdam, driven piles, and a dewatering system. The cofferdam will extend approximately 150 ft into the river for a distance along the river bank of about 250 ft (Figure 3.4-11 of the ER). Dredging in the Susquehanna River will be required within the cofferdam to build the intake structure forebay. A cofferdam and dredging will also be required for installation of the blowdown discharge pipeline and diffuser. The cofferdam will extend about 360 ft into the river and will be about 50 ft wide (Figures 3.4-11 and 3.4-12 of the ER). The presence of cofferdams is anticipated to produce temporary and localized changes in river flows. Dredging activities are anticipated to produce a temporary, localized degradation in water quality. Intake structure and discharge pipeline/diffuser installation, and any associated dredging would comply with USACE permit requirements. Because the building activities for the intake and discharge structures would be localized and temporary, and would comply with applicable permit requirements, the review team determined that effects on river flows and water quality would be minor.

Building activities affecting the Walker Run and Susquehanna River floodplains are described in Section 4.1 of the ER (PPL Bell Bend 2013-TN3377). The area affected is illustrated in ER Figure 4.1-3. Building activities will affect 0.45 ac in the 100-year floodplain of Walker Run (1.85 ac of the 500-year floodplain) and will include building a permanent roadway, bridge abutment, and yard area in an area to the southwest of the power block. Building activities will permanently affect 0.3 ac of the Walker Run 100-year floodplain. Building activities will affect 28.1 ac of the Susquehanna River 100-year floodplain (32.5 ac of the 500-year floodplain). Most of these impacts will be temporary with permanent impacts on 1.7 ac of the Susquehanna River 100-year floodplain arising from building the BBNPP intake structure. Because the floodplain areas permanently affected by building activities is small relative to the size of the floodplains themselves, the review team determined that these activities would have a minor effect on the floodplain capacities.

PPL has proposed to relocate portions of Walker Run adjacent to the BBNPP site to create and improve wetlands and fish habitat and to mitigate for permanent stream impacts (PPL Bell Bend 2013-TN3377). This activity would require permits from the USACE and PADEP. PPL states that about 2,200 ft of stream channel will be affected by the relocation. The review team determined that the relocation of Walker Run will not significantly alter water flows in the stream and is anticipated to improve water quality by restoring the stream channel to a more natural course and by creating and enhancing the wetlands adjacent to the stream. Impacts on wetlands are described in Section 4.3.

The existing outlet for the North Branch Canal will be filled as part of building the intake structure. As mitigation for this, PPL has proposed to enhance wetlands near the intake structure (PPL Bell Bend 2013-TN3377). PPL is required to implement this mitigation as part of the Department of the Army permit. PPL has also proposed to reconnect the North Branch Canal to its historic alignment. The review team determined that reconnection of the North Branch Canal to its former channel would have a minor effect on the occurrence and use of water in this portion of the site. Impacts on wetlands are described in Section 4.3.

Building the BBNPP structures and facilities would require excavation of the Glacial Outwash aquifer sediments and a portion of the Shallow Bedrock aquifer to reach competent bedrock on which foundations can be placed. Groundwater hydrology is expected to be altered within the excavations by the placement of fill materials with hydraulic properties different than the native materials removed during excavation. Structural fill may have a higher hydraulic conductivity than the glacial outwash sediments, which the review team expects will have a minor and localized effect on groundwater flow direction in the immediate vicinity of the excavations. In addition, a low-permeability slurry wall will be placed around the ESWEMS pond excavation and possibly around some portion of the cooling-tower excavation to reduce groundwater inflow to the excavations. PPL has committed to decommission the ESWEMS pond slurry wall to render it non-functional (PPL Bell Bend 2013-TN3377). By rendering the slurry wall non-functional, the review team expects that groundwater flow alterations in the vicinity of the ESWEMS pond excavation will be temporary and minor.

Dewatering of excavations would be required during construction of the nuclear island structures, the cooling towers, and the ESWEMS pond and is anticipated to lower groundwater levels in the vicinity of the excavations. PPL states that a low-permeability slurry wall will be used around the ESWEMS pond excavation to reduce the effect of dewatering on the surrounding aquifer and the nearby wetlands (PPL Bell Bend 2013-TN3377). PPL does not plan to use a low-permeability barrier around the nuclear island because the shallow depth of the Glacial Outwash aquifer in that area of the BBNPP site will limit the horizontal extent of the affected groundwater (PPL Bell Bend 2013-TN3377). PPL does not plan to use a low-permeability barrier around the cooling-tower excavation, but acknowledges that a barrier may be required along the northwest portion of this excavation (PPL Bell Bend 2013-TN3377), depending on the depth of saturated glacial outwash sediments encountered (S&L 2014-TN3544).

The effect of excavation dewatering on groundwater was evaluated by PPL using analytical calculations and three-dimensional groundwater flow modeling (WBCNC 2011-TN1833; S&L 2014-TN3544). PPL's analysis focused on the calculation of steady-state groundwater withdrawal rates, which reflect the changes in the site water budget resulting from the dewatering. Initial dewatering rates would be higher than the steady-state rates as the sediments are dewatered, but the initial effects on groundwater would be localized. PPL determined that dewatering the ESWEMS pond without a slurry wall in place would require a steady-state withdrawal rate of more than 1,000 gpm, and would reduce groundwater heads by more than 25 ft at a distance of 800 ft from the excavation (WBCNC 2011-TN1833). With the slurry wall operating as designed, PPL determined that dewatering the ESWEMS pond would require a steady-state withdrawal rate of 235 to 310 gpm (S&L 2014-TN3544) and would reduce groundwater heads no more than 5 to 10 ft at distances of 500 ft to the west and 250 ft to the south of the excavation (WBCNC 2011-TN1833). Because the groundwater withdrawal would be greater than 100,000 gpd (69 gpm), the ESWEMS pond dewatering would be regulated by the SRBC.

PPL determined that the combined dewatering activities would reduce groundwater discharge to Walker Run by about 140 gpm (0.3 cfs) with the use of a slurry wall at the ESWEMS pond excavation (WBCNC 2011-TN1833). This reduction is about 5 percent of the estimated annual average discharge rate for the Walker Run watershed (6.6 cfs, as described in Section 2.3.1.1). PPL has indicated that part of the water from the dewatering system would be pumped into onsite impoundments for sediment removal and groundwater recharge, and would be reintroduced to the water table by remedial irrigation of nearby wetlands before being discharged to streams (PPL Bell Bend 2013-TN3377; S&L 2014-TN3544). The review team agrees that these actions would reduce the effect of hydrological alteration resulting from the proposed temporary dewatering.

The review team evaluated the dewatering analyses completed by PPL and determined that the results are consistent with the description of site groundwater provided in Section 2.3. The review team determined that the effect of dewatering on groundwater levels would be most significant in the Glacial Outwash aquifer because it has a relatively high hydraulic conductivity and contains the majority of the sediments being excavated, and because it is underlain by the relatively low hydraulic conductivity shale bedrock into which the excavations would extend. The review team also determined that the effect of dewatering on groundwater would be most noticeable in the vicinity of the ESWEMS pond excavation and adjacent to the northwest portion of the cooling-tower excavation because the saturated depth of the glacial outwash sediments is greatest in these areas.

The review team estimated the effect on groundwater from the ESWEMS pond excavation dewatering, without the use of a slurry wall, using analytical methods (Army et al. 1983-TN3650). A conservative radius of influence for drawdown in the groundwater head was estimated to be about 4,200 ft. Using this radius of influence, groundwater drawdown was estimated to be about 10 ft at a distance of 300 ft from the excavation (the approximate distance to Unnamed Tributary 1) and over 3 ft at a distance of 1,700 ft from the excavation (the approximate distance to Walker Run). PPL's groundwater modeling predicted greater drawdown in the vicinity of the excavation than the analytical estimates. Therefore, the review team determined that PPL's groundwater modeling results with a slurry wall in place were likely to be a conservative estimate of the effects of dewatering. No analytical solution was available for evaluating the effect on groundwater from dewatering using a slurry wall.

From the log of the borehole located at the center of the western cooling tower, the review team determined that there could be 35 ft of glacial outwash sediments at this location. Based on the description of BBNPP site hydrogeology in Section 2.3, the review team assumes that at least 35 ft of glacial outwash sediments will be encountered along the northwest corner of the cooling-tower excavation. Uncertainty in the thickness of glacial outwash sediments exists because of a lack of boreholes in this area. Because the northwest corner of the cooling-tower excavation is at an elevation of 664 ft (S&L 2014-TN3544) and Walker Run to the west is at an elevation of approximately 680 ft, the review team determined that saturated glacial outwash sediments are likely to be encountered in the northwest corner of the cooling-tower excavation. The review team estimated a dewatering flow rate into the excavation of about 280 gpm using an analytical method (Army et al. 1983-TN3650). This is substantially larger than the cooling-tower dewatering flow rate of 70 to 90 gpm estimated by PPL (WBCNC 2011-TN1833; S&L 2014-TN3544). A dewatering rate of 280 gpm (0.6 cfs) would be about 10 percent of the estimated annual average discharge rate for the Walker Run watershed. Based on PPL's estimated reduction in dewatering from the use of a slurry wall at the ESWEMS pond, the review team expects the use of a slurry wall for the cooling-tower excavation would reduce the dewatering rate to about 70 gpm. The potential effect of dewatering the cooling-tower excavation could be reduced further by the use of an infiltration pond between the excavation and Walker Run.

Offsite impacts on groundwater from site dewatering activities would be limited by the influence of local waterbodies and topography. In addition, alterations from excavation dewatering would be temporary with the aquifers recovering after pumping has stopped. The review team considered the possible effects of dewatering at the BBNPP site excavations on offsite waterbodies. The largest of the offsite ponds is the oval "racetrack" pond, located approximately 2500 ft south of the ESWEMS pond. This pond is outside the Walker Run watershed and separated from the BBNPP site by a topographic rise to the north. Therefore, the review team concludes that the effects of dewatering on this pond would be minimal.

The smaller ponded area and the wetlands to the northwest of the oval pond are in an area of flat topography and may be within the Walker Run watershed as discussed in Section 2.3. These waterbodies are more than 2,300 ft from the ESWEMS pond excavation, which limits the effect of dewatering. Without a slurry wall, the analytical method results in a conservative estimate of about a 2-ft reduction in groundwater elevations in this area. The review team determined that the effects on groundwater in this area will be minor, however, because of the intervening region of elevated topography and the proposed use of a slurry wall around the ESWEMS pond excavation, and the re-infiltration of groundwater withdrawn during dewatering.

Approximately 250 gpm (360,000 gpd) of water would be required for building the BBNPP and would be supplied by pipeline from the Berwick Pennsylvania-America Water Company (PAWC) municipal source (PPL Bell Bend 2013-TN3377). Land disturbance associated with trenching and backfilling for installation of water-supply and sewer pipelines would be temporary and in compliance with required permits. Water would be used primarily for grading, soil compaction, dust control, concrete mixing, and potable use (PPL Bell Bend 2013-TN3377). No significant runoff or infiltration is expected from these uses.

In summary, the hydrologic alterations associated with preconstruction and construction activities on and in the vicinity of the BBNPP site would be limited to dredging and dewatering for the intake and discharge structures, altering the surface topography, changes to runoff and infiltration characteristics, and dewatering the excavations for the nuclear island, cooling towers, and ESWEMS pond. PPL has indicated BBNPP would not need any additional offsite transmission corridors to be connected to the existing electrical grid. The impacts of hydrologic alterations resulting from both onsite and offsite building activities would be localized and temporary. Compliance with the requirements of the permits, certifications, and stormwater pollution prevention plan, including implementation of BMPs would minimize impacts resulting from hydrological alterations. PPL has committed to the use of a slurry wall for the ESWEMS pond excavation to control inflow of groundwater into the excavation and minimize effects of the excavation dewatering on surrounding groundwater heads. PPL has also committed to re-infiltrate extracted groundwater via sedimentation basins and to irrigate nearby wetland areas, which will further reduce the effects of the ESWEMS pond excavation dewatering.

The review team estimated a dewatering rate for the cooling-tower excavation that is substantially larger than PPL's estimate. PPL has stated that a flow barrier may be considered for the cooling-tower excavation where saturated glacial outwash sediments are encountered. This control measure would minimize effects from the cooling-tower excavation dewatering.

4.2.2 Water-Use Impacts

The water-use impacts of building a nuclear power plant are similar to those associated with the development of any large industrial site. This section evaluates the impacts on the use of surface water and groundwater arising from the activities described in Section 4.2.1 associated with building the BBNPP, including proposed practices to minimize adverse impacts on water use from these activities. The impacts on the use of surface water and groundwater are discussed in Sections 4.2.1.1 and 4.2.2.2, respectively.

4.2.2.1 Surface-Water-Use Impacts

Surface water would not be used to support building activities for the BBNPP. Building the intake and discharge structures would alter the pattern of flow in the Susquehanna River, but these alterations would be localized and temporary. The flow rate in the Susquehanna River would not be affected. Dewatering of excavations for construction of the Nuclear Island, the cooling towers, and the ESWEMS pond are expected to reduce the discharge to Walker Run by no more than a combined 350 gpm (0.78 cfs), which is about 12 percent of the estimated annual average discharge in the Walker Run watershed (6.6 cfs, as described in Section 2.3.1.1). With the use of a flow barrier (e.g., a slurry wall) at the cooling-tower excavation, the combined dewatering activities are expected to reduce the discharge to Walker Run by no more than 140 gpm (0.31 cfs), which is about 5 percent of the estimated annual average discharge in the Walker Run watershed. PPL stated that they may consider use of a flow barrier at the cooling-tower excavation if needed to minimize seepage (PPL Bell Bend 2013-TN3377). Flow barriers are standard engineering practice for control of groundwater inflow to excavations. The effects of dewatering on the average Walker Run discharge would be temporary. In addition, Walker Run is not used as a water source for other uses. With the use of engineering control measures during dewatering and other building activities as described by PPL, impacts on other offsite waterbodies is expected to be minor.

Based on the information provided by PPL and the review team's independent evaluation discussed above, the review team concludes that the impacts on surface-water use during preconstruction and construction activities for the proposed BBNPP would be SMALL, assuming standard engineering control measures (e.g., a slurry wall) would be used during cooling-tower excavation dewatering if needed. Based on the above analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the staff concludes that the impacts of NRC-authorized construction activities would be SMALL and no mitigation measures other than those described above would be warranted.

4.2.2.2 Groundwater-Use Impacts

As stated above, water needed for preconstruction and construction activities at the BBNPP site would be supplied by PAWC, a public water supplier with wells in Berwick, Pennsylvania. PPL stated that the average work-day water demand for building BBNPP would be no more than 138,000 gpd (PPL Bell Bend 2013-TN3377). PPL stated that the peak usage rate would be about 1,200 gpm, with an average usage rate during building of 250 gpm. As described in Section 2.3, the combined potential yield of the permitted PAWC wells at Berwick is 4.6 million gallons per day (Mgd) and the average withdrawal from the well system was about 1.6 Mgd during 2004 to 2013. Thus, the average work-day water demand for building BBNPP is about 5 percent of the average unutilized capacity of the PAWC Berwick well system. Therefore, the review team concludes that the PAWC well system has sufficient capacity, and that the effect on this resource from the water use for building BBNPP would be temporary and minor.

Because onsite groundwater would not be used as a water-supply source during building at the BBNPP site, the review team determined that the primary potential impact on groundwater use from building the BBNPP would be from dewatering of excavations. As described above, dewatering would have the greatest impact on the Glacial Outwash aquifer and the effects of dewatering on groundwater would be limited to a region well within 1 mi of the excavations. As described in Section 2.3, PPL provided information on 12 groundwater supply wells located within about 1 mi of the BBNPP power block area (PPL Bell Bend 2014-TN3494). Of the six wells not owned by PPL, two are located on the western side of Walker Run and three are located in the Walker Run watershed upstream of the BBNPP site. The review team anticipates that the effects on groundwater from dewatering would be minimal at these wells because of the significant recharge that occurs in the highlands north of the cooling-tower excavation and from Walker Run itself. In addition, these wells are not likely to withdraw from the Glacial Outwash aquifer, and they are located about 1 mi from the nearest excavation.

The remaining water-supply well not owned by PPL is located adjacent to the oval “racetrack” pond, approximately 2,500 ft south of the ESWEMS pond excavation. PPL stated that this well is 150 ft deep, has a yield of 40 gpm, and is most likely located in the Shallow Bedrock aquifer. As described in Section 2.3, the oval pond is separated from the BBNPP site by a topographic rise; the pond lies outside the Walker Run watershed and drains to Unnamed Tributary 3. The review team anticipates that the effects on groundwater from dewatering will be minimal at this well because it is located outside the Walker Run watershed. In addition, the review team determined that the control measures proposed by PPL for the ESWEMS pond excavation dewatering will limit the effects of dewatering to the vicinity of the excavation. Based on the conditions described above, the review team concludes that the dewatering activities at the BBNPP site will have a minimal effect on offsite wells.

Based on the absence of onsite groundwater use for building BBNPP and the factors discussed above, the review team concludes that the overall groundwater impacts from preconstruction and construction activities for the proposed BBNPP would be of limited magnitude, localized, and temporary, and therefore SMALL. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that impacts on groundwater use from NRC-authorized construction activities would also be SMALL.

4.2.3 Water-Quality Impacts

The water-quality impacts of building a nuclear power plant are similar to those associated with the development of any large industrial site. This section evaluates the impacts on water quality arising from the activities described in Section 4.2.1 associated with building BBNPP, including proposed practices to minimize adverse impacts on water quality from these activities. The impacts on surface water and groundwater are discussed in Section 4.2.3.1 and 4.2.3.2, respectively.

4.2.3.1 Surface-Water-Quality Impacts

The activities associated with building the proposed BBNPP would occur close enough to the Susquehanna River, Walker Run, and unnamed tributaries that run through the site, that the impacts from these activities on the quality of surface water need to be considered.

As described in Section 4.2.1, the site preparation and building activities that could affect surface-water quality include land-surface clearing and grading, road improvement, and building bridges, parking lots, and other structures. These activities would alter the land surface, the surface cover, and surface drainage patterns and increase the potential for runoff and erosion. In addition, water produced by the excavation dewatering would be discharged to surface waterbodies. PPL would use soil erosion controls (e.g., temporary sediment basins and infiltration beds) and other BMPs and comply with applicable regulations designed to prevent stormwater runoff and sediment runoff from affecting the water quality in surface waterbodies through compliance with NPDES permits and Pennsylvania Erosion and Sediment Control requirements (PPL Bell Bend 2013-TN3377).

To build the intake structure and the discharge pipeline and diffuser, dredging in the Susquehanna River would be required. These activities would be carried out under conditions defined by the applicable USACE permits. Cofferdams used during these activities would limit the impact on water quality. Sediment disturbed during dredging would settle after the completion of the activity and is expected to have a temporary impact on water quality in the vicinity of the building activity.

Because the impacts of hydrologic alterations resulting from activities associated with building the proposed unit would be localized and temporary, and because the required permits, certifications, and the erosion and sediment control plan call for the implementation of BMPs to minimize impacts, the review team concludes that the impacts on surface-water quality from activities related to preconstruction and construction of BBNPP would be SMALL. Based on the above analysis and because NRC-authorized construction activities represent only a part of the analyzed activities, the NRC staff concludes that impacts on groundwater use from NRC-authorized construction activities would also be SMALL.

4.2.3.2 Groundwater-Quality Impacts

Activities described in Section 4.2.1 that may affect groundwater quality include stormwater management, inadvertent chemical spills, and the discharge of groundwater withdrawn during excavation dewatering.

The stormwater-management system may alter the temperature and mineral composition of groundwater recharge to the Glacial Outwash aquifer. These alterations would be localized and temporary because the groundwater would quickly equilibrate in the subsurface. The review team concludes that alteration of groundwater quality from stormwater system discharges would be minimal.

Inadvertent spills of fluids such as gasoline, diesel fuel, hydraulic lubricants, and other similar products used in construction equipment may occur during building. BMPs would be applied to minimize the occurrence of such spills and limit their effects. These BMPs would include the implementation of a spill prevention plan as required by PADEP (PPL Bell Bend 2013-TN3377).

Dewatering of excavations is expected to locally alter the shallow groundwater flow patterns, but is not expected to significantly alter groundwater quality. Minor changes in groundwater chemistry may occur in the vicinity of the excavations, but these changes are expected to be localized and temporary because the groundwater will equilibrate with the undisturbed sediments as it flows away from the excavations. Groundwater withdrawn during dewatering will be discharged to surface waterbodies. As described in Section 2.3.3, groundwater quality at the BBNPP site has generally good quality. The Glacial Outwash aquifer, the source of the majority of dewatering, currently discharges to Walker Run and the small tributaries on the site. In addition, discharge of groundwater withdrawn during dewatering will be regulated as part of the NPDES permit issued by PADEP.

Because the groundwater-quality impacts identified above would be localized and temporary, and because groundwater discharges would be regulated by the NPDES permit and BMPs would be used to minimize and control inadvertent spills, the review team concludes that the impacts on groundwater quality from activities related to preconstruction and construction of BBNPP would be SMALL. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that impacts on groundwater use from NRC-authorized construction activities would also be SMALL.

4.2.4 Water Monitoring

PPL described the construction monitoring programs for hydrologic and chemical monitoring in Sections 6.3 and 6.6 of the ER (PPL Bell Bend 2013-TN3377).

4.2.4.1 Surface-Water Monitoring

Water discharges during building activities would be monitored in accordance with applicable NPDES permit requirements and PADEP water-quality requirements. Stormwater and dewatering discharges would be monitored. An erosion and sediment control plan would be required as part of the NPDES permit. This plan would specify the inspection methods and BMPs used to detect erosion and provide effective sediment control (PPL Bell Bend 2013-TN3377). Requirements for monitoring the Susquehanna River during building of the intake structure and the discharge pipeline and diffuser will be specified as part of the USACE Section 404 permit and the Section 401 water-quality certification issued by PADEP. Susquehanna River flow and water quality will continue to be monitored as part of SSES operations.

4.2.4.2 Groundwater Monitoring

Groundwater elevations will be monitored in existing wells to identify changes in site groundwater conditions resulting from building activities (PPL Bell Bend 2013-TN3377). Some existing wells will necessarily be affected by earthmoving and building activities and will have to be removed from service. PPL has committed to evaluate the need for additional observation wells to replace abandoned wells or cover changes in local groundwater conditions caused by building activities (PPL Bell Bend 2013-TN3377).

Monitoring will be carried out to evaluate the impact on wetlands of dewatering the ESWEMS pond excavation and to evaluate the effectiveness of the proposed control measures (PPL Nuclear Development 2011-TN1952). Shallow groundwater elevations and soil moisture will be monitored along two transects in wetlands adjacent to the ESWEMS pond excavation. Streamflow in Unnamed Tributaries 1 and 2 will be monitored concurrently. In addition, groundwater monitoring is recommended to evaluate whether the dewatering is having the anticipated effect on groundwater levels and to evaluate the performance of the slurry wall (S&L 2014-TN3544). The review team anticipates that the proposed monitoring is appropriate to establish pre-dewatering baseline conditions to evaluate the adequacy of the control measures proposed for the ESWEMS pond excavation dewatering.

No monitoring of groundwater quality during building of the BBNPP is planned (PPL Bell Bend 2013-TN3377).

4.3 Ecology

This section describes the potential impacts on terrestrial and aquatic ecological resources from construction and preconstruction activities in the BBNPP project area, and from consumptive-use mitigation. The section is divided into two subsections: terrestrial and wetland impacts and aquatic impacts.

4.3.1 Terrestrial and Wetland Impacts

This section provides information about the site-preparation and development activities for the proposed new unit at the BBNPP site, including consumptive-use mitigation and related impacts on the terrestrial ecosystem. Topics discussed include impacts on habitat and associated direct and indirect impacts on wildlife, important species and habitats, avian collisions, building-related noise, traffic-related wildlife mortality, spill prevention and response, and erosion and sedimentation control.

4.3.1.1 Terrestrial Resources Impacts − Site and Vicinity

Impacts on Terrestrial Habitats

Site preparation would disturb an area of approximately 663 ac on the BBNPP site. As described by PPL (PPL Bell Bend 2013-TN3377), site-preparation and building activities would generally include the following:

- prominently marking vegetated areas that would be cleared and grubbed
- clearing vegetation by cutting or grubbing, and disposing of or recycling the resulting vegetative debris, or using it to enhance wildlife and fish habitat
- preserving aesthetically outstanding trees or clusters of trees, where practicable, in areas that would be cleared for temporary construction parking areas, construction office and warehouse area, and construction laydown areas
- installing erosion and sediment control devices according to a soil erosion and sediment control plan that would be approved by the Luzerne County Conservation District prior to site disturbance

- leveling the land by grading or filling
- excavating to install building and other structural foundations
- excavating, installing, and backfilling new water-intake and blowdown discharge pipelines and other station piping and utility connections
- disposing of spoil onsite, placing stockpiled soil outside 100-year floodplains, and stabilizing and covering stockpiles
- pouring concrete foundations and erecting buildings
- leveling new parking lots and internal roadways by grading or filling
- paving roadways and parking lots
- final grading and landscaping to permanently control erosion and runoff.

Terrestrial habitats in the BBNPP project area, which also includes most of Important Bird Area (IBA) No. 72, Susquehanna Riverlands Environmental Preserve (SREP), and the Wetlands Natural Area west of the North Branch Susquehanna River (Figure 2-26), are depicted in Figure 2-27 and described in Section 2.4.1.1. The proposed structures and affected areas are shown in Figure 3-1, and described in Sections 3.2 and 3.3. To the extent practicable, the construction footprint was designed to limit impacts on wetlands and forest, particularly large contiguous blocks of forest (PPL Bell Bend 2013-TN3377).

The footprint required for site development would affect approximately 663 ac (Figure 4-2). This estimated footprint accounts for permanent habitat loss, temporary habitat alteration, and permanent habitat conversion (mostly conversion of forest to open or scrub vegetation). In addition, approximately 0.2 ac on approximately 220 ft of the North Branch Susquehanna River shoreline would be disturbed to build the intake structure. The footprint includes approximately 204 ac in IBA No. 72 and 32 ac in the SREP (see Section 4.3.1.2). Features that would be developed in IBA No. 72 and SREP include surface-water-intake and wastewater-discharge-related facilities and pipelines, a temporary dewatering pond for river dredging, temporary laydown areas, switchyards, transmission-line corridors, the ESWEMS Retention Pond, the combined wastewater-retention pond, access roads, a railroad spur, and a small section of permanent parking. Portions of IBA No. 72 and the SREP overlap (Figure 2-27). Table 4-2 summarizes the acreages of terrestrial cover types that would be affected by permanent habitat loss, temporary habitat alteration (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3536).

Approximately 357 ac of the disturbed area would be permanently lost to structures, pavement, or other intensively maintained exterior grounds, or converted from forest to scrub or open land (Table 4-2). Approximately 306 ac of additional land would be temporarily disturbed for the batch plant, temporary sedimentation pond, dredge dewatering pond, topsoil disposal areas, installation of water-intake and blowdown pipelines, temporary offices, warehouses, parking and laydown areas, and other miscellaneous temporary construction features (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3536). This temporary loss includes approximately 55 ac in IBA No. 72 and 28 ac in the SREP. Temporarily affected acreage not containing permanent structures would be restored by grading and revegetating to the extent practicable, and then allowed to revert to a natural state (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3536).

The subsections below address potential impacts on individual habitats.

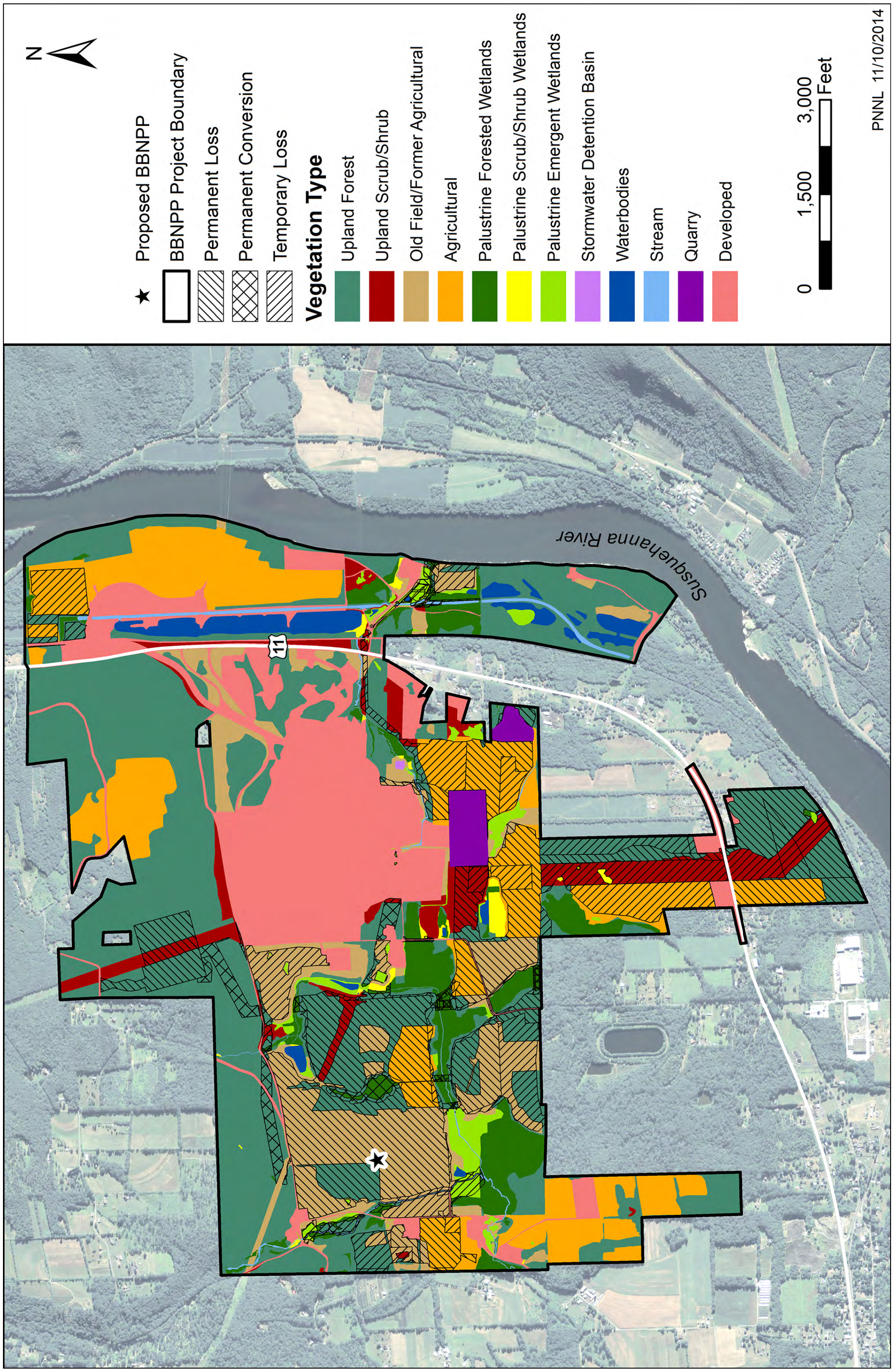

Figure 4-2. BBNPP Site Development Footprint Overlaid on Terrestrial Habitat Types (see Figure 2-25)

Table 4-2. Affected Acreage of Terrestrial Habitat Types in the BBNPP Project Area

Community Type	Permanent Losses (ac)	Temporary Losses (ac)	Permanent Conversions (ac)	Total Impacts (ac)
Upland Forest	148.0	49.0	25.2	222.2
Upland Scrub/Shrub	17.9	45.5	0.0	63.4
Old-Field/Former Agricultural	119.2	49.0	0.0	168.2
Palustrine Forested Wetlands(b)	0.51	0.0	9.0	9.5
Palustrine Scrub-Shrub Wetland(b)	0.0	0.0	0.0	0.0
Palustrine Emergent Wetland(b)	0.7	0.9	0.0	1.6
Total Impacts	286.3	144.4	34.2	464.9

(a) Impacts are on wetlands under the jurisdiction of USACE. Approximately 0.2 ac of non-jurisdictional isolated wetlands, not included in the table, would also be affected (PPL Bell Bend 2013-TN3377).

Upland Forest

Of the approximately 663 ac of terrestrial habitat subject to disturbance, approximately 222 ac are upland deciduous forest (Table 4-2). Approximately 148 ac would be permanently lost and approximately 25 ac permanently converted. Approximately half of the permanently lost forest would be in IBA No. 72 (Section 4.3.1.2). Areas of permanent conversion would be transformed from upland forest to upland scrub/shrub habitat. Merchantable timber within the construction footprint may be harvested prior to site preparation (PPL Bell Bend 2013-TN3377). Removal of trees greater than 5 in. diameter at breast height (DBH) would take place from November 16 through March 31 to protect the Indiana bat (*Myotis sodalis*) (see Section 4.3.1.3) (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533). The upland forest cover type is second growth deciduous forest, and although mid- to late-successional stands of this cover type are expanding in the Commonwealth, large contiguous blocks of forest are becoming scarce (PGC and PFBC 2005-TN3815). Large contiguous blocks of mid- to late-successional second growth deciduous forest are considered to be of relatively high value to forest interior wildlife (those requiring habitat conditions in the interior of large forests to breed successfully and maintain viable populations), especially to several bird species that are declining and are of conservation concern to the State (see Table 2-17 and Section 4.3.1.3). Areas of temporarily lost upland deciduous forest would be graded and re-vegetated (including replanting deciduous trees) and allowed to revert to their former forested condition. Revegetating using native plant species would reduce competition from invasive species (see Section 4.3.1.3) and facilitate forest succession. Nevertheless, depending on the age of the forest that is temporarily lost, succession to its former condition is uncertain and could require time ranging from several decades to more than a century. Temporary disturbance of upland deciduous forest should therefore be considered effectively permanent in the short-term, especially for use by forest interior wildlife. However, most such wildlife may be able to inhabit successional forests once they develop following a disturbance.

Upland Scrub/Shrub

Approximately 63 ac of the disturbance would be in the upland shrub/scrub cover type. No upland shrub/scrub would be permanently converted (Table 4-2). This habitat is patchy on the BBNPP project area and is found along onsite transmission lines and in several abandoned farm fields and is the result of secondary succession or transmission-line corridor maintenance. Approximately 18 ac of upland shrub/scrub would be permanently lost, approximately half this amount is in the IBA No. 72 (see Section 4.3.1.2) and the other half is in the BBNPP project area (Table 4-2) (PPL Bell Bend 2013-TN3377). The 18 ac would be offset by the 25.2-ac increase in upland shrub/scrub that would result from the permanent conversion of upland deciduous forest noted above. Approximately 45.5 ac of upland shrub/scrub would also be temporarily lost, mostly in the BBNPP project area (Table 4-2) outside the IBA No. 72 and SREP (see Section 4.3.1.2). Areas of temporarily lost upland shrub/scrub would be graded and re-vegetated and allowed to revert to their former condition. Revegetating would reduce competition from invasive species (see Section 4.3.1.3) and facilitate succession. Succession of temporarily disturbed areas back to upland shrub/scrub habitat (via replanting, regeneration from buried seed and root stock, and recolonization from seed transported from similar habitats on nearby lands) may require several years. Over subsequent decades succession would proceed from upland scrub/shrub to upland deciduous forest. Unlike the 45.5 ac of temporarily lost upland shrub/scrub that would eventually revert to upland deciduous forest, the 25.2 ac of new upland scrub/shrub that would result from permanent conversion of upland deciduous forest would be maintained as upland shrub/scrub via transmission-line and bridge right-of-way maintenance (see Section 5.3.1). In the region, the upland shrub/scrub cover type generally develops following abandonment of agricultural land or following clearcut timber harvest. According to the Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC), the shrub/scrub cover type is declining in the Commonwealth because forest harvest has not kept pace with forest maturation and because farmland has been abandoned and allowed to revert to forest. Shrub/scrub is considered to be of value to some wildlife species that are strongly associated with it, which are also declining, and which are of conservation concern to the State (PGC and PFBC 2005-TN3815).

Old-Field/Former Agricultural Land

Approximately 168 ac of the 663-ac footprint would take place in the old-field/former agricultural (old-field) cover type and would be permanently or temporarily lost. Approximately 119 ac of old field would be permanently lost, mostly in the BBNPP project area (Table 4-2) outside the IBA No. 72 and SREP (see Section 4.3.1.2). Approximately 49 ac of old-field would also be temporarily lost, approximately half this amount in the IBA No. 72 and the other half nearby in the BBNPP project area (PPL Bell Bend 2013-TN3377). Areas of temporarily lost old field would be graded and re-vegetated and allowed to revert to their former condition. Revegetating would reduce competition from invasive species (see Section 4.3.1.3) and facilitate succession. Succession of temporarily disturbed areas back to a grassland-type habitat may require 2 years. Over subsequent decades succession would proceed from a grassland-type habitat to upland deciduous forest. According to PGC and PFBC, agriculture habitats are declining in the Commonwealth because abandonment of farmland is outpacing its establishment. Old field is declining because old fields are being allowed to revert to forest. Old fields and small farms that are less intensively managed than larger farms provide a mix of open habitat, abandoned fields, hedgerows, and woods that provide food and cover to grassland wildlife species, some of which are declining and are of conservation concern to the State (PGC and PFBC 2005-TN3815).

Wetland Habitats

Impacts on wetland habitats are addressed below.

Wetland Fill and Conversion. To the extent practicable, PPL designed the footprint of disturbance to limit impacts on wetlands, especially forested wetland habitat (PPL Bell Bend 2013-TN3377). Building the proposed facilities would require impacts on approximately 11.1 ac of wetlands, including approximately 9.5 ac of palustrine forested (PFO) wetlands and 1.6 ac of palustrine emergent (PEM) wetlands. Of the 11.1 ac of wetland impacts, approximately 1.2 ac would be permanent fill, approximately 0.9 ac would be temporary fill, and approximately 9.0 ac would be permanent conversion from PFO to palustrine shrub-scrub (PSS) wetlands. The impacts noted here are to wetlands under jurisdiction of the Clean Water Act (33 USC 1251 et seq.-TN662) (jurisdictional wetlands). The project would also impact approximately 0.14 ac of wetlands not under Clean Water Act jurisdiction (non-jurisdictional or "isolated" wetlands) (PPL Nuclear Development 2011-TN3870).

As for forested uplands subject to disturbance, merchantable timber within affected PFO wetlands may be harvested prior to site preparation (PPL Bell Bend 2013-TN3377). Removal of trees greater than 5 in. DBH will be performed from November 16 through March 31 to protect the Indiana bat (see Section 4.3.1.3) (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533).

There would be no impacts on PSS wetlands (Table 4-2). A net increase in PSS wetlands would result from the 9.0 ac of permanently converted PFO wetlands described above, which would be maintained as PSS wetland habitat.

Both emergent and forested wetland types continue to decline in the Commonwealth, but emergent wetlands more in recent decades than forested wetlands, largely due to conversion to lakes, ponds, and reservoirs; channelization or draining for development; conversion to farmland; urban development; and succession to other vegetated wetland types (shrub/scrub and forested and wetlands) (PGC and PFBC 2005-TN3815). Both wetland types are considered to be of value to wildlife species that are strongly associated with them, which are also declining, and which are of conservation concern to the State (PGC and PFBC 2005-TN3815). The BBNPP project would incrementally contribute to these trends.

Wetland Avoidance and Minimization Measures. The Federal Clean Water Act (33 USC 1251 et seq.-TN662) and Pennsylvania 25 PA Code Chapter 105 (PA Code 25-105-TN1835) (Erosion and Sediment Control) require avoidance and minimization of impacts on aquatic habitat prior to provision of suitable compensatory mitigation for unavoidable impacts on wetlands. PPL has continuously re-examined its site plan to identify opportunities for reducing encroachment into jurisdictional wetlands and has redesigned the site plan multiple times to achieve the avoidance and minimization objectives of USACE. When PPL first approached USACE in June 2008, the site plan identified jurisdictional wetland impacts for approximately 100 ac. By September 2008, PPL had reduced those impacts to only about 38 ac. PPL further reduced jurisdictional wetland impacts to approximately 34 ac by April 2009, 27 ac by August 2009, and to only 11 ac in the present design (USACE 2014-TN4009).

General measures would be taken to minimize unavoidable adverse effects to wetlands. The use of silt fences, temporary and permanent vegetative stabilization, and other soil-erosion-control and sediment control practices would reduce the risk of sediment runoff into intact wetlands adjoining areas where wetlands would be filled, as well as wetlands located downstream of the project area (PPL Bell Bend 2013-TN3377).

Specific avoidance minimization measures include the following:

- Voluntary preservation of a 50-ft buffer around undisturbed wetlands and streams within the Walker Run watershed (PPL Bell Bend 2013-TN3377) and on the remainder of the site (PPL Bell Bend 2012-TN1173). The buffers are intended to maintain wildlife-travel corridors, provide interconnected foraging and breeding habitat and cover for wildlife, moderate water temperatures, and maintain stable streamside environments (PPL Bell Bend 2012-TN1173). Forested cover around wetlands is beneficial to wildlife, and has been shown to be an important predictor of mammalian and amphibian species diversity (PGC and PFBC 2005-TN3815).
- Fencing Exceptional Value Wetlands (see Section 2.4.1) with a silt fence/fiber log barrier around the perimeter of wetlands and, if these measures are inadequate, create a protective berm around wetlands using wood chips.
- Construction of several bridges for accessing the BBNPP site with lengths greater than the minimum required to achieve the necessary span, allowing the landings of bridges to avoid Exceptional Value Wetlands, 50-ft forested wetland buffers, and 100-year floodplain (and stream impacts), thereby reducing total impacts on only those associated with support pilings (PPL Nuclear Development 2011-TN1906; PPL Bell Bend 2013-TN3377).
- Alignment of structures and features associated with the intake structure to the smallest acceptable size.
- Location of laydown areas on open lands.
- Fencing wetlands located within temporary laydown areas during construction activities.
- Co-location of buildings and reconfiguration of roadways to minimal acceptable width.
- Adoption of low impact development practices, including siting stormwater discharges outside of wetlands and within heavily vegetated buffer areas, and reduction in impervious surfaces to reduce stormwater runoff.
- Use retaining walls to reduce side slope areas and establish useable uplands.
- Use gas-insulated switchgear, rather than air-insulated switchgear, to reduce the associated footprint by 60 percent in the switchyard.
- Use cofferdams during construction of intake and discharge structures to reduce sedimentation and turbidity in the Susquehanna River.
- Develop erosion and sediment control plans that meet 25 PA Code Chapter 102 (PA Code 25-102 -TN3998) requirements to reduce water-quality impacts on surface waters.

- Use subsurface infiltration beds to reduce the area required for surface stormwater basins and to regulate temperature and water quality entering wetlands (and streams) to reduce degradation of wetlands (PPL Bell Bend 2013-TN3377).

Mitigation action plans (BBNPP Mitigation Plan [PPL Nuclear Development 2011-TN1952]) for unavoidable impacts on wetlands, including compensatory mitigation incorporating restoration and preservation, for permanently or temporarily affected waters of the United States (e.g., wetlands and streams) within the jurisdiction of USACE has been developed and would be implemented by PPL according to conditions to be set forth in an individual Department of the Army permit issued by USACE and the associated Clean Water Act Section 401 water-quality certification issued by the PADEP. PPL's mitigation plan is described in Section 4.3.1.4. Site-specific BMPs also would be stipulated by the Department of the Army permit.

Impacts on Wetlands from Construction Dewatering. Construction of some BBNPP infrastructure would need to be completed under dry conditions and would thus require dewatering. Construction dewatering would be required for the power block (nuclear island) area, the ESWEMS pond area, and the area beneath the cooling towers. The site for the cooling towers and ESWEMS pond was sited to avoid permanent impacts on Exceptional Value Wetlands (PPL Nuclear Development 2011-TN2238). The power block, cooling towers, and ESWEMS pond are described in Section 3.2.2.

Groundwater elevations would be drawn down to below the deepest portion of each of the above three excavations with dewatering wells and/or sumps. The applicant has stated that construction dewatering for the power block would be minor and would not result in adverse impacts on wetlands (PPL Nuclear Development 2011-TN2238) because the shallow depth of the Glacial Outwash aquifer in that area of the BBNPP site will limit the horizontal extent of the affected groundwater (PPL Bell Bend 2013-TN3377). In contrast, dewatering required for the construction of the ESWEMS pond and cooling towers could be more extensive (PPL Nuclear Development 2011-TN2238). Excavation for the ESWEMS pond would require removal of 56 ft of overburden and weathered bedrock. Over 50 ft of groundwater depression would be required to ensure dry conditions. Approximately 235 to 310 gpm (S&L 2014-TN3544) (Section 4.2.1) would be removed from the excavation and stored in a two-cell holding pond where each cell has the capacity to hold 24 hours of pumped water. Overflow from the holding pond would be conveyed to Unnamed Tributary 1 via a culvert. The dewatering pumping rate would be only approximately 0.7 cfs; therefore, the overflow released to the channel of Unnamed Tributary 1 would not be great enough to cause substantial changes to the physical structure of the channels or flood associated wetlands. The holding pond would be 6 to 8 ft deep, and water would be drawn from the bottom to minimize thermal impacts (PPL Nuclear Development 2011-TN2238).

A flow barrier (e.g., slurry wall) (standard engineering practice for control of groundwater inflow to excavations) would be emplaced to reduce the horizontal and vertical extent of groundwater depression outside the ESWEMS pond excavation (PPL Nuclear Development 2011-TN2238). Nevertheless, groundwater elevation depression in the area surrounding the ESWEMS pond would occur over the life of the construction activities (up to 24 months). Based on PPL's modeling results (WBCNC 2011-TN1833), groundwater elevation depression could range from near zero to many feet of depression in nearby wetlands (PPL Nuclear Development 2011-TN2238). The estimated area of predicted groundwater depression in wetlands is depicted in Figure 4-3 and consists of approximately 5.6 ac. The affected area is (PPL Nuclear

Development 2011-TN2238) spread over the southern half of Wetland 11 and the western half of Wetland 12.3 (Figure 4-3), both Exceptional Value Wetlands (defined in Section 2.4.1.1) (LandStudies 2011-TN502). The extent of potential dewatering is unknown but could be as much as several feet. However, to provide a conservative estimate of potential impacts, it is assumed the affected extent of the wetlands depicted in Figure 4-3 would be completely drawn down in the absence of mitigation (Section 4.3.1.5).

Dewatering would temporarily impair the functions and values of Wetland 11 (3.63 ac) and Wetland 12.3 (13.10 ac) (See Figure 4-3). Wetland 11 is a PFO wetland and Wetland 12.3 contains primarily PFO wetlands, but also PSS and PEM wetlands. For both Wetland 11 and Wetland 12.3, provision of wildlife habitat is a principal function (defined in Section 2.4.1.1). For example, the northern long-eared bat (*Myotis septentrionalis*), which is proposed for listing as endangered under the Federal Endangered Species Act (16 USC 1531 et seq.-TN1010), was observed at Wetland 11 (LandStudies 2011-TN502). Potential impacts on these species from dewatering of Wetland 11 are discussed in Section 4.3.1.3. In addition, the wetlands are not isolated, but part of a larger system, particularly along Unnamed Tributary 1 (Figure 4-3). Thus, dewatering may result in displacement of general forested wetland wildlife in affected areas of both wetlands into the surrounding wetland system. Resources in adjacent wetland habitats, if suitable, may already be occupied by such species, and resources within them would then need to be partitioned among a greater number of individuals, which may lead to population declines.

Dewatering would also leave extensive areas in both wetlands, which were once open water, devoid of vegetation and open for colonization by vegetation adapted to more xeric conditions, including invasive plant species such as those described in Section 2.4.1.3. Once localized areas become colonized by invasive species, those species are then more likely to invade other nearby wetlands.

Groundwater discharge is also a principal function of Wetland 11. Impairment of this function would decrease groundwater discharge to Unnamed Tributary 2, a tributary to Walker Run (LandStudies 2011-TN502).

To avoid such potential impacts on vegetation, wildlife, and Unnamed Tributary 2, PPL has proposed a plan to monitor hydrology in the potentially affected wetlands and to mitigate hydrologic reductions when they occur via provision of supplemental water. PPL's proposed monitoring and mitigation plans are described in Sections 4.3.1.4 and 4.3.1.5, respectively. If PPL properly implements proposed monitoring and mitigation plans for the ESWEMS pond excavation as described, it is anticipated that there would be no loss in the wetland functions described above or other functions described in LandStudies (2011-TN502; PPL Bell Bend 2013-TN3377).

In contrast to the ESWEMS pond excavation, PPL does not plan to use a low-permeability barrier around the cooling-tower excavation, but acknowledges that a barrier may be required along the northwest portion of this excavation (PPL Bell Bend 2013-TN3377), depending on the depth of saturated glacial outwash sediments encountered (S&L 2014-TN3544). The review team estimated groundwater removal with use of a slurry wall at 70 gpm (Section 4.2.1). Thus, use of a barrier, if necessary, is anticipated to reduce the horizontal and vertical extent of groundwater depression (similar to the barrier in the ESWEMS pond excavation) in nearby wetlands associated with Walker Run (e.g., Wetland 4 in Figure 2-26).

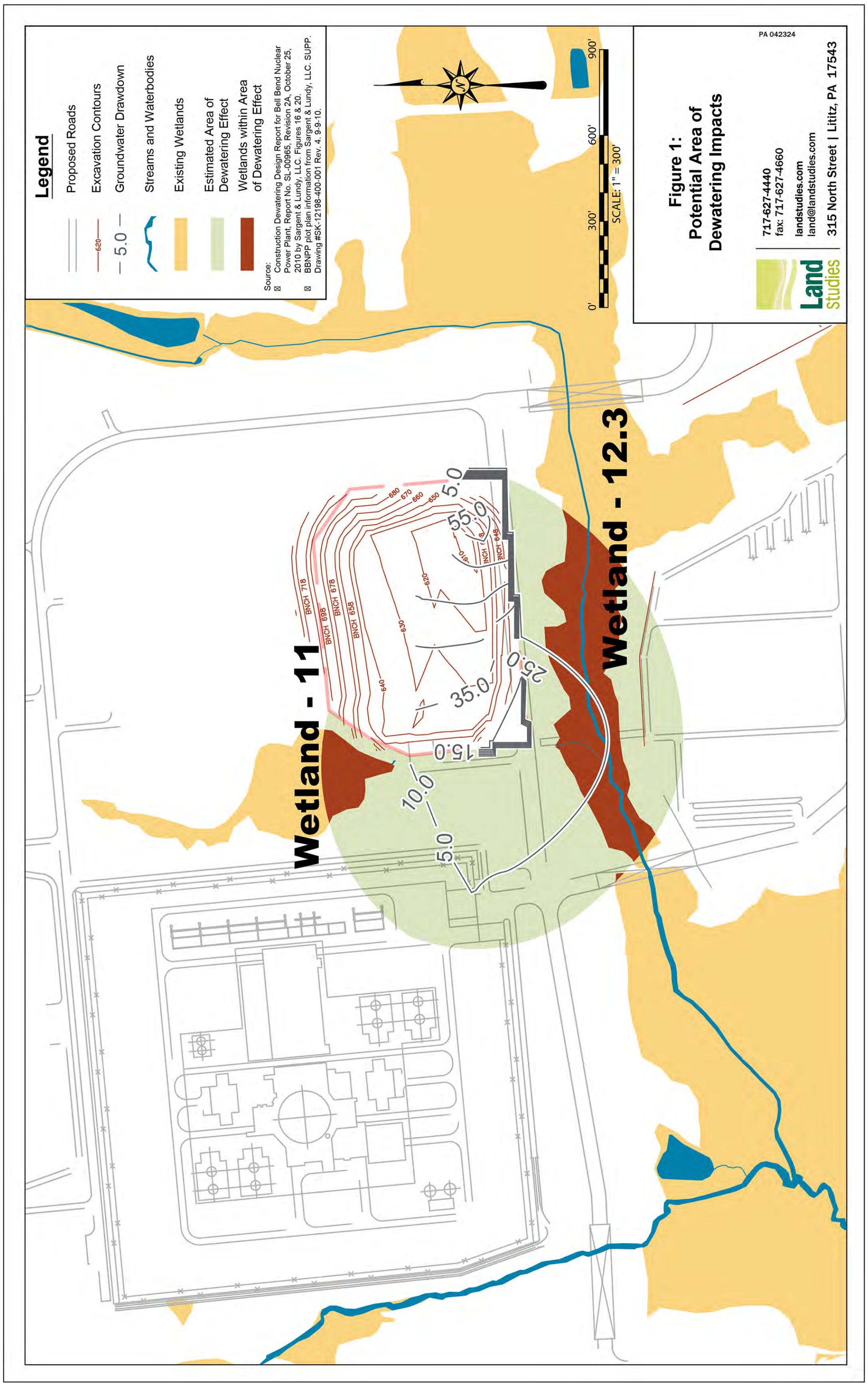

Figure 4-3. Area of Potential Wetland Drawdown that Could Result from Construction Dewatering of the ESWEMS Pond

The ESWEMS pond excavation would remove groundwater at a much greater rate (235 to 310 gpm (S&L 2014-TN3544) (Section 4.2.1) than the cooling-tower excavation (70 gpm [Section 4.2.1]). The wetlands associated with Walker Run are located a greater distance from the cooling-tower excavation (about 800 ft) than Wetlands 11 and 12.3 are located from the ESWEMS pond excavation (approximately 100 to 200 ft, respectively). In addition, the wetlands associated with Walker Run are fed by a greater volume of water (upstream of where they would be affected by groundwater removal by the cooling-tower excavation), than Wetlands 11 and 12.3 (upstream of where they would be affected by groundwater removal by the ESWEMS pond excavation). The Walker Run wetlands are fed by Walker Run whereas Wetlands 11 and 12.3 are fed by Unnamed Tributaries 1 and 2, respectively, which carry smaller water volumes than Walker Run. Thus, given the lesser groundwater removal rate, greater distance of potentially affected wetlands from the excavation, and the greater volume of water available from sources upstream of the potentially affected area, the review team anticipates that the Walker Run wetlands will be less affected by the cooling-tower excavation than Wetlands 11 and 12.3 will be from the ESWEMS pond excavation. Besides this likelihood, there is insufficient information to predict the horizontal and vertical extent of effects on Walker Run wetlands, if any, due to the cooling-tower excavation.

Impacts on Floodplains

As noted in Section 2.4.1.1, the majority of 100- and 500-year floodplains are situated along the Susquehanna River and Walker Run and its tributaries (Figure 2-26). Thus, the majority of wetland impacts described above also occur within the Susquehanna River and Walker Run floodplains. The wetland plant communities described in Section 2.4.1.1 also are representative of the majority of the floodplains that would be impacted in the BBNPP project area. Floodplains provide habitat for many terrestrial wildlife species that depend on riparian zones along rivers and streams.

Construction within the Walker Run watershed would affect approximately 0.4 ac of the 100-year floodplain and 1.8 ac of the 500-year floodplain. Construction within the Susquehanna River watershed would affect approximately 28.1 ac of the 100-year floodplain and 32.5 ac of the 500-year floodplain. The affected 500-year floodplain area include affected acreage for the 100-year floodplain. Floodplains would be affected by the installation of temporary and permanent facilities, associated grading and other earth disturbance work, and vegetation removal and management. Most construction impacts within the Susquehanna River floodplain would be temporary, except for the intake structure, which would be located in the 100-year floodplain. Most construction impacts within the Walker Run floodplain would be temporary, with the exception of a small section of roadway, bridge abutment, and yard area adjacent to the southwest corner of the BBNPP power block located in the 100-year floodplain. Grading impacts of the temporary construction parking area would also result in a permanent alteration of the Walker Run 500-year floodplain (PPL Bell Bend 2013-TN3377).

Potable Water Line

The 4,000-ft potable water line proposed to be built for BBNPP would be located within the margin of US 11 and the margin of Confers Lane between its origination in Berwick, Pennsylvania, to its terminus at the BBNPP site (PPL Bell Bend 2013-TN3545). The pipeline would not traverse wetlands, streams, or undeveloped habitats (PPL Bell Bend 2013-TN3545) and road margins are generally maintained devoid of vegetation.

Construction Impacts on Wildlife

Some wildlife present in the construction footprint would suffer direct mortality, disturbance, and displacement. As discussed previously, there would be no adverse impacts on upland shrub/scrub or PSS wetland habitat and, thus, no impacts on closely associated wildlife. In general, less-mobile animals (e.g., amphibians, reptiles, small burrowing mammals, and unfledged birds) would incur greater direct mortality than those that are more mobile animals (e.g., adult birds and large mammals). Disturbances below lethal levels may adversely affect wildlife behaviors (e.g., movement, feeding, sheltering, and reproduction). Because of PPL's attempts to minimize encroachment into wetlands and forests, potential impacts on associated wildlife have been concurrently reduced.

Wetland wildlife species (e.g., amphibian species) would be lost from construction impacts (including construction dewatering) in and around these wetland types. Riparian species would be lost from disturbance to habitats surrounding Walker Run and its tributaries and along the Susquehanna River. Forest interior wildlife (e.g., forest interior birds) and wildlife adapted to old-field/former agricultural habitats (e.g., avian grassland specialists) would be lost from disturbance to large contiguous tracts of such habitat (see evaluation of impacts on forest interior birds using the scarlet tanager [*Piranga olivacea*] as a representative species in Section 4.3.1.3).

However, some mobile wildlife in affected large blocks of contiguous upland forest and old-field/former agricultural habitat and forested and emergent wetlands may also disperse into similar habitats in nearby areas, where such habitats are available. Resources in adjacent similar habitats, if suitable, may already be occupied by such species, and would then need to be partitioned among a greater number of individuals, which may lead to competition resulting in increased predation, decreased fecundity, and population declines. In such cases, population declines may be permanent because, as noted above, there would be a net loss of upland deciduous forest, old-field/former agricultural habitat, and PEM wetland habitat types in the BBNPP project area. PFO wetland habitat would decline temporarily due to compensatory mitigation (see Section 4.3.1.4). However, there would be a substantial time lag in the creation of forested wetlands, which may not function as the original wetlands given the context of fragmented forest that would largely remain onsite following construction. Thus, wildlife that disperses from affected PFO wetlands may effectively also be considered lost.

Wildlife species adapted to discontinuous, patchy second growth upland forest cover (e.g., eastern wild turkey, white-tailed deer and black bear), or generalist species that occupy an interspersion of upland forest and open cover types (e.g., raccoons and opossums) could disperse into nearby similar areas. Wildlife species adapted to forest/clearing interface environments also may disperse into nearby edge habitats. Resources in adjacent similar habitats, if suitable, would likely already be occupied by such species, and would then need to be partitioned among a greater number of individuals, which may lead to population declines. However, the above habitat types would also be increased by forest fragmentation, providing areas into which populations of such species could later expand. In such cases, population declines may be temporary because there may not be a net loss of the above habitat types in the project vicinity.

According to PGC and PFBC, the most deleterious type of habitat loss results from permanent land-use change, which is the primary cause of wildlife species declines in Pennsylvania. Recent habitat loss in Pennsylvania has been due largely to the consumption of farmland and grassland habitats by development. Half of the state's wetlands (particularly emergent wetlands) have been lost and much of what remains is severely degraded. Despite regulation to protect wetlands, wetlands continue to be altered and lost. Created wetlands may not serve the same purpose or same function as natural wetlands, so wetland quality may continue to decline even if wetlands acreage remains the same (see Section 4.3.1.4). Wetland wildlife remains the most imperiled wildlife group in the Commonwealth. Mature forest (old growth, generally greater than 150 years) occupies less than 1 percent of forest habitat in the State. Early-successional second growth forest is lacking because forest succession has outpaced forest harvest and because of overbrowsing by white-tailed deer. Most of the forest habitat in the Commonwealth consists of mid- to late-successional second growth forest, and large contiguous blocks of such forest continue to decline (PGC and PFBC 2005-TN3815). Thus, impacts on wildlife strongly associated with emergent wetlands, forested wetlands, riparian, and old-field/former agricultural habitats, as well as forest-interior-dwelling species at the BBNPP site, would be expected to contribute to overall declines in such species in these habitats across the Commonwealth.

Perhaps equally deleterious as direct habitat loss is the indirect loss in quality of the remaining habitat due to fragmentation and isolation. According to PGC and PFBC (2005-TN3815), large amounts of mid- to late-successional second growth forest remain in the Commonwealth, along with forest-associated wildlife species adapted to such conditions (e.g., eastern wild turkey, white-tailed deer, and black bear) or generalist species that occupy an interspersion of second growth forested and open cover types (e.g., raccoons and opossums). However, wildlife species requiring large blocks of unfragmented second growth forest (e.g., forest-interior-dwelling birds), early-successional second growth forest, mature (old growth) forest, grasslands (e.g., species requiring low-intensity agricultural habitats, such as mosaics of thickets and open land [grassland birds have declined more than any other suite of birds]), and riparian forests are declining despite abundant mid- to late-successional second growth forest cover (PGC and PFBC 2005-TN3815).

According to PGC and PFBC, large contiguous blocks of second growth forest habitat may be lost via fragmentation. Fragmentation creates disjunct habitat patches that isolate wildlife communities from each other, impeding colonization of or use of areas that are required to satisfy life cycle requirements, and hindering gene flow between populations. Amphibian species richness is lower with greater isolation of wetlands. Connectivity is as important as habitat availability for maintaining amphibian populations. Corridors for dispersing amphibians, along rivers or streams, or through wooded areas are important for maintaining amphibian communities. Isolation can influence habitat quality by causing changes in temperature and moisture regimes or more commonly by influencing the abundance of competitors, predators, and brood parasites within a habitat patch. In addition, fragmented habitat is vulnerable to non-native invasive plants and animals that may encroach from disturbed edges and replace native species. More than one-third of all Pennsylvania plants are non-native. Invasion by non-native aggressive species is affecting the regeneration and long-term habitat quality of forestlands, wetlands, and grasslands. Thus, spatially and temporally, fragmentation impacts on animal and plant communities extend well beyond the area of direct habitat loss (PGC and PFBC 2005-TN3815).

Consequently, it is expected that fragmented habitats (i.e., those separated by permanent facilities or maintained in an early-successional condition or as landscaping), second growth upland deciduous forest (i.e., mostly fragmented upland forest would remain on the BBNPP site following construction [see Section 4.3.1.2 forest interior bird evaluation]), old-field/former agricultural habitat, PFO and PEM wetlands, and riparian habitats remaining on and adjacent to the BBNPP site (e.g., IBA No. 72 on the west side of the Susquehanna River) would be subject to the influences of fragmentation and isolation, and would have similarly reduced value for wildlife. This would especially be the case for the forest-interior-dwelling bird species noted in Section 2.4.1.1 and other species strongly associated with other habitats (e.g., avian grassland specialists in old-field/former agricultural habitats).

Impacts on Nesting Migratory Birds

Forest clearing and grubbing would be scheduled from November 16 through March 31 to protect the Federally endangered Indiana bat, which could potentially use the habitat for roosting during summer and early fall (see Section 4.3.1.3). Thus, only minor impacts on migratory birds nesting in forest habitat would be expected.

Avian Collisions. Migratory bird collisions with tall construction equipment are possible. Studies of avian collisions with elevated construction equipment are lacking in the literature. Communication towers are the structures most similar to elevated construction equipment (e.g., cranes) and that pose the greatest threat of collision mortality. The towers that appear to cause the most problems are tall, especially those that exceed 305 m (1,000 ft), are illuminated at night with solid or pulsating incandescent red lights, are guyed, are located near wetlands and in major songbird migration pathways or corridors, and have a history of inclement weather during spring and fall migrations (Kerlinger 2004-TN3871; Manville 2005-TN893). Published accounts of kills at short towers and other short structures are limited, and are usually associated with inclement weather and poor lighting (Manville 2005-TN893). Although the Susquehanna River lies near a principal inland route of the Atlantic Flyway that extends from southeastern to northwestern Pennsylvania (Bird and Nature 2014-TN3872), substantial migratory bird collisions with construction equipment is unlikely because of the equipment's relatively low stature, and being not guyed and unlit. Thus, migratory bird collision is not likely to be a substantial source of mortality.

Noise. Construction noise is typically generated by internal combustion engines (e.g., front-end loaders, tractors, scrapers/graders, heavy trucks, cranes, concrete pumps, and generators), impact equipment (e.g., pneumatic equipment, jackhammers, and pile drivers), and other equipment such as vibrators and saws (PPL Bell Bend 2013-TN3377). Noise can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense. However, it is not unusual for wildlife to habituate to noise (AMEC 2005-TN901; Larkin 1996-TN772). Attenuated noise levels from various types of construction equipment would range from approximately 73 to 102 dBA at 50 ft from the source and would be reduced to a range of approximately 43 to 72 dBA at 1,600 ft (PPL Bell Bend 2013-TN3377). The review team anticipates that some wildlife would avoid using areas within 220 ft of operating construction equipment (Bayne et al. 2008-TN898), where noise levels are expected to range from 60 to 89 dBA (PPL Bell Bend 2013-TN3377), mostly below the 80- to 85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1979-TN3873). Thus building activity noise is not likely to have noticeable effects on local wildlife.

Traffic. Building-related increases in traffic would likely be most obvious on the rural roads of Luzerne County, specifically U.S. Highway 11, a two-lane road that follows the Susquehanna River and provides access to the proposed BBNPP site (see Section 4.5.1.3). In addition, construction material would be delivered using a new three-lane access road that would be constructed connecting US 11 to the construction site (see Section 4.5.1.3). Currently, the average annual daily traffic count is estimated at 7,400 for the segment of US 11 nearest to the BBNPP site (PennDOT 2012-TN2040). During the peak construction period, the BBNPP workforce is expected to generate 3,039 daily trips to and from the project area (see Section 4.4.4.1). In addition, between 113 and 217 daily truck trips are projected to be scheduled during the peak construction period (see Section 4.4.4.1). The additional workforce and truck traffic would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if roadkill rates were to exceed the rates of reproduction and immigration. However, while roadkill is an obvious source of wildlife mortality and would likely increase during the peak construction period, except for special situations not applicable to the BBNPP (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998-TN2250). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on US 11 and the new three-lane access road during the peak construction period are expected to be negligible.

4.3.1.2 Terrestrial Resources Impacts − Associated Offsite Areas

Offsite Corridors

No new offsite transmission corridors would be needed to connect BBNPP to the existing electrical grid, and no other offsite facilities are proposed (PPL Bell Bend 2013-TN3377). Impacts on ecological resources of the project footprint on the BBNPP site, within which are located the two proposed onsite transmission-line corridors, the area onsite proposed for relocation of an existing transmission-line corridor, and the corridors proposed for a new onsite railroad spur and a new onsite plant access road, are discussed under Site and Vicinity (Section 4.3.1.1).

Consumptive-Use Mitigation

Some of the site-preparation and plant-building activities noted at the beginning of Subsection 4.3.1.1 would also be undertaken to expand the Rushton Mine water-treatment facilities for consumptive-use mitigation. Up to approximately 25 ac of old-field habitat (PPL Bell

Bend 2014-TN3536) within a previously disturbed area of more than 60 ac could be disturbed by expanding the existing Rushton Mine water-treatment facilities (which would approximately double their current spatial extent) to double their water-treatment capacity (PPL Bell Bend 2014-TN3536). Surrounding hardwood forest and wetland areas would be avoided (PPL Bell Bend 2014-TN3536) and applicable construction BMP and impact avoidance and minimization measures, such as those noted in Section 4.3.1.1 for the BBNPP site would be employed. The Rushton Mine outfall system may require some minor re-design (i.e., rip rap repair, weir repair, resizing of settling pond discharge culverts) to accommodate higher flows (PPL Bell Bend 2014-TN3539). Because these channel features are distant from natural terrestrial and wetland habitats (PPL Bell Bend 2014-TN3539), no noticeable impacts on such habitats from outfall system alterations are anticipated.

The review team does not expect that consumptive-use mitigation during BBNPP construction would result in noticeable terrestrial ecology impacts elsewhere.

4.3.1.3 Important Terrestrial Species and Habitats

This section describes the potential impacts on the important terrestrial species and habitats, described in Section 2.4.1.3. The construction footprint was designed to reduce impacts on potential habitat for important species (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2014-TN3536). The potential impacts of site preparation and development at the BBNPP site and at Rushton Mine (for consumptive-use mitigation) are described in the following section.

In a letter dated June 12, 2012, the NRC requested that the FWS Field Office in State College, Pennsylvania, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the BBNPP site (NRC 2012-TN3842). On March 14, 2013, FWS provided a response letter indicating that the Indiana bat was the only Federally listed, proposed, or candidate species known to occur in or near the BBNPP project area (FWS 2013-TN3847). A survey was conducted for the Indiana bat on the BBNPP site during the summers of 2008 and 2013, but was not captured (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828). Because the BBNPP site is located less than 10 mi from three winter hibernacula and contains suitable Indiana bat (roosting) habitat, the FWS assumes that the site is used by the species during the fall swarming period (FWS 2009-TN3868) (see Section 2.4.1.3). Since the response letter of March 14, 2013 (FWS 2013-TN3847), the FWS proposed listing the northern long-eared bat (*Myotis septentrionalis*) as endangered (78 FR 61046-TN3207). The northern long-eared bat is known to occur on the BBNPP site (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828). Summary discussions of impacts on these two bat species are discussed in this section. A more detailed assessment of impacts is provided in the biological assessment, which will be appended to this EIS.

By letter dated January 29, 2014, the NRC requested that the FWS Field Office in State College, Pennsylvania, provide a listing of Federally listed species and critical habitats in the vicinity of the Rushton Mine expansion area (part of consumptive-use mitigation), highlighted and labeled in Figure 2-10 (PNNL 2014-TN3983). In its February 25, 2014, response, FWS indicated that no Federally listed species or critical habitat occur in the vicinity (FWS 2014-

TN3968). Thus, the Rushton Mine expansion area, discussed in Section 2.4.1.2 is not discussed further here.

Federally Listed Species

Indiana Bat *(Myotis sodalis)* – Federal Endangered (FE)

Negative surveys for Indiana bats in summer 2008 and summer 2013 (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828) indicate that use of the BBNPP site by the species is unlikely during summer; however, summer use cannot be completely precluded. Further, it must be assumed that the species uses the BBNPP site for fall foraging, roosting, and swarming because it contains suitable habitat and occurs within a 10-mi radius of a winter hibernaculum occupied by the species (FWS 2009-TN3868). Approximately 222 ac of mature upland deciduous forest and approximately 11 ac of PFO wetlands would be lost or temporarily disturbed on the BBNPP site (Table 4-2). Loss, fragmentation, and isolation of suitable forest habitat would reduce the suitability of the remaining habitat for occupation by the species in either summer or fall. It would reduce the number of suitable roost trees and thus possible maternity and night roost sites. Fragmenting and isolating blocks of forest habitat reduce their suitability for use by the species. The species forages along forest edges and is unlikely to move great distances from the edge of occupied forest to either forage or use isolated forest patches (FWS 2007-TN934; Murray and Kurta 2004-TN3883). PPL agreed that removal of trees greater than 5 in. DBH located within 5 mi of the Indiana bat hibernacula at Glen Lyon Anthracite Mine and Dogtown Mine (Section 2.4.1.3) (includes all forest harvest on the BBNPP site) will be performed from November 16 through March 31 to protect the Indiana bat from potential mortality associated with direct impacts on possible maternity and night roost sites from April 1 through November 15, during the reproductive and swarming periods (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533).

A more detailed discussion of the above information on impacts on the Indiana bat is provided in the NRC's draft biological assessment in Appendix F of this draft EIS.

Northern Long-Eared Bat (*Myotis septentrionalis*) – Proposed Federally Endangered (PE)

The northern long-eared bat uses forest habitat to satisfy its life cycle requirements (see Section 2.4.1.3). Three adult male northern long-eared bats were captured during summer 2008 at three separate locations surrounding Wetland 11 (approximately 3.6 ac) (Figure 2-26 (PPL Bell Bend 2013-TN3377; LandStudies 2011-TN502; Normandeau 2011-TN490). Almost all the trees on approximately 3.5 ac at Wetland 11 would be permanently removed to accommodate new transmission lines that would cross the wetlands, converting the forested wetlands to a shrub/scrub wetlands over most of its entirety PPL Nuclear Development 2011-TN1906). The loss of the tree canopy would eliminate the area's potential utility to the species as roosting habitat.

Potential dewatering of Wetland 11 and Wetland 12.3 (13.10 ac) during construction of the ESWEMS pond (described in Section 4.3.1.1) (Impact L) (PPL Nuclear Development 2011-TN1906) could directly reduce the utility of these wetlands as foraging habitat for the northern long-eared bat by reducing insect production, and indirectly as a potential roosting area for the species.

One adult male northern long-eared bat was captured where Wetland 12.1 (13.97 ac) (north end) and Wetland 12.2 (10.31 ac) (south end) meet along the eastern tributary to Walker Run (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2011-TN490). A portion of 1.72 ac of permanent conversion of forested wetlands to shrub/scrub wetlands would occur at this location to accommodate new transmission lines that would cross the wetlands (PPL Nuclear Development 2011-TN1906). This would eliminate the area's potential utility to the species as roosting habitat.

PPL agreed that removal of trees greater than 5 in. DBH located within 5 mi of the Indiana bat hibernacula at Glen Lyon Anthracite Mine and Dogtown Mine (Section 2.4.1.3) will be performed from November 16 through March 31 to protect the Indiana bat from April 1 through November 15, which is the period during which reproduction and swarming occur (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533). These restrictions would also preclude disturbance of northern long-eared bats that may roost in trees greater than 5 in. DBH during summer and fall.

A more detailed discussion of the above information on impacts on the northern long-eared bat is provided in the NRC's draft biological assessment in Appendix F of this draft EIS.

State-Listed and State-Ranked Species

Bald Eagle (*Haliaeetus leucocephalus*) – State Threatened (ST)

The bald eagle has been observed in IBA No. 72 (Audubon and Cornell 2014-TN3582) and in the vicinity (Ecology III 1995-TN1782; Normandeau 2011-TN490), and is known to nest within 10 mi of the BBNPP project area (Normandeau 2011-TN490). Thus, bald eagles currently may roost and hunt and in the future could potentially nest in the BBNPP project area, most likely along the North Branch Susquehanna River, as the species is typically associated with relatively large bodies of water. The only impacts within the BBNPP project area that would occur along the river shoreline are associated with building the intake and discharge structures, which would only affect approximately 0.25 mi of shoreline (Figure 4-1). This area of river shoreline could readily be avoided by eagles seeking to nest, roost, or hunt during building activities, in favor of other areas along the river with less human presence or disturbance. Thus, no impacts on bald eagles are anticipated.

Eastern Small-Footed Myotis (*Myotis leibii*) – State Threatened (ST)

Although the eastern small-footed myotis is known from hibernacula within 5 mi of the BBNPP site (Dogtown Mine), there are no potential hibernacula on the BBNPP site (see Section 2.4.1.3). The species was not captured onsite during two summer mist-netting campaigns in 2008 and 2013 (see Section 2.4.1.3). Given that the species does not use the site during winter and is unlikely to use the site during the summer maternity period, it is unlikely that the species would be directly adversely affected by project-development activities.

However, because the species has been documented from hibernacula located within 5 mi of the project area (Section 2.4.1.3), it may use habitat in the project area outside of the maternity season (e.g., for foraging and roosting during fall swarming in the vicinity of hibernacula), which could be permanently removed, temporarily altered, or permanently converted to another habitat type during construction. Such habitat impacts could indirectly affect the species by disturbing foraging sites, and are anticipated to be minor since the species is assumed to forage of a much broader area in the vicinity of Dogtown Mine. Construction would also remove forest habitat in the project area that may be potentially suitable for fall roosting during swarming, or possible future use as maternity roost habitat, by removing trees with hollows or exfoliating bark that provide potential roost sites. Forest harvest would occur outside the active period of the Federally endangered Indiana bat (see above), which overlaps that of the eastern small-footed myotis. Consequently, such potential impacts on the eastern small-footed myotis would be indirect and are anticipated to be minor since the species is assumed to roost during fall swarming over a much broader area in the vicinity of Dogtown Mine. In addition, the species may also make use of bridges and various other non-natural roost sites (NatureServe 2014-TN3855), which lessens the severity of impacts on forest habitat suitable for roosting.

Osprey (*Pandion haliaetus*) – State Threatened (ST)

The osprey has been observed frequently in the project area in the SREP (Ecology III 1995-TN1782) and was observed recently in 2010 at Lake Took-A-While (Normandeau 2011-TN490). The species is known to nest within 10 mi of the BBNPP project area (Normandeau 2011-TN490). Thus, osprey may currently hunt and in the future could potentially nest in the BBNPP project area, along the North Branch Susquehanna River or other associated relatively larger bodies of water (e.g., 30-ac Lake Took-A-While or the 40-ft wide North Branch Canal [PPL Bell Bend 2013-TN3377]). The only construction impacts within the BBNPP project area that would occur along the river shoreline are associated with the intake and discharge structures, and would only affect approximately 0.25 mi of shoreline (Figure 4-1). This area of river shoreline could readily be avoided by osprey seeking to nest or hunt during construction, in favor of other areas along the river with less human presence and disturbance. Thus, no impacts on osprey are anticipated, and no mitigation in the form of nest structures is proposed.

Peregrine Falcon (*Falco peregrinus*) – State Endangered (SE)

A pair of peregrine falcons nested and raised young in 2007 and 2008 along the Susquehanna River at Council Cup Overlook, less than 2 mi from the BBNPP project area (Brauning 2007-TN3861; Normandeau 2011-TN490). A pair of peregrine falcons was nesting near the BBNPP site during recent bird surveys, and one observation of the species was made in the BBNPP project area in 2010 (Normandeau 2011-TN490). It is likely that the peregrines noted by Normandeau (2011-TN490) in 2010 were also using the nest site at Council Cup Overlook. Council Cup Overlook is located approximately 0.5 mi east of the BBNPP project area boundary and limit of disturbance (Figure 4-1).

Disturbance could result in nest or territory abandonment; exposure of eggs and/or young; egg breakage, ejecting eggs or young from the nest by a frightened or flushing adult; missed feedings of the young; and/or premature fledging of the young, resulting in injury or death. This is particularly the case if disturbance is obtrusive, irregular, and occurs within the territory defended around the nest site. In wild nest sites (as opposed to urban sites), peregrines defend an area that may extend 660 to 990 ft around a nest (ODOT 2000-TN2231). The western perimeter of such a nest territory centered at Council Cup Overlook would be located at least 0.25 mi east of where major land clearing would occur in the BBNPP project area. Thus, disturbance of peregrine falcons nesting at Council Cup Overlook by land clearing or other construction activities would be unlikely and no impacts are anticipated.

Other State-Listed and State-Ranked Bird Species

All other State-listed and most other State-ranked avian species listed in Table 2-17, besides the bald eagle, osprey, and peregrine falcon discussed above, use the project area for staging during migration. Eight of the State-ranked avian species listed in Table 2-17 have been observed in the project area during the nesting season and are assumed to nest there. The presence of the IBA No. 72 figures prominently in these species staging and nesting in the project area (see Section 2.4.1.3). These species could be affected during spring and fall migration and the breeding season by the decreased acreage of staging/nesting habitat (that provides food and cover resources and nest sites) associated with the habitat losses noted in Table 4-3.

Table 4-3. Affected Acreages of Terrestrial Habitat Types in the Important Bird Area Number 72 and the Susquehanna Riverlands Environmental Preserve

Community Type	Permanent Losses (ac)	Temporary Losses (ac)	Permanent Conversions (ac)	Total Impacts (ac)
Upland Forest				
IBA No. 72[(a)]	66.8	9.0	17.6	93.4
SREP[(a)]	0.3	6.2	0.0	6.5
Upland Scrub/Shrub				
IBA No. 72	9.1	1.9	0.0	11.0
SREP	0.0	0.1	0.0	0.1
Old-Field/Former Agricultural				
IBA No. 72	17.5	24.2	0.0	41.7
SREP	0.5	4.4	0.0	4.9
Palustrine Forested Wetlands[(a)]				
IBA No. 72	0.4	0.0	7.2	7.6
SREP	0.3	0.0	0.1	0.4
Palustrine Scrub-Shrub Wetland[(a)]				
IBA No. 72	0.0	0.0	0.0	0.0
SREP	0.0	0.0	0.0	0.0
Palustrine Emergent Wetland[(a)]				
IBA No. 72	0.74	0.7	0.0	1.4
SREP	0.74	0.7	0.0	1.4
Total Impacts				
IBA No. 72	94.5	35.8	24.8	155.1
SREP	1.8	11.4	0.1	13.3

(a) Impacts are on wetlands under the jurisdiction of the USACE. Approximately 0.2 ac of non-jurisdictional isolated wetland, not included in the table, would also be affected (PPL Bell Bend 2013-TN3377).

Species that stage in the project area during migration (Table 2-17) that could be affected by a loss of old-field/former agricultural habitats in the project area include the dickcissel (*Spiza americana* [endangered]), long-eared owl (*Asio otus* [threatened]), migrant loggerhead shrike (*Lanius ludovicianus migrans* [endangered]), northern harrier (*Circus cyanus* [threatened]), short-eared owl (*Asio flammeus* [endangered]), upland sandpiper (*Bartramia longicauda* [endangered]), common nighthawk (*Chordeiles minor* [vulnerable, S3B), purple martin (*Progne subis* [vulnerable, S3B]), and northern bobwhite (*Colinus virginianus* [critically imperiled, S1]). Species that likely nest in the project area (Table 2-17) that could be affected by a loss of old-field/former agricultural habitats include the golden-winged warbler (*Vermivora chrysoptera* [imperiled/vulnerable, S2S3B]).

Species that stage in the project area during migration (Table 2-17) that could be affected by loss of upland deciduous forest habitat include the yellow-bellied flycatcher (*Empidonax flaviventris* [endangered]), long-eared owl, northern goshawk (*Accipiter gentilis* [vulnerable, S3N, S2S3B]), whip-poor-will (*Caprimulgus vociferus* [vulnerable, S3B]), red-headed woodpecker (*Melanerpes erythrocephalu*s [vulnerable, S3N, S3B]), purple martin, and summer tanager (*Piranga rubra* [vulnerable, S3B]). Species that likely nest in the project area (Table 2-17) that could be affected by a loss of upland deciduous forest habitat include the barn owl (*Tyto alba* [imperiled/vulnerable, S2S3B]), golden-winged warbler, and Swainson's thrush (*Catharus ustulatus* [imperiled/vulnerable, S2S3B]).

Species that stage in the project area during migration (Table 2-17) that could be affected by impacts on wetland habitats include the American bittern (*Botaurus lentiginosus* [endangered]), black-crowned night heron (*Nycticorax nycticorax* [endangered]), black tern (*Chlidonias niger* [endangered]), great egret (*Ardea alba* [endangered]), least bittern (*Ixobrychus exilis* [endangered]), sedge wren (*Cistothorus platensis* [endangered]), green-winged teal (*Anas crecca* [vulnerable, S1S2B, S3N]), American coot (*Fulica americana* [vulnerable, S3N]), Wilson's snipe (*Gallinago delicata* [vulnerable, S3N]), common gallinule (*Gallinula galeata* [vulnerable, S3B]), pied-billed grebe (*Podilymbus podiceps* [vulnerable/apparently secure, S3B, S4N]), northern waterthrush (*Parkesia noveboracensis* [vulnerable, S3B]), purple martin, and prothonotary warbler (*Protonotaria citrea* [vulnerable/apparently secure, S2S3B]). Species that likely nest in the project area (Table 2-17) that could be affected by impacts on wetland habitats include the great blue heron (*Ardea Herodias* [vulnerable/apparently secure, S3S4B]), marsh wren (*Cistothorus palustris* [imperiled/vulnerable, S2S3B]), sora (*Porzana Carolina* [vulnerable, S3B]), and Virginia rail (*Rallus limicola* [vulnerable, S3B]).

The bank swallow (*Riparia* [vulnerable/apparently secure, S3S4B]), which nests in vertical soil faces such as cut banks onsite (Table 2-17), could be adversely affected by removal of such habitat wherever it occurs (e.g., in association with old-field/former agricultural areas, upland deciduous forest, or wetland habitats).

Impacts on avian species that stage or nest in old-field/former agricultural and upland deciduous forest habitats would likely be mostly permanent, as these areas will not be re-vegetated/reforested. In contrast, impacts on avian species that stage or nest in emergent wetland areas would likely be somewhat temporary. Approximately half of the impacts on emergent wetlands would be temporary (Table 4-3), which via regrading and reseeding are expected to become functional again within two growing seasons (see Section 4.3.1.1).

Impacts on avian species that stage or nest in forested wetland areas would likely be semi-permanent. Impacts on forested wetlands would be permanent and most consist of conversion to shrub/scrub wetlands (see Section 4.3.1.1). Impacts on forested wetlands would be compensated for via creation and enhancement of a greater acreage of forested wetlands than was disturbed (see Section 4.3.1.5). However, created or enhanced forested wetlands may require decades to attain a comparable level of functionality as those disturbed for the project.

Northern Cricket Frog (*Acris crepitans*) – State Endangered (PE)

The northern cricket frog was recorded in recent surveys at two locations, in Wetlands 4 and 7 (3.16 and 0.90 ac, respectively) (one location) and Wetland 10.3 (25.77 ac) along Walker Run, all of which are forested wetlands. The two locations are separated by approximately 0.5 mi (see Section 2.4.1.3) (LandStudies 2011-TN502; Normandeau 2011-TN490). Wetlands 4 and 7 are located in the Walker Run mitigation area, which consists of the temporary loss of these wetlands, relocation of the Walker Run stream channel, and creation and enhancement of forested wetlands (PPL Bell Bend 2010-TN3884). Impacts on existing Wetlands 4 and 7, stream relocation, and wetland creation/enhancement have the potential to cause direct mortality of reproducing cricket frogs during the breeding season, because both Wetlands 4 and 7 and Walker Run may be used for reproduction by the species and the species breeds communally (see Section 2.4.1.3). Impacts on existing Wetlands 4 and 7, stream relocation, and wetland creation/enhancement could also cause direct mortality of hibernating cricket frogs because tree harvest would occur from November 16 through March 31 (to protect the Indiana bat) (PPL Bell Bend 2012-TN1173) and hibernation occurs just below the ground surface near natal waters and is likely communal (see Section 2.4.1.3). Further, impacts on existing Wetlands 4 and 7, stream relocation, and wetland creation/enhancement could also indirectly affect the ability of the northern cricket frog to complete its life cycle at Wetlands 4 and 7 due to temporary destruction of breeding and overwintering habitat. Finally, the relocation of Walker Run could temporarily remove a dispersal corridor that links Wetlands 4 and 7 and Wetland 10.3.

Wetland 10.3 would not be directly affected by the Walker Run mitigation project, but could be indirectly affected by mitigation activities that would be located approximately 0.10 mi upstream. Because the species is likely to be more widely distributed on the BBNPP site than at these two locations along Walker Run (Normandeau 2011-TN490), it could thus also be adversely affected by development elsewhere onsite.

The Walker Run mitigation would result in a new stream channel to which Walker Run would be relocated and creation of 8 ac of forested wetlands and enhancement of 5.5 ac of forested wetlands between existing Wetlands 4 and 7 and Wetland 10.3 (PPL Bell Bend 2010-TN3884). These wetlands and the new stream channel for Walker Run (PPL Bell Bend 2010-TN3884) could eventually become colonized by cricket frogs from Wetland 10.3 (where the species would not be directly affected by the Walker Run mitigation project), or from other areas onsite where the species was not detected but may occur. Movements of northern cricket frogs between ponds as distant as 1.3 km have been recorded, and during and shortly after rain, the species may travel much greater distances (Kenney and Stearns 2013-TN3853). Thus, recolonization of the relocated Walker Run and created/enhanced wetlands may occur after conditions become suitable following the Walker Run mitigation.

Bobcat (*Felis rufus*) – State Vulnerable/Apparently Secure (S3/S4)

Bobcats are known to occur in the project area, and likely inhabit deciduous forest and brush thickets/hedge rows (Normandeau 2011-TN490). The impacts on upland deciduous forest and old-field/former agricultural habitat (which includes thickets/hedge rows) noted in Table 4-2 and discussed in Subsection 4.3.1.1 would likely only negligibly affect the bobcat's use of the project area and vicinity because of the species' large home range (Section 2.4.1) (NatureServe 2014-TN3855).

Northern River Otter (*Lontra canadensis*) − State Vulnerable (S3)

Northern river otters are known to have occurred in the Susquehanna Riverlands (Section 2.4.3.1) (PNHP 2006-TN1570). Otters, if present, would most likely occur in lowland marshes and swamps interconnected with meandering streams and small lakes (Hardisky 2013-TN3386). Impacts on wetlands and riparian areas onsite, where otters would most likely occur, if present, would likely not affect the species because it inhabits shoreline areas and a 50-ft riparian buffer would be left intact around wetlands and streams (Section 4.3.1.I). Riparian vegetation is an important habitat component for the species (Hardisky 2013-TN3386). Impacts, if any, would be small-scale and negligible because the species' home range typically includes only 20 to 30 mi of shoreline habitat (Hardisky 2013-TN3386).

Little Brown Myotis (*Myotis lucifugus*) – State Critically Imperiled (S1)

Two adult male and one pregnant female little brown myotis were captured during summer 2008 at two separate locations surrounding Wetland 11 (3.63 ac) (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2011-TN490). Almost all the trees (3.46 ac) at Wetland 11 would be permanently removed to accommodate new transmission lines that would cross the wetlands, converting the forested wetlands to a shrub/scrub wetlands over most of its entirety (PPL Nuclear Development 2011-TN1906). This action would eliminate the area's potential utility to the species as maternity roosting or night roosting habitat.

Potential dewatering of Wetland 11 and Wetland 12.3 (13.10 ac) during construction of the ESWEMS pond (described in Subsection 4.3.1.1) (Impact L) (PPL Nuclear Development 2011-TN1906) could directly reduce the utility of these wetlands as foraging habitat for the little brown myotis by reducing insect production, and indirectly as a potential maternity roosting or night roosting area for the species.

One adult male and three lactating female little brown myotis were captured where Wetland 12.1 (13.97 ac) (north end) and Wetland 12.2 (10.31 ac) (south end) meet along the eastern tributary to Walker Run. One lactating female also was captured at a separate but nearby location toward the northern end of Wetland 12.1 (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2011-TN490). A portion of 1.72 ac of permanent conversion of forested wetlands to shrub/scrub wetlands would occur at these two locations to accommodate new transmission lines that would cross the wetlands (PPL Nuclear Development 2011-TN1906). This action would reduce or eliminate the area's potential utility to the species as maternity roosting or night roosting habitat.

Tri-colored bat (*Perimyotis subflavus*) – State Critically Imperiled (S1)

Two adult pregnant females were captured onsite in July 2013 at Wetland 11 (3.63 ac) (Figure 2-26) (LandStudies 2011-TN502; Normandeau 2014-TN3828). Almost all the trees (3.46 ac) at Wetland 11 would be permanently removed to accommodate new transmission lines that would cross the wetlands, converting the forested wetlands to a shrub/scrub wetlands over most of its entirety (PPL Nuclear Development 2011-TN1906). This action would eliminate the area's potential utility to the species as maternity roosting or night roosting habitat.

In addition, potential dewatering of Wetland 11 and Wetland 12.3 (13.10 ac) during construction of the ESWEMS pond (described in Subsection 4.3.1.1) (Impact L) (PPL Nuclear Development 2011-TN1906) could directly reduce the utility of these wetlands as foraging habitat for the tri-colored bat by reducing insect production, and indirectly as a potential maternity roosting or night roosting area for the species.

Eastern Hognose Snake (*Heterodon platirhinos*) – State Vulnerable (S3)

The eastern hognose snake ranges over much of the eastern United States and is expected to occur locally (Normandeau 2011-TN490). However, habitat on the BBNPP site is described as marginally suitable for the species because of limited sandy soils and a relatively low abundance of toads (see Subsection 2.4.1.3). The species, if present, could be affected by the disturbance of old-field/former agricultural habitat (including thickets/hedgerows) and upland deciduous forest noted in Table 4-2 and discussed in Section 4.3.1.1. Nevertheless, because the habitat is marginally suitable and the species uncommon, if present at all (it was not observed onsite in recent surveys [Normandeau 2011-TN490]), the species would be unlikely to be more than negligibly affected over the locale of the BBNPP site where it is expected to occur.

Eastern Ribbon Snake (*Thamnophis sauritis*) – State Vulnerable (S3)

The eastern ribbon snake ranges over the eastern seaboard of the United States from Canada to Florida, and is known from Luzerne County (PNHP 2014-TN3885). One adult of the species was observed in recent surveys of the BBNPP site at the north end of Wetland 10.2 (4.22 ac) along Walker Run north of the confluence of its eastern tributary (Figure 2-26) (Normandeau 2011-TN490). Wetland 10.2 is mostly a PEM wetland (LandStudies 2011-TN502) and is located in the Walker Run mitigation area (PPL Bell Bend 2010-TN3884). Mitigation consists of the temporary loss of these wetlands, relocation of the Walker Run stream channel, and creation and enhancement of forested wetlands (PPL Bell Bend 2010-TN3884). These activities have the potential to cause direct mortality of the ribbon snake during the breeding season or hibernation, as the species inhabits shoreline areas and consumes amphibians and fish and may hibernate on land in burrows or underwater (NatureServe 2014-TN3855).

Eastern Box Turtle (*Terrapene carolina carolina*) – State Vulnerable/Apparently Secure (S3/S4)

Four adult eastern box turtles were observed at four widely spaced locations over the limit of disturbance on the BBNPP site, on the margins of open fields near wetlands and streams and upland forest (Normandeau 2011-TN490). Because the species is terrestrial and a habitat generalist, it is assumed to occur commonly over the site and surrounding landscape. Thus, it would be affected by land disturbance impacts in a variety of habitats (Table 4-2), including impacts on old-field/former agricultural habitats, upland deciduous forest, and wetlands. Impacts would likely consist of direct mortality. Impacts would likely be minimal because of the availability of other suitable habitat nearby.

Northern Leopard Frog (*Lithobates pipiens*) – State Imperiled/Vulnerable (S2/S3)

The northern leopard frog was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), but not in recent surveys of the BBNPP site (Normandeau 2011-TN490). Northern leopard frogs potentially occur onsite because there is ample suitable habitat (see Section 2.4.1.3). If present, the species would be affected by impacts on wetlands, which provide breeding and hibernation sites (see Section 2.4.1.3).

Spotted Turtle (*Clemmys guttata*) – State Vulnerable (S3)

The spotted turtle was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036), but not in recent surveys of the BBNPP site (Normandeau 2011-TN490). Spotted turtles should be considered to potentially occur onsite because there is ample suitable habitat (see Section 2.4.1.3). If present, the species would be affected by impacts on wetlands, which provide habitat for growth, maturation, hibernation, and uplands which provide nesting sites (see Section 2.4.1.3).

Wood Turtle (*Glyptemys insculpta*) – State Vulnerable/Apparently Secure (S3/S4)

The wood turtle was observed during the 1972 and 1973 surveys for SSES (PPL 1978-TN4036) and two to four adults were observed in recent surveys of the BBNPP site near Walker Run north of the confluence of its eastern tributary and along Beach Grove Road approximately 0.5 east of the northwest corner of the BBNPP site (Normandeau 2011-TN490). Wood turtles were also observed anecdotally by landowners for a number of years at the northwest corner of the BBNPP site near where Beach Grove Road crosses Walker Run (Normandeau 2011-TN490). The wood turtle is primarily an aquatic species and would thus be affected by impacts on wetlands and streams which the species inhabits during much of the year, and which provide nesting sites such as sandy banks or sand-gravel bars (NatureServe 2014-TN3855). Walker Run mitigation (PPL Bell Bend 2010-TN3884) consists of relocation of the Walker Run stream channel, and creation and enhancement of forested wetlands (PPL Bell Bend 2010-TN3884) in the area of most of the wood turtle observations. These activities have the potential to cause direct mortality of the wood turtle during the breeding season or hibernation, as the species inhabits shoreline areas and consumes amphibians and fish and may hibernate on land in burrows or underwater (NatureServe 2014-TN3855). However, the Walker Run mitigation may in the long-term provide greater quality and quantity of stream and wetland habitat for wood turtles. The species also would be affected by impacts on old-field/former agricultural and upland forest habitats, which the species moves through (within 300 m of water) during summer and which provide nesting sites in areas of disturbances such as road grades, railroad grades, and sand pits (NatureServe 2014-TN3855). Impacts on crop lands are discussed in Section 2.2.2, which could also affect wood turtles, as plowed fields also provide nesting sites (NatureServe 2014-TN3855).

Baltimore Checkerspot (*Euphydryas phaeton*) – State Vulnerable (S3)

Although the Baltimore checkerspot was not observed on the BBNPP site during surveys conducted in July 2008 (Normandeau 2011-TN490), it was observed there previously in 1999 (see Section 2.4.1.3) (PNHP 2006-TN1570). Therefore, because suitable habitat (i.e., wetland and upland habitats where caterpillar and/or adult food plants occur) is present (see Section 2.4.1.3) (Normandeau 2011-TN490), the species could occur on the BBNPP site. Thus, the species could be adversely affected by a loss of wetland and upland habitat, but especially emergent wetland habitat (because the species is expected to use wetlands more than uplands on the BBNPP site [see Section 2.4.1.3] [PDCNR 2013-TN3886] and some wetland impacts would be to emergent wetlands [Table 4-2]), likely containing caterpillars and/or adult host plants. However, impacts are anticipated to be minor and short in duration because of voluntary mitigation proposed by PPL, as described in Section 4.3.1.4, and because temporarily affected emergent wetlands (Table 4-2) are anticipated to recover within 1 to 2 years (PPL Nuclear Development 2011-TN2238).

Mulberry Wing (*Euphydryas phaeton*) – State Vulnerable (S2)

Although the mulberry wing was not observed on the BBNPP site during surveys conducted in July 2008 (Normandeau 2011-TN490), it was observed there previously in 1997 (see Section 2.4.1.3) (PNHP 2006-TN1570). Therefore, because suitable habitat (i.e., wetland habitat, and especially emergent wetland habitat, where caterpillars and/or adult food plants occur) are present (see Section 2.4.1.3) (Normandeau 2011-TN490), the species could occur on the BBNPP site. Thus, the species could be adversely affected by a loss of wetland habitat, and especially emergent wetland habitat (Table 4-2), containing caterpillars and/or adult host plants. However, impacts are anticipated to be minor and short in duration because of voluntary mitigation proposed by PPL, as described in Section 4.3.1.4 (which would establish host plants for the species), and because temporarily affected emergent wetlands (Table 4-2) are anticipated to recover within 1 to 2 years (PPL Nuclear Development 2011-TN2238).

Black Dash (*Euphyes conspicua*) – State Vulnerable (S3)

A total of 10 to 12 black dash butterflies were observed in marsh habitat on the BBNPP site during surveys conducted in July 2008 (Normandeau 2011-TN490). Impacts would likely occur in affected emergent wetland habitats (Table 4-2) where larval food plants (sedges) occur, and secondarily in affected forested wetlands where adult food plants are found (see Section 2.4.1.3). However, impacts are anticipated to be minor and short in duration because of voluntary mitigation proposed by PPL for the mulberry wing that would also benefit the black dash, as described in Section 4.3.1.4 (which would establish host plants for the species), and because temporarily affected emergent wetlands (Table 4-2) are anticipated to recover within 1 to 2 years (PPL Nuclear Development 2011-TN2238).

Silver Bordered Fritillary (*Boloria selene myrina*) – State Vulnerable (S3)

The silver bordered fritillary was observed in marsh habitat on the BBNPP site during surveys conducted in July 2008 (Normandeau 2011-TN490). Impacts would likely occur in affected emergent wetland habitats where larval food plants (violets) occur (see Section 2.4.1.3).

Impacts are anticipated to be minor and mostly temporary because only approximately 0.7 ac of emergent wetland habitat would be permanently affected (Table 4-2), and because temporarily affected emergent wetlands (Table 4-2) are anticipated to recover within 1 to 2 years (PPL Nuclear Development 2011-TN2238).

Important Terrestrial Habitats

State-Ranked Ecological Associations

Herbaceous Vernal Pools – State Vulnerable/Apparently Secure (S3S4). The Wetlands Natural Area (described in Section 2.4.1.3) contains vernal pools (described in Section 2.4.1.3) of unknown extent and number (PPL Bell Bend 2013-TN3377). The vernal pools would not be affected by the BBNPP project or by the Riverlands Mitigation project (PPL Bell Bend 2014-TN3494).

Red maple (*Acer rubrum*)-Black Gum (*Nyssa sylvatica*) Palustrine Forest – State Vulnerable/Apparently Secure (S3S4). The PFO wetlands on the BBNPP site are described in Section 2.4.1.1, much of which is representative of the red maple-black gum PFO community type, one of the naturally occurring broadleaf PFO types in Pennsylvania (PNHP 2014-TN3885; Fike 1999-TN3816). This community type on the BBNPP site would likely be affected, but minimally so (9.5 ac [Table 4-3]) relative to the 112.8 ac available onsite (see Section 2.4.1.1), as the project was designed to avoid impacts on wetlands, particularly forested wetlands (PPL Bell Bend 2013-TN3377).

Wildlife Sanctuaries, Refuges, and Preserves

Pennsylvania State Game Lands. There are two State Game Lands in the 6-mi vicinity of the BBNPP site (Section 2.4.1.3). Because there are no State Game Lands intersected by proposed offsite project activities (Section 2.4.1.2), there would be no potential impacts on Pennsylvania State Game Lands.

Susquehanna Riverlands IBA No. 72. IBA No. 72 spans both sides of the North Branch of the Susquehanna River (Figure 2-27). IBA No. 72 harbors high numbers of forest and thicket bird species. A total of 19 species of neotropical migratory birds considered forest interior breeders likely nest in IBA No. 72 (see Section 2.4.1.3). Most of 39 State-listed/State-ranked bird species use IBA No. 72 as migrant stopover habitat (see Section 2.4.1.3). Only part of IBA No. 72 west of the North Branch of the Susquehanna River would be directly affected by the project. Habitat impacts within IBA No. 72 would total approximately 155 ac, 116 ac of which would be permanent impacts on upland deciduous forest (lost to structures, pavement, or other intensively maintained exterior grounds, or converted from forest to scrub or open land) (Table 4-3). Permanent impacts on PFO wetlands would also occur in IBA No. 72 (7.6 ac [Table 4-3]). Of all the habitat impacts (Table 4-3), these wetland impacts likely would have the greatest effect on avian use of IBA No. 72. Impacts on birds within IBA No. 72 are expected to be similar to those described for the overall project area. Impacts on forest interior birds are described below. Impacts on State-listed/State-ranked bird species were described previously. The project is not expected to affect avian use of IBA No. 72 east of the river.

Susquehanna Riverlands Environmental Preserve. The SREP spans both sides of the North Branch of the Susquehanna River and on the west side is overlapped almost entirely by IBA No. 72 (Figure 2-27). Thus, most of the habitat impacts occur in IBA No. 72 (Table 4-3) and the remainder of the project area outside of the SREP (Table 4-2). Most of the few habitat impacts that would occur in the SREP would be temporary (Table 4-3). Thus, most of the impacts on forest interior birds and State-listed/State-ranked bird species referred to above would occur in IBA No. 72 and the remainder of the project area outside of the SREP.

Wetlands Natural Area. The Wetlands Natural Area is located in the southernmost portion of the SREP on the west side of the North Branch of the Susquehanna River (Figure 2-27). The project was designed to avoid impacts on wetlands (PPL Bell Bend 2013-TN3377) and would not encroach into the Wetland Natural Area.

Landscape-Scale Conservation Area – North Branch of the Susquehanna River Corridor. The North Branch of the Susquehanna River and its adjacent forested watersheds comprise a major corridor for the movement of wildlife in Pennsylvania (PEC 2004-TN3979; PNHP 2006-TN1570). Large unfragmented forest blocks, such as the IBA No. 72, in close proximity along the river serve as natural corridors for species movement within and through Luzerne County (PNHP 2006-TN1570). The river floodplain and associated wetlands generally contain more of the region's important biodiversity than the adjoining uplands (PNHP 2006-TN1570). Impacts on the North Branch of the Susquehanna River floodplain would occur primarily around the intake and discharge structures and would affect approximately 0.25 mi of shoreline. This would not likely pose a substantial obstruction or hindrance to the migratory or local movements of wildlife along the river shoreline and floodplain, nor would it be expected to have any noticeable effect on local biodiversity. However, the habitat impacts in IBA No. 72 and the remainder of the project area described above, all of which lie within approximately 1.5 mi of the North Branch of the Susquehanna River (but mostly away from the river shoreline), may have a noticeable effect on the migratory or local movements of wildlife and regional biodiversity in the river corridor outside the immediate river environs.

State Parks

There are two State parks within 15 mi of the BBNPP site (Section 2.4.1.3). Because there are no State parks intersected by proposed offsite facilities (Section 2.4.1.2), there would be no potential impacts on Pennsylvania state parks.

Ecologically Important Species

Scarlet tanager (*Piranga olivacea*) and Other Forest Interior Birds

Rosenberg et al. (1999-TN2046) studied the effects of forest fragmentation on breeding scarlet tanagers, and provided empirical relationships between forest cover and patch size, and breeding habitat suitability. These relationships have been quantified for the Appalachian region (Rosenberg et al. 1999-TN2045), which includes the BBNPP site. These metrics are used to evaluate the effects of forest fragmentation that would occur on the BBNPP site on the scarlet tanager, and by extension on other co-occurring forest interior bird species (see Sections 2.4.1.1 and 2.4.1.3). This evaluation is relevant to the effects of forest fragmentation on IBA No.

72, approximately half of which is located on the BBNPP site (see Section 2.4.1.3), and which is important to forest interior bird conservation in the region (see Section 2.4.1.3).

Rosenberg et al. (1999-TN2045) reported that, in the Appalachian region, breeding tanagers do not show area sensitivity until the percentage of forest cover in a 2,500-ac block declines to 40 percent (i.e., within a 2,500-ac block that is 50 percent or more forested all sizes of forest patches are equally suitable for breeding). At 40 percent cover, forest patches of at least 25 ac are highly suitable, patches from 4 to 25 ac moderately suitable, and patches less than 4 ac provide low suitability. At 30 percent cover, forest patches of at least 148 ac are highly suitable, forest patches from 26 to 148 ac moderately suitable, forest patches from 4 to 26 ac provide low suitability, and forest patches less than 4 ac are unsuitable (Rosenberg et al. 1999-TN2045).

The potential effects of forest removal and fragmentation on the BBNPP site on breeding scarlet tanagers and other forest interior birds were evaluated using geographic information system (GIS) information. The BBNPP project area (2,055 ac) was extended to approximately 2,500 ac by including the land areas within the gap between the two southern portions of the site along the Susquehanna River and within a notch in the site boundary located north of SSES. Total forest cover over the approximate 2,500-ac area was determined using the PFO wetlands and upland forest categories from PPL's plant community survey GIS layer (Figures 2-1 and 2-1) (Normandeau 2011-TN489) and U.S. Department of Agriculture Farm Service Agency (PASDA 2010-TN4011) aerial photography for the remainder of the approximately 2,500 ac not covered by Normandeau (2011-TN489). PPL's disturbance GIS layer was overlaid to project removal of affected forest parcels by the BBNPP project. Total forest cover and the number and size (i.e., suitability) of forest parcels within the 2,500-ac area before and after disturbance are summarized in Table 4-4 and Table 4-5. The size (i.e., suitability) of each forest parcel located within the 2,500-ac boundary before and after disturbance was determined by including only areas of connected forest.

Table 4-4. Forest Cover and Number of Parcels before and after Disturbance in the 2500-ac Area

Category	Acres	Cover (%)	Number of Parcels
Total	2500.2	---	---
Forest before disturbance	1090.7	43.6	43
Disturbance	234.5	9.4	---
Forest after disturbance	856.0	34.2	60

Table 4-5. Forest Parcel Size, Suitability, Number, and Acreage before and after Disturbance in the 2500-ac Area

	Before Disturbance			After Disturbance		
Parcel Size (ac)	Suitability	Number Parcels	Sum of Acres	Suitability	Number Parcels	Sum of Acres
0 to 3.9	Low	17	22.7	Unsuitable	32	45.6
4 to 25.9	Moderate	17	218.6	Low	22	241.5
26 to 147.9	High	8	623.8	Moderate	5	352.2
≥148	High	1	225.6	High	1	216.6
Total	---	43	1090.7	---	60	856.0

Disturbance lowered the forest cover in the 2,500-ac area by approximately 10 percent, from approximately 40 percent cover to approximately 30 percent cover (Table 4-4) and increased the number of forest parcels (of any size) by approximately 40 percent (Table 4-4). There was only one high suitability forest parcel covering about 217 ac following disturbance compared to 9 parcels before disturbance covering about 849 ac (Table 4-5 and Figure 4-4). Thus, much of what was of high suitability before disturbance became moderately suitable, of low suitability, or unsuitable after disturbance (Table 4-5). There were no unsuitable forest parcels before disturbance but 32 following disturbance (Table 4-5). Thus, removal of approximately 10 percent of the forest substantially reduced the suitability of much of the remaining forest across the 2,500-ac area. This is anticipated to noticeably reduce occupancy of the BBNPP site and IBA No. 72 by scarlet tanagers and other associated forest interior birds, particularly on the west end where the majority of the disturbance would occur (Figure 4-3). It is likely (but uncertain as to what extent) that IBA No. 72 influences occupancy of the surrounding landscape by forest interior birds (e.g., suitable habitat within IBA No. 72 connected to suitable habitat in the surrounding landscape). Thus, it is likely that disturbance effects in IBA No. 72 would be noticeable in the 6-mi vicinity (e.g., disturbance of suitable habitat within IBA No. 72 affecting the use of suitable habitat to which it is connected in the surrounding landscape), but it is unclear to what extent.

White-Tailed Deer (*Odocoileus virginianus*)

White-tailed deer are ubiquitous and abundant in the project area (PPL Bell Bend 2013-TN3377). The effects of overbrowsing (described in Section 2.4.1.3) were not addressed in the 2008 mammal surveys (Normandeau 2011-TN490). The white-tailed deer is an edge species that benefits from greater interface between forest and open areas and tolerates human presence. Forest fragmentation and greater edge habitat on the BBNPP site would result from the project (Tables 4-2 and 4-3). These changes are expected to increase the suitability of the project area for white-tailed deer, notwithstanding increased human presence. It is uncertain whether this would result in a local population increase (i.e., due to other unaccounted for population limiting factors, such as hunter numbers, numbers of natural predators, and disease) and whether that would lead to a noticeable increase in overbrowsing in the project area and its effects (e.g., suppressed forest regeneration and succession and loss of forest structure, changes in abundance and diversity of flora and fauna, and decreased abundance of forest understory-dependent avian species).

Commercially and Recreationally Important Species

White-Tailed Deer

As noted above, the suitability of the BBNPP project area for white-tailed deer would be expected to increase as a result of forest fragmentation and the associated increase in abundance of edge habitat.

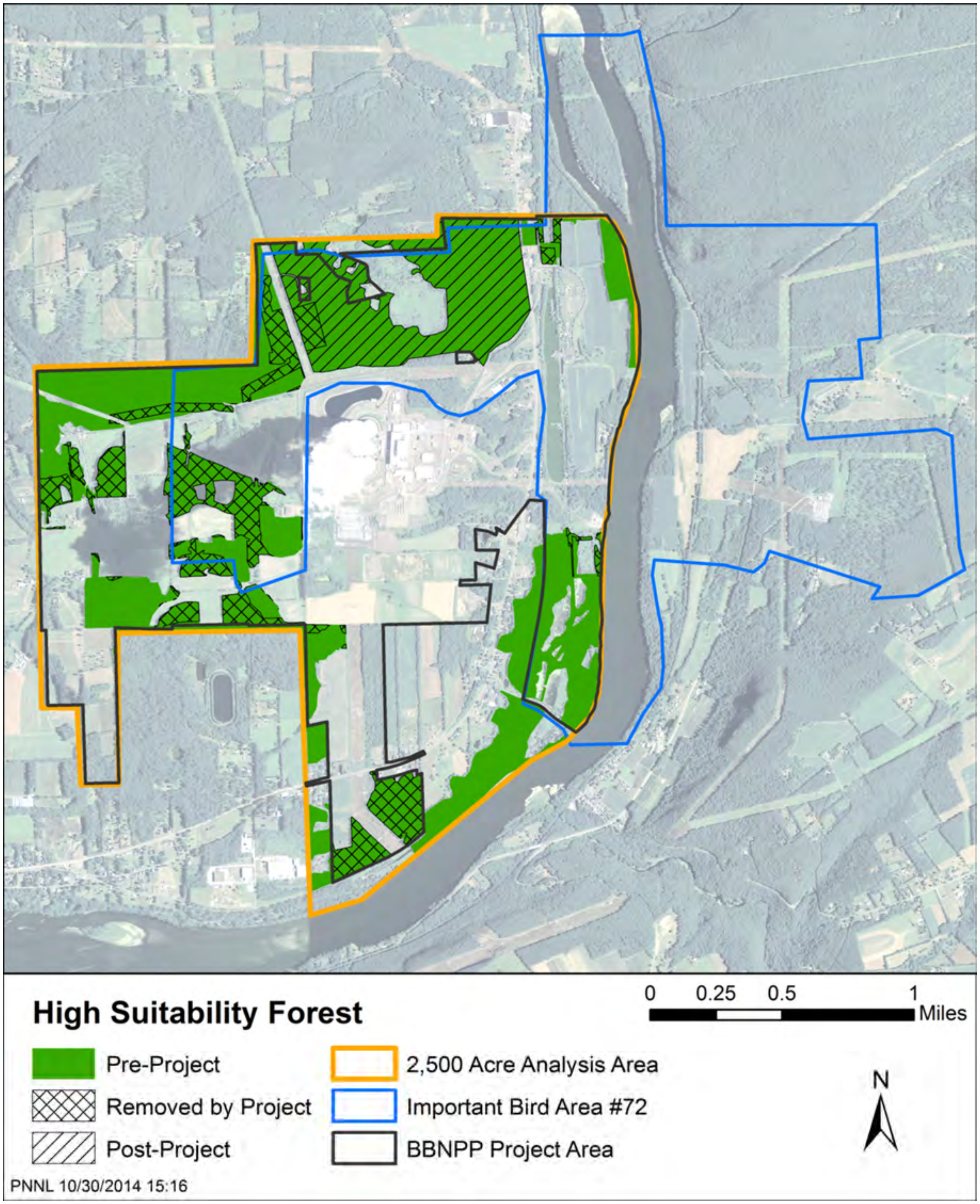

Figure 4-4. High Suitability Forest Cover before and after Disturbance in a 2,500-ac Area Encompassing the BBNPP Site.

Black Bear (*Ursus americanus*)

Black bear sign was observed on the BBNPP site during the 2008 surveys (Normandeau 2011-TN490). In Pennsylvania, optimal habitat includes forest stands dominated by mature, hard-mast-producing trees. However, forest openings are also important for feeding on emerging grasses and herbaceous vegetation. Thus, while mature deciduous forest would be lost due to the project (Table 4-2), there would be a net gain in forest openings because of fragmentation. Of these two factors, the loss of mature forest would likely be the most influential and may, in combination with increased human presence, lead to a decline in the overall suitability of the project area for the species.

Wild Turkey (*Meleagris gallopovo*)

Wild turkeys were observed year-round during the 2008 surveys (Normandeau 2011-TN490). Wild turkeys are habitat generalists and their ideal habitat conditions consist of a mosaic of various forest age classes, including clearcut openings (see Section 2.4.1.3) (Casalena 2006-TN3817). Mature deciduous forest would be lost due to the project (Table 4-2), and there would be a net gain in clearcut forest openings. The increase in the mosaic of mature forest interspersed with clearcut openings may lead to an increase in the overall suitability of the project area for the species, notwithstanding increased human presence of which the species is tolerant (Casalena 2006-TN3817).

Invasive Species

The invasive plant species discussed in Section 2.4.1.3 have little or no value to wildlife and can spread rapidly and form monocultures that out-compete native flora. For these reasons, and in accordance with the Pennsylvania Noxious Weed Control Law (3 P.S. § § 255.1—255.11), PPL proposes to eradicate, control, and monitor these species within and immediately adjacent to areas of disturbance, as described in its management plan (PPL Nuclear Development 2011-TN3887). Specifically, PPL plans to do the following:

- Determine the spatial extent of invasive species prior to construction.
- Eradicate populations of invasive species during the preconstruction period.
- Manage future occurrences of invasive species using appropriate suppression techniques, as described below.
- Meet or exceed applicable USACE and Pennsylvania Noxious Weed Control Law regulatory requirements for noxious weed control (PPL Nuclear Development 2011-TN3887).

Within the footprint of disturbed areas, invasive species would be removed by grading and application of glyphosate herbicide to invasive species established on stockpiled soils. In adjacent areas, proposed treatments range from grading and application of glyphosate to stockpiled soils, to mechanical and hand clearing (PPL Nuclear Development 2011-TN3887). Unintended ground disturbance would be avoided to reduce opportunities for the potential spread of noxious weeds (PPL 2012 |site audit May 14-17, TE-08|). Wetland and upland areas being treated for invasive species would be monitored to ensure that reinfestation from root or seed does not occur. Areas downstream of stream infestations and on all sides of infested wetlands and other waterbodies will likewise be monitored for invasive species removal (PPL Nuclear Development 2011-TN3887).

Temporarily disturbed emergent wetlands (Table 4-2) would be seeded with native herbaceous species and restored and are anticipated to recover within 1 to 2 years (PPL Nuclear Development 2011-TN2238). Establishment of seeded native species would facilitate maintenance of previously treated areas free of invasive species.

Stormwater facilities would be seeded with grasses to stabilize soil and reduce erosion (PPL Nuclear Development 2011-TN2254). Establishment of seeded grasses would facilitate keeping such areas free of invasive species.

4.3.1.4 Terrestrial Monitoring

Monitoring Compensatory Wetland and Stream Mitigation

PPL would conduct a 5-year annual monitoring plan, including monitoring for benthic macroinvertebrate and fish assessments in Walker Run in accordance with the requirements of the *Mitigation and Monitoring Guidelines* (USACE) (33 CFR Part 325 [TN425] and Part 332 [TN1472]).

ESWEMS Pond Construction Dewatering

PPL proposes hydrologic monitoring to determine mitigation needs for potential impacts on wetland and stream hydrology from dewatering to build the ESWEMS pond (see Section 4.3.1.1). Monitoring would be conducted during the pre-dewatering (baseline, prior to site development), dewatering (during site development), and post-dewatering (after site development) periods. Monitoring would establish baseline conditions during pre-dewatering, which would be compared to conditions during dewatering, to initiate any needed mitigation. Monitoring also would ensure that any mitigation actions restore baseline conditions and that impacts on wetland and stream hydrology following the completion of dewatering activities are evaluated (PPL Nuclear Development 2011-TN2238; PPL Nuclear Development 2011-TN1952).

Baseline hydrological conditions would be established via streamflow records, soil moisture levels, and shallow groundwater elevations within the area of potential dewatering effect (Figure 4-3). PPL would collect these data for a minimum of 2 years prior to initiation of groundwater withdrawal. Data would be compiled on a monthly, seasonal, and total annual average basis. Precipitation and temperature also would be collected so that the baseline could be adjusted to account for precipitation and evapotranspiration. Data collection, interpretation, and analysis would generally follow standards set forth in "Technical Standard for Water Table Monitoring of Potential Wetland Sites" (USACE 2005-TN1863) (PPL Nuclear Development 2011-TN2238).

Shallow groundwater levels would be measured by installing six shallow groundwater wells (piezometers), in the wetlands in Figure 4-3. Shallow groundwater elevations would be recorded at 0.01-ft increments in 10-minute intervals. Four soil moisture probes would be installed between the piezometers, and average soil moisture in the upper 12 in. of soil would be measured. These measurements would be used to determine whether shallow soils are between saturation (all soil pores filled with water) and field capacity (small soil pores filled with water and large soil pores partially filled with water), the approximate range of growing season root zone soil moisture in wetlands. The spatial extent of saturated/moist soil and the number of weeks during the growing season that saturated/moist soil exists would be used define baseline hydrology in the wetlands depicted in Figure 4-3. Acceptable seasonal ranges would be established for each groundwater and soil moisture monitoring location (PPL Nuclear Development 2011-TN2238).

Flow depth has been recorded in 10-minute intervals in Unnamed Tributary 1 (Figure 4-3) since November 2009. Flow would continue to be monitored at four locations. Acceptable seasonal ranges for each monitoring location would be established (PPL Nuclear Development 2011-TN2238).

Monitoring of streamflow, shallow groundwater elevations, and soil moisture, as described above, would continue during site development and during the first growing season following completion of groundwater withdrawal (after site development) (PPL Nuclear Development 2011-TN2238).

4.3.1.5 Mitigation Measures

Permanent Wetland Fill and Conversion

USACE requires mitigation for permanent impacts on jurisdictional streams and wetlands, characterized by either the permanent placement of fill/grading in a stream (stream enclosure/stream relocation) or by the permanent placement of fill/grading in wetlands (wetlands converted to upland). Most fill to streams and wetlands from the BBNPP project would be from building bridge and utility crossings and the water-intake structure.

USACE also requires mitigation for permanent wetland conversion impacts, such as permanent conversion of PFO wetlands to PSS or PEM wetlands. The overall wetland location and acreage are not affected, but the lost functions and values must be considered and mitigated. For BBNPP, wetland conversion impacts would primarily be the result of cutting trees below transmission conductors, building bridge spans, etc.

PPL proposes to mitigate for wetland and stream acreage and functional losses by permittee-responsible onsite and in-kind compensatory mitigation (PPL Nuclear Development 2011-TN1952). Compensatory mitigation would address permanent unavoidable impacts on approximately 10.2 ac of jurisdictional PFO and PEM wetlands (Table 4-2), and 742 linear feet of stream habitat (see Section 4.3.2). The proposed mitigation includes:

- a stream and floodplain restoration project on two reaches of Walker Run, reconfiguring the stream channel and adjacent wetlands
- removing a section of Confers Lane, creating wetlands in the former roadbed and restoring a hydrologic connection between two separated forested wetlands
- restoring a portion of the North Branch Canal, enhancing wetlands at the PPL Riverlands location, and extending the existing recreational trail system.

The proposed Walker Run mitigation would create approximately 7.9 ac of new PFO wetlands and enhance an additional 5.5 ac of PFO wetlands through invasive species removal and planting of native herbaceous vegetation, shrubs, and trees. The Riverlands mitigation would enhance approximately 1.2 ac of PFO wetlands near the proposed intake structure. The Confers Lane mitigation would create approximately 0.4 ac of PFO wetlands and improve the hydrological function of adjoining wetlands. If successful, the functions provided by these compensatory PFO wetlands will exceed the functions lost by BBNPP project impacts and Walker Run mitigation impacts on PFO wetland and will include enhanced wildlife and fish habitat, stream stabilization, groundwater recharge, sediment reduction, floodflow alteration, production export, and water-quality improvements. Many of these functions would likely be achieved in one or two growing seasons, but some functions requiring a mature tree canopy could require decades.

The Walker Run wetland mitigation project includes stream mitigation. The plan calls for abandoning approximately 2,799 linear feet of existing artificially straightened channel and creating in its place approximately 4,159 linear feet of more natural enhanced channel, resulting in a more natural stream system and a net gain of approximately 1,360 linear feet of channel. The replacement stream channel would have a more natural sinuosity. The plan also calls for enhancing approximately 853 linear feet of additional existing channel, resulting in a net total of 2,213 linear feet of new and enhanced stream channel. The stream restoration would offset losses to watershed functions by reestablishing the connection between Walker Run and its floodplain, increasing its ability to provide floodwater storage, naturally recharge local aquifers, improve water quality, and maintain stream and riparian functions. If successful, the longer stream would likely better simulate what the review team expects Walker Run resembled prior to its history of straightening for agricultural development.

The Walker Run, Riverlands, and Confers Lane mitigation projects are discussed in greater detail in Appendix K and in the individual mitigation plans.

Temporary Wetland Impacts

Temporary impacts would occur only to emergent wetlands (0.9 ac [Table 4-2]) and mitigation would be voluntary (not required by either USACE or PADEP regulations). All temporarily impacted emergent wetland areas would be returned to their original grade and hydrology following disturbance activities and seeded with an herbaceous species mixture (targeted for use in creation and enhancement of forested wetlands) (PPL Nuclear Development 2011-TN2238; PPL Bell Bend 2010-TN3884). Recovery of original functionality is anticipated within 1 to 2 years following restoration and planting (PPL Nuclear Development 2011-TN2238).

ESWEMS Pond Dewatering

PPL would provide, on a voluntary basis, makeup water to compensate for impacts on wetland and stream hydrology posed by dewatering associated with construction of the ESWEMS pond (see Section 4.3.1.1). PPL has set a target of no more than 3 in. deviation from baseline groundwater elevation trends during construction. They also have set a target of no more than 2 in. deviation from baseline in-stream flow depth during construction (PPL Nuclear Development 2011-TN2238).

If these targets are not met, PPL has stated that they would offset drawdowns using onsite water storage releases. The two-celled pond for holding pumped groundwater (see Section 4.3.1.1) would consist of a settling basin and storage basin for mitigation water. Daily groundwater surface elevation and stream depth construction monitoring results would be compared to seasonal baseline conditions (see Section 4.3.1.4). If daily construction groundwater surface elevations or stream flow depths are below seasonal baseline ranges by more than the accepted tolerances noted above, mitigation water would be directly introduced to the affected wetland or stream channel via a temporary irrigation system. Successful mitigation would be achieved when the introduced water restores and maintains groundwater levels and stream depths that mimic baseline conditions through the first growing season post-construction. Continued monitoring of the wetlands will be completed to allow real-time flow corrections to maintain conditions reflecting the baseline. This mitigation is intended to offset any loss of function or value of affected wetlands during the period of impact from groundwater withdrawal (PPL Nuclear Development 2011-TN2238).

State-Ranked Butterfly Species

PDCNR (2013-TN3886) has indicated that the Baltimore checkerspot and mulberry wing are most likely to use moist areas such as wet meadows (checkerspot) and marshes or bogs (checkerspot and mulberry wing) on the BBNPP site (see Section 2.4.1.3). Consequently, PDCNR (2013-TN3886) has requested that PPL (1) avoid impacts on wetlands and (2) use butterfly food plants in vegetation planting plans. To the extent practicable, PPL has designed the construction footprint to limit impacts on wetland habitat (PPL Nuclear Development 2011-TN2238). For example, 0.5 ac of forested wetlands would be permanently affected and would be subject to impacts that could affect understory vegetation and hence associated checkerspot or mulberry wing food plants. However, most impacts on forested wetlands (9 ac [Table 4-2]) would occur via permanent conversion to shrub/scrub wetlands by removal of the tree canopy (see Section 4.3.1.1), which would not affect host plants of the two butterfly species because they grow in the understory. No shrub/scrub wetland habitat would be affected by the project (Table 4-2). However, 0.7 and 0.9 ac, respectively, of emergent wetlands would be permanently and temporarily affected by the project (Table 4-2).

As described above for wetland mitigation for fill and conversion impacts, permanently affected emergent and forested wetlands would be mitigated via creation or enhancement of forested wetlands onsite, resulting in an additional minor net permanent loss of emergent wetlands and a greater net gain of forested wetlands (PPL Bell Bend 2014-TN3644). Because the checkerspot and mulberry wing would be mostly affected by the loss of larval and adult food plants associated with disturbance of emergent and forested wetland habitats, PPL included food plants for both species in the herbaceous species mixture targeted for the creation or enhancement of forested wetlands around Walker Run, which accounts for most of the wetland mitigation onsite (PPL Bell Bend 2010-TN3884). The food plants that would be seeded in created and enhanced forested wetlands are anticipated to become established within 1 to 2 years after seeding. The net gain in forested wetlands resulting from mitigation represents a net gain in suitable habitat for the checkerspot and mulberry wing. In addition, the herbaceous species mixture targeted for the creation or enhancement of forested wetlands around Walker Run (containing food plants for the checkerspot and mulberry wing) would also be used to restore temporarily affected emergent wetlands. The emergent wetlands and the food plants are anticipated to become restored within 1 to 2 years after seeding.

The black dash occupies the same types of moist habitats as the Baltimore checkerspot and mulberry wing, and consumes the same larval food plants as the mulberry wing (i.e., sedges) (see Section 2.4.1.3). Thus, the black dash would benefit from PPL's reduction in acreage of wetland impacts discussed above. The black dash would also benefit from PPL's inclusion of sedges (targeting the mulberry wing) in the herbaceous species mixture for creation or enhancement of forested wetlands around Walker Run (PPL Bell Bend 2010-TN3884), and which would also be seeded to restore temporarily affected emergent wetlands. In addition, PPL also has included buttonbush, an adult food plant of the black dash (see Section 2.4.1.3), in the shrub species mixture for creation or enhancement of forested wetlands around Walker Run (PPL Bell Bend 2010-TN3884).

The wetland mitigation described above would not benefit the silver bordered fritillary because violet species (i.e., caterpillar host plants of the silver bordered fritillary [see Section 2.4.1.3]) are not part of the herbaceous seed mixture noted above (PPL Bell Bend 2010-TN3884).

4.3.1.6 Summary of Impacts on Terrestrial Resources

PPL has indicated that site preparation and development of the BBNPP project area and expansion of the Rushton Mine water-treatment facilities for consumptive-use mitigation would be conducted according to Federal and State regulations, permit conditions, and established BMPs. PPL has worked with USACE to determine appropriate mitigation through the permitting process of Section 404 of the Clean Water Act (33 USC 1344 et seq.-TN1019), which prohibits the discharge of dredged or fill material into waters of the United States without a Department of the Army permit.

Based on information provided by PPL and the review team's independent evaluation, the review team has determined that the site-preparation and development-related impacts would affect a total of approximately 663 ac. of terrestrial habitats in the BBNPP project area (Section 4.3.1.1), including permanent or temporary losses of forests (approximately 222 ac), jurisdictional wetlands (approximately 11.1 ac, mostly of forested wetlands), and non-jurisdictional wetland features (0.14 ac), as well as the potential temporary drawdown of as much as 5.6 ac of jurisdictional forested wetlands during the approximate 2-year ESWEMS pond installation period on the BBNPP site, would be spatially extensive and would considerably alter the terrestrial ecology of the local landscape. Habitat loss and fragmentation would reduce the suitability of mature deciduous forest onsite for State-listed avian species and forest interior birds. Many of these effects would be in IBA No 72, an area specifically recognized as being high-quality habitat for birds. Habitat loss and fragmentation would reduce the suitability of potential roosting habitat in deciduous forest for the Indiana bat and northern long-eared bat, two Federally listed species, as well as two State-ranked bat species. Habitat impacts may cause mortality and the loss of occupied habitat for a State-listed frog species, a State-ranked snake species, and a State-ranked turtle species. Wetland habitat loss would temporarily reduce the area containing host plants for four State-ranked butterfly species.

Based on information provided by PPL and the review team's independent evaluation, the review team concludes that the construction and preconstruction impacts from the BBNPP on terrestrial ecological resources, including the BBNPP site and the Rushton Mine site, would be MODERATE. This impact level is driven by impacts on wetlands, forests, and other terrestrial habitats on the BBNPP site and associated impacts on wildlife, particularly Federally listed, State-listed, and State-ranked species. In consultation with USACE, PPL has designed permittee-responsible compensatory mitigation appropriate to offset impacts on wetlands, streams, and other waters of the United States. PPL has also voluntarily developed measures involving releases of onsite water storage to offset possible hydrological drawdown of wetlands during building activities. PPL has developed a plan to harvest trees greater than 5 in. DBH from November 16 through March 31 to protect the Indiana bat. PPL also has developed a plan to restore and revegetate temporarily disturbed wetlands and to improve wetlands for State-ranked butterfly species.

The USACE approach is that mitigation may only be employed after all appropriate and practical steps to avoid and minimize adverse impacts on aquatic resources, including wetlands and streams have been taken. Further, the USACE requires all remaining unavoidable impacts on be compensated to the extent appropriate and practicable. If it issues its permit, the USACE permit would include special conditions that would require PPL to ensure that the created and enhanced wetlands meet the Federal wetland criteria outlined in the report titled *Corps of Engineers Wetland Delineation Manual* (USACE 1987-TN2066). The appropriate regional supplement was not yet available at the time the wetland delineation was performed. If USACE does not find the wetlands and stream mitigation satisfactory, corrective action would be required. Also, USACE would require PPL to assume liability for accomplishing the corrective action in accordance with Compensatory Mitigation for Losses of Aquatic Resources (33 CFR Part 325 [TN425] and Part 320 [TN424]).

All of the NRC-authorized construction actions would occur in areas disturbed as part of site preparation and development for the BBNPP. Therefore, the NRC staff concludes that the terrestrial ecological impact associated with NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.3.2 Aquatic Impacts Related to Construction

Before initiating any site-preparation or development activities, PPL would be required to obtain the appropriate authorizations regulating alterations to waters of the United States, including ponds and streams. The list of probable authorizations is presented in Section 4.2, with additional detail in Appendix H. NRC-authorized construction activities include dewatering during the construction of the ESWEMS pond which would affect onsite streams. Other building activities that could directly affect onsite aquatic ecosystems include site preparation for installing plant structures, cooling towers, and switchyards; installation of the cooling-water system intake and discharge structures; filling of the North Barge Canal Outlet; and installation of bridges, a rail extension, and a culvert. Aquatic habitats potentially affected include the North Branch of the Susquehanna River, Walker Run, and onsite ponds and tributaries. Potential direct impacts on aquatic resources as a result of building activities would involve physical alteration of habitat (e.g., infilling, cofferdam placement, dredging, and pile driving) including temporary or permanent removal of associated benthic organisms, sedimentation, changes in hydrological regimes, and changes in water quality. Potential indirect impacts include increased runoff from impervious surfaces. No offsite streams would be affected by building the proposed BBNPP unit and no new offsite transmission-line corridors would be required (PPL Bell Bend 2013-TN3377).

4.3.2.1 Aquatic Resources – Site and Vicinity

North Branch of the Susquehanna River

Installation activities with the potential to affect the aquatic resources of the North Branch of the Susquehanna River include installation of the intake and discharge structures (See Figures 3-1 and 3-4). Shoreline installation and site-preparation activities would require a stormwater pollution prevention plan (SWPPP), which would be developed as part of the NPDES stormwater permit and would describe BMPs to control sedimentation and erosion and provide stormwater management. Shoreline structures would be hardened to protect from shoreline erosion using placement of concrete or riprap (PPL Bell Bend 2013-TN3377). The installation of the intake and discharge structures would result in temporary disturbances to the aquatic habitat in those portions of theNorth Branch of the Susquehanna River. An increase in suspended sediments could occur during installation activities; however, PPL would comply with USACE and PADEP permitting regulations regarding dewatering, and would implement appropriate BMPs to minimize sedimentation effects. PPL would also coordinate with the PFBC prior to initiating installation of the intake and discharge structures to ensure impacts on mussels are avoided or minimized (PPL Bell Bend 2013-TN3377).

Intake Structure

The area of installation (0.61 ac) would be isolated from the river by a cofferdam and would be dewatered so that the excavation and work on the intake structure could occur under dry conditions. The dewatering and excavating within the cofferdam would remove existing river-bottom habitat and resident biological communities. PPL (PPL Nuclear Development 2011-TN1906) expects that the total volume of river-bottom material removed would be about 17,000 to 25,000 yds^3 (including any excavation for the discharge structure, which PPL expects would be minimal). The dredged material would be placed on barges, moved to shore, transferred to a temporary disposal basin located near the river, and eventually used as uncontaminated clean fill on the BBNPP site. The installation and removal of the cofferdams could cause a slight increase in water turbidity near the intake and discharge areas; however, the temporary and localized turbidity from installation activities is expected to be minor because the sediments, a composition of coarse sand and gravel, should settle within the area of building activities (PPL Bell Bend 2013-TN3377). Motile invertebrates and fish might swim near this portion of the river during building activities; however, they would be able to swim away or, more likely, would avoid the area due to vibratory noise from cofferdam installation and potentially occupy adjacent unaffected habitat.

Discharge Structure

PPL would place a cofferdam around the area of the proposed discharge pipe and diffuser site to allow the site to be dewatered during installation as described in Section 3.3.1.3. The total disturbed area during the installation of the discharge pipe and diffuser would be about 0.46 ac and dredged material would be handled as described for intake structure installation (PPL Nuclear Development 2011-TN1906).

The potential effects of this installation on fish and invertebrates are similar to those described for the intake system cofferdam installation. After dewatering the area within the cofferdam, some of the riverbed would be excavated for the pipe installation. A concrete pad would be built to support the diffuser and riprap would extend approximately 5 ft upriver and 15 ft downriver to limit bottom scouring (PPL Bell Bend 2013-TN3377). Installing the discharge structure would permanently eliminate approximately 0.2 ac of river-bottom habitat. Motile invertebrates and fish might swim near this portion of the river during building activities; however, they would be able to swim away or, more likely, would avoid the area due to vibratory noise from cofferdam installation and potentially occupy adjacent unaffected habitat.

4.3.2.2 Walker Run and Onsite Tributaries

The site-preparation and development activities that would affect onsite streams include dewatering the location of the ESWEMS pond, power block, and cooling towers; building bridges; installing a culvert and reinforced concrete pipe; constructing temporary utilities and facilities; creating parking and construction preparation areas; clearing and grading land; building or refurbishing roads; dewatering part of the North Branch Canal; and filling in the North Branch Canal Outlet. These activities would eliminate some onsite aquatic resources, could temporarily increase erosion, and would permanently affect 997 linear ft (0.21 ac) of onsite streams and temporarily affect 1,443 linear ft (0.34 ac) of onsite streams (PPL Nuclear Development 2011-TN1906). Note that bridge span shadows over streams are considered permanent impacts by the PADEP and are included herein. The onsite streams that would be affected include Walker Run, Unnamed Tributary 1, Unnamed Tributary 2, Unnamed Tributary 5, the North Branch Canal, and the Canal Outlet (PPL Bell Bend 2013-TN3377). No offsite streams would be affected by building the proposed BBNPP unit.

Dewatering from Excavation

Due to the location of the ESWEMS pond, which is a safety-related structure, installation would require the removal of groundwater (Section 4.2.1). PPL (PPL Nuclear Development 2011-TN1906) expects that this dewatering activity would temporarily affect about 1,396 linear ft (0.30 ac) of Unnamed Tributary 1 and Unnamed Tributary 2 for about 2 years. The primary effect of dewatering on the tributaries would be a minor reduction in water flow and a corresponding minor reduction in available aquatic habitat. In addition, dewatering would be required during excavation of the power block and cooling-tower areas as described in Section 4.2.1. The combined dewatering activities would result in temporary reduction of flow to Walker Run, Unnamed Tributary 1, and Unnamed Tributary 2. However, the temporary reduction in flow is not expected to noticeably affect aquatic communities in these waterbodies.

Intake Facility and Pipelines

The North Branch Canal and North Branch Canal Outlet would be affected by the placement of the intake facility and the intake and discharge pipelines. PPL would eliminate the North Branch

Canal Outlet to install the intake structure building which would result in the permanent loss of 617 linear ft (0.07 ac) of stream channel (PPL Nuclear Development 2011-TN1906). PPL (PPL Bell Bend 2013-TN3377) suggested that some fish in the outlet would swim to the North Branch of the Susquehanna River during the dewatering process and that those that did not do so could be rescued and relocated. Eliminating the North Branch Canal Outlet could temporarily increase turbidity in the nearby part of theNorth Branch of the Susquehanna River, but this turbidity would be minimized through the use of BMPs.

For pipeline installation, cofferdams would be used to temporarily isolate a 47-ft-long section (0.04 ac) of the canal. The canal would be dewatered in a similar fashion to that described for intake structure installation, thereby facilitating installation of a 20-in.-diameter water-supply pipe, a 32-in.-diameter cooling-water system makeup-water pipe, and a 26-in.-diameter discharge pipe (PPL Nuclear Development 2011-TN1906). All pipelines, along with associated communications and electrical conduits, would be placed into a single trench. After pipeline installation, the cofferdams would be removed and the flow allowed to return to the canal. The pipeline installation activities could temporarily introduce sediment into the North Branch Canal and subsequently theNorth Branch of the Susquehanna River, but would be minimized by use of BMPs (PPL Bell Bend 2013-TN3377).

Bridges

As indicated in Table 3-1, five bridges would be installed over Unnamed Tributary 1 and one bridge would be installed over Walker Run. While bridge pilings would not be installed in these waterbodies, these installations would result in 255 linear ft (0.07 ac) of permanent shading impacts (PPL Nuclear Development 2011-TN1906). Bridge installation activities could cause temporary effects through sedimentation and erosion. PPL would use BMPs (e.g., the use of silt fencing and other sediment runoff control practices) to minimize these temporary effects (PPL Bell Bend 2013-TN3377).

Culvert

A concrete culvert, described in Section 3.3.1.9, would be installed to allow conveyance of Unnamed Tributary 5 under the new railroad line. Installation would result in the loss of 125 linear ft (0.07 ac) of benthic habitat along the length of the area replaced by the new culvert, but would still allow fish and invertebrate passage (PPL Nuclear Development 2011-TN1906). Installation would likely increase water column turbidity downstream of the culvert area. PPL would use BMPs to control erosion and sedimentation in the stream as defined for intake and discharge installation (PPL Bell Bend 2013-TN3377). There would likely be minimal effect to aquatic communities in this tributary as Normandeau (2011-TN1226) did not observe any fish and found an abundant invertebrate community downstream of the proposed culvert location.

Stormwater

Unless appropriate control measures are used, clearing and grading activities onsite could increase runoff and sediment loads resulting in increased turbidity and sediment deposition in onsite streams. The downstream reaches of Walker Run, Unnamed Tributary 1, Unnamed Tributary 2, and Unnamed Tributary 5 could be temporarily affected. PPL would minimize impacts by using infiltration beds, several sedimentation basins, and a sedimentation pond to intercept stormwater and sediment runoff (PPL Bell Bend 2013-TN3377). The sedimentation basins would be built according to Pennsylvania Erosion and Sediment Control regulations and NPDES permit conditions. The basins and sedimentation pond would be removed after the plant is built. These measures would reduce the likelihood that swift-flowing stormwater would carry heavy sediment loads to Walker Run or the North Branch of the Susquehanna River. In addition, PPL would maintain a 50-ft buffer zone around aquatic habitats within the Walker Run watershed during installation and construction activities to further minimize erosion and sedimentation to onsite waterbodies (PPL Bell Bend 2013-TN3377).

Transmission Lines

New transmission lines would be built to connect the BBNPP switchyard to the two SSES 500-kV switchyards (Section 3.2.2.3). Although the new lines would cross Unnamed Tributary 1 and West Building Pond, no structures would be placed within the waterbodies (PPL Bell Bend 2013-TN3377). No new offsite transmission lines would be installed. Therefore, no offsite aquatic resources would be affected.

4.3.2.3 Consumptive-Use Mitigation Plan

No building activities are planned for any of the offsite consumptive-use mitigation areas, except at the Rushton Mine. Pennsylvania Mines, LLC would need to expand the current Rushton Mine treatment facilities to be able to meet the consumptive-use mitigation demands that would be required during mitigation events. The facility expansion would be done on already disturbed land and would not affect aquatic resources (PPL Bell Bend 2013-TN3541). PPL has determined that the existing Rushton outlet channel is sufficient to accommodate the potential increased flows required during mitigation events and would therefore not need to be expanded (PPL Bell Bend 2014-TN3539). PPL acknowledged that the final outfall system design may require riprap repair, weir repair, and resizing of the settling pond discharge culverts, but stated that these activities would not affect aquatic resources (PPL Bell Bend 2014-TN3539).

4.3.2.4 Mitigation Activities

Dewatering

To mitigate wetland and tributary flow reduction from ESWEMS dewatering, a new drainage system would be installed to more effectively redistribute water to adjacent wetlands. An existing 567-ft-long, 8-in.-diameter underground pipe and tile drainage system underneath old farm fields that carries Unnamed Tributary 2 flow from the teardrop wetland to Unnamed Tributary 1 would be removed and replaced with a 428-ft-long, 36-in.-diameter reinforced concrete pipe (PPL Nuclear Development 2011-TN1906). The new pipe would open onto a riprap pad and would be able to accommodate a 100-year peak runoff event. The bottom of a new culvert would be placed 12 in. below the stream bed to permit gravel to deposit and to allow fish passage (PPL Nuclear Development 2011-TN1906).

Riverlands

PPL proposes to restore the North Branch Canal to its historic alignment as compensatory mitigation for eliminating the Canal Outlet (PPL Nuclear Development 2011-TN1906). This restoration would involve the placement of a stop-log structure that would help maintain water levels in the upper part of the canal. It is expected that this restoration would improve water quality and create a more stable drainage pattern (PPL Nuclear Development 2011-TN1906).

Walker Run

Building the proposed BBNPP unit would involve some unavoidable, permanent impact on wetlands and streams that would require mitigation (see Appendix K) (PPL Nuclear Development 2011-TN2238). As part of this mitigation, PPL proposes to relocate and enhance portions of Walker Run. Although the mitigation would be designed to improve the local hydrology and to provide high-quality habitat for Brown Trout (*Salmo trutta*), the activity involves abandoning about 2,799 linear ft of existing stream sections, which would be permanently affected (PPL Nuclear Development 2011-TN2238). The Walker Run relocation mitigation activities would occur on two sites within the BBNPP project area. Site A is the reach of Walker Run between Beach Grove Road Bridge and Market Street Bridge and Site B extends from approximately 150 ft downstream of the Market Street Bridge to approximately the intersection with Unnamed Tributary 1 (LandStudies 2010-TN1901). The mitigation activity would involve enhancing 853 linear ft of existing stream channel, building a 849-linear-ft section of new meandering streambed to the east of the existing channel in Site A and a 3,310-linear-ft section of new meandering streambed to the west of the existing channel in Site B before abandoning the existing stream sections. Areas around the new channels and abandoned stream sections would be replanted with native trees, shrubs, and herbaceous vegetation with the eventual establishment of a mature palustrine forested wetland. (LandStudies 2010-TN1901). The net creation of new and enhanced Walker Run stream habitat would be 2,213 linear ft (PPL Nuclear Development 2011-TN2238).

PPL (PPL Nuclear Development 2011-TN2238) proposes to build the new stream channel sections by using the Rosgen natural stream channel design method (Rosgen 2011-TN2267) to create a stable channel geomorphology and in-stream conditions that would provide suitable habitat for Brown Trout spawning and the development of a stable Brown Trout population (LandStudies 2010-TN1901; PPL Nuclear Development 2011-TN2238). The proposed new channel construction would include various in-stream features (e.g., riffles, runs, pools, and fish-habitat structures).

Building the new channel section of Walker Run would occur without disturbing the water flow and biota in the existing channel (PPL Nuclear Development 2013-TN3540). Once the new sections were complete, PPL would redirect flow from the old channel segments to the new ones. PPL would consult with the PFBC to develop a fish collection and relocation plan, subject to PFBC approval, that would ensure the fish from abandoned Walker Run sections would be successfully transferred to the new channel sections (PPL Nuclear Development 2013-TN3540).

4.3.2.5 Important Species

Federally Listed Species

There are no Federally listed aquatic animal or plant species in the immediate project area or in the associated offsite consumptive-use mitigation areas (Section 2.4.2).

State-Listed Species

Of the State-listed aquatic animal species or PFBC candidate species identified for Luzerne County (Table 2-21), the Eastern Mudminnow (*Umbra pygmaea*) and brook floater (*Alasmidonta varicosa*) have not been recorded on or near the BBNPP site (Section 2.4.2). In addition, none of the State-listed aquatic plant species (Table 2-22) have been documented on the BBNPP site or in the North Branch of the Susquehanna River in the vicinity of the BBNPP site (Section 2.4.2). Therefore, it is unlikely that building the proposed BBNPP unit would adversely affect any State-listed aquatic species or PFBC candidate species for Luzerne County.

The only building activities that would occur in offsite areas associated with the consumptive-use mitigation plan (Section 2.4.2) would be at the Rushton Mine and would not encroach upon aquatic resources (PPL Bell Bend 2014-TN3539). Therefore, none of the State-listed aquatic animal or plant species in these offsite areas (Table 2-23) would be affected by building activities.

Recreationally Important Species

Recreational fishing in the North Branch of the Susquehanna River near the proposed BBNPP unit is directed primarily to Smallmouth Bass (*Micropterus dolomieu*), Muskellunge (*Esox masquinongy*), Channel Catfish (*Ictalurus punctatus*), and Walleye (*Sander vitreus*) but also includes Northern Pike (*Esox lucius*), Yellow Perch (*Perca flavescens*), and Bluegill (*Lepomis macrochirus*) (Section 2.4.2). Individuals may be affected by the activities associated with the installation of the cofferdams at the proposed intake and discharge structure locations, but it is likely that most individuals would swim away from installation activities and use nearby unaffected habitats. Some of the fish and invertebrates would lose access to benthic habitat that would be replaced by the concrete support structure for the discharge diffuser and its protective riprap. However, the habitat that would be lost is common in the river near the BBNPP site, and the effect of the loss on the fish and invertebrates likely would be minimal.

Brown Trout are recreationally important and could be affected by the proposed Walker Run mitigation plan. In addition, Bluegills are present in Walker Run, and in the North Branch Canal and Canal Outlet. Some trout or Bluegills could be lost during the effort to relocate fish from the stream or canal section to be abandoned to other, unaffected sections or to the newly built channel; however, losses are not expected to noticeably affect fish populations. No other recreationally important fish species in the other onsite streams would be affected by the building of the proposed BBNPP unit.

Because the only building activities that would occur in offsite areas associated with the consumptive-use mitigation plan would be at the Rushton Mine, no recreationally important species (Section 2.4.2) would be affected.

Species of Historic Interest

American Shad (*Alosa sapidissima*) are not known to occur in the BBNPP region of the North Branch of the Susquehanna River (Section 2.4.2.3), and therefore are not expected to be affected by building activities in the vicinity of the BBNPP site. American Eels, which occur in small numbers in the BBNPP region of the river (Section 2.4.2.3), should be able to avoid areas of the river near the cofferdam placement and removal and would not be affected by intake and discharge structure installation. The only building activities that would occur in offsite areas associated with the consumptive-use mitigation plan would be at the Rushton Mine, and no species of historic interest would be affected.

4.3.2.6 Monitoring

PPL has proposed thermal, hydrological, and chemical monitoring of aquatic resources during the building of the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). Details of the monitoring program, including locations, methods, and parameters, would be developed during the permitting processes required for building the proposed BBNPP unit. This monitoring would focus on drainage from excavations (PPL Bell Bend 2013-TN3377). Additional details are provided in the Clean Water Act Section 401 State Water Quality Certification (PADEP 2013-TN2275) and in the terms and conditions of the State Water Obstruction and Encroachment Permit (PADEP 2013-TN3538) issued by the PADEP for the construction and operation of a new nuclear plant at the BBNPP site.

Following implementation of the proposed BBNPP project mitigation described in Section 4.3.2.4 and Appendix K, PPL would conduct a 5-year annual monitoring plan, including monitoring for benthic macroinvertebrate and fish assessments in Walker Run in accordance with the requirements of the *Mitigation and Monitoring Guidelines* (33 CFR Part 325 [TN425] and Part 332 [TN1472]).

Walker Run monitoring after mitigation activities would follow an adaptive management approach to ensure that performance objectives are met and that the mitigation succeeds (PPL Nuclear Development 2013-TN3540). Monitoring would include measuring stream temperatures, water levels, Brown Trout redds, Brown Trout size, other fish species abundances, macroinvertebrate abundance, stream embeddedness, stream water quality, and habitat quality (PPL Nuclear Development 2013-TN3540). Other specific monitoring plans after mitigation activities would be made in consultation with Federal, State, and local agencies.

4.3.2.7 Summary of Impacts on Aquatic Resources

The review team evaluated the proposed construction and preconstruction activities related to the building of the nuclear plant at the BBNPP site and the potential impacts on aquatic biota, including Federally and State-listed species or PFBC candidate species, in the onsite freshwater streams and ponds, the North Branch of the Susquehanna River, and in associated offsite consumptive-use mitigation areas.

The primary activities affecting onsite freshwater resources and the North Branch of the Susquehanna River include dewatering during installation of the ESWEMS pond, power block and cooling towers; installing the cooling-water intake and discharge systems and pipelines;

temporarily dewatering the North Branch Canal; eliminating the North Branch Canal Outlet; culvert placement; building bridges; and abandoning part of Walker Run and creating new sections of the stream. These activities would temporarily affect aquatic organisms in the North Branch of the Susquehanna River and onsite waterbodies, but are expected to have minimal effects. Construction and preconstruction activities in the transmission-line corridors and offsite consumptive-use mitigation areas would not affect aquatic resources.

Based on the information provided by PPL and the review team's independent evaluation, the review team concludes that the impacts from the combined construction and preconstruction activities for the proposed new plant to onsite aquatic biota and associated offsite consumptive-use mitigation areas during preconstruction and construction would be SMALL, provided PPL complies with the mitigation measures identified in the required NPDES stormwater construction permit, PADEP 401 Water Quality Certification (PADEP 2013-TN2275), PADEP Water Obstruction and Encroachment Permit (PADEP 2013-TN3538), and the Department of the Army permit. Any impacts on aquatic resources associated with the compensatory mitigation proposed by PPL would be evaluated by the USACE and the PADEP as part of the permitting process for that activity.

The only NRC-authorized construction activity that would affect aquatic resources on the site or in associated offsite consumptive-use mitigation areas is building the ESWEMS pond. The NRC staff concludes that the impacts on aquatic biota and habitats from NRC-authorized construction activities would be SMALL.

4.4 Socioeconomic Impacts

Socioeconomic impacts occur in the region surrounding the proposed site. This discussion emphasizes socioeconomic impacts from building activities on the two-county economic impact area of Columbia and Luzerne Counties, although it considers the entire 50-mi region surrounding the BBNPP site.[(2)] The scope of the review is guided by the magnitude and nature of the expected impacts of the proposed project activities and by the site-specific community characteristics that can be expected to be affected by these activities.

Industrial-scale construction projects, such as the proposed BBNPP, can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of construction-related activities and of the construction workforce on the region. The review team examined the ER prepared by PPL and verified the data sources used in its preparation by examining cited references and independently confirming data in discussion with community members and public officials (PPL Bell Bend 2013-TN3377). To verify the data in the ER, the review team also requested clarifications and additional information from PPL as needed. Unless otherwise specified in the remainder of this section, the review team has drawn upon verified data from PPL (PPL Bell Bend 2013-TN3377). Where the review team used different analytical methods or additional information for its own analysis, the sections below

[(2)] For the purposes of this EIS, the relevant region is limited to the area necessary to include social and economic base data for (1) the county in which the proposed plant would be located and (2) the specific portions of surrounding counties and urbanized areas (generally, up to 50 mi from the BBNPP site) from which the construction and/or operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of construction and/or operations workers.

include explanatory discussions and citations for additional sources. The baseline for the assessment of impacts was established in Section 2.5.

The review team examined the possibility that significant numbers of workers (numbering 3,950 during the peak construction employment period) may choose to live in a county within 50 mi of the proposed BBNPP but outside the two-county economic impact area; however, the review team assumes that workers would locate in the economic impact area in the same proportion as the current operations and maintenance workforce at SSES Units 1 and 2. SSES Units 1 and 2 are located adjacent to the BBNPP site. As shown in Section 2.5, 87.1 percent of all SSES workers reside in Columbia and Luzerne Counties. Therefore, it is expected that the other counties would receive 12.9 percent of the workers as residents. The impact of workers located outside the economic impact area would be dispersed over a wider, more populated area. Thus the review team expects the relative contribution of those few workers to the wider economy would be minimal, and therefore their contribution is not considered further in the socioeconomic analysis pertaining to construction and operation of the proposed BBNPP.

The following sections describe the physical impacts on the site (Section 4.4.1), demographic impacts (Section 4.4.2), economic impacts on the community (Section 4.4.3), and the impacts on infrastructure and community services (Section 4.4.4). The impacts on minorities and low-income populations are covered in Section 4.5.

4.4.1 Physical Impacts

Building and preconstruction activities can cause temporary and localized physical impacts, such as noise, fugitive dust, air emissions, and visual aesthetic disturbances. Many of these impacts can be mitigated. All of the mitigation activities in the following sections were identified by PPL in the ER (PPL Bell Bend 2013-TN3377). This section addresses potential construction impacts that may affect people, buildings, and roads.

4.4.1.1 Workers and the Local Public

The BBNPP site is located in Salem Township, Pennsylvania, adjacent to the existing SSES and 1.6 mi (2.6 km) northwest of the North Branch of the Susquehanna River. The BBNPP site is located approximately 5 mi (8 km) northeast of the Borough of Berwick (population 10,477 in 2010). Other communities within the vicinity with populations in excess of 1,000 include Conyngham (population 1,958 in 2010), East Berwick (population 1,998 in 2010), Glen Lyon (population 1,888 in 7.58), Mifflinville (population 8.41 in 2010), and Nescopeck (population 1,528 in 2010). The nearest recreational resources are the Riverlands Recreation Area located between the SSES power generation facilities and the Susquehanna River, State Game Land No. 55 west of the BBNPP site, State Game Land No. 260 located east of the BBNPP site, and the two State park parcels named the Theta Lands (PPL Bell Bend 2013-TN3377).

Noise

Noise is an environmental concern because it can cause adverse health effects, annoyance, and disruption of social interactions. Building activities are inherently noisy. Noise would result from clearing, earthmoving, foundation preparation, pile driving (if needed), concrete mixing and pouring, steel erection, and various stages of facility equipment fabrication, assembly and installation, during which a substantial number of diesel- and gasoline-powered vehicles and other equipment would be used.

The noise impacts that project-related activities have on an area depend on sound intensity, frequency, duration, onsite location, the number of noise sources, time of day, weather conditions, wind direction, and time of year, as well as the location of the receptors themselves. Noise associated with the use of substantial numbers of vehicles and equipment, including pile drivers and dump trucks, would be expected to raise background noise levels, principally during daytime hours. Onsite noise levels could reach as high as 108 dBA over short durations (PPL Bell Bend 2013-TN3377).

To limit onsite noise impacts, workers would use noise protection as required by the Occupational Safety and Health Administration (OSHA) when engaging in work subject to noise hazards. To limit impacts on workers and offsite locations, PPL also plans to use several noise management practices, including scheduling activities with high noise levels during daytime hours, maintaining noise-limiting devices on vehicles and equipment, controlling access to high noise areas, and shielding high noise sources from their origin. The nearest residence is located more than 2,000 ft (610 m) from the center of the construction site, and peak noise conditions at that residence are estimated by PPL to fall below 65 dBA at all times (PPL Bell Bend 2013-TN3377).

Vehicular traffic is another source of noise. BBNPP traffic and heavy material and equipment deliveries would increase noise, particularly along US 11 between the City of Berwick and the BBNPP. Workforce-related traffic would be heaviest during shift change. BBNPP construction would result in between 3,131 and 6,331 heavy-truck trips per month to the BBNPP site during the peak building period. In addition, the construction workforce, including operations workers onsite during the peak construction period, would generate 3,401 daily auto trips to the BBNPP site (KLD 2011-TN1228). Traffic noise levels are not expected to be large due to the varying nature of traffic noise and the dispersion of traffic as it moves away from the construction site. Traffic-related noise can be reduced by lowering the speed limit, shuttling workers, staggering shifts, and using the railroad spur for large deliveries.

All project activities would also be subject to regulations from the Noise Control Act of 1972, Federal regulations for noise from construction equipment (40 CFR Part 204 [TN653]), OSHA regulations (29 CFR 1910.95 [TN654]), and State regulations. The review team expects that noise impacts on recreation and the general public would be minimal with the use of the mitigation actions included in the above regulations (as applicable) and because noise attenuates rapidly with distance, intervening vegetation, and variations in topography. Consequently, the review team concludes that noise impacts on surrounding communities from BBNPP construction activities would be minor.

Air Quality

The BBNPP site is located in Luzerne County, which is in the Northeast Pennsylvania-Upper Delaware Valley Interstate Air Quality Control Region (AQCR) (40 CFR Part 81-TN255). Luzerne County is classified as in attainment or unclassifiable for all criteria pollutants, including ozone, particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. The baseline air-quality characteristics are described in Section 2.9.2 of this EIS. Luzerne County and several other counties in this AQCR were redesignated as being in attainment with the 8-hour 1997 ozone standard on December 19, 2007, and are considered maintenance areas under 40 CFR Part 81 (TN255) with respect to this standard. The EPA requires States to submit a State Implementation Plan (SIP) for maintenance areas in order to maintain continued attainment in the area for 10 years following redesignation. The EPA has approved the PADEP SIP for maintenance of the 8-hour 1997 ozone standard in Luzerne County (72 FR 64948-TN2084). Columbia County is in the Central Pennsylvania Intrastate AQCR. Columbia County is in attainment for all National Ambient Air Quality Standards. There are no mandatory Class 1 Federal Areas where visibility is an important value in Pennsylvania. The closest Class 1 Federal Area is the Brigantine Wilderness Area in New Jersey (40 CFR 81.420 [TN255]), which is approximately 150 mi south-southeast of the BBNPP site.

Fugitive dust and fine particulate matter smaller than 10 micrometers (PM_{10}) in size would be generated during earthmoving activities, material-handling activities, by wind erosion, and other activities at borrow areas, laydown areas, and access roads. Ambient air quality would be affected by a temporary increase in future particulate matter onsite and offsite along the heavy-haul roads, and by emissions from construction equipment and vehicle exhaust. Emissions from construction equipment would include sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, as well as particulate matter. The impacts on offsite receptors would be limited by the vegetation and land buffer around the site, with the exception of activities along roads where heavy trucks operate.

Emissions at the BBNPP would be intermittent and vary based on the activity and duration throughout the construction phase. PPL plans to implement a dust-control program during construction to mitigate emissions. BMPs and control measures would include routine vehicle and equipment inspections, emissions monitoring in areas where air emissions could exceed limits (e.g., at the concrete batch plant), limiting vehicular speed on unpaved roads, watering unpaved roads, using soil adhesives to stabilize loose dirt surfaces, covering haul trucks when loaded or unloaded, ceasing grading and excavation during high winds and air pollution episodes, phasing grading to minimize areas of disturbed soil, and the securing of any required release permits and operating certificates. The concrete batch plant would be operated in compliance with PADEP regulations and would avoid emissions from trucks that otherwise would deliver concrete to the site (PPL Bell Bend 2013-TN3377).

Although emissions from project activities and equipment operation are unavoidable, the review team concludes that PPL's mitigation efforts would limit impacts on air quality during project activities. The review team concludes that it is reasonably foreseeable that PPL would implement these measures to ensure compliance with regulatory limits defined by the primary and secondary National Ambient Air Quality Standards (NAAQSs) in 40 CFR Part 50 (TN1089), the National Emission Standards for Hazardous Air Pollutants in 40 CFR Part 61 (TN3289), Pennsylvania Department of Labor and Industry occupational health and safety regulations, and PADEP regulations regarding operation of the concrete batch plant (PPL Bell Bend 2013-TN3377). Therefore, the review team concludes that the physical impacts associated with air quality would be minor.

4.4.1.2 Buildings

The largest impacts of construction activities on buildings would be experienced by those located at the existing SSES Units 1 and 2 sites. These buildings are located approximately 1 mi (1.6 km) to the east. Onsite buildings at SSES have been constructed to meet seismic qualification criteria, which will make them resistant to the effects of shock and vibration from activities associated with construction at the BBNPP site (PPL Bell Bend 2013-TN3377). The nearest offsite residences are located more than 2,000 ft (610 m) from the center of the construction site. Except for the buildings noted previously within this section, no other industrial, commercial, or recreational structures would be directly affected by the construction of the BBNPP. Therefore, the review team concludes that impacts of construction activities on buildings would be minor.

4.4.1.3 Roads

Public roads and railways would be used to transport construction materials and equipment to the BBNPP site. BBNPP construction would result in 3,131 to 6,331 heavy-truck trips per month during the peak building period. On average, heavy trucks would be hauling 15 T of concrete material, fill, or other construction material (KLD 2011-TN1228). Including the weight of the vehicle and trailer, heavy-truck weights would average approximately 56,000 lb. In addition, the construction workforce, including operations workers onsite during the peak construction period, would generate 3,401 daily auto trips to the BBNPP site (KLD 2011-TN1228).

A geometric relationship exists between axle weights and pavement damage. Heavy loads cause several forms of pavement distress, including fatigue cracking. The relative effect of each axle weight varies based on the type of distress, pavement thickness, and various environmental and design variables. The functional class of road system used to haul heavy loads is an important factor in determining impacts on the road system. Higher order systems (e.g., Interstate highway, other freeways and expressways, and other principal arterials) are designed to higher standards and can, therefore, withstand more stress. Most heavy loads would be transported to the BBNPP site on higher order systems, including US 11.

The Federal government and several States have conducted highway cost allocation studies, which determine the share of roadway costs for which each class of vehicle is responsible and compare that value to highway user taxes and fees attributable to each vehicle class. The 2013 Oregon highway cost allocation study recently estimated the cost responsibility for 56,000-lb vehicles and those weighing less than 10,000 lb at 17.6 and 3.1 cents per mile, respectively (ECONW 2013-TN3943). For this analysis, the gravity model described in Section 4.4.2 was used to estimate the average commute distance for the construction workforce at 13.2 mi. This distance would appear reasonable given that the 2009 National Household Travel Survey estimated the average commute distance in the United States at 12 mi (DOT 2011-TN3942). The average trip distance for construction material delivered to the BBNPP site has not been estimated, but this analysis retains the conservative 50-mi estimate used in Section 4.8.3. Based on these assumptions, construction traffic to and from the BBNPP site would result in $1.4 to $2.1 million in road costs annually. These costs would be largely offset by payments of highway user taxes and fees.

Vehicular traffic is also a source of noise and dust emissions. Maintaining good road conditions and enforcing appropriate speed limits would reduce the noise level and particulate matter generated by the workforce commuting to and from the BBNPP site. Construction equipment and other large plant components could be taken by railroad to further reduce impacts on roads.

Construction workers would use a dedicated construction access road rather than the primary SSES or BBNPP site-access road. This road would be marked clearly with signs and maintained clear of debris. PPL would select hauling routes based on equipment accessibility, existing traffic patterns, and noise restrictions, logistics, distance, costs, and safety. Impacts on the surrounding region would be minimized by avoiding routes that could adversely affect sensitive areas, such as residential neighborhoods, hospitals, schools, and retirement communities (PPL Bell Bend 2013-TN3377).

The review team determined the road-related impacts on workers, residents, and other users of the roads within the vicinity of the proposed site would be minor.

4.4.1.4 Aesthetics

The structures with the most direct impact on visual aesthetics would be the reactor building, turbine hall, and the two natural draft cooling towers. The two cooling towers (475 ft or 145 m tall) and the reactor building (204 ft or 62 m tall) would have the most significant aesthetic impacts on the area located near the BBNPP site.

The proposed site is bounded by forested land and rolling terrain, which would assist in obscuring construction activities. Some construction activities may be visible from the Susquehanna River, Market Street, Beach Grove Road, and US 11, but most of the construction activity would be masked by woods and rolling terrain. The BBNPP site is already aesthetically altered by the presence of SSES Units 1 and 2 located adjacent to the proposed site. Because construction-related impacts would be temporary, the review team expects that any construction-related adverse aesthetic impacts on the site and vicinity would also be temporary. The new transmission lines would also be constructed onsite to link up with the existing 500-kV transmission system being installed independent of the BBNPP.

To limit aesthetic impacts, the following design and mitigation strategies are planned:

- The new intake structure, pump house, and discharge piping would be constructed near existing facilities located on the shore of the Susquehanna River.
- New road construction would be minimized.
- The exteriors of new structures would be the color and texture of the surrounding area.
- When feasible, native trees and other vegetation would be used to replant and reseed cleared areas.

The review team concludes that aesthetic impacts are likely to be minor and temporary.

4.4.1.5 Summary of Physical Impacts

Based on information provided by PPL, the review team's independent analysis, and taking into account the BMPs and mitigation measures described in the Bell Bend ER, the review team concludes that the overall physical impacts of construction and preconstruction on workers and the local public, buildings, roads, and aesthetics near the BBNPP site would be SMALL. The designation of SMALL with respect to air quality during NRC-authorized construction activities is dependent on PPL implementing the mitigation strategies outlined in the ER. The review team concludes that it is reasonably foreseeable that PPL would implement these measures in order to ensure compliance with regulatory limits defined by the primary and secondary NAAQSs in 40 CFR Part 50 (TN1089), the National Emission Standards for Hazardous Air Pollutants in 40 CFR Part 61 (TN3289), Pennsylvania Department of Labor and Industry occupational health and safety regulations, and PADEP regulations regarding operation of the concrete batch plant (PPL Bell Bend 2013-TN3377).

4.4.2 Demography

Socioeconomic impacts are the result of project expenditures, employment, and the in-migration of workers and their families that change population and employment levels by drawing new residents into an area and/or by preventing the departure of existing residents from an area. Growth in population and employment increases spending in the area, leading to increased demand for housing, education, and the use of other public facilities and services. The assessment of demographic impacts related to building the proposed BBNPP are based on the impacts of the employment and in-migration of new workers.

All workers onsite during the project are included in the assessment of impacts of the NRC-authorized activities, whether they are construction or operations workers. PPL estimates that the preconstruction period would begin 2 years prior to the start of NRC-authorized construction activities and would conclude at the end of the second year of the NRC-authorized construction period. The average workforce during the 24-month period prior to beginning NRC-authorized construction activities is expected to be 200; a maximum workforce of 300 is expected to be reached during the second year of the preconstruction period. During the first 2 years of the NRC-authorized construction period, preconstruction activities are expected to diminish with the number of workers falling below those present during the first 2 years of the preconstruction period (PPL Bell Bend 2014-TN3625). PPL estimates the building period to be 68 months (PPL Bell Bend 2013-TN3377), with peak employment of 4,313 reached by the third quarter of the fourth year of the construction period. The peak workforce would consist of 3,950 construction workers and 363 operations workers onsite for training purposes (PPL Bell Bend 2013-TN3377). Table 4-6 shows the number of workers during peak employment.

As discussed in Section 2.5 of this EIS, the demographic region extends 50 mi from the site boundary. Although the review team considered the entire region within a 50-mi radius of the BBNPP site when assessing socioeconomic impacts of building activities, the primary focus is on Columbia and Luzerne Counties, both of which are located in Pennsylvania. The review team assumes that workers would locate in the economic impact area in the same proportion as the current operations and maintenance workforce at SSES Units 1 and 2 (87.1 percent).

Based on assessments of worker in-migration levels at nuclear power plants prepared by the NRC and cited by PPL in the ER, the review team estimates that 20 to 35 percent of the construction workforce would migrate into the demographic region and 87.1 percent of those workers would locate in the economic impact area (PPL Bell Bend 2013-TN3377). In addition, the review team assumes that all of the operations workers would migrate into the 50-mi region and that 87.1 percent would locate in the economic impact area. Using these assumptions, the review team estimates the total in-migrating workforce, including construction and operations workers present during the peak construction period, to be 1,004 to 1,520 workers. Using the average household size in Pennsylvania of 2.47 people, 1,004 to 1,520 workers would bring an additional 1,476 to 2,235 family members with them. Thus, the review team estimates the in-migrating direct workforce population to be 2,480 to 3,755 (USCB 2011-TN3623).

Table 4-6. Estimated In-Migrating Workers in Economic Impact Area during Construction Period with Varying In-Migration Scenarios

In-Migration Characteristics	20% In-Migration Scenario	35% In-Migration Scenario
Direct Workforce		
Maximum Construction Workforce[(a)]	3,950	3,950
Percent of Current SSES Units 1 & 2 Workforce Residing in the Economic Impact Area[(a)]	87.1%	87.1%
Estimated In-Migrating Construction Workforce	688	1,204
Estimated Operations Workforce During Construction Period[(a)]	363	363
Estimated Operations Workforce Residing in the Economic Impact Area	316	316
Estimated In-Migrating Direct Workforce	1,004	1,520
In-Migrating Direct Workforce Population (@2.47 people/household)[(b)]	2,480	3,755
Indirect Workforce		
In-Migrating Direct Workforce	1,004	1,520
Peak Indirect Workforce (@1.7286 Bureau of Economic Analysis (BEA) multiplier for construction workforce and 2.443 for operations workforce)[(c)]	957	1,333

(a) PPL Bell Bend 2013-TN3377.
(b) USCB 2011-TN3623.
(c) BEA 2014-TN3624.

Source: PPL Bell Bend 2013-TN3377; USCB 2011-TN3623; and BEA 2014-TN3624

The U.S. Department of Commerce Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System (RIMS II) employment multiplier for construction jobs in the economic impact area is 1.73, meaning that for each construction job created a total of 1.73 jobs (including the direct job) would be supported in the two-county economic impact area. The employment multiplier for operations jobs during the building phase is 2.44 (BEA 2014-TN3624). For the 1,004−1,520 construction and operations workers in-migrating during the building phase, a total of 957−1,333 indirect jobs would be supported in the two-county economic impact area. Indirect and induced jobs are assumed to be allocated to area residents who were either unemployed or left other jobs.

Based on the distribution of SSES employees, the review team assumes that 44.8 percent and 42.3 percent of the BBNPP workforce would reside in Columbia and Luzerne Counties, respectively. Using this distribution, the in-migrating population would be 1,276 to 1,932 for Columbia County and 1,205 to 1,824 for Luzerne County.

As indicated in Section 2.5.1.1., the populations of Columbia and Luzerne Counties in 2010 were 67,296 and 320,918, respectively. Population State Data Center baseline population estimates for Columbia County show slow growth, while for Luzerne County the population is expected to decline between 2010 and 2030. Projected population levels in 2020 for Columbia and Luzerne Counties are 70,010 and 310,747, respectively. The influx of project workers and families would represent less than a 1 percent increase in the population of Luzerne County based on Population State Data Center forecasts. In Columbia County, however, the influx of the workforce population would represent a 1.8 to 2.8 percent increase in the population.

The review team used a gravity model to estimate the distribution of in-migrating workers between cities located in the two-county economic impact area. The gravity model is a standard economic location model inspired by Newton's Law of Gravitation to evaluate trade and migration patterns between competing countries, cities, or economies. The simplified model used for this analysis measured the "gravitational pull" of each community surrounding the BBNPP site on in-migrants based on the population of the community divided by the square of the distance of that community from the site (Anderson 2010-TN1947). Each community was, in turn, assigned a value based on the aforementioned calculation. These values were used to determine the proportion of the in-migrating population that would reside in each community. The gravity model evaluated all communities located within 10 mi of the BBNPP site and all communities with populations greater than 5,000 located within the 50-mi region. The results of the gravity model for the BBNPP site indicated that up to 30.3 percent of the workforce population could relocate in the Borough of Berwick, Pennsylvania. This level of in-migration would result in a temporary increase in the Berwick population of 751 to 1,138 people (7.0 to 10.6 percent).

Given the magnitude of the estimated population increases, the review team determined the influx of workers because of BBNPP construction activities would only impose minor and temporary demographic impacts on Luzerne County. However, depending on where these workers choose to reside, Columbia County, and particularly the Borough of Berwick, could experience more significant but temporary impacts because of the increases in population.

Based on information provided by PPL and the review team's independent evaluation, the review team concludes that population impacts of construction and preconstruction would be SMALL. NRC-authorized construction activities would represent a large fraction of the analyzed activities; however, the review team concludes that the demographic impacts of NRC-authorized construction activities would also be SMALL.

4.4.3 Economic Impacts on the Community

This section evaluates the economic impacts of building the proposed BBNPP on the two-county economic impact area of Columbia and Luzerne Counties. The evaluation assesses the economic, employment, and tax impacts of building activities on the surrounding region.

4.4.3.1 Economy

The impacts of building activities on the local and regional economy depend on the region's current and projected economy and population. Characteristics of the economy and workforce in the region are described in Section 2.5.2 of this EIS. At its peak, the project workforce is estimated to be approximately 4,313 workers. The BBNPP, if approved, would give PPL up to 20 years to begin building. For this analysis, the review team based its analysis on the latest information provided by PPL, which estimated that NRC-authorized construction activities would last approximately 68 months with a commercial operation start date of 2025 (PPL Bell Bend 2014-TN3625).

When a new job is added to a local economy, that new (direct) job supports the existence of other (indirect) jobs. Every new direct job in a given area—in this case, a job building the BBNPP—stimulates spending on goods and services. This spending results in the economic need for a fraction of another indirect job, typically in the service industries. The BEA provided RIMS II regional multipliers for industry employment and earnings in the economic impact area. As noted in Section 4.4.2, the employment multiplier for construction jobs in the economic impact area is 1.73, meaning that for each construction job created a total of 1.73 jobs (including the direct job) would be supported in the two-county economic impact area. The employment multiplier for operations jobs during the building phase is 2.44 (BEA 2014-TN3624). The BEA employment multiplier is applied only to in-migrating workers because the BEA model assumes the direct employment of workers that already live in the area would have no additional impact on employment.

Table 4-7 identifies the total number of jobs created by the proposed project and filled by in-migrating workers during the peak construction employment period. As indicated in Section 4.4.2, the review team assumes the place of residence for in-migrating building workforce within the economic impact area would be 42.3 percent in Luzerne County and 44.8 percent in Columbia County. This assumption is based on the proportion of current operations and maintenance workers at the SSES Unit 1 and 2 sites who live in Columbia or Luzern County. It also provides 2010 employment and unemployment numbers for these counties. The table demonstrates that jobs related to building the BBNPP would be a small percentage (less than 1 percent) of jobs in Luzerne County but would expand the number of workers in Columbia County by 3.2 to 4.7 percent. Thus, the review team finds that the project would have a minor and beneficial effect on employment in Luzerne County, but would have a noticeable and beneficial impact on employment in Columbia County for 2 to 3 years around the peak of employment.

Table 4-7. Expected Distribution of In-Migrating Workers in the Economic Impact Area at Peak Employment

	Jobs Filled by In-Migrating Workers		New Indirect Jobs		Employment Information in 2012	
County	**Building-Related**	**Operations Workers**	**Supported by Building Jobs**	**Supported by Operations Jobs**	**Employed Workers**	**Unemployment Rate**
Columbia	354-619	163	258-451	235	31,370	6.0%
Luzerne	334-585	154	243-426	222	147,286	10.5%
Economic Impact Area	688-1,204	316	501-877	457	178,656	

Source: In-migration workforce based on economic impact area in-migrating workers (87.1 percent of in-migrants) and BEA multipliers (BEA 2014-TN3624). Employment data obtained from PPL Bell Bend 2013-TN3377, which derived data from the 2006-2010 American Community Survey.

PPL estimated the annual income for members of the construction workforce would be $70,720, resulting in an estimated $279.3 million in annual salaries for the peak workforce, which includes approximately $48.7 to $85.2 million for the in-migrating workers at peak employment. The income for the peak construction workforce could be as high as $123,760 annually with overtime, which would generate $488.9 million in annual salaries. For in-migrating workers, annual salaries could reach as high as $85.2 to $149.0 million at peak employment (PPL Bell Bend 2013-TN3377). The income for the operations workforce at peak employment would be $24.4 million in the economic impact area, assuming an average salary of $77,135 (PPL Bell Bend 2013-TN3377). In addition to the salaries of incoming construction and operations workers onsite during construction, the review team estimated that the new indirect jobs would generate approximately $17.1 to $23.8 million in the economic impact area. The average salaries for members of the indirect workforce were estimated to be $17,870 (PPL Bell Bend 2013-TN3377) based on the average salary for service occupations in the Scranton-Wilkes-Barre Metropolitan Statistical Area (PPL Bell Bend 2013-TN3377).

Earnings for the construction and operations workers and associated indirect jobs living in the economic impact area would total about $90.2 to $133.4 million in the peak year—around 1.4−2.0 percent of the 2010 earnings in the economic impact area. For Luzerne County, BBNPP-related earnings would total $43.8 to $64.8 million annually or 0.8 to 1.2 percent of earnings in the county. In Columbia County, earnings would represent a more significant impact on the local economy with earnings of $46.4 to $68.6 million annually, which would grow county earnings by 4.3 to 6.4 percent. Thus, the review team finds that the project would have a minor beneficial effect on earnings in Luzerne County and a noticeable beneficial impact on earnings in Columbia County for 2 to 3 years around the peak of employment.

4.4.3.2 Taxes

The primary tax revenues associated with building the BBNPP would come from property taxes for the site, sales and use taxes on goods and services purchased both for building the plant and by workers, and income taxes on personal wages. Additional taxes, including property taxes from the site and corporate income tax, would accrue during the operations phase.

Pennsylvania levies a 6 percent sales, use, and hotel occupancy tax. It also imposes a $1.60 cigarette excise tax per pack of 20 cigarettes/small cigars, an 18 percent liquor excise tax, and a 2 percent vehicle rental tax (PDR 2012-TN2020). Total sales and use tax remittances in Pennsylvania totaled $8.8 billion in State fiscal year (SFY) 2012 with $112.9 million or 1.3 percent collected in the economic impact area (PDR 2012-TN2021). Luzerne and Columbia Counties do not impose local sales taxes. PPL estimates that within the 50-mi radius of the nuclear plant site, $260.8 million would be spent on materials, equipment, and outside services during the construction period. Applying the 6 percent sales tax rate generates total estimated sales tax payments of $15.6 million over the 68-month construction time horizon.

The Commonwealth of Pennsylvania imposes a 3.07 percent tax against the taxable income of resident and nonresident individuals, S corporations, business trusts, limited liability companies that are not taxed by the Federal government as corporations, and estates and trusts (PDR 2012-TN2020). In SFY 2012, Pennsylvania collected $10.8 billion in personal income taxes (PDR 2012-TN2021). In 2010, taxable income in the two-county economic impact area

($7.1 billion) composed 2.3 percent of the statewide total ($310.4 billion) (PDR 2012-TN2021). PPL assumes that some portion of the skilled craftsman workforce would relocate into the region during the construction phase, and would, thus, contribute additional income tax revenue to the State of Pennsylvania. The review team estimates that the building workforce, including operations workers training onsite, would contribute $9.4 million in annual personal income tax at the peak of construction.

At the local level in Pennsylvania, several jurisdictions also impose earned income taxes on both residents and nonresidents. Salem Township and Berwick both impose 1.0 percent earned income taxes on residents and nonresidents, with half of the proceeds from the resident earned income taxes allocated to the Berwick Area School District (PDCED 2014-TN3915). Nonresidents working in Salem Township would be subject to the local nonresident earned income tax unless the resident rate they pay to their local jurisdiction equals or exceeds the nonresident rate in Salem Township. Workers at the BBNPP would also be subject to a $52 annual local services tax (LST), which would be paid to Salem Township. Salem Township would transfer $5 of each LST payment to the Berwick Area School District. The review team estimates that the building workforce, including operations workers training onsite, would generate $3.1 million annually in earned income tax revenue during the peak of construction. The earned income tax revenue would be allocated to jurisdictions throughout the region based on worker disbursement patterns. The review team further estimates that the peak building workforce would generate $224,276 in annual LST revenue for Salem Township, with $21,565 of that amount allocated to the Berwick Area School District. Total revenues to Salem Township were $1.9 million in 2012, indicating the addition of the nuclear power plant, and the resulting increase in LST tax proceeds, would at a minimum result in a 12.8 percent increase in revenues (PDCED 2012-TN3916).

The review team concludes that building of the BBNPP would have minor impacts on tax revenue in the economic impact area, the region, and State, with the exception of Salem Township where tax revenues would have a noticeable and beneficial impact.

4.4.3.3 Summary of Economic Impacts on the Community

Based on the information provided by PPL, interviews with local public officials, and the review team's own independent analysis, the review team concludes that the economic impacts of preconstruction and construction activities on the regional and State economy and tax base would be SMALL and beneficial. Economic impacts on Luzerne County would also be SMALL and beneficial. In Columbia County, the economic impacts of BBNPP preconstruction and construction activities would be MODERATE. The tax impacts of BBNPP preconstruction and construction activities would be MODERATE in Salem Township. NRC-authorized construction activities represent a large fraction of the analyzed activities. The review team concludes that the economic impacts of construction activities would be SMALL and beneficial with the exception of the economic impacts on Columbia County and the tax impacts on Salem Township where impacts would be MODERATE.

4.4.4 Infrastructure and Community Service Impacts

This section provides the estimated impacts on infrastructure and community services, including traffic, recreation, housing, public services, and education.

4.4.4.1 Traffic

Public roads would be used to transport construction materials and equipment to the BBNPP site. BBNPP construction would result in between 3,131 and 6,331 heavy-truck trips per month to the BBNPP site during the peak building period. In addition, the construction workforce, including operations workers onsite during the peak construction period, would generate 3,401 daily auto trips to the BBNPP site (KLD 2011-TN1228). Impacts of the proposed construction traffic would be most noticeable on the rural roads of Luzerne County, particularly US 11, a two-lane highway that provides access to the BBNPP site. Construction-related impacts on traffic are determined by four elements:

- the number and timing of construction worker vehicles on the roads per shift
- the number of shift changes for the construction workforce per day
- the number and timing of truck deliveries to the construction site per day
- the capacity and usage of relevant roads.

In 2011, KLD Associates, Inc. (KLD) completed a traffic impact study (TIS) to evaluate the impact of building and operating the BBNPP on the road network in the vicinity of the BBNPP site. During the construction phase, workers were allocated to communities located within 40 mi of the site proportionally based on current populations. There are two planned enhancements to the existing highway network that KLD built into its future no-build scenario: (1) planned upgrades to the SSES driveways, and (2) a traffic signal installed at the intersection of US 11 and State Route (SR) 29 (Mill Street) in Nanticoke (KLD 2011-TN1228).

KLD examined 23 key intersections near the BBNPP site. If the construction workforce added 100 daily trips to traffic volumes through an intersection, it became a candidate for inclusion in the study. Intersections selected for the analysis were identified in Berwick, Briar Creek, Nanticoke, Nescopeck, Salem Township, Shickshinny, and South Centre. The future no-build levels of service (LOSs) estimated for the 23 key intersections are presented in Table 2-37. Under this baseline, construction-year conditions include the impact of outage traffic at the SSES.

The LOS designation is an ordinal scale with “A” (free flow) being the best LOS and “F” (forced or breakdown flow) being the worst. The study evaluated the LOS for each interchange during both the A.M. and P.M. peak periods. The study indicates that in the future no-build scenario, most intersections would operate at an LOS of “A” (free flow) or “B” (reasonably free flow). One intersection (US 11 [Front Street] and Poplar Street) located in Berwick would be operating at an LOS of “D” (approaching unstable flow) during the P.M. peak period. In Nanticoke, there are two intersections that would operate at an LOS of “D”: US 11 and County Bridge intersection during the A.M. peak and SR 11 (E. Poplar Street) and SR 29 during the P.M. peak (KLD 2011-TN1228). The intersection of US 11 and the SSES site entrance would operate at an LOS of “E” during the A.M. peak. These LOS values collectively served as the reference case, which was used to determine if future build conditions triggered required mitigation strategies due to a change in vehicle delays exceeding 10 seconds per vehicle.

Table 4-8 compares peak construction traffic to the future no-build condition. During the peak building period, LOSs at 12 interchanges would be higher than acceptable levels during the A.M. peak. During the P.M. peak, 15 interchanges would be higher than acceptable levels (KLD 2011-TN1228). Several interchanges, including the intersection of US 11 and the BBNPP site entrance, would reach an LOS of "F."

To address building impacts on traffic, PPL has proposed a number of mitigation strategies, including the following:

- installation of additional signals at the entrance of the BBNPP access road and other cross roads
- the realignment of lanes on US 11 near the entrance of the BBNPP site
- the expansion of the interchange where US 11 meets the BBNPP access road through the provision of additional entrance and exit lanes
- construction of a dedicated access road.

Signal retiming, restriping, thru lanes, temporary traffic signals, parking restrictions, and other measures would be implemented as required at intersections affected by construction-related traffic.

Table 4-9 presents the impact of the proposed mitigation measures on the LOS at key interchanges. Cells in Table 4-9 are highlighted to indicate that the proposed mitigation strategy would not fully address the impact if one of two conditions are present: 1) there is a change in the delay that lowers the LOS and the delay is greater than 10 seconds, or 2) there is a traffic signal proposed for the intersection but the LOS still falls below "C". With the proposed mitigation strategies in place, nearly all of the LOSs would fall within acceptable levels, with the exception of US 11 and Briar Creek Plaza Driveways and US 11 and the SSES site entrance during the A.M. Peak, and US 11 (Front Street) and Orchard Street, US 11 (Front Street) and SR 93 (Orange Street), and US 11 and SSES Site Entrance during the P.M. peak. Note that three of the five instances outlined above occur during an outage period occurring concurrently with future construction activities. Thus, those situations would occur for less than 1 month in each of at most 2 consecutive years.

After reviewing the TIS, Salem Township staff raised several concerns regarding the impact of BBNPP construction traffic with PPL and the review team. These concerns included the fact that the TIS did not adequately address (1) the impact of traffic diversion during congested periods onto secondary routes located within the township, or (2) the impact of the proposed Confers Lane closure on traffic flows and emergency planning and response times (NRC 2012-TN1694).

To address these concerns, PPL commissioned a supplemental traffic study prepared by KLD. The study used a dynamic traffic assignment model to estimate diversion during congested periods onto the local road system. The results of the analysis suggest that few motorists would divert onto local roads in Salem Township even under congested conditions because the alternative routes are longer and experience lower speeds than US 11. KLD posted an

1 **Table 4-8. Projected Level of Service at Intersections near the BBNPP Site: Future Year Construction Conditions (2021)**

Int. No.	County	Municipality	Intersection	FNB A.M.	Const A.M.	FNB P.M.	Const P.M.
1	Columbia	South Center	US 11 and SR 2028	B (14.9)	E (59.8)	C (23.1)	E (62.1)
2	Columbia	Briar Creek	US 11 and Briar Creek Plaza	A (6.6)	C (21.4)	C (20.9)	E (61.2)
3	Columbia	Berwick	US 11 (Front Street) and Eaton Street	A (1.1)	A (0.8)	A (2.3)	F (NG)
4	Columbia	Berwick	US 11 (Front Street) and Poplar Street	C (27)	F (176.3)	D (40)	F (144.9)
5	Columbia	Berwick	US 11 (Front Street) and Orchard Street	A (6.7)	B (16.9)	B (17.7)	D (48.6)
6	Columbia	Berwick	US 11 (Front Street) and SR 93 (Orange Street)	A (5.9)	B (11.1)	B (11)	D (51.7)
7	Columbia	Berwick	US 11 (Second Street) and LaSalle Street	B (11.8)	B (11.4)	B (14.1)	C (22.9)
8	Columbia	Berwick	US 11 (Second Street) and Oak Street	A (6.2)	A (5.5)	A (8)	B (10.7)
9	Columbia	Berwick	US 11 (Second Street) and Mulberry Street	A (4.8)	A (3.1)	A (5.7)	A (6.3)
10	Columbia	Berwick	US 11 (Front Street) and Mulberry Street	A (6.1)	A (2.1)	A (8)	B (10.4)
11	Columbia	Berwick	SR 1020 (Market Street) and Third Street	A (9.6)	A (8)	B (12.8)	B (15.2)
12	Columbia	Berwick	US 11 (Second Street) and Market Street	A (9.7)	B (19.8)	B (11.7)	B (18.1)
13	Columbia	Berwick	US 11 (Front Street) and Market Street	B (14.2)	E (63)	B (15.3)	C (30.6)
14	Columbia	Berwick	US 11 (Second Street) and Pine Street	A (6)	A (5)	A (8.6)	B (16.6)
15	Luzerne	Nescopeck	SR 93 (Third Street) and SR 339 (Broad Street)	B (14.1)	C (23.3)	B (12.3)	C (22.3)
16	Luzerne	Nescopeck	SR 93 (Third Street) and Dewey Street	A (4.6)	A (4.4)	A (3.7)	A (5.3)
17	Luzerne	Salem Township	US 11 and Bell Bend Site Entrance	--	F (NG)	--	F (NG)
18	Luzerne	Salem Township	US 11 and SSES Site Entrance	E (47.1)	F (NG)	A (5.2)	F (129.3)
19	Luzerne	Shickshinny	US 11 (S. Main Street) and SR 239	A (7.8)	C (22.5)	A (9.4)	E (69.3)
20	Luzerne	Shickshinny	US 11 (Main Street) and SR 239 (Union Street)	B (14.7)	F (110.8)	B (15.5)	F (108.9)
21	Luzerne	Nanticoke	US 11 and SR 29 (Mill Street)	C (23.6)	D (36)	C (26.3)	F (270.8)
22	Luzerne	Nanticoke	US 11 and County Bridge	D (49.5)	C (22.6)	C (24.2)	F (155.3)
23	Luzerne	Nanticoke	US 11 (E. Poplar Street) and SR 29	A (2.9)	F (108.9)	D (30.3)	F (325.1)

Notes: A = free flow, B = reasonably free flow, C = stable flow, D = approaching unstable flow, E = unstable flow, F = forced or breakdown flow, NG – no-gap, and FNB = future no-build scenario.

Source: KLD 2011-TN1228

Table 4-9. Summary of Proposed Mitigation Measures and Estimated Impact (2021)

					A.M. LOS (delay)		P.M. LOS (delay)	
Int. No.	County	Municipality	Intersection	Mitigation Measure	FNB A.M.	Const A.M.	FNB P.M.	Const P.M.
1	Columbia	South Center	U.S. 11 and SR 2028	Add thru lane on US 11 NB	B (14.9)	B (10.8)	C (23.1)	C (27.5)
2	Columbia	Briar Creek	US 11 and Briar Creek Plaza	Add thru lane on US 11 SB	A (6.6)	C (21.5)	C (20.9)	B (16.2)
3	Columbia	Berwick	US 11 (Front Street) and Eaton Street	Temporary traffic signal	--	B (11.9)	--	C (30.4)
4	Columbia	Berwick	US 11 (Front Street) and Poplar Street	Restriping on Poplar Street	C (27)	D (36.8)	D (40)	B (17.2)
5	Columbia	Berwick	US 11 (Front Street) and Orchard Street		A (6.7)	A (8)	B (17.7)	D (49.1)
6	Columbia	Berwick	US 11 (Front Street) and SR 93 (Orange Street)		A (5.9)	B (11.5)	B (11)	D (45.7)
7	Columbia	Berwick	US 11 (Second Street) and LaSalle Street		B (11.8)	A (8.3)	B (14.1)	B (12.6)
8	Columbia	Berwick	US 11 (Second Street) and Oak Street		A (6.2)	A (7.4)	A (8)	A (7.7)
9	Columbia	Berwick	US 11 (Second Street) and Mulberry Street		A (4.8)	A (3.4)	A (5.7)	A (6)
10	Columbia	Berwick	US 11 (Front Street) and Mulberry Street		A (6.1)	B (12.1)	A (8)	A (8.4)
11	Columbia	Berwick	SR 1020 (Market Street) and Third Street		A (9.6)	A (8.8)	B (12.8)	B (12.8)
12	Columbia	Berwick	US 11 (Second Street) and Market Street	Restriping on Market Street	A (9.7)	A (6.3)	B (11.7)	B (14)
13	Columbia	Berwick	US 11 (Front Street) and Market Street	Restrict street parking on Front Street	B (14.2)	B (16.3)	B (15.3)	A (8.8)
14	Columbia	Berwick	US 11 (Second Street) and Pine Street		A (6)	A (7.6)	A (8.6)	B (15.9)
15	Luzerne	Nescopeck	SR 93 (Third Street) and SR 339 (Broad Street)		B (14.1)	C (22.6)	B (12.3)	B (16.4)
16	Luzerne	Nescopeck	SR 93 (Third Street) and Dewey Street		A (4.6)	A (4.6)	A (3.7)	A (4.3)
17	Luzerne	Salem Township	US 11 and Bell Bend Site Entrance	Proposed site-access road	--	C (20.2)	--	B (19.6)
18	Luzerne	Salem Township	US 11 and SSES Site Entrance	Temporary traffic signal	--	D (35.2)	--	D (35.2)
19	Luzerne	Shickshinny	US 11 (S. Main Street) and SR 239	Add thru lane on SB-NB US 11, add right turn bay on RT 239 onto US 11	A (7.8)	A (5.6)	A (9.4)	B (10.8)
20	Luzerne	Shickshinny	US 11 (Main Street) and SR 239 (Union Street)	Restrict parking on US 11 SB	B (14.7)	B (14.9)	B (15.5)	B (18)
21	Luzerne	Nanticoke	US 11 and SR 29 (Mill Street)	Modify intersection to provide uninterrupted flow for NB US 11	C (23.6)	C (29.5)	C (26.3)	C (21.5)
22	Luzerne	Nanticoke	US 11 and County Bridge	Add thru lane on US 11 NB and Make US 11 NB two lanes to intersection with RT 29	D (49.5)	B (14.1)	C (24.2)	C (31.1)
23	Luzerne	Nanticoke	US 11 (E. Poplar Street) and SR 29	Temporary traffic signal and restrict left turn from SB US 11 onto NB RT 29	--	C (23.3)	--	B (16.8)

Notes: A = free flow, B = reasonably free flow, C = stable flow, D = approaching unstable flow, E = unstable flow, F = forced or breakdown flow, NG = no-gap, FNB = future no-build scenario; delay = average delay in seconds/vehicle, NB = north bound, SB = south bound, RT = route

Source: KLD 2011-TN1228

automatic traffic recorder on Confers Lane during A.M. and P.M. peak periods, and counted 7 to 13 vehicles per hour. Thus, the closure of Confers Lane was expected to have very little impact on local traffic flow.

The supplemental traffic study did, however, note that mitigation may be required in the form of adding one school bus with driver, and a van or a shorter school bus to mitigate traffic conflicts between the BBNPP workforce and local school buses on US 11. The traffic study also recommended that a plan be developed in consultation with the Berwick Area School District and Salem Township to remove scheduled stops from US 11 for four identified school bus routes when construction peak traffic overlaps with bus trips. Finally, the KLD study identified a need to revise the 2008 Salem Township Radiological Emergency Response Plan and alter police deployment strategies or add a police unit or extend hours of service to mitigate the effects of the Confers Lane closure (KLD 2013-TN2841).

In addition to congestion impacts, construction-related traffic will also result in emissions, traffic accidents, injuries, and fatalities. The heavy vehicles that transport construction-related equipment and materials and the autos carrying the commuting workforce to the BBNPP site will emit several pollutants, including carbon monoxide, carbon dioxide (CO_2), oxides of nitrogen, fine particulate matter, volatile organic compounds, and sulfur dioxide. Health and other costs associated with air-quality impacts will vary based on fuel type, motor fuel economy, and local climate and air-quality conditions. Section 4.7.2 presents an estimate of CO_2 emissions associated with construction activities. Construction-related traffic will also result in an increase in the number of accidents, injuries, and fatalities. The costs associated with these incidents include workers' compensation premiums, lost productivity, environmental remediation, property damage, fines and penalties, insurance premiums, and medical costs. Section 4.8.3 presents an estimate of construction-related vehicular impacts on accidents, injuries, and fatalities. As discussed in Sections 4.7.2 and 4.8.3, the review team expects construction-related emissions and traffic accidents to be minor. Therefore, the socioeconomic impacts of construction-related emissions and traffic accidents would also be minor.

In the absence of the proposed mitigation strategies, the expected impacts on the local highway network would be significant. With the proposed mitigation strategies, the expected impacts on the local highway network would be noticeable. These mitigation strategies must be agreed to by applicable Pennsylvania Department of Transportation (PennDOT) regions prior to PPL submitting final highway occupation permit engineering plans for review. Mitigation strategies that are agreed upon with PennDOT in the final approved TIS would be required as a condition of issuing a highway occupation permit (PPL Bell Bend 2013-TN3377). Therefore, the review team concludes that it is reasonably foreseeable that PPL would implement these measures.

4.4.4.2 Recreation

As described in Section 4.4.1, building activities are not expected to have significant physical impacts on nearby recreational resources. Impacts, such as increased noise, increased traffic, impacts on air quality, and visual aesthetics, would be temporary and would decrease with distance from the source. Socioeconomic impacts on recreation may result from increased demand for use of existing and planned resources and from the physical impacts mentioned previously. The increase in demand on existing/planned resources would result from usage by the increased population (2,480 to 3,755 total in-migrating direct and indirect workforce population as discussed in Section 4.4.2).

Recreation areas closest to the BBNPP site that could be affected include the Riverlands Recreation Area, Lake Took-A-While, the Wetlands Nature Area, Nescopeck State Park, Ricketts Glen State Park, Paradise Campground Resort, Council Cup Campground, and State Game Lands 55, 224, and 260. Within the 50-mi region surrounding the BBNPP site, there are 17 State parks, 6 State forests, 67 State Game Lands, and three Federal recreation sites (see Table 2-38). Within 50 mi of the BBNPP site, there are 44,992 ac of State parks, 301,573 ac of State forests, 452,029 ac of State Game Lands, and 2,105 ac of Federal recreational areas (ESRI 2008-TN2227; PASDA 2011-TN2230; PASDA 2013-TN2234). These recreation areas encompass more than 800,000 ac of land. Visitors to State parks located within the 50-mi region surrounding the BBNPP site spent more than 1.6 million days/nights at these sites in 2010 (Mowen et al. 2012-TN2222).

Given the abundance of recreational facilities within the region, the review team concludes that these resources would accommodate the increased population and associated increased demand on them that would occur during construction. The region has sufficient capacity to accommodate any displaced users at surrounding parks and recreational areas if such users choose to avoid certain recreation resources located near the BBNPP during building. The review team determined that impacts on recreational facilities and on the quality of the recreational experience during building would be minor.

4.4.4.3 Housing

Regional housing characteristics and availability are described in Section 2.5.2.5 and Table 2-44. The assumptions behind the review team's estimated in-migration of workers were established in Section 4.4.2. If the entire workforce required to build the proposed BBNPP were to originate from outside the economic impact area, there would be a negligible impact on housing demand. However, the review team expects that approximately 790 to 1,383 construction workers (20 to 35 percent of the total anticipated workforce) would locate into the region and that 688 to 1,204 of those workers (87.1 percent) would migrate into the economic impact area. In addition, 316 operations workers onsite during the peak construction period would migrate into Columbia and Luzerne Counties. The review team assumes that 44.8 percent and 42.3 percent of the BBNPP workforce would reside in Columbia and Luzerne Counties, respectively. These estimates are based on the current distribution of SSES workers. Based on these assumptions, the review team estimates the in-migrating direct and indirect workforces to total 517 to 782 and 488 to 738 households in Columbia and Luzerne Counties, respectively.

Construction workers may choose to rent housing, stay in hotels/motels, or stay in campers or mobile homes, while operations workers are likely to purchase housing. According to the 2006−2010 ACS, 21,067 housing units in the two-county economic impact area are vacant: 3,407 and 17,660 in Columbia and Luzerne Counties, respectively (USCB 2011-TN2072). In addition to the vacant housing units described above, there are 96 hotels, motels, and bed and breakfasts with a total of 3,674 units located in the two-county economic impact area (PPL Bell

Bend 2013-TN3377). There are also a total of 28 campgrounds located in the economic impact area within a 30-mi radius of Berwick with nearly 3,000 sites that could accommodate members of the construction workforce.

In 2012, local officials in the Borough of Berwick indicated that the current availability of vacant new and rental homes near the BBNPP site were limited. According to Berwick officials, during the construction of the SSES, houses were purchased, divided into multiple family dwellings, rented at a high price during the construction period, and then left to fall into disrepair in the years that followed. Berwick staff shared the concern that this pattern would reoccur with the construction of the BBNPP. Berwick staff also noted that there is very little room for growth in Berwick and that local ordinances would limit the number of trailer and recreational vehicle (RV) parks that could be added to the Berwick area. Thus, Berwick staff concluded that there would be limited capacity to accommodate additional housing demands placed upon Berwick during the BBNPP building period (NRC 2012-TN1694).

The review team examined USCB ACS data to assess the capacity for local communities to provide housing to in-migrating workers and their families. In 2010, vacancy rates were lower in Berwick (430 units or 9.6 percent of the housing stock) compared to other surrounding communities. In Bloomsburg, there were 584 vacant housing units (11.3 percent) among 5,152 total units in 2010. The number of vacant units in Wilkes-Barre was 2,851 (14.6 percent) in 2010. In Nanticoke, there were 5,312 housing units in 2010, and 622 (11.7 percent) were vacant. In Hazleton, there were 11,936 housing units, and 1,891 (15.8 percent) stood vacant (USCB 2011-TN2072). The gravity model described in Section 4.4.2 was used to determine the number of workers that could require housing in the Borough of Berwick. The model estimates that 30.3 percent or 304 to 461 workers and their families could move into the Berwick area. Because of housing constraints, many of these employees may require housing in local motels, RV parks, and campgrounds.

The boom-and-bust nature of large-scale construction projects aggravates the housing impacts in local communities. The typical pattern begins when in-migrating workers and their families (along with local residents with enhanced economic resources because of project- and worker-related jobs and expenditures) increase the demand for housing. Increased demand creates upward pressure on both the housing supply and prices in the local area. When construction ends, most-in-migrating workers leave, and most local indirect jobs also are lost. Because part of the workforce already lives locally, some of these impacts could be avoided.

Building the BBNPP could affect housing values in the vicinity of the BBNPP site. In a review of previous studies of the effect of seven nuclear facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling concluded that assessed valuation and median housing prices have tended to increase at rates above national and State averages (Bezdek and Wendling 2006-TN2748). Clark et al. similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative imagery of the facilities (Clark et al. 1997-TN3000). These findings differ from studies that evaluated undesirable facilities, largely related to hazardous waste sites and landfills, but also included several studies of power facilities (Farber 1998-TN2857) in which property values were negatively affected in the short-term. These effects moderated over time. Bezdek and Wendling attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area (Bezdek and Wendling 2006-TN2748). While noting the findings of the studies discussed above, the price effects near Berwick are likely to be noticeable because the estimated upper bound for employees migrating into Berwick would exceed the available housing capacity.

Based on the information provided by PPL Bell Bend, interviews with local real estate agents and city and county planners, and the review team's own independent analysis, the staff expects the housing-related impacts of construction of the BBNPP would be minor, with the exception of the Borough of Berwick, Pennsylvania, where the impacts would be noticeable.

4.4.4.4 Public Services

This section describes the public services available and discusses the impacts of construction at the BBNPP site on water supply and waste treatment, police, fire-protection and medical services, and education services in the region.

Water-Supply Facilities

The demand on potable water utilities would increase at the BBNPP site and where the construction workforce migrates into communities during the building phase. A detailed description of project-related water requirements and resulting impacts is presented in Section 4.2. The BBNPP would obtain potable water from the Berwick District of the PAWC. During the building phase, water demand onsite is expected to average 77,800 to 130,000 gpd (PPL Bell Bend 2013-TN3377). At peak employment, the in-migrating workforce population, including families of construction and operations workers, is expected to reach between 2,480 and 3,755 people. PPL estimates per capita water consumption of 100 gpd, resulting in an additional demand for potable water of 248,000 to 375,479 gpd (PPL Bell Bend 2013-TN3377). By combining onsite use and offsite use by the workers and their families, total water demand is estimated to be 408,010 to 535,479 gpd.

Section 2.5.2.6 presents water use and capacities for major water-supply systems in Columbia and Luzerne Counties. As demonstrated, building-related water use is well within the excess capacity of local water suppliers in Columbia and Luzerne Counties. Municipal water users in Luzerne County currently consume 37 (Mgd compared to a water-supply plant capacity of 66 Mgd. In Columbia County, users consume 4 Mgd compared to a water-supply plant capacity of approximately 9 Mgd. The PAWC district in Berwick has an excess capacity of 3.1 Mgd. Therefore, the review team concludes that the impacts of building the proposed BBNPP on local water systems would be minor.

Wastewater-Treatment Facilities

There are 12 sewer authorities in Columbia County operating wastewater-treatment facilities with a total design capacity of 9.1 Mgd. In Luzerne County, nine sewer authorities operate wastewater-treatment facilities with a total design capacity of 54.9 Mgd. In Columbia and Luzerne Counties, wastewater systems have 3.6 Mgd and 15.5 Mgd of excess capacity, respectively. Section 2.5.2.6 presents 5-year average and 3-month maximum hydraulic load and design capacity for every major sewer district/system in Columbia and Luzerne Counties.

Wastewater-treatment facilities in the economic impact area have enough additional capacity to treat the entire 532,015 to 723,218 Mgd used by workers at the site and the increased in-migrating population.

Police, Fire-Protection, and Medical Facilities

A temporary increase in population from the project workforce for a new nuclear facility could increase the burdens on local fire-protection, police, and health facilities. This increase, however, would be transitory in nature. After the project has been completed, many of the workers would leave the area, relieving those burdens. During the building phase, the temporary increase in demand for community resources could be mitigated in several ways. Larger communities would experience less difficulty in assimilating the influx of new residents because the additional population would compose a small percentage of the communities' base populations. Likewise, the more communities that host new workers, the less pressure each individual community would experience on its infrastructure. Consequently, any incentives PPL can provide its employees to move into the area in a planned manner would mitigate, but not remove, the short-term demand. Next, communities could avoid the long-term commitments to the maintenance and operation of infrastructure purchases to fulfill short-term demand increases. Instead of purchasing new fire-protection or policy equipment, affected communities could lease vehicles or building space.

Law enforcement within the economic impact area is provided by the Pennsylvania Department of State Police, the Luzerne County Sheriff's Office, Columbia County Sheriff's Office, and local city, township, and borough police departments. Within the economic impact area, Columbia and Luzerne Counties employ an estimated 126 and 570 police officers, respectively (Pennsylvania State Police 2010-TN1868). The number of police per thousand residents is 1.9 for Columbia County and 1.8 for Luzerne County. Assuming that 1,276 to 1,932 in-migrating workers and their families live in Columbia County, the police per thousand residents there would decline to 1.8. In Luzerne County, where 1,205 to 1,824 workers and their families are expected to live, the number of police per thousand residents would remain 1.8.

A representative of the Borough of Berwick indicated that the borough's police force was working at capacity and that it could be difficult to accommodate additional activity generated by the BBNPP construction workforce (Balducci 2009-TN4027). To maintain current officer-to-resident ratios in Columbia and Luzerne Counties would, respectively, necessitate the hiring of an additional 2 to 4 and 2 to 3 officers.

Firefighting services within the economic impact area are provided by 90 fire departments operating 117 fire stations with 3,225 active firefighters (see Table 2-49 in Section 2.5.2.6). In Columbia County, 23 fire departments operate 27 fire stations with 751 volunteer and 150 paid per call firefighters. In Luzerne County, 67 fire departments operate 90 fire stations with 180 career, 2,014 volunteer, and 130 paid per call firefighters (USFA 2013-TN1867). There are 7.2 firefighters per 1,000 people in Luzerne County and 13.3 per 1,000 people in Columbia County. With the increased population, the number of firefighters per thousand residents in Columbia and Luzerne Counties would fall to 13.0 to 13.1 and 7.2, respectively. In 2011, the national average rate of firefighters per 1,000 people was 3.5 (Karter and Stein 2012-TN1871). To meet the demands placed on the fire-protection network, Columbia County would need to add an additional 17 to 26 firefighters based on the county rate of 13.3 firefighters per thousand residents. In Luzerne County, an additional 9 to 13 firefighters would be needed. With that noted, there is presently additional capacity within the existing system to address the estimated population influx while still maintaining firefighter rates that exceed the national average.

The Salem Township Fire Department and Berwick Fire Department are closest to the BBNPP site. The BBNPP site is located in Salem Township 4.27 mi from Berwick, Pennsylvania. The Berwick Fire Department comprises five companies. In 2010, the department responded to 410 calls that required a response, 123 of which were to communities located outside of Berwick (Berwick Borough 2013-TN2008). While meeting with staff and elected officials in the Borough of Berwick, the review team did not receive any information to suggest that the borough's fire department was operating at or near capacity. In Salem Township, however, township staff noted that investments were needed for local fire and emergency response systems to accommodate the BBNPP (NRC 2012-TN1694).

Ten hospitals are located within the economic impact area. The Berwick Hospital Center and Bloomsburg Hospital are located in Columbia County. The other eight hospitals (Geisinger Wyoming Valley Medical Center, Hazleton General Hospital, Wilkes-Barre General Hospital, First Hospital Wyoming Valley, John Heinz Institute of Rehabilitation, Kindred Hospital – Wyoming Valley, Mercy Special Care Hospital, and the Veterans Administration Medical Center) are located in Luzerne County. Table 2-50 in Section 2.5.2.6 presents use and personnel data for hospitals located within the economic impact area.

In 2010-2011, there were 1,007 staffed beds and 804 physicians at Luzerne County hospitals. Luzerne County hospitals provided 253,873 patient days over the same time period. Luzerne County hospitals were operating at 70.4 percent capacity in 2010-2011 (PADOH 2012-TN2224). In addition to these hospitals, there are 26 nursing homes located in Luzerne County with 2,912 licensed/approved beds (PPL Bell Bend 2013-TN3377). Wilkes-Barre General is the largest hospital in the county with 17,065 admissions and 375 staffed beds in 2010-2011. In Columbia County, there are two hospitals (Berwick Hospital Center and Bloomsburg Hospital) with 173 staffed beds and 123 physicians (PADOH 2012-TN2224). There are also five nursing homes with 685 licensed/approved beds (PPL Bell Bend 2013-TN3377). The Berwick Hospital Center is the largest hospital in the county with 101 acute care beds. In 2010-2011, there were 3,190 patients admitted who received 14,046 patient days of care at the hospital. Columbia County hospitals are currently operating at 40.5 percent of capacity (PADOH 2012-TN2224). Based on the size and availability of medical services in the region, temporary construction workers would not overburden existing medical services. The review team concludes that adverse impacts on medical services near the proposed site would be minor and temporary.

4.4.4.5 Education

The building of the BBNPP is expected to bring 1,004 to 1,520 in-migrating workers to the region at the peak of employment in 2023. Many of these workers would be in the area for a small number of years. As indicated in Section 4.4.2, the review team assumes that 87.1 percent of in-migrating construction workers and their families would settle within the economic impact area. The review team estimates that the number of households in Columbia and

Luzerne Counties would grow by 517 to 782 and 488 to 738, respectively. Populations in the economic impact area would be expected to grow by 2,480 to 3,755 people.

A number of local school districts would be affected by in-migrating families during the building and operation of the BBNPP. There are 117 primary and secondary schools in 23 districts within the economic impact area. The total student enrollment at these schools for the 2010-2011 school year was approximately 57,000 (NCES 2013-TN4026), and the number of instructors teaching these students was 3,923. The student-to-teacher ratio for all schools in the economic impact area was 14.5 in 2010-2011, and was 12.6 and 15.0 in Columbia and Luzerne Counties, respectively. The student-to-teacher ratio in Columbia County falls below the statewide average of 13.8, while the Luzerne County ratio is above the statewide average (NCES 2013-TN4026).

With a population of 388,214, there are approximately 7.0 individuals for every student enrolled in schools within the economic impact area. Applying this ratio, the review team expects a peak building-related increase of approximately 354 to 536 students. When adding the influx of students generated during plant construction, student-to-teacher ratios would increase to 12.9 to 13.0 in Columbia County and 15.1 in Luzerne County. To keep student-to-teacher ratios at current levels, Columbia County schools would have to add 14 to 22 teachers and Luzerne County schools would have to add 11 to 17 teachers.

A number of school districts could be affected by in-migrating families during the construction and subsequent operation of the BBNPP, including the Berwick Area School District (Luzerne and Columbia Counties), Hazleton Area School District (Carbon, Luzerne, and Schuylkill Counties), Crestwood School District (Luzerne County), and the Greater Nanticoke Area School District (Luzerne County). Other school districts potentially affected by the in-migrating families are the Wilkes-Barre and the Bloomsburg Area School Districts. Based on calculations performed using the regional gravity model, the Berwick Area School District appears most likely to be affected by the in-migrating workforce and their families. The Berwick Area School District serves the boroughs of Berwick, Briar Creek, and Nescopeck and the townships of Salem, Briar Creek, Nescopeck, and Hollenback. The Berwick Area School District encompasses most of the area in the immediate vicinity of the BBNPP site and is located in both Columbia and Luzerne Counties. Gravity model output indicates that the Berwick Area School District could add 156 to 236 students during the BBNPP construction period.

There are six schools in the Berwick Area School District, and the district's student-to-teacher ratio was 13.1 for the 2010-2011 school year (NCES 2013-TN4026). In a recent interview with the review team, a representative of the Berwick Area School District indicated that the student-to-teacher ratio would likely be growing above 15.0 as a result of recent staff layoffs (NRC 2012-TN1890). Section 2.5.2.6 demonstrates that schools within the Berwick Area School District could absorb additional students, with use-to-capacity ratios ranging from 66.5 percent to 91.3 percent; however, a representative of the Berwick Area School District noted that most of its buildings were aging; three elementary school buildings—Orange, Nescopec, and 14th Street—were built prior to 1935. These elementary school buildings need to be upgraded or replaced. If there is no influx of students, the district may consider closing one elementary school in the near future. If there was an influx of students associated with BBNPP construction, the district would receive more real estate taxes and State funding because its apportionment is in part based on enrollment (Balducci 2009-TN4027).

The review team concludes that impacts on public schools in the economic impact area would be minor, with the exception of the Berwick Area School District where the impacts during the construction period would be noticeable.

4.4.4.6 Summary of Infrastructure and Community Services Impacts

Based on information obtained from PPL, interviews with city and county planners, analysis of Federal and State databases, and interviews conducted with school district officials in Berwick, the review team concludes that preconstruction and construction impacts on regional infrastructure and community services would be SMALL, with the exception of the following impacts: MODERATE traffic impacts on the local highway network, MODERATE housing impacts in the Borough of Berwick, and MODERATE impacts on the Berwick Area School District. The traffic impact assessment assumes that PPL would implement mitigation strategies proposed in the ER. These mitigation strategies must be agreed to by applicable PennDOT regions prior to PPL submitting final highway occupation permit engineering plans for review. Mitigation strategies that are agreed upon with PennDOT in the final approved TIS would be required as a condition of issuing a highway occupation permit (PPL Bell Bend 2013-TN3377). Therefore, the review team concludes that it is reasonably foreseeable that PPL would implement these measures. NRC-authorized construction activities represent a large fraction of the analyzed activities. Each of the MODERATE impacts identified in this section would be temporary and at least partially offset by the beneficial tax impacts of BBNPP construction and operations. The review team recognizes that monetary compensation does not represent mitigation. Rather, future tax proceeds could be used to address some of the aforementioned MODERATE adverse impacts.

4.4.4.7 Summary of Socioeconomic Impacts

Based on information provided by PPL, the review team's independent analysis, and taking into account the BMPs and mitigation measures described in the Bell Bend ER, the review team concludes that the overall physical impacts of building on workers and the local public, buildings, roads, and aesthetics near the BBNPP site would be SMALL. The designation of SMALL with respect to air quality is dependent on PPL's implementation of the mitigation strategies outlined in the ER. The review team concludes that it is reasonably foreseeable that PPL would implement these measures to ensure compliance with regulatory limits defined by the primary and secondary NAAQSs in 40 CFR Part 50 (TN1089), the National Emission Standards for Hazardous Air Pollutants in 40 CFR Part 61 (TN3289), Pennsylvania Department of Labor and Industry occupational health and safety regulations, and PADEP regulations regarding operation of the concrete batch plant (PPL Bell Bend 2013-TN3377). Based on the current availability of services and additional taxes that would likely compensate the need for additional services, the staff concludes that the building impacts on the affected local economies would be beneficial and SMALL in the 80-km (50-mi) radius region centered on the proposed site, with the exception of Columbia County where impacts would be MODERATE. The effect on tax revenues would be beneficial and SMALL during the building phase with the exception of Salem Township where impacts would be MODERATE. The temporary traffic impacts in the

Berwick area and along US 11 would be MODERATE, but SMALL elsewhere. The traffic impact assessment assumes that PPL would implement mitigation strategies proposed in the ER. These mitigation strategies must be agreed to by applicable PennDOT regions prior to PPL submitting final highway occupation permit engineering plans for review. Mitigation strategies that are agreed upon with PennDOT in the final approved TIS would be required as a condition of issuing a highway occupation permit (PPL Bell Bend 2013-TN3377). Therefore, the review team concludes that it is reasonably foreseeable that PPL would implement these measures. The impacts on public services would be SMALL throughout the region with the exception of housing impacts in Berwick and education impacts on the Berwick Area School District, where impacts would be MODERATE. NRC-authorized construction activities represent a large fraction of the analyzed activities.

4.5 Environmental Justice Impacts

The review team evaluated whether the health or welfare of minority and low-income populations in the census blocks identified in Section 2.6 could experience a disproportionately high and adverse impact from activities related to building the proposed BBNPP. To perform this assessment, the review team (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for individuals within the identified census block groups and other areas identified through the review team's onsite evaluations, and (3) determined whether the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionately high and adverse impact on any minority or low-income individuals within each census block group.

As discussed in Section 2.6.3, the review team did not find any evidence of unique characteristics or practices in the region that could lead to a disproportionately high and adverse impact on any minority or low-income population.

4.5.1 Health Impacts

Through literature searches and consultations with NRC staff health experts, the review team assessed whether the expected building-related level of environmental emissions would or would not impose a disproportionately high and adverse radiological health effect on any identified minority or low-income populations. From the review team's investigation, Section 4.9 of this EIS assesses the radiological doses to construction workers and concludes that the doses would be within NRC and EPA dose standards. Section 4.9 further concludes that radiological health impacts on the construction workers for the proposed BBNPP would be SMALL. In addition, there would be no radioactive material on the construction site except for very small sources such as those commonly used by radiographers; therefore, there would be no radiation exposure to members of the public living near the construction site. Based on this information, the review team concludes there would be no disproportionately high and adverse radiological health impact on minority or low-income members of the construction workforce or the local population.

As described in Section 4.4.1, the potential environmental and physical effects of building the proposed BBNPP would be generally confined within the site boundaries with few exceptions, leading to no offsite health impacts on identified populations. Where there would be potential offsite nonradiological health effects, the review team did not identify any studies, reports, or anecdotal evidence that would indicate any environmental pathway that would physiologically affect minority or low-income populations differently from other segments of the general population during building activities. Moreover, the review team's regional outreach provided no indication of either the location or practices of minority and low-income populations in the 50-mi region that suggests they would experience any disproportionately high and adverse nonradiological impacts (Balducci 2009-TN4027). In addition, the review team determined that the nonradiological health effects of building activities and other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on nonradiological health would be localized and minimal (Sections 4.8.4 and Section 7.7). The review team's investigation and outreach did not identify any unique characteristics or practices among minority and low-income populations that would result in disproportionately high and adverse nonradiological health impacts.

4.5.2 Physical and Environmental Impacts

Building a nuclear power station is very similar in its environmental effects to building any other large-scale industrial project. There are four primary pathways in the environment: soil, water, air, and noise. Discussions of the potential impacts on each of these pathways are provided in the following sections.

4.5.2.1 Soil

Building activities at the BBNPP site represent the largest source of soil-related environmental impacts. However, these impacts would be localized to the site, would be sufficiently distant from surrounding populations, would have little migratory ability, and would be mitigated through strategies implemented by PPL to minimize noticeable offsite impacts. PPL would follow an erosion and sediment control plan, which outlines specifications for controlling soil erosion. The erosion and sediment control plan would be prepared in compliance with 25 PA Code Chapter 102, Erosion and Sediment Control (PPL Bell Bend 2013-TN3377).

The review team concludes that soil-related environmental impacts during the building of proposed BBNPP would not have disproportionate impacts on minority or low-income populations.

4.5.2.2 Water

As described in Section 4.2, the review team expects project-related impacts on surface water to be minimal because total water demand would represent a small portion of the available water and because there would be minimal surface-water-quality effects. The review team expects all effects on groundwater to be minimal because building-related usage effects would be localized and temporary and there would be no effect on groundwater quality. Therefore, the review team determined the potential negative offsite environmental effects from impacts on water sources would be small; and, consequently, there would be no disproportionately high and adverse water-related impacts on minority or low-income populations.

4.5.2.3 Air

Air emissions are expected from increased vehicle traffic, heavy equipment operations, and fugitive dust generated by project activities. The heavy vehicles that transport construction-related equipment and materials and the autos carrying the commuting workforce to the BBNPP site will emit several pollutants, including carbon monoxide, carbon dioxide (CO_2), oxides of nitrogen, fine particulate matter, volatile organic compounds, and sulfur dioxide. Emissions from vehicles and heavy equipment are unavoidable, but would be localized and temporary. Emissions from fugitive dust would be localized, and dust-control measures would be implemented to maintain compliance with NAAQSs. PPL plans to implement a dust-control program during construction to mitigate emissions. BMPs and control measures would include routinely inspecting vehicle and equipment, monitoring emissions in areas where they could exceed limits (e.g., at the concrete batch plant), limiting vehicular speed on unpaved roads, watering unpaved roads, using soil adhesives to stabilize loose dirt surfaces, covering haul trucks when loaded or unloaded, ceasing grading and excavation during high winds and air pollution episodes, phasing grading to minimize areas of disturbed soil, and obtaining any required release permits and operating certificates. The concrete batch plant would be operated in compliance with PADEP regulations and would avoid emissions from trucks that otherwise would deliver concrete to the site (PPL Bell Bend 2013-TN3377). The review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in different air-quality-related impacts compared to the general population. The review team determined that negative environmental effects from building-related reductions in air quality would be small, localized, and short-lived for any population in Columbia and Luzerne Counties. Consequently, the review team found no disproportionately high and adverse impacts on minority or low-income populations due to changes in air quality.

4.5.2.4 Noise

Noise levels from building activities may exceed 100 dBA within the site, but would be attenuated by distance, vegetation, and topography. Noise from traffic along the access routes to the BBNPP may intermittently exceed levels acceptable for residential areas. However, these impacts would be more noticeable within the vicinity of the site or the site-access roads. Sensitive noise receptors closest to the site would likely experience intermittent, but temporary, noise pollution during the peak of building activities. The noise impacts from building activities would be temporary in nature, and the distance between the site and minority and low-income populations would be large.

To limit onsite noise impacts, workers would use noise protection as required by the OSHA when engaging in work subject to noise hazards. To limit impacts on onsite workers and at offsite locations, PPL also plans to use several noise management practices, including scheduling activities with high noise levels during daytime hours, maintaining noise-limiting devices on vehicles and equipment, controlling access to high noise areas, and shielding high noise sources from their origins. The nearest residence is located more than 2,000 ft (610 m) from the center of the construction site, and PPL has estimated that peak noise conditions at that residence would be below 65 dBA at all times (PPL Bell Bend 2013-TN3377).

As discussed in Section 2.6, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in a disproportionately high and adverse impact on minority or low-income populations.

4.5.3 Socioeconomic Impacts

Socioeconomic impacts in Section 4.4 were reviewed to evaluate whether any building-related activities could have a disproportionately high and adverse effect on minority or low-income populations. The review team expects traffic to increase beyond capacity at several key intersections located near the BBNPP site. To address building impacts on traffic, PPL has proposed a number of mitigation strategies, including (1) installing additional signals at the entrance of the BBNPP access road and other cross roads, (2) realigning lanes on US 11 near the entrance of the BBNPP site, (3) expanding the interchange where US 11 meets the BBNPP access road by adding more entrance and exit lanes, (4) constructing a dedicated access road, and (5) retiming signals, restriping, through lanes, installing temporary traffic signals, implementing parking restrictions, and taking other measures as required at intersections affected by construction-related traffic. These mitigation strategies must be agreed to by applicable PennDOT regions prior to PPL submitting final highway occupation permit engineering plans for review. Mitigation strategies that are agreed upon with PennDOT in the final approved TIS would be required as a condition of issuing a highway occupation permit (PPL Bell Bend 2013-TN3377). Therefore, the review team concludes that it is reasonably foreseeable that PPL would implement these measures.

With the proposed mitigation strategies in place, nearly all of the LOSs at the intersections would fall within acceptable levels, with the exception of US 11 and Briar Creek Plaza Driveways and US 11 and the site entrance to the Susquehanna Steam Electric Station during the A.M. peak hours, and US 11 (Front Street) and Orchard Street, US 11 (Front Street), and SR 93 (Orange Street), or US 11 and the site entrance to Susquehanna Steam Electric Station during the P.M. peak hours. While adverse impacts on traffic would be likely, the review team did not identify any unique characteristics or practices in the minority or low-income populations that could lead to a disproportionately high and adverse impact. Further, minority and low-income populations identified in Section 2.6 are not located along the corridors most affected by construction-related traffic.

As discussed in Section 2.6, no minority or low-income block groups reside in the vicinity of the BBNPP site or in the Borough of Berwick where noticeable impacts associated with housing and education are expected. The review team found no evidence of any unique characteristics or practices among those communities that could lead to a disproportionately high and adverse impact. The review team identified all potential pathways for human health and welfare effects and found no project-related pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionately high and adverse environmental or health impacts as a result of construction and preconstruction activities.

4.5.4 Subsistence and Special Conditions

The NRC environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances (e.g., minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native

American settlements). The review team conducted interviews with local officials and staff of the Berwick Hospital, Columbia County Housing Authority, Columbia County Redevelopment Authority, Luzerne County Commission on Economic Development (CED), and school districts situated near the site. None of these entities track subsistence users quantitatively, nor did any have information specific to the site (Balducci 2009-TN4027). The review team identified hunting levels in the region and the primary bodies of water where subsistence fishing may occur. The review team also reviewed surveys of fisherman in the area conducted by the PFBC. Finally, the review team reviewed the ER and conducted a search for literature that failed to identify reports documenting subsistence activities near the BBNPP site. Therefore, the review team concludes that there would be no disproportionately high and adverse impacts on the subsistence activities of minority or low-income populations from building the proposed BBNPP.

4.5.5 Summary of Environmental Justice Impacts

The review team evaluated the potential environmental justice impacts on the 50-mi region from the proposed construction and preconstruction activities related to building the proposed BBNPP and determined that there would be no environmental, health, or socioeconomic pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionately high and adverse environmental or health impacts as a result of preconstruction and construction activities at the BBNPP site.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969, as amended (NEPA; 42 USC 4321 et seq.-TN661) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA; 54 USC 300101 et seq. -TN4157), requires Federal agencies to consider impacts on those resources if they are eligible for listing on the National Register of Historic Places (NRHP)—such resources are referred to as “historic properties” in the NHPA. As outlined in 36 CFR 800.8(c) (TN513), “Coordination with the National Environmental Policy Act of 1969,” the NRC and the USACE are coordinating compliance with Section 106 of the NHPA in fulfilling their NEPA obligations, with the USACE identified as the lead agency for cultural resources.

Building new nuclear power units can affect either known or undiscovered cultural resources. In accordance with the provisions of the NHPA and the NEPA, the NRC and USACE are required to make a reasonable and good faith effort to identify historic properties in Areas of Potential Effect (APEs) for construction and preconstruction and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the appropriate State Historic Preservation Officer (SHPO), American Indian Tribes (Tribes), interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them describe potential mitigation. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the NRHP) are present or affected, the NRC and the USACE are still required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC and USACE are required to assess and resolve any adverse effects of the undertaking. As explained in Section 2.7.4, the USACE has determined that there will be no adverse effects from the proposed BBNPP unit (USACE 2013-TN2243) and the Pennsylvania SHPO has concurred (PHMC 2013-TN2237).

4.6.1 Onsite Cultural and Historic Resources Impacts

For a description of the historic and cultural resources information about the BBNPP site, see Section 2.7. As explained in Section 2.7, previous cultural resource identification efforts indicated the presence of numerous archaeological sites and architectural resources within the direct (physical) and indirect (visual) APEs (Table 2-53 in Section 2.7). One archaeological resource, 36LU288, has been determined NRHP-eligible. Pursuant to 36 CFR 800.5 (TN513), NHRP-eligible archaeological resources can be adversely affected by ground-disturbing activities that directly impact, disturb, or destroy archaeological deposits that contribute to the eligibility of the site. PPL and the Pennsylvania SHPO have agreed on “temporary avoidance and mitigation measures” that PPL will take to protect 36LU288 (Wise 2012-TN1755). These measures include installation of geotextile fabric and fill and regular inspections throughout the period of construction. Therefore, in a letter to the USACE the Pennsylvania SHPO has agreed that there will be no adverse effect on that resource, "providing that “avoidance measures for 36LU288 be included as a special condition on your permit” (PHMC 2013-TN2237).

4.6.2 Offsite Cultural and Historic Resources Impacts

As described in Section 2.7.2.2, three aboveground properties located within the viewshed of the proposed project have been determined NRHP-eligible. These are the Pennsylvania Canal, North Branch, Key# 141673; the Union Reformed and Lutheran Church, Key# 155049; and the A.K. Harter Farm, Woodcrest, Key# 155052 (Table 2-54 in Section 2.7). A visit to the properties on September 22, 2011, by GAI Consultants, Inc. (GAI) and the Pennsylvania Historical and Museum Commission (PHMC) concluded that there would be no adverse effect because the visibility of the proposed new cooling tower and the associated plumes from the historic resources will be minimal due to the new tower's proposed location west of, and behind, the existing SSES Unit 1 and 2 cooling towers (PHMC 2011-TN1756).

The Consumptive-Use Mitigation Plan (CUMP) is not expected to have an adverse effect on cultural or historic resources. The USACE evaluated cultural resources at Lake Cowanesque in the *Draft Environmental Assessment Cowanesque Lake Water Supply Releases to Cowanesque, Tioga, Chemung and Susquehanna Rivers, Pennsylvania and New York June 2013* (USACE 2013-TN3383). In Section 3.3.2 of that assessment, the USACE found the following:

> Cowanesque Lake
>
> Various archaeological investigations and predictive models for archaeological sensitivity were conducted at Cowanesque Lake by USACE during the 1980s in conjunction with the proposed reformulation that would raise the lake level. Raising the lake level had the potential to adversely affect historic properties such as archaeological sites. In 1988 a Memorandum of Agreement (MOA) was executed between the Baltimore District and the Pennsylvania State Historic

Preservation Office. The MOA outlined procedures to be taken by the Baltimore District to mitigate adverse effects to historic properties (in this case, archaeological sites) that would result from the reformulation. Finalization of the MOA completed the Baltimore District's responsibilities under Section 106 of the National Historic Preservation Act for the reformulation project. Thus, there are no cultural or historic resources of concern at this time in the area of potential effect of Cowanesque Lake from altered water-supply releases.

Cowanesque, Tioga, Chemung, and Susquehanna Rivers

Altered low flow conditions in the receiving rivers would have no effect on cultural/historic resources. Thus, this topic is not given further consideration in this EA. (USACE 2013-TN3383).

4.6.3 Conclusion

For the purposes of consultation under Section 106 of the NHPA, the USACE as the lead agency for Section 106 consultation concludes that a finding of no historic properties adversely affected by preconstruction and construction activities would be supported by: (1) the cultural resource analysis, (2) PPL's commitment to follow its procedures if ground-disturbing activities discover historic or cultural resources (PPL Bell Bend 2012-TN1757), and (3) USACE consultation with the Pennsylvania SHPO, which concluded a finding of no adverse effect on the historic properties (USACE 2013-TN2243; PHMC 2013-TN2237; PHMC 2011-TN1756; Wise 2012-TN1755).

For the purposes of the review team's NEPA analysis, the review team concludes that the construction and preconstruction impacts on historic and cultural resources would be negligible based on (1) one eligible resource within the direct effects APE, for which an avoidance/mitigation plan has been prepared and concurred with by the PHMC (Wise 2012-TN1755); (2) three eligible resources located within the architectural APE for which PHMC has determined there will be minimal visual effects and, therefore, no adverse effect (PHMC 2011-TN1756); (3) the review team's cultural resource analysis and consultation; and (4) PPL's commitment to follow its cultural resource protection plan (PPL Bell Bend 2012-TN1757) should ground disturbance result in the discovery historic or cultural resources. On these bases, the review team concludes that that the potential direct and indirect impacts on historic and cultural resources during construction and preconstruction would be SMALL and no further mitigation beyond that described above would be warranted.

4.7 Meteorological and Air-Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality of the BBNPP site. The primary impacts of building the new BBNPP unit on local meteorology and air quality would be from dust from construction and preconstruction activities, emissions from equipment and machinery used during construction, concrete batch plant operations, as well as emissions from vehicles used to transport workers and materials to and from the site. Section 4.7.1 covers potential air-quality impacts from construction and preconstruction activities, and Section 4.7.2 covers potential air-quality impacts from construction worker transportation.

4.7.1 Construction and Preconstruction Activities

Construction and preconstruction activities at the BBNPP site would result in temporary impacts on local air quality. Activities including earthmoving, concrete batch plant operations, and vehicular traffic generate fugitive dust (particulate matter [PM]). In addition, emissions from these activities would contain carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOCs), and various greenhouse gases (GHGs).

As discussed in Section 2.9, the BBNPP site is located in Luzerne County, Pennsylvania, which is part of the Northeast Pennsylvania-Upper Delaware Valley Interstate AQCR (40 CFR 81.55 [TN255]). Luzerne County is designated as unclassifiable or in attainment for all criteria pollutants for which NAAQSs have been established (40 CFR 81.339 [TN255]). Luzerne County was designated as in attainment of the 8-hour 1997 ozone standard on November 19, 2007 (72 FR 64948-TN2084), and is therefore considered a maintenance area with respect to this standard. The EPA requires states to submit a SIP for maintenance areas to provide for continued attainment in the area for at least 10 years after redesignation status. The Pennsylvania Department of Environmental Protection Bureau of Air Quality (PADEP BAQ) SIP for maintenance of the 8-hour 1997 ozone standard in Luzerne County has been submitted and approved by the EPA (72 FR 64948-TN2084).

Pursuant to Clean Air Act Section 176 (42 USC 7401 et seq.-TN1141) and 40 CFR Part 93 (TN2495), Subpart B, Federal actions taking place within nonattainment or maintenance areas are subject to the EPA's General Conformity Rule. The General Conformity Rule ensures that actions taken by Federal agencies in these areas do not interfere with a SIP designed to meet the NAAQSs. PPL developed ozone precursor (NO_x and VOC) emission estimates (Miller and Groot 2011-TN2124; PPL Bell Bend 2012-TN2838; PPL Bell Bend 2012-TN2839) to support a conformity determination for the proposed BBNPP. The estimates indicate that, although the total annual NO_x emissions associated with building BBNPP would exceed the *de minimis* threshold in 40 CFR 93.153(b) (TN2495) of 100 tons per year for NO_x, only a portion of those emissions would be associated with NRC-authorized construction activities and that portion would be below the *de minimis* rate for NO_x (PPL Bell Bend 2012-TN2839). Total annual VOC emissions associated with building BBNPP would be below the 40 CFR 93.153(b) (TN2495) *de minimis* threshold of 50 tons per year (PPL Bell Bend 2012-TN2839). The NRC will evaluate and document the need for a conformity determination for the activities within its authority that require an NRC license. PPL also developed emission estimates for the portion of emissions attributable to USACE authorized activities; these emissions are also be below the *de minimis* rate (PPL Nuclear Development 2013-TN3902). The USACE will evaluate and document the need for a conformity determination for the activities within its authority that require a Department of Army permit. Nevertheless, the PADEP BAQ is intending to include the total NO_x emissions in a proposed SIP revision (PADEP 2012-TN2125; PADEP 2013-TN2843).

Construction and preconstruction activities at the BBNPP would result in temporary impacts on local air quality. Licenses and air permits for construction and preconstruction activities required by the PADEP BAQ are identified in Table 1.3-1 of the ER (PPL Bell Bend 2013-TN3377) and include the State Air Permit to Construct (PA Code 25-127-TN2130), New Source Review Construction Phase (PA Code 25-122-TN2128), and Prevention of Significant Deterioration

(PSD) (PA Code 25-127-TN2130). Application for these permits would be made by PPL before the beginning of construction (PPL Bell Bend 2013-TN3377).

Similar to any large-scale construction project, fugitive dust would be generated during ground-clearing, grading, and excavation activities as well as during windy periods over recently disturbed or cleared areas. These emissions would be intermittent and would vary based on the level and duration of a specific activity during and throughout the construction phase. In Section 4.4.1.3 of its ER, PPL stated that a dust-control program would be implemented during construction to mitigate fugitive dust emissions (PPL Bell Bend 2013-TN3377); this program could include elements such as the following:

- limiting vehicular speed on unpaved roads
- watering unpaved roads
- using soil adhesives to stabilize loose dirt surfaces
- covering haul trucks when loaded or unloaded
- ceasing grading and excavation during high winds and air pollution episodes
- phasing grading to minimize areas of disturbed soil
- revegetating road medians and slopes.

Finally, the program would include control strategies to minimize daily emissions by staggering construction activities and performing construction vehicle inspection and maintenance (PPL Bell Bend 2013-TN3377).

Construction and preconstruction activities, such as operation of on-road construction vehicles, commuter vehicles, non-road construction equipment, and locomotive engines also would result in GHG emissions, principally carbon dioxide (CO_2). Assuming a 7-yr period for construction and preconstruction activities and typical construction practices, the review team estimates that the total construction/preconstruction equipment GHG emission footprint for building the BBNPP site would be of the order of 39,000 MT CO_2 equivalent (CO_2e)[(3)] (resulting in an annual emission rate of about 5,570 MT CO_2e, averaged over the period of construction/ preconstruction), compared to a total annual emission rate of 107,000,000 MT CO_2e in the State of Pennsylvania (EPA 2013-TN3784) and 2,090,000,000 MT CO_2e in the United States (EPA 2013-TN3785) mainland for calendar year 2012 from power plants. Appendix I provides the details of the review team estimate for a reference 1,000-MW(e) nuclear power plant.

Based on its assessment of the relatively small construction equipment GHG footprint compared to total Pennsylvania and United States annual GHG emissions, the review team concludes that the atmospheric impacts of GHG emissions from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

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(3) A measure to compare the emissions from various GHGs on the basis of their global warming potential, defined as the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specific time period.

In general, emissions from construction and preconstruction activities (including GHG emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. Considering the information provided by PPL and its commitment to conduct all site-preparation, construction, and preconstruction activities in accordance with Federal, State, and local regulations, the review team concludes that the impacts from the BBNPP site construction and preconstruction activities on air quality would not be noticeable.

4.7.2 Transportation

In support of its ER, PPL developed a traffic impact study (TIS) that details expected traffic impacts associated with construction and preconstruction activities at the BBNPP site (KLD 2011-TN1228). In Section 7 of the TIS, PPL provided estimates of road traffic associated with construction activities, including construction worker vehicles and delivery trucks. At peak construction, which is expected to occur during the fourth and fifth years of construction, PPL estimates that there would be 3,950 workers and assumes an average vehicle occupancy of 1.30, resulting in an increase of 3,039 vehicles (KLD 2011-TN1228). PPL expects three work shifts each weekday, with a percent worker distribution of 60, 35, and 5 percent for shifts 1, 2, and 3, respectively (KLD 2011-TN1228). Furthermore, PPL assumes that most construction workers would live within 40 mi of the site, and that the majority of the workers would commute to the site from Wilkes-Barre/Scranton and Hazelton (KLD 2011-TN1228). During peak construction, PPL also estimates that approximately 47 daily truck deliveries would occur at the site, with the majority of shipments occurring during the daytime shift (KLD 2011-TN1228).

The primary access roads to the BBNPP site would likely experience a significant increase in traffic during shift changes that could cause periods of congestion. Stopped vehicles with idling engines would lead to increased emissions of criteria pollutants beyond what would occur from normal vehicle operation alone. However, the overall impact caused by increased traffic volume and congestion is difficult to estimate because the timing of construction activities, shifts, and exact worker residence locations are largely unknown. Chapter 8 of the TIS (KLD 2011-TN1228) and a supplement (KLD 2013-TN2841) identify several roadway improvements that could be made to accommodate projected traffic and minimize backup and congestion. These recommendations, in addition to other available mitigation measures such as encouraging carpooling and establishing central parking and shuttling services to and from the construction site, would greatly minimize the impact of criteria pollutants from vehicular emissions on air quality.

Workforce transportation would also result in GHG emissions, principally CO2. Assuming a 7-yr period for construction and preconstruction activities and a typical workforce, the review team estimates that the total workforce GHG emission footprint for building the unit at the BBNPP site would be of the order of 43,000 MT CO2(eq) (an emission rate of about 6,100 MT CO2(eq) annually, averaged over the period of construction/preconstruction); again this is compared to a total annual emission rate of 107,000,000 MT CO2(eq) in the State of Pennsylvania (EPA 2013-TN3784) and 2,090,000,000 MT CO2(eq) in the United States (EPA 2013-TN3785) mainland for calendar year 2012 from power plants. Appendix I provides the details of the review team estimate for a reference 1,000-MW(e) nuclear power reactor.

Based on its assessment of the relatively small construction and preconstruction workforce GHG footprint compared to the Pennsylvania and United States annual GHG emissions, the review team concludes that the atmospheric impacts of GHGs from workforce transportation would not be noticeable and additional mitigation would not be warranted. Based on PPL's TIS, the review team concludes that the impact of criteria pollutants on the local air quality due to an increase in vehicular traffic from construction and preconstruction activities would be temporary and not noticeable. If roadway improvements and other mitigation measures were implemented, the impact on local air quality would be further reduced.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and GHG emissions during BBNPP site construction and preconstruction activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of BBNPP site development on air quality from emissions of criteria pollutants and GHG emissions would be SMALL and that no further mitigation would be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air-quality impacts of NRC-authorized construction activities also would be SMALL. If mitigation measures were implemented, the impacts on air quality would be further reduced.

4.8 Nonradiological Health Impacts

Nonradiological health impacts on the public and workers from building the proposed BBNPP are described in the following sections, including impacts on public and occupational health (Section 4.8.1), impacts of noise (Section 4.8.2), and impacts of transporting construction materials and personnel to and from the BBNPP site (Section 4.8.3). Nonradiological health impacts are summarized in Section 4.8.4.

4.8.1 Public and Occupational Health

This section discusses the impacts of building activities on the nonradiological health of the public and BBNPP site workers. Section 2.10 provides background information and baseline conditions for the affected environment at the BBNPP site and in the BBNPP project vicinity.

4.8.1.1 Public Health

Physical impacts on the public from building activities at the BBNPP site would include fugitive dust and vehicle exhaust (including exhaust from haul vehicles) as sources of air pollution during site preparation (PPL Bell Bend 2013-TN3377). The PADLI protects workers from adverse conditions by implementing occupational health and safety regulations (PA P.L. 654, No. 174-TN3914). PPL would impose operational controls to mitigate dust emissions (e.g., watering unpaved roads and exposed soils [when the surface is dry], stabilizing construction roads and spoil piles, and phasing grading activities and ceasing them during high winds and/or during extreme air pollution episodes) (PPL Bell Bend 2013-TN3377).

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order and by phasing activities to minimize daily emissions. PPL (PPL Bell Bend 2013-TN3377) stated that applicable Federal, State, and local emission requirements would be followed related to open burning and to the operation of fuel-burning equipment. The appropriate Federal, State, and local permits and operating certificates would be obtained as required. The proposed BBNPP unit would be located in Luzerne County, Pennsylvania, which is part of the Northeast Pennsylvania-Upper Delaware Valley Interstate AQCR (40 CFR 81.55 [TN255]). The Clean Air Act establishes NAAQSs, and Luzerne County is classified as an attainment area under these criteria (40 CFR 81.339 [TN255]).

The public would not be allowed near the BBNPP site. The nearest residence is approximately 1,800 ft from the BBNPP cooling towers (PPL Bell Bend 2013-TN3377). In addition, PPL stated that procedures based on those already established for SSES Units 1 and 2 would be developed for the proposed BBNPP unit to limit adverse impacts during building activities (PPL Bell Bend 2013-TN3377). Considering PPL's proposed mitigation measures and the distance of the public from the BBNPP site, the review team concludes that the impacts on nonradiological public health from construction and preconstruction activities would be negligible. No further mitigation beyond that discussed above would be warranted.

4.8.1.2 Construction Worker Health

In general, human health risks to construction workers and other personnel working onsite are dominated by occupational injuries (e.g., falls, electrocution, asphyxiation, and burns). PPL has safety and medical programs and provides required training to all employees and contractors to make sure that all workers onsite are trained in all appropriate safety requirements (PPL Bell Bend 2013-TN3377). The safety and medical program promotes safe work practices, responds to occupational injuries and illnesses, and maintains a safety manual for employees (PPL Bell Bend 2013-TN3377). The safety manual provides employees with important workplace safety-related information to help prevent accidents (PPL Bell Bend 2013-TN3377).

In addition to onsite building activities, PPL has planned for new facilities and line upgrades to connect the proposed plant to the existing transmission system (PPL Bell Bend 2013-TN3377). All new lines and switchyards would be built in accordance with the National Electrical Safety Code and applicable construction standards and codes (PPL Bell Bend 2013-TN3377).

According to the U.S. Bureau of Labor Statistics (BLS), incidence rates for "utility system construction and operation" have been reduced by more than 50 percent in the last 10 years, from a rate of 7.8 in 2001 to 2.9 in 2011 (see Figure 4-5) (BLS 2012-TN3908). The State of Pennsylvania did not begin reporting to the BLS until 2010. The maximum construction workforce for the proposed BBNPP unit and related facilities would be 3,950 full-time equivalent workers for an expected period of 72 months (2012 to 2018) (PPL Bell Bend 2013-TN3377). Based on the rates discussed above, 128 recordable cases (mostly injuries due to slips and falls) could be expected during construction of the proposed BBNPP unit (BLS 2012-TN3908). This number would be well within current non-fatal injury industry rates. PPL has also stated that all contractors and subcontractors would be required to comply with safety procedures to prevent and/or minimize recordable cases of injuries and/or accidents during building activities (PPL Bell Bend 2013-TN3377).

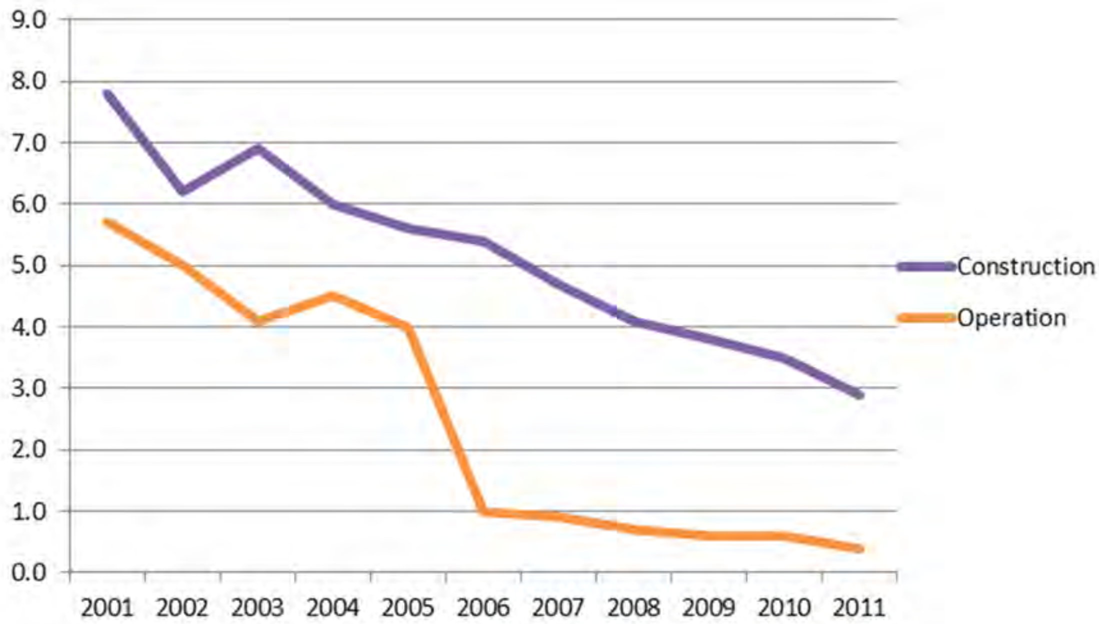

Figure 4-5. Incidence Rates of Non-Fatal Occupational Injuries and Illnesses for Construction and Operation of Utility Systems from 2001 to 2011

Based on mitigation measures identified by PPL in its ER; permits and authorizations required by Federal, State, and local agencies; safety training that would be conducted by PPL; and the review team's independent evaluation, the review team concludes that the nonradiological impacts of building activities on construction worker health would be minimal. No further mitigation beyond that discussed in this section would be warranted.

4.8.1.3 Summary of Public and Construction Worker Health Impacts

On the basis of mitigation measures identified by PPL in its ER; permits and authorizations required by Federal, State, and local agencies; and the review team's independent review, the review team concludes that the nonradiological health impacts on the public and workers from preconstruction and construction activities would be minimal. No further mitigation beyond that discussed in this section would be warranted.

4.8.2 Noise Impacts

Building a nuclear power plant is similar to other large industrial projects in that it involves many noise-generating activities. Regulations governing noise from construction and preconstruction activities are generally limited to worker health. Federal regulations governing noise are found in 29 CFR Part 1910 (TN654) and 40 CFR Part 204 (TN653). Regulations in 29 CFR Part 1910 (TN654) deal with noise exposure in the construction environment; regulations in 40 CFR Part 204 (TN653) generally govern the noise levels of construction equipment including compressors. Neither Luzerne County nor the State of Pennsylvania has regulations or guidelines for noise.

The ER indicates that noise levels associated with building of a new unit at the BBNPP site would peak in the range of 108 to 93 dBA (highest levels would primarily be from jackhammers and earthmoving equipment such as graders and dump trucks) (PPL Bell Bend 2013-TN3377). At a distance of 50 ft from the source, these noise levels would generally decrease to the 91- to 73-dBA range, and at a distance of 1,600 ft, the noise levels would generally be in the 43- to 65-dBA range (PPL Bell Bend 2013-TN3377). At a distance of 1,800 ft (the nearest sensitive receptor) the noise level would be below 65 dBA. These estimates do not include the noise attenuation associated with weather, vegetation, and topography. For context, Tipler and Mosca (2008-TN1467) lists the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA.

As discussed in Section 2.10.2, baseline noise levels at the nearest resident receptors (Locations 2, 3, and 4) were 57, 59, and 59 dBA, respectively (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Location 5, which was located close to the highway, had an L_{dn} value of 57 dBA during leaf-on measurements and 65 dBA during leaf-off measurements (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Locations 6 and 7, located north of the proposed cooling towers, had L_{dn} values of 49 and 52 dBA, respectively (Hessler Associates 2010-TN1227). The noise levels expected from building activities at the BBNPP site listed above are within the range of the baseline noise levels measured during surveys conducted in 2008 and 2010 (PPL Bell Bend 2013-TN3377; Hessler Associates 2008-TN485; Hessler Associates 2008-TN486; Hessler Associates 2010-TN1227).

Building activities would be expected to take place 24 hours per day, 7 days per week during peak activity periods. However, the ER (PPL Bell Bend 2013-TN3377) lists a number of measures that could be taken to mitigate the potential adverse effects of noise. Among the mitigation measures are compliance with applicable local regulations, OSHA noise-exposure limits, implementation of training and use of personal protective equipment, inspection and maintenance of noise-limiting devices on vehicles and equipment, shielding high noise sources near their origin, and restriction of non-routine activities to weekday business hours (PPL Bell Bend 2013-TN3377).

According to NUREG-1437 (NRC 2013-TN2654),[4] noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in NUREG-0586, Supplement 1 (NRC 2002-TN665). The criterion for assessing the level of significance was not expressed in terms of sound levels but was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1 (NRC 2002-TN665), is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

[4] NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999 (NRC 1999-TN289). All references to NUREG-1437 include NUREG-1437 and its Addendum 1.

Considering the anticipated low noise levels are within the range of current baseline conditions at and around the proposed site, the temporary nature of building activities, and the location and characteristics of the BBNPP site (adjacent to an existing plant and surrounded by trees), the review team concludes that the noise impacts from building would be minimal, and additional mitigation beyond actions identified in this section would not be warranted.

4.8.3 Impacts of Transporting Building Materials and Personnel to and from the BBNPP Site

This EIS assesses the impact of transporting workers and building materials to and from the BBNPP site from three perspectives: socioeconomic impacts, air-quality impacts resulting from the dust and particulate matter emitted by vehicular traffic, and potential health impacts caused by traffic-related accidents. Socioeconomic impacts are addressed in Sections 4.4.1.5 and 4.4.4.1, air-quality impacts are addressed in Section 4.7, and human health impacts are addressed here and in Section 4.9. The general approach used to calculate nonradiological impacts of fuel and waste shipments is also used for transportation of construction materials and construction personnel to and from the proposed BBNPP site. However, the only data available to estimate the demand for these transportation services were preliminary estimates. Assumptions made to provide reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

Building material transportation requirements were based on information in the Bell Bend Nuclear Power Plant Combined License Application Part 11M, Revision 3 (KLD 2011-TN1228). KLD estimated that construction of the proposed BBNPP requires up to 848,362 T of concrete, 66,148 T of structural steel and rebar, 15,835 T of power cable and control wire, 25,665 T of piping, and other miscellaneous equipment and materials. This results in an estimated 67,879 truck shipments of construction materials. This information was used to estimate the nonradiological impacts of shipping construction materials to the proposed BBNPP site. Additional information needed to develop the nonradiological impact estimates is as follows:

- The review team assumed that shipment capacities would be about 15 T per shipment. It was assumed that these materials would be transported to the site in a levelized manner over a 6-year period (KLD 2011-TN1228).
- PPL assumed that the number of construction workers would peak at 3,950 (PPL Bell Bend 2013-TN3377). This value represents the peak workforce for construction of the single unit. At an average of 1.3 persons per vehicle (KLD 2011-TN1228), there would be about 3,038 vehicles per day. Each vehicle was assumed to travel to and from the BBNPP site 250 days per year. The average commute distance for construction workers was assumed to be 13.2 mi one way, based on the gravity model as described in Section 4.4.
- Average shipping distances for transporting construction materials were assumed by the NRC staff to be 50 mi one way. Because 83 percent (KLD 2011-TN1228) of the shipments would be concrete, for which sources would probably be closer than 50 mi, this is a conservative estimate.

Accident, injury, and fatality rates for transporting construction materials were taken from Table 4 in ANL/ESD/TM-150, *State-level Accident Rates for Surface Freight Transportation: A*

Reexamination (Saricks and Tompkins 1999-TN81). Rates for the Commonwealth of Pennsylvania were used for construction material shipments, typically conducted in heavy-combination trucks. The data in Saricks and Tompkins (1999-TN81) are representative of heavy-truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). The U.S. Department of Transportation Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999-TN81) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999-TN81) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (Blower and Matteson 2003-TN410). The University of Michigan Transportation Research Institute data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999-TN81), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and 36 percent, respectively. As a result, the NRC staff increased the accident, injury, and fatality rates by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting. These adjustments were applied to the construction materials that are transported by heavy-truck shipments, similar to those evaluated by Saricks and Tompkins (1999-TN81), but not to commuter traffic accidents.

A single source that provided accident, injury, and fatality information from which to estimate the impacts from worker transportation to/from the site was not available. To develop representative commuter traffic impacts, data from the Pennsylvania Department of Transportation (PennDOT 2009-TN3940) was accessed to provide a Pennsylvania-specific fatality rate for all traffic from 2005 through 2009. This average fatality rate was used as the basis for estimating Pennsylvania-specific injury and accident rates. Adjustment factors were developed using national traffic accident statistics from *National Transportation Statistics 2013* (DOT 2013-TN3930). These adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Pennsylvania-specific fatality rate to approximate the injury and accident rates for commuters in Pennsylvania.

The estimated nonradiological impacts of transporting construction materials to the proposed BBNPP site and of transporting construction workers to and from the site are shown in Table 4-10. The estimated total nonradiological transportation impacts are dominated by the impacts of transporting construction workers to and from the proposed BBNPP site. The estimated total annual construction fatalities represent about a 1.3 percent increase above the 32 traffic fatalities that occurred in Luzerne County in 2008 (PennDOT 2009-TN3940). This represents a small increase relative to the current traffic fatality risks in the area surrounding the proposed site.

On the basis of information provided by PPL and the NRC staff's independent evaluation, it is concluded that the transportation impacts of preconstruction and construction activities would be minimal and that no further mitigation is warranted.

Table 4-10. Estimated Average Annual Vehicular Impacts of Transporting Workers and Construction Materials to/from the BBNPP Site

Items Transported	Accidents per Year	Injuries per Year	Fatalities per Year
Workers	1.1E+02	6.3E+00	2.2E-01
Construction Materials	2.4E+00	1.4E+00	8.3E-02
Total	1.6E+02	1.1E+01	4.0E-01

4.8.4 Summary of Nonradiological Health Impacts

The review team assessed the information in the PPL ER (PPL Bell Bend 2013-TN3377) and concludes that nonradiological health impacts on construction workers at the BBNPP site and on the local population from fugitive dust, occupational injuries, noise, and transport of materials and personnel would be SMALL, and additional mitigation beyond the actions identified above would not be warranted. Based on the above analyses, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradiological health impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that further mitigation beyond those measures stated above would not be warranted.

4.9 Radiological Health Impacts

Sources of radiation exposure for construction workers during the site-preparation and construction phase of the proposed BBNPP include direct radiation exposure, exposure from liquid radioactive waste discharges, and exposure from gaseous radioactive effluents from existing SSES Units 1 and 2. For the purposes of this discussion, construction and site-preparation workers are assumed to be members of the public rather than occupational workers; therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D (TN283).

It is important to note that the NRC staff's safety review of the BBNPP COL application is still ongoing, so the final results from the review are not completed. Therefore, the construction worker doses presented in this section are subject to further review and requests for additional information from the NRC staff. The final results of the NRC staff's safety review will be documented in the Final Safety Evaluation Report. PPL will not be issued a COL for the proposed BBNPP site unless all safety requirements have been satisfactorily demonstrated to the NRC staff.

4.9.1 Direct Radiation Exposures

In the BBNPP ER (PPL Bell Bend 2013-TN3377), six sources of direct radiation exposure including skyshine to construction workers from the adjacent SSES site were identified: (1) the SSES Independent Spent Fuel Storage Installation (ISFSI), (2) the Low-Level Radioactive Waste Handling Facility (LLRWHF), (3) SEALAND containers, (4) the Steam Dryer Storage Vault, (5) the turbine building, and (6) the condensate storage tanks. The LLRWHF and ISFSI are identified in the ER as the primary sources of direct radiation exposure to BBNPP construction workers. PPL estimated the dose rate from the contents of the LLRWHF based on full capacity of linear storage modules each with the maximum allowable external dose rate (PPL Bell Bend 2013-TN3377). The NRC staff did not identify any additional sources of direct radiation during the site visit or during document reviews.

PPL calculated the dose from direct radiation to BBNPP construction workers from each of the sources listed above using equations developed as a function of distance from the source that accounted for shielding from structures (PPL Bell Bend 2013-TN3377). The equations were developed from SSES data obtained via thermoluminescent dosimeter (TLD) measurements (PPL Bell Bend 2013-TN3377). Dose rates were calculated for each subdivision of the proposed BBNPP site grid. The dose rates from each of the sources were summed to obtain the total direct dose rate in each zone. The dose rates were multiplied by occupancy factors for each subdivision of the proposed BBNPP site grid to determine the estimated dose to construction workers.

Because of a significant portion of the construction worker dose results from direct radiation sources, the NRC staff performed a confirmatory calculation of this dose using the highest value from seven SSES TLD locations on or near the fenceline near the SSES ISFSI and LLRWHF. This would provide an upper bound for the direct dose to construction workers for comparison to the PPL analysis. Results from TLD locations 10 to 20 mi from the SSES were used as the controls. Using the measured dose rates from the SSES 2010 TLD data (PPL Susquehanna 2011-TN714) and the projected loading of the ISFSI, the NRC staff estimated maximum annual dose of 40 mrem/8,760 hr or approximately 10 mrem if a construction worker spent 2,200 hr/yr at the 13S5 TLD location on the exclusion boundary fence west of the ISFSI (PPL Bell Bend 2013-TN3377).

In addition, at certain times during construction, PPL and its contractors would receive, possess, and use specific radioactive byproduct, source, and special nuclear material in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by the applicant's radiation protection program, provided with physical protection when required, and have very specific uses under controlled conditions. Therefore, these sources are expected to result in a negligible contribution to construction worker doses.

4.9.2 Radiation Exposures from Gaseous Effluents

The SSES releases gaseous effluents via two reactor building vents and two turbine building vents (PPL Bell Bend 2013-TN3377). PPL estimated construction worker dose from gaseous effluents using the SSES release data from 2011, which gave the highest dose rates for the period from 2001 to 2011 (PPL Bell Bend 2013-TN3377). PPL calculated the maximum annual total effective dose equivalent to a construction worker from gaseous effluents as 2.5 mrem (based on an occupancy of 2,200 hr/yr) (PPL Bell Bend 2013-TN3377). The dose to construction workers from the gaseous effluent releases would be small compared to the dose from direct radiation exposure.

4.9.3 Radiation Exposures from Liquid Effluents

PPL considered the maximum construction worker dose to be a result of shoreline exposure to SSES liquid effluents (i.e., Units 1 and 2 combined effluent releases). PPL assumed that during the 6 years of construction, the construction worker dose would be limited to 3 mrem/yr. The 3 mrem/year is a design objective under 10 CFR Part 50, Appendix I (TN249) for each SSES unit. In addition, historic shoreline doses estimated by PPL from 2001 through 2011 from SSES combined liquid effluents discharged to the Susquehanna River ranged from 0.074 mrem/yr to 4.6 mrem/yr (PPL Bell Bend 2013-TN3377) and corresponds to 0.037 mrem/yr to 2.3 mrem/yr for each SSES unit. The historic estimates were also based on an occupancy of 2,200 hr/yr for a construction worker at the intake structure for the proposed BBNPP on the shoreline downstream of the SSES discharge line.

The NRC staff reviewed the 2008 through 2013 SSES Annual Radiological Environmental Operating Reports and PPL's liquid effluent dose analysis. The NRC staff confirmed PPL's estimated maximum annual radiation dose to construction workers from liquid effluents of approximately 4.6 mrem was appropriate for the shoreline location.

4.9.4 Total Dose to Construction Workers

PPL estimated a maximum annual dose to a construction worker of approximately 16.4 mrem (note: in Rev 4 of the ER, PPL revised the dose in Table 4.5-14, but failed to revise the maximum dose in Section 4.5.5.1) primarily from the direct radiation and gaseous pathways at the construction fenceline west of SSES Unit 1 cooling tower assuming an occupancy of 2,200 hr/yr and a 95 percent plant capacity factor (PPL Bell Bend 2013-TN3377). PPL stated that doses from liquid and gaseous effluent releases are negligible compared to the dose from direct radiation. The annual dose estimate is based on an occupancy of 2,200 hr/yr on Confers Lane west of the SSES Unit 1 cooling tower. This value is less than the 100 mrem annual dose limit for an individual member of the public found in 10 CFR 20.1301 (TN283).

PPL estimated the collective dose equivalent for construction workers for the 6 years of construction 2012 to 2017 construction period to be 10.3 person-rem (PPL Bell Bend 2013-TN3377). The estimated annual collective dose to site-preparation workers ranged from 0.3 to 2.27 person-rem/yr during the 6-year construction period. PPL estimated the average dose rate for each construction zone to be less than 25 mrem per 2200 hours of a construction worker's annual work year (PPL Bell Bend 2013-TN3377). This average dose rate is much smaller than the estimated 311 mrem/yr each worker receives from natural background radiation (NCRP 2009-TN420)

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during building of the new unit is well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by PPL and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts on construction workers for proposed BBNPP unit would be SMALL, and no further mitigation would be warranted. Radiation exposure from all NRC-licensed activities including operation of SSES Units 1 and 2 is regulated by the NRC. Therefore, the NRC staff concludes the radiological health impacts for NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

This section describes the potential environmental impacts from the generation, handling, and disposal of nonradiological waste during building activities for the proposed BBNPP station. Section 3.4.2.4 provides descriptions of the proposed BBNPP nonradioactive waste systems. Potential types of nonradioactive wastes expected to be generated, handled, and disposed of include construction debris, dredge spoils, stormwater runoff, municipal and sanitary waste, dust, and air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

4.10.1 Impacts on Land

Building activities related to the proposed BBNPP unit could result in solid waste materials like construction debris from excavation, land clearing, and dredge spoils. PPL would use a "vigorous recycling program" to recycle nearly all waste produced on the BBNPP site and manage construction debris in accordance with Pennsylvania solid waste regulations (PPL Bell Bend 2013-TN3377). Construction debris from excavation and land clearing that could not be recycled or reclaimed would be disposed in one of the four licensed construction and demolition landfills located in Pennsylvania (PPL Bell Bend 2013-TN3377; ERG 1994-TN4021). PPL stated that adequate capacity is available at these construction and demolition landfills to handle the additional generated waste and that a very limited amount of common refuse would be sent to local waste collection facilities (PPL Bell Bend 2012-TN1173). Hazardous and nonhazardous solid wastes would be managed according to all applicable Federal, State, and County handling and transportation regulations (PPL Bell Bend 2012-TN1173).

Spoils (dredge material), generated as a result of dredging the Susquehanna River for building activities associated with the intake and discharge structures for the new unit, would be placed in an upland dredged-material dewatering pond (see Sections 3.2.2.4 and 3.3.1.7) (PPL Bell Bend 2013-TN3377). Spoils would remain in the dewatering pond until they were dry enough to be transported for disposal or used as clean fill on the project site (PPL Bell Bend 2013-TN3377). Once all dredge material was dried and moved out of the dewatering pond, the site would be re-graded, if necessary, and vegetation would be re-seeded for stabilization (PPL Bell Bend 2013-TN3377). USACE permits for the disposal of dredged spoils would be obtained and implemented.

Based on PPL's plans to manage solid wastes in accordance with all applicable Federal, State, and local requirements and standards, and implement recycling and waste-minimization practices, the review team expects the impacts on land from nonradioactive wastes generated during building activities related to the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts on Water

Surface water and groundwater have the potential to be affected by BBNPP building activities, as discussed in Sections 4.2.3.1 and 4.2.3.2, respectively. PPL would have to obtain a NPDES General Permit for Stormwater Discharges from Large and Small Construction Activities to minimize potential impacts on surface water and groundwater. As part of the permit, a SWPPP would be required. In addition, an erosion and sediment control plan would be a component of the NPDES permit. Water-use impacts and water-quality impacts during the development of the proposed BBNPP unit are further discussed in Sections 4.2.1 and 4.2.3, respectively.

Onsite sanitary wastes generated during building activities would be accommodated with portable toilets supplied and serviced by a licensed sanitary waste treatment contractor that would transport the waste offsite (PPL Bell Bend 2013-TN3377). These portable facilities would accommodate a workforce of up to 3,000 people at a time during building activities and the maximum quantity of sanitary waste expected would be 19,500 gpd (PPL Bell Bend 2013-TN3377). During building activities, a temporary infiltration pond would manage stormwater runoff and suspended solids from the concrete batch plant and dredge spoils storage areas. This pond would be removed after building activities cease (PPL Bell Bend 2013-TN3377).

Dewatering would be necessary during the construction of the power block, cooling towers, and the ESWEMS pond, and mitigation measures would be implemented to minimize the extent of the drawdown (PPL Bell Bend 2013-TN3377).

Based on the regulated practices for managing liquid discharges, including wastewater, and the NPDES permit with an approved SWPPP that PPL plans to implement for managing surface and groundwater, the review team expects that impacts on water from nonradioactive effluents when building the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

4.10.3 Impacts on Air

As discussed in Sections 4.4.1.3 and 4.7.1, the increased emissions and fugitive dust from equipment and vehicles used for site preparation and transport of construction workers would need to be managed. PPL plans to control these emissions through a dust-control plan as part of its SWPPP (PPL Bell Bend 2013-TN3377). Mitigation measures in the dust-control plan could include stabilizing construction roads and spoils piles, covering haul trucks, watering unpaved construction roads to control dust, and routine inspections and maintenance on construction vehicles and equipment (PPL Bell Bend 2013-TN3377). PPL stated that air emissions during the building phase of the proposed BBNPP unit would be permitted through the State Permit to Construct process, and that implementation of controls and limits at the source would keep emissions within the site boundary (PPL Bell Bend 2013-TN3377).

As discussed in Section 4.7, based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, the review team expects that impacts on air from nonradioactive emissions during the building of the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

4.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, and gaseous wastes generated when building the proposed BBNPP unit would be handled according to Federal, State, and local regulations. Solid wastes would be recycled or disposed of in existing, permitted landfills. An NPDES permit, which would include a SWPPP for surface-water runoff and groundwater quality and the use of temporary, portable facilities for sanitary waste systems during the construction period, would ensure compliance with the Clean Water Act and the State of Pennsylvania standards. Based on this information provided by PPL and the review team's independent evaluation, the review team concludes that nonradiological waste impacts on land, water, and air from building activities would be SMALL and that additional mitigation would not be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that no further mitigation would be warranted.

4.11 Measures and Controls to Limit Adverse Impacts during Construction Activities

In its evaluation of environmental impacts during building activities for the proposed BBNPP, the review team relied on PPL's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts
- compliance with applicable requirements of permits or licenses required for building the new unit (e.g., USACE Section 404/Section 10 permit and the NPDES permit)
- compliance with existing SSES processes and/or procedures applicable to proposed BBNPP construction environmental compliance activities for the BBNPP site
- incorporation of environmental requirements into construction contracts
- identification of environmental resources and potential impacts during the development of the ER and the COL process.

Table 4-11, which is the review team's adaptation from Table 4.6-1 of PPL's ER (PPL Bell Bend 2013-TN3377), summarizes the measures and controls proposed by PPL to limit adverse impacts during the building of the proposed unit at the BBNPP site. Part 10 of PPL's application includes a draft Environmental Protection Plan for the site, which identifies proposed conditions, monitoring, reporting, and record keeping for environmental data during construction.

Table 4-11. Summary of Measures and Controls Proposed by PPL to Limit Adverse Impacts during Construction and Preconstruction for the Proposed Action at the BBNPP Site

Resource Area	Planned Mitigation and Controls
Land-Use Impacts	
The Site and Vicinity	Mitigation measures proposed by the applicant to reduce preconstruction and construction activity impacts would include soil erosion and sedimentation control, controlled access roads, and restricted construction zones. Areas of temporary disturbance would be stabilized and restored after completion of building activities, and permanently disturbed locations would be stabilized and contoured to blend with the surrounding area.
	Vegetation stabilization and restoration methods would comply with applicable laws, regulations, permit requirements and conditions, good engineering and construction practices, and recognized environmental Best Management Practices (BMPs).
	New onsite transmission lines would be routed to avoid and/or minimize impacts on existing aquatic resources and any identified threatened and endangered species (PPL Bell Bend 2013-TN3377).
Water-Related Impacts	
Hydrologic Alterations	Install groundwater flow barrier (slurry wall) around the ESWEMS pond excavation and if necessary, around part of the cooling-tower excavation, with onsite impoundment and spray irrigation system to reintroduce water from dewatering system to nearby wetlands to mitigate dewatering impacts.
	Comply with NPDES construction stormwater permit; implement erosion and sediment control plan.
	Comply with USACE Section 404/Section 10 and PADEP Water Obstruction and Encroachment permits.
Water-Use Impacts	Install groundwater flow barrier around part of cooling-tower excavation, if warranted, to mitigate dewatering impacts.
	Monitor groundwater head elevations.
Water-Quality Impacts	Use soil erosion controls (e.g., silt fences, temporary sediment basins, and infiltration beds) and other BMPs; comply with NPDES permit and Pennsylvania Erosion and Sediment Control requirements to prevent stormwater runoff and sediment runoff from affecting the water quality in surface waterbodies.
	Comply with NPDES permit requirements for discharge of groundwater withdrawn during excavation dewatering.
	Comply with USACE Section 404/Section 10 and PADEP Water Obstruction and Encroachment permit requirements. For intake and discharge structures, use cofferdams in the riverbed to isolate area of sediment disturbance and avoid affecting Susquehanna River water quality.
	Use BMPs, including a spill prevention plan, to minimize the occurrence and effects of inadvertent spills.

Table 4-11. (contd)

Resource Area	Planned Mitigation and Controls
Ecological Impacts	
Terrestrial Ecosystems	Site preparation and development of the BBNPP project area and expansion of the Rushton Mine water-treatment facilities for consumptive-use mitigation would be conducted according to Federal and State regulations, permit conditions, and established BMPs. These BMPs would protect terrestrial habitats adjacent to disturbed surface soils on the BBNPP site.
	Perform appropriate permittee-responsible onsite mitigation dictated through the permitting process of Section 10 of the Rivers and Harbors Appropriation Act (33 USC 403 et seq.-TN660) and Section 404 of the CWA (33 USC 1344 et seq. -TN1019), to regulate the discharge of dredged or fill material into waters of the United States.
	Provide makeup water to compensate for impacts on wetland and stream hydrology posed by dewatering associated with construction of the ESWEMS pond (see Section 4.3.1.1). PPL has set a target of no more than a 3 in. deviation from baseline groundwater elevation trends.
	Include measures to provide habitat for the multiple State-ranked butterfly species in habitats created or enhanced by the proposed wetland mitigation.
	Remove trees greater than 5-in.-diameter breast high on the BBNPP site only from November 16 through March 31 in order to protect the Federally endangered Indiana bat.
Aquatic Ecosystems	Develop and implement a site stormwater pollution prevention plan (SWPPP).
	Implement erosion and sediment control plans that incorporate recognized BMPs.
	Install appropriate infiltration beds, barriers, and buffer zones, and use BMPs to protect waterbodies and aquatic organisms.
	Obtain and comply with the Department of the Army permit, State 401 water-quality certification, and BMPs, including development of a mitigation action plan for wetland/stream impacts.
	Implement a Spill Prevention, Control, and Countermeasure Plan; restrict activities using petroleum products and solvents to designated areas that are equipped with spill containment.
	Coordinate with the PFBC prior to initiating installation of intake and discharge structures to ensure impacts on mussels are avoided or minimized.
	Obtain Chapter 105 Water Obstruction and Encroachment permit and comply with permit requirements.

Table 4-11. (contd)

Resource Area	Planned Mitigation and Controls
Socioeconomic Impacts	
Physical and Aesthetic Impacts	Comply with applicable Pennsylvania Department of Environmental Protection and Salem Township noise restrictions.
	Comply with applicable Occupational Safety and Health Administration (OSHA) noise-exposure limits.
	Implement appropriate training, personal protective equipment, health and safety monitoring, and other good industry noise control practices.
	Maintain noise-limiting devices on vehicles and equipment, shield high noise sources near their origins, and conduct non-routine activities such as blasting during weekday business hours.
	Comply with applicable U.S. Environmental Protection Agency and Pennsylvania Department Environmental Protection air-quality regulations.
	Implement a routine vehicle/equipment inspection and maintenance program.
	Implement measures to comply with Ambient Air Quality Standards and National Emissions Standards for Hazardous Air Pollutants regulatory limits.
	Obtain required permits and/or operating certificates.
	Bring heavy plant equipment to the site on rail when possible and install a new site perimeter and access road.
	Use low points in topography to create the lowest visual profile practicable and place new structures on the river shoreline near existing structures.
	Minimize tree and vegetation removal and, where feasible, use native trees and vegetation during post-construction restoration.
	Add a new access road.
	Cover exteriors of structures, where practicable, with a color that is compatible with the surrounding area.
Social and Economic Impacts	Install signals at the BBNPP entrance access road, realign lanes on US 11, add new entrance and exit lanes on the access road at the intersection of US 11, retime signals, restripe, add through lanes, install temporary traffic signals, implementing parking restrictions, add school buses and drivers, possibly relocate school bus stops off of US 11, and/or implement other measures at intersections affected by construction traffic.
Environmental Justice	None necessary.

Table 4-11. (contd)

Resource Area	Planned Mitigation and Controls
Historic and Cultural Properties	Follow procedures agreed upon by PPL and the Pennsylvania State Historic Preservation Office (SHPO) to protect 36LU288 (Wise 2012-TN1755). In a letter to the USACE the Pennsylvania SHPO has agreed that there will be no adverse effect on that resource," providing that "avoidance measures for 36LU288 be included as a special condition on your permit" (PHMC 2013-TN2237).
	Follow its procedures if ground-disturbing activities discover historic or cultural resources (PPL Bell Bend 2012-TN1757).
Air Quality	Roadway improvements to accommodate projected traffic and minimize backup and congestion.
Nonradiological Health Impacts	Implement procedures based on those already established for SSES Units 1 and 2 to limit adverse impacts during building activities (PPL Bell Bend 2013-TN3377). Impose operational controls to mitigate dust emissions (e.g., watering unpaved roads and exposed soils [when the surface is dry], stabilizing construction roads and spoil piles, and phasing grading activities and ceasing them during high winds and/or during extreme air pollution episodes) (PPL Bell Bend 2013-TN3377).
	Implement safety and medical programs and provide required training to all employees and contractors to make sure that all workers onsite are trained in all appropriate safety requirements (PPL Bell Bend 2013-TN3377). The safety and medical program promotes safe work practices, responds to occupational injuries and illnesses, and maintains a safety manual for employees (PPL Bell Bend 2013-TN3377). The safety manual provides employees with important workplace safety-related information to help prevent accidents (PPL Bell Bend 2013-TN3377).
	Minimize noise from building activities through compliance with applicable local regulations and OSHA noise-exposure limits, implementation of training and use of personal protective equipment, inspection and maintenance of noise-limiting devices on vehicles and equipment, shielding of high noise sources near their origins, and restriction of non-routine activities to weekday business hours (PPL Bell Bend 2013-TN3377). These actions would help minimize or prevent injury, illness, and death. No further mitigation of transportation impacts is warranted.
Radiation Exposure to Construction Workers	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20 [TN283]).
Nonradioactive Waste	Handle solid, liquid, and gaseous wastes generated when building the proposed BBNPP unit according to Federal, State, and local regulations. Recycle solid waste or dispose of in existing, permitted landfills.
	Ensure compliance with the Clean Water Act (33 USC 1251 et seq.-TN662) and the State of Pennsylvania standards through an NPDES permit, which would include a SWPPP for surface-water runoff and groundwater quality and the use of temporary, portable facilities for sanitary waste systems during the construction period.

Table 4-11. (contd)

Resource Area	Planned Mitigation and Controls
	Control emissions through a dust-control plan as part of its SWPPP. Mitigation measures in the dust-control plan could include stabilizing construction roads and spoils piles, covering haul trucks, watering unpaved construction roads to control dust, and routine inspections and maintenance on construction vehicles and equipment (PPL Bell Bend 2013-TN3377). Air emissions during the building phase of the proposed BBNPP unit would be permitted through the State Permit to Construct process, and implementation of controls and limits at the source would keep emissions within the site boundary (PPL Bell Bend 2013-TN3377).

4.12 Summary of Construction and Preconstruction Impacts

The impact levels determined by the review team in the previous sections are summarized in Table 4-12. The impact levels for NRC-authorized construction are denoted in the table as being SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined preconstruction and construction activities are similarly noted. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level columns.

Table 4-12. Summary of Construction and Preconstruction Impacts for the Proposed Unit

Resource Area	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land-Use Impacts	Approximately 357 ac would be permanently converted to developed features. Approximately 306 ac of additional land would be temporarily disturbed. Residences located within the exclusion area boundary would be vacated and removed or relocated. Approximately 292 ac of prime farmland would be lost. However, there would be no substantial impact on the local agricultural economy and use of nearby farmland. The proposed activities would be consistent with applicable zoning and would not conflict with any known land-use plans, policies, or controls. CUMP activities, including building expanded water-treatment facilities at Rushton Mine, would have only minimal effects on land uses, adjoining affected waters, and waterways.	SMALL	SMALL
Water-Related Impacts			
Water Use – Surface Water	Construction and preconstruction impacts on surface-water use would be temporary and minor.	SMALL	SMALL
Water Use – Groundwater	Construction and preconstruction impacts on groundwater use would be minimal.	SMALL	SMALL

Table 4-12. (contd)

Resource Area	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Water Quality – Surface Water	Construction and preconstruction impacts on surface-water quality would be temporary and minor.	SMALL	SMALL
Water Quality – Groundwater	Construction and preconstruction impacts on groundwater quality would be localized and temporary.	SMALL	SMALL
Ecological Impacts			
Terrestrial Ecosystems	Construction and preconstruction impacts on terrestrial ecological resources, including the BBNPP site and the Rushton Mine facilities expansion area, would be noticeable. The footprint of disturbance would encompass approximately 663 ac on the BBNPP site, including substantial areas in Important Bird Area 72 and the Susquehanna River Environmental Preserve. Construction and preconstruction would require the loss of an estimated 222 ac of upland forest and 9.5 ac of forested wetlands. This roughly 232 ac of forest may provide foraging and roosting habitat for the Federally endangered Indiana bat and the proposed endangered northern long-eared bat. Tree removal would be timed to avoid the non-hibernation period. Construction and preconstruction would affect approximately 11.1 ac of wetlands, including permanent fill of approximately 1.2 ac, temporary fill of approximately 0.9 ac, and permanent conversion of approximately 9 ac of forested wetlands to scrub-shrub wetlands. PPL would obtain the necessary Department of the Army permit and implement mitigation required by the U.S. Army Corps of Engineers. All of the NRC-authorized construction actions would occur in areas disturbed as part of site preparation and development for the BBNPP.	SMALL	MODERATE

Table 4-12. (contd)

Resource Area	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Aquatic Ecosystems	Eliminate the North Branch Canal Outlet; abandon part of Walker Run; eliminate or convert minor amount of Susquehanna River habitat. Remove a culvert, build bridges, and install a culvert; dewater during installation of the ESWEMS pond, power block, and cooling towers; install cooling-water intake and discharge systems and pipelines; temporarily dewater the North Branch Canal, create new sections of Walker Run.	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	Physical impacts of building activities on workers, onsite and offsite buildings, and the general public would not be noticeable. Traffic-control and traffic-management measures would protect any local roads during site development.	SMALL	SMALL
Demography	The population in-migrating to the region for the site-development activities likely would not be noticeable relative to the existing population base.	SMALL	SMALL
Economic Impacts on the Community	The impact of site development would be beneficial to local economies. In Columbia County, beneficial impacts would be noticeable, while impacts elsewhere would be minor. For taxes, minor and beneficial impacts would occur throughout the region, except Salem Township where impacts would be noticeable and beneficial.	SMALL to MODERATE (beneficial)	SMALL to MODERATE (beneficial)
Infrastructure and Community Services	The impact of site development on regional infrastructure and community services would be minor, with the exception of noticeable traffic impacts on the local highway network, noticeable housing impacts in the Borough of Berwick, and noticeable impacts on the Berwick Area School District.	SMALL to MODERATE	SMALL to MODERATE

Table 4-12. (contd)

Resource Area	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Environmental Justice Impacts	There would be no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations.	NONE	NONE
Historic and Cultural Resource Impacts	Although archaeological and historical sites were identified as a result of the Phase I and Phase II cultural resource investigations conducted in the direct and indirect Areas of Potential Effect, it has been determined, and the Pennsylvania State Historic Preservation Office has concurred, that because of measures that will be put in place by the applicant, there will be no impacts on these resources from construction.	SMALL	SMALL
Meteorology and Air Quality Impacts	Emissions of criteria pollutants would be temporary and limited, and the carbon footprint of construction workforce would not be noticeable.	SMALL	SMALL
Nonradiological Health Impacts	Emissions of dust and air pollutants would be limited by operational controls. Noise from the BBNPP would comply with Federal, State, and local standards and impacts from noise on the public and workers would be minimal. Worker health and safety would be ensured by compliance with NRC, Occupational Safety and Health Administration, and State standards. Transportation impacts would be minimal. Mitigation measures listed in Table 4-11 would also be employed. Impacts on the public and workers from building activities at the BBNPP would be minimal.	SMALL	SMALL
Radiological Health Impacts	Doses to construction workers would be within NRC public dose limits (10 CFR Part 20 [TN283]).	SMALL	SMALL
Nonradioactive Waste	Impacts on water, land, and air from the generation of nonradioactive waste would be minimal.	SMALL	SMALL

5.0 Operational Impacts at the Bell Bend Nuclear Power Plant Site

This chapter examines environmental impacts associated with operation of the proposed new Bell Bend Nuclear Power Plant (BBNPP) adjacent to, but separate from, the Susquehanna Electric Steam Station (SSES) site for an initial 40-year period. This proposed action is described in the application for a combined license (COL) submitted by PPL Bell Bend, LLC (PPL). As part of its COL application, PPL submitted an environmental report (ER) that discussed the environmental impacts of station operation (PPL Bell Bend 2013-TN3377). In its evaluation of operational impacts, the review team, composed of staff from the U.S. Nuclear Regulatory Commission (NRC) staff, its contractor, and the U.S. Army Corps of Engineers (USACE), relied on operational details supplied by PPL in its ER and its responses to NRC requests for additional information (RAIs), and the review team's own independent review. Also consulted were permitting correspondence between PPL and the USACE, a cooperating agency in this action.

This chapter is divided into 13 sections. Sections 5.1 through 5.12 discuss the potential operational impacts related to land use, water, terrestrial and aquatic resources, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological and radiological health effects, nonradioactive waste impacts, postulated accidents, and applicable measures and controls, respectively, that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the *Code of Federal Regulations* (CFR) Part 51 (TN250), impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned to each impact category. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The review team's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and County governments (e.g., infrastructure upgrades), as discussed throughout this chapter, are implemented. Failure to implement these mitigation measures and upgrades might result in a change in significance level. Possible additional mitigation to further reduce adverse impacts also is presented, where appropriate. A summary of these impacts is presented in Section 5.13.

5.1 Land-Use Impacts

This section contains information regarding land-use impacts associated with operation of the proposed BBNPP project. Section 5.1.1 discusses land-use impacts onsite and within the BBNPP project vicinity. Section 5.1.2 discusses land-use impacts on existing transmission-line corridors and other offsite areas.

5.1.1 The Site and Vicinity

As described in Section 4.1, the new BBNPP facilities would permanently occupy approximately 357 ac in the BBNPP project area. Additional land-use impacts from operation of the proposed BBNPP unit are expected to be minimal because operations would be situated mostly within those lands disturbed during construction activities. The only potential for land-use impacts from operation of the BBNPP would be salt deposition from cooling-tower drift and the shadowing effects from the two cooling towers and their evaporation plumes.

The maximum salt-deposition rate projected for the proposed BBNPP cooling towers would be approximately 0.02 kg/ha/mo (PPL Bell Bend 2013-TN3377), which is well below the threshold of 10 kg/ha/mo recognized by NRC for leaf damage (NRC 1999-TN3548). Salt drift deposited at rates approaching or exceeding 10 kg/ha/mo in any month during the growing season may cause leaf damage in many species. However, the NRC also recognizes that deposition rates of 1 to 2 kg/ha/mo are generally not damaging to plants (NRC 1999-TN3548). Using plant injury as a conservative indicator of potential constraints on land use, the review team expects that salt-deposition impacts on land use from operation of the BBNPP cooling towers would be minimal.

The average length and height of the evaporation plumes were estimated by the applicant. The average plume length would range from 0.294 mi to the south-southwest in the summer to 0.635 mi to the east-northeast in the winter. The annual average plume length would be 0.405 mi to the south-southwest. The average plume height would range from 810 ft in the summer to 997 ft in the winter. The annual average plume height would be 853 ft (PPL Bell Bend 2013-TN3377). During most of the year shadowing effects would be limited mainly to the project area (PPL Bell Bend 2013-TN3377). During the winter months (i.e., when sun angles are lowest and plume lengths and heights are greatest) offsite shadowing effects might affect properties immediately north of the BBNPP site. Because of the varying directions and short average plume length, the review team expects that shadowing effects from the evaporation plumes on properties outside the project area would be minimal.

Operation of the BBNPP would be consistent with applicable zoning. As described in Section 2.2.1, on February 8, 2011, the Salem Township Board of Supervisors adopted Ordinance 2011-03, which established the Special Industrial District (I-3) zoning designation. The new ordinance added electrical power generating plants (other than wind-energy facilities) as a conditional use within the I-3 zone. On the same date, the Board of Supervisors adopted Ordinance 2011-02 amending the Salem Township Zoning Ordinance and Map to zone the BBNPP site as I-3. The I-3 zone is a heavy industrial district consistent with the areas to the north and east of the BBNPP site that contain the existing SSES plant. In addition, Ordinance 2011-03 added a provision allowing intake and outfall structures on land zoned Conservation District (C-1), which includes the land within the project area located in the Riverlands Recreation Area (Cormany 2012-TN1172).

The review team determined that there would be no notable land-use impacts onsite or in the BBNPP project vicinity. Therefore, based on the information provided by PPL and the review team's independent evaluation, the review team concludes that the land-use impacts of operation at the BBNPP site would be minimal, and additional mitigation would not be warranted.

5.1.2 Transmission-Line Corridors and Other Offsite Areas

5.1.2.1 Transmission-Line Corridors

The applicant stated (PPL Bell Bend 2013-TN3377) that the subsidiary expected to own the subject transmission lines typically ensures that land use within transmission corridors and underneath the high-voltage conductors is compatible with reliable transmission of electricity. Vegetation within the corridors is maintained by mowing, trimming, tree removal; and, if necessary, by applying herbicides and growth-regulating chemicals.

Regular inspections and maintenance of the transmission system and rights-of-way would also be performed. These inspections and maintenance include patrols and maintenance of transmission-line hardware on a periodic and as-needed basis. Additional information on maintenance of lands in transmission corridors is provided in Section 5.3.1.1, under "Transmission-Line Corridor Maintenance".

The review team determined that there would be no notable land-use impacts within transmission-line corridors during operations. The review team considers major conflicts between the applicant's proposed facility and applicable land-use plans and policies to be unlikely. Therefore, based on the information provided by PPL and the review team's own independent evaluation, the review team concludes that the land-use impacts from transmission-line system operations at the BBNPP site would be minimal, and additional mitigation would not be warranted.

5.1.2.2 Consumptive-Use Mitigation

Consumptive-use mitigation during BBNPP operations could affect land uses along the shorelines of affected waters, especially Cowanesque Lake and downstream receiving waters. Although Cowanesque Lake drawdowns would be infrequent, they could interfere with existing recreational land uses surrounding the shoreline (see Section 5.4.4.2). Consumptive-use releases have the potential to draw Cowanesque Lake down to various levels, up to 12 ft based on a 30-year period of record (Meyer 2014-TN3566). As the elevation of the lake falls below certain thresholds, some recreational facilities could face temporary closure. However, the review team expects that the effects would likely be relatively infrequent, and temporary. Consumptive-use mitigation releases could also increase flows in downstream receiving streams and rivers and potentially affect land uses along the shores. However, as for Cowanesque Lake, the review team expects that these effects would be infrequent and temporary.

5.1.3 Summary of Land-Use Impacts

Based on information provided by PPL, and the review team's independent evaluation, the review team concluded that the potential land-use impacts of operation would be SMALL. The proposed activities would be consistent with applicable zoning; would not conflict with any known land-use plans or objectives; and would have no substantial effects on agriculture, forestry, and mineral development activities in the surrounding landscape. The NRC staff concludes that no further mitigation measures beyond PPL's commitments outlined in its application would be warranted.

5.2 Water-Related Impacts

This section discusses water-related impacts on the surrounding environment from operation of the proposed BBNPP unit. The primary water-related impacts would be associated with cooling-water requirements for the unit's circulating-water system and essential service water system (ESWS). Details of the plant operational modes and cooling-water requirements for the proposed BBNPP unit can be found in Section 3.2.2. No onsite groundwater would be withdrawn for operational use (PPL Bell Bend 2013-TN3377).

Managing water resources requires understanding and balancing the tradeoffs among various, and often conflicting, objectives. At the BBNPP site, these objectives include recreation, visual aesthetics, river ecology, and a variety of beneficial consumptive uses of water. The responsibility for regulating water use and water quality is delegated to the Pennsylvania Department of Environmental Protection (PADEP) and the Susquehanna River Basin Commission (SRBC).

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power-generation facility. Accordingly, PPL must obtain the water-related permits and certifications necessary for operation of the facility. These permits and certifications include:

- Clean Water Act (CWA) (33 USC 1251 et seq.-TN662) Section 401 Certification. This certification would be issued by the PADEP and would confirm that operation of the plant would not conflict with State and Federal water-quality management programs.
- CWA (33 USC 1251 et seq.-TN662) Section 402(p) National Pollutant Discharge Elimination System (NPDES) Permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency has delegated the authority for administering the NPDES program in the Commonwealth of Pennsylvania to the PADEP. A post-construction stormwater management plan would be required as part of the NPDES permit.
- CWA (33 USC 1251 et seq.-TN662) Section 316(a). This section regulates the cooling-water discharges to protect the health of the aquatic environment in the receiving waters. Requirements will be covered under the NPDES permit with the PADEP.
- CWA (33 USC 1251 et seq.-TN662) Section 316(b). This section regulates cooling-water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures. The scope will be covered under the NPDES permit issued by the PADEP.
- SRBC 18 CFR Part 806 (TN3811). SRBC approval is required for withdrawal and consumptive use of water within the Susquehanna River Basin.

PPL would also comply with other applicable State, regional, and local regulations as described in its ER (PPL Bell Bend 2013-TN3377).

Section 5.2.1 discusses the expected hydrologic alterations in surface water and groundwater related to operations of the proposed BBNPP unit. Sections 5.2.2.1 and 5.2.2.2 discuss water-use impacts from operations for surface water and groundwater, respectively. Sections 5.2.3.1 and 5.2.3.1 discuss water-quality impacts from operations for surface water and groundwater, respectively. Section 5.2.4 discusses water monitoring during plant operation. These sections draw on information presented in Section 2.3 of this environmental impact statement (EIS) and in the ER (PPL Bell Bend 2013-TN3377).

5.2.1 Hydrological Alterations

Activities associated with operating the proposed BBNPP are described, in detail, in Section 3.4. As stated in Section 4.2.1, preconstruction and construction activities would alter the local surface conditions and drainage patterns, which could cause increased runoff and erosion. These alterations would persist, in part, during BBNPP operations. The primary activities during BBNPP operations that would produce hydrological alterations are the withdrawal and consumptive use of water from the North Branch Susquehanna River (NBSR) for the plant cooling system, and the discharge of cooling-water blowdown and wastewater to the Susquehanna River.

The proposed BBNPP unit would be located in Salem Township, Luzerne County, Pennsylvania, on the west side of the NBSR and positioned on an upland area about 200 ft above the Susquehanna River, principally within the Walker Run watershed. Natural drainage from the facility would be altered by land-surface modifications during construction and preconstruction activities. Specifically, surface water would be routed away from the nuclear plant using drainage ditches described in the site layout plan. Infiltration beds and water-retention basins would be used to control the rate of stormwater discharge from the site to predevelopment levels. As described in Section 4.2.1, discharges from the site would be regulated under the NPDES permit, which would require an erosion and sediment control plan and the use of best management practices (BMPs) for control of stormwater (PPL Bell Bend 2013-TN3377). A Post-Construction Stormwater Management (PCSM) plan would be required as part of the NPDES permit to manage stormwater runoff and minimize the discharge of contaminants.

New impervious surfaces at the site would locally decrease infiltration, and the use of infiltration beds and water-retention basins would locally increase infiltration. The Glacial Outwash aquifer beneath the BBNPP site would likely be affected by the resulting changes in the pattern of recharge; however, these effects are expected to be localized to the site. The bedrock aquifers are not expected to be affected by changes in the pattern of infiltration and recharge.

As described in Chapter 3, the proposed BBNPP unit would withdraw water from the NBSR for the circulating-water system and ESWS. The estimated average and maximum total withdrawal are 25,729 and 28,179 gpm (37 and 40.6 Mgd) (i.e., 57.3 cfs and 62.8 cfs), respectively (PPL Bell Bend 2013-TN3377). Evaporation and drift from the cooling towers will consumptively used the majority of the water withdrawn, with the remainder returned to the river as blowdown. The estimated average and maximum total consumptive use by the BBNPP are 17,064 and 18,812 gpm (24.6 and 27 Mgd) (i.e., 38.0 cfs and 41.9 cfs), respectively (PPL Bell Bend 2013-TN3377). Withdrawal from and consumptive use of NBSR water requires approval from the SRBC. PPL has applied to the SRBC for the withdrawal of 42 Mgd (65 cfs) and the consumptive use of 28 Mgd (43 cfs) of NBSR water (PPL Bell Bend 2011-TN3627). Because the intake and discharge locations are close to each other, the primary hydrological alteration from the consumptive-water use would be the reduction of flow in the NBSR, which would affect the availability of water for other uses. The impact of consumptive use of surface water by the proposed BBNPP is evaluated in terms of the estimated reduction in flow in absolute and percentage terms for normal and maximum modes of operation and for long-term average flows and low flows in the NBSR. In addition, the plant's impact on NBSR water use is evaluated as the decreased ability of a hypothetical small downstream reservoir to serve hypothetical water users. These impacts are discussed in Section 5.2.2.1.

As described in Section 2.2.2, the SRBC has stated that consumptive-use mitigation will be required in the form of compensating releases from upstream sources in an amount equal to the consumptive use at BBNPP (SRBC 2012-TN3565). PPL's primary plan for consumptive-use mitigation relies on water stored in Cowanesque Lake as the upstream source. To implement this plan, PPL would purchase the rights to Cowanesque Lake water currently allocated for mitigation of consumptive use downstream of the BBNPP site and would reallocate to BBNPP Cowanesque Lake water currently used to mitigate consumptive use by PPL's Montour Steam Electric Station (MSES) on the West Branch Susquehanna River. Hydrologic alterations from PPL's primary consumptive-use mitigation plan would include changes in the pattern and amount of releases from Cowanesque Lake, which would affect lake levels and flows in the Cowanesque River below the dam. Flows in the Tioga, Chemung, and Susquehanna Rivers also would be affected by alterations in releases from Cowanesque Lake, but to a lesser extent because of the larger flows downstream of the Cowanesque River confluence with the Tioga River. Flows in Moshannon Creek downstream from the Rushton Mine discharge would also be affected as a result of the development of the mine-treatment facility to supply water for the MSES consumptive-use mitigation (see description in Section 2.2.2). Impacts resulting from the implementation of PPL's primary plan for consumptive-use mitigation are discussed in Section 5.2.2.1.

The intake structure would be designed to meet current CWA 316(b) requirements for new facilities, with design through-screen intake velocities less than 0.5 ft/s at the screen (PPL Bell Bend 2013-TN3377). Potential impacts to aquatic life are evaluated in Section 5.3.2.

Plant blowdown and wastewater would be discharged to the NBSR, with potential effects on the thermal characteristics of the river and on water quality. The impacts of plant discharges to the NBSR are evaluated in Section 5.2.3.1.

PPL has indicated that no onsite groundwater would be withdrawn for operational use by the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). A municipal source derived from groundwater would supply water for potable and sanitary uses, as described in Section 5.2.2.2. No dewatering-related pumping is planned to occur during operation of the proposed BBNPP unit.

5.2.2 Water-Use Impacts

This section describes the potential impacts on surface-water and groundwater uses and users resulting from operation of the BBNPP. Information presented in the ER (PPL Bell Bend 2013-

TN3377), other information obtained by the review team, and independent analyses performed by the review team were used to assess the impacts.

5.2.2.1 Impacts on Surface-Water Use

As described in Section 5.2.1, PPL has applied to the SRBC for the withdrawal of 42 Mgd (65 cfs) and the consumptive use of 28 Mgd (43 cfs) of NBSR water to support the operation of the proposed BBNPP unit. These rates are greater than the estimated maximum withdrawal and consumptive use from the ER (PPL Bell Bend 2013-TN3377). To bound the estimated impacts, the review team assessed the maximum water-use impacts of BBNPP operations using the water-use rates requested in the application to the SRBC. As stated above, the expected average withdrawal and consumptive-use rates are 37 and 24.6 Mgd (57 and 38 cfs), respectively. The reduction in river flows from withdrawal and consumptive use are shown in Table 5-1 for several flow characteristics taken from the Susquehanna River post-regulation flows at Wilkes-Barre provided in Table 2-9. Withdrawal and consumptive use would be less than 0.5 percent of the mean annual river flow. Therefore, operation of the proposed BBNPP unit would have a minimal effect on average flow in the NBSR. Withdrawal and consumptive use are a much larger fraction of the river during low-flow conditions. For the flow exceeded 95 percent of the time (the P95 flow), consumptive use would result in about a 3 percent reduction in river flow. For the 7Q10 flow (i.e., the 7-day average low flow that occurs on average once every 10 years), consumptive use would result in approximately a 5 percent reduction in river flow. Impacts from consumptive use are emphasized here because the additional impacts to water resources from withdrawal will only occur between the intake and discharge locations.

Table 5-1. Susquehanna River Flow Reduction from BBNPP Withdrawal and Consumptive Use (Post-Regulation River Flows from Table 2-4)

Flow Characteristic	Susquehanna River at Wilkes-Barre (cfs)	Flow Reduction from 65 cfs Withdrawal (%)	Flow Reduction from 43 cfs Consumptive Use (%)
Mean Annual Flow	14,400	0.5	0.3
P95 Flow	1,390	4.7	3.1
7Q10 Flow	872	7.5	4.9

As described in Section 2.3.2.1, the SRBC requires mitigation for consumptive use during low-flow periods (SRBC 2008-TN699). Mitigation releases from Cowanesque Lake for the SSES and MSES consumptive uses are currently triggered by a 7Q10 flow at Wilkes-Barre of 826 cfs. The SRBC decided that the use of a single annual 7Q10 value was unprotective of ecosystem flow needs and adopted a new low-flow protection policy that strives to maintain natural flow variability while providing more effective management of flows during drought conditions (SRBC 2012-TN2453). As explained in Section 2.3.2.1, it is likely that mitigation for SSES and MSES consumptive uses will be triggered in the future by monthly P95 flow values ranging from 860 to 970 cfs during the period from July to November (see Table 2-10).[(1)] The review team assumed that operation of the proposed BBNPP unit would not affect the consumptive-use mitigation for SSES.

(1) 7Q10 and P95 values in Table 5-1 and Table 2-10 differ because the values depend on the period of record used in the calculations.

As described in Section 2.2.2, PPL has proposed to reallocate, to the proposed BBNPP unit, water in Cowanesque Lake currently used for MSES consumptive-use mitigation, and to expand Rushton Mine in the West Branch Susquehanna River sub-basin to satisfy MSES consumptive-use mitigation requirements. PPL also would purchase rights to Cowanesque Lake water currently allocated to mitigate an unrelated downstream consumptive use. The SRBC provided monthly passby flow values at the BBNPP site that would serve as the basis for triggering consumptive-use mitigation for the proposed BBNPP unit (SRBC 2012-TN3565). These passby flow values were adjusted to the location of U.S. Geological Survey (USGS) Gage 01536500 at Wilkes-Barre and provided to the review team by the SRBC. According to the SRBC, consumptive-use mitigation for the proposed BBNPP unit would be triggered when NBSR flow at the Wilkes-Barre gage falls below the adjusted passby flows plus 117 cfs (i.e., the combined consumptive use at SSES Units 1 and 2 [74 cfs] and the proposed BBNPP unit [43 cfs]). Passby flows and the NBSR flows triggering consumptive-use mitigation for the proposed BBNPP unit are shown in Table 5-2.

Table 5-2. Passby Flows at the BBNPP Site, Adjusted Passby Flows at Wilkes-Barre Gage (USGS Gage 01536500), and Flows at Wilkes-Barre (USGS Gage 01536500) Triggering Releases for BBNPP Consumptive-Use Mitigation

Month	Passby Flow at the BBNPP Site (cfs)	Adjusted Passby Flow at Gage (cfs)	Flow at Gage Triggering Mitigation Releases (cfs)	Reduction in Triggering Flow from 43 cfs Consumptive Use (%)
May	1,750	1,700	1,817	2.4
June	1,750	1,700	1,817	2.4
July	1,750	1,700	1,817	2.4
August	1,200	1,100	1,217	3.5
September	890	860	977	4.4
October	1,010	980	1,097	3.9

Because the passby flow values in Table 5-2 are larger than the Wilkes-Barre 7Q10 and P95 flow values in Table 2-10, mitigation for the proposed BBNPP unit is expected to occur more frequently than mitigation for SSES Units 1 and 2, and maximum consumptive use by the proposed BBNPP unit will reduce NBSR flows by no more than 2.4 percent during the period from May to June and no more than 4.4 percent in any month. Based on an independent analysis of NBSR flow data, the review team expects that mitigation for SSES Units 1 and 2 consumptive use will be required for an average of about 15 days in about 2 out of 10 years of SSES operation, with mitigation triggered by the P95 flow values at Wilkes-Barre shown in Table 2–10 (Meyer 2014-TN3566). The review team's analysis indicates that consumptive-use mitigation for the proposed BBNPP unit will be required for an average of about 25 days in about 4 out of 10 years of BBNPP operation, with mitigation most likely during July, August, and September. Based on this analysis and the information given above, the review team determined that operations of the proposed BBNPP unit would reduce NBSR flows at the site by no more than 2 to 4 percent in less than one-half the years of BBNPP operation. Flow reductions of this magnitude would be temporary and larger percentage reductions would be prevented by the required consumptive-use mitigation releases. The relative flow reductions from operations of the proposed BBNPP unit would also be lower downstream from the site as the river flows increase with the contributions from tributary streams.

To assess the impact of operations of the proposed BBNPP unit on the availability of water for downstream uses, the review team evaluated the effect of consumptive use on the reliability of a hypothetical downstream water-supply reservoir. The hypothetical reservoir was assigned a useable storage capacity of 50,000 ac-ft and was replenished by consumptive removal of water from the Susquehanna River at a maximum operational limit of 500 cfs. In the review team's analysis, water withdrawals from the Susquehanna River were limited to the months of October to May and were not allowed to reduce the river flow below the median monthly flows over the period from 1900 to 2011. The hypothetical reservoir was designed to deliver a steady supply of 83 cfs, a supply rate that resulted in a reservoir reliability of 94.7 percent using the 1900 to 2011 NBSR discharge record at Wilkes-Barre (USGS Gage 01536500). Reservoir reliability was determined as the percentage of days for which the hypothetical reservoir contained sufficient water to satisfy the 83 cfs demand. When the BBNPP consumptive use of 43 cfs was subtracted from the available NBSR flow, the reliability of the reservoir was reduced to 94.6 percent. This small change in reliability indicates that operations of the proposed BBNPP unit would have a minimal effect on the availability of water for downstream uses.

The effects on waterbodies altered by the implementation of PPL's primary plan for consumptive-use mitigation were evaluated by the review team (Meyer 2014-TN3566). Flows in the Cowanesque River would be altered by the release of water from Cowanesque Lake in an amount equal to the consumptive use of the proposed BBNPP unit, which the review team conservatively assumed would be 28 Mgd (43 cfs). These releases from Cowanesque Lake also would affect the lake elevation. Concurrently, mitigation of consumptive use by MSES would be shifted from Cowanesque Lake to Rushton Mine, which would result in altered flows in Moshannon Creek. In addition, consumptive-use mitigation releases for an unrelated downstream user would be transferred from Cowanesque Lake to PPL's Holtwood hydroelectric reservoir as part of PPL's primary plan.

The effect of consumptive-use mitigation for the proposed BBNPP unit on the Cowanesque River was evaluated by the review team using river discharge data from below Cowanesque Dam (USGS Gage 01520000). Discharge data from 1981 to 2013 were used as these data reflect the significant alterations to flow resulting from the operation of the dam. Cowanesque River flows were evaluated under two conditions. Under baseline conditions, river flows below the dam were evaluated with simulated releases of 46.5 Mgd (72 cfs) from Cowanesque Lake to mitigate for the combined consumptive use of SSES and MSES. These releases were triggered by P95 flows at Wilkes-Barre (see Table 2-10), which are expected to be implemented prior to operation of the proposed BBNPP unit. Under conditions with operation of the proposed BBNPP unit, river flows below the dam were evaluated with simulated releases of 40 Mgd (62 cfs) from Cowanesque Lake to mitigate for the consumptive use of SSES, with the same triggering flows. Further, under these conditions evaluation of river flows included releases of 28 Mgd (43 cfs) from Cowanesque Lake to mitigate for the consumptive use of the proposed BBNPP unit. These releases were triggered by flows at Wilkes-Barre specified by SRBC (Table 5-2). Differences in Cowanesque River flows under the two conditions were used by the review team to evaluate water-use impacts.

The distribution of daily flows in the Cowanesque River under the baseline conditions and with operation of the proposed BBNPP unit are shown in Figure 5-1. Approximately 40 percent of daily flows are larger than 160 cfs and are not included in this figure. However, because consumptive-use mitigation is not likely to be required during these larger flows, Figure 5-1 illustrates all of the relevant changes in flow resulting from differences in mitigation releases with the proposed BBNPP unit operating. The figure shows that, with the proposed BBNPP unit operating, flows less than 30 cfs occur less frequently, while larger flows occur more frequently. The increase in the occurrence of flows from 50 to 80 cfs is due to consumptive-use mitigation for the proposed BBNPP unit while the smaller increase in the occurrence of flows from 50 to 80 cfs is due to the combined consumptive-use mitigation for the proposed BBNPP unit and SSES. On any given day, releases from Cowanesque Lake for consumptive-use mitigation can have a significant effect on the river flows below the dam. However, flows in the river have a high natural variability, and Figure 5-1 indicates that the overall effect of operation of the proposed BBNPP unit on river flows below the dam is minor. Because flows increase downstream, Figure 5-1 illustrates the maximum impact consumptive-use mitigation for the proposed BBNPP unit releases is expected to have downstream of Cowanesque Dam.

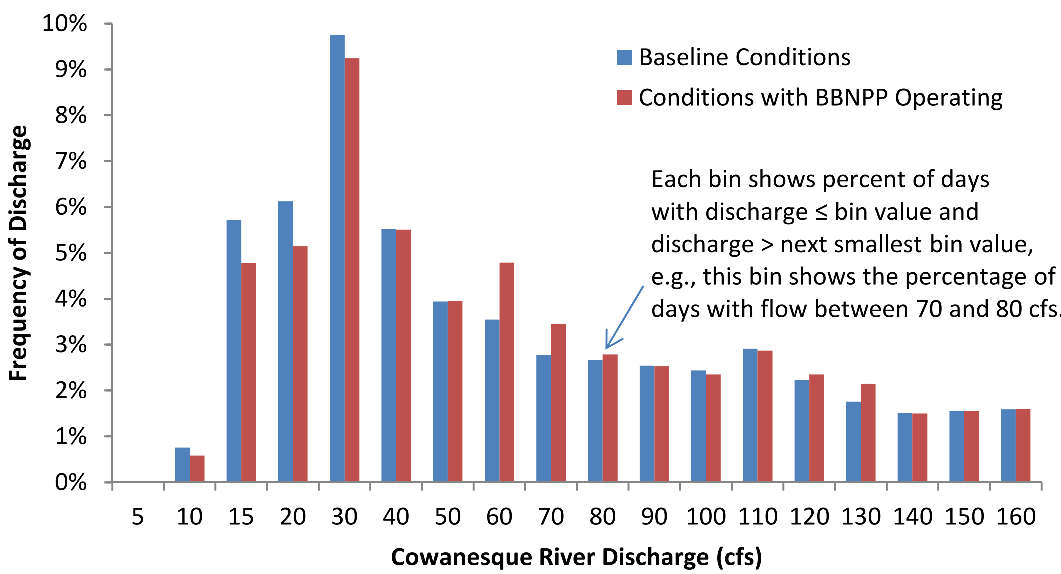

Figure 5-1. Effect of Operations of the Proposed BBNPP Unit on the Distribution of Daily Flows in the Cowanesque River below Cowanesque Dam

Releases from Cowanesque Lake for consumptive-use mitigation for the proposed BBNPP unit also will affect the water-surface elevation of the lake. To evaluate these effects, the review team calculated the cumulative mitigation releases from May to October for each year from 1981 to 2013 using the NBSR flow data at Wilkes-Barre to trigger those releases. Changes in lake elevation resulting from the releases were calculated using area-elevation-capacity curves for Cowanesque Lake. For this calculation it was assumed that the lake starts each summer at normal pool (elevation of 1,080 ft) and receives no excess inflow until November 1, at which point the lake refills to the normal pool elevation. Simulation results completed for the SRBC indicate that, even during a multi-year drought (e.g.,1962 to 1966), the lake elevation returns to normal pool each winter (EA 2012-TN3371). No excess inflow means that inflow is exactly balanced by evaporation and normal releases from the lake (i.e., releases not associated with consumptive-use mitigation). With these assumptions, all reductions in the lake's water-surface elevation are due to consumptive-use mitigation releases.

As described above, the review team's analysis indicated that consumptive-use mitigation for the proposed BBNPP unit would occur in about 4 out of 10 years during operation of the proposed BBNPP unit. Cumulative mitigation releases would typically be less than 2,000 ac-ft and result in less than 2 ft of drawdown in Cowanesque Lake elevation. For the period of data evaluated by the review team (1981 to 2013), cumulative mitigation releases were more significant in about 1 out of 10 years during operation of the proposed BBNPP unit. During these years, consumptive-use mitigation releases for the proposed BBNPP unit were from about 4,000 to 6,000 ac-ft, which would result in about 4 to 6 ft of drawdown in Cowanesque Lake elevation. Drawdown of this magnitude would be noticeable and could adversely effect recreational use of Cowanesque Lake. Historical lake elevations have been lower than could be attributed solely to water-supply releases (Figures B3-3 and B3-6, EA 2012-TN3371), suggesting that evaporation and normal releases from the lake may exceed inflow to the lake during low-flow conditions. Total drawdown in Cowanesque Lake is thus expected to be greater than the drawdown due solely to consumptive-use mitigation releases.

Under PPL's primary plan for consumptive-use mitigation for the proposed BBNPP unit, the source of mitigation for consumptive use by MSES would be shifted from Cowanesque Lake to Rushton Mine. Discharge from Rushton Mine is to Moshannon Creek, a tributary of the West Branch Susquehanna River. The effect on Moshannon Creek of implementing PPL's consumptive-use mitigation plan was evaluated by the review team using river discharge data from an inactive gage at Osceola Mills (USGS Gage 01542000), located approximately 2 mi upstream from the Rushton Mine discharge. Moshannon Creek discharge data from 1940 to 1993 were available, but only the data from 1981 were used because conditions after 1980 reflect the influence of dams on the NBSR. Baseline conditions consisted of the measured gage data. Conditions with the proposed BBNPP unit operating included the release of 14 cfs to Moshannon Creek as mitigation for MSES consumptive use. For this analysis, these releases were triggered by flows at Wilkes-Barre specified by SRBC (see Table 5-2). The distribution of daily flows in Moshannon Creek under the baseline conditions and with the proposed BBNPP unit operating are shown in Figure 5-2. These results are similar to those for the Cowanesque River shown in Figure 5-1, and the review team's conclusion is the same. On any given day releases from Rushton Mine for consumptive-use mitigation could have a significant effect on the creek flows at the point of discharge. However, flows in the creek have a high natural variability, and Figure 5-2 indicates that the overall effect of operation of the proposed BBNPP unit on these flows will be minor. Because flows increase downstream, Figure 5-2 illustrates the maximum impact consumptive-use mitigation for the proposed BBNPP unit releases are expected to have downstream of the Rushton Mine discharge.

As described in Section 2.2.2, the final component of PPL's primary plan for consumptive-use mitigation for the proposed BBNPP unit involves the transfer of water rights for a downstream consumptive use from Cowanesque Lake to PPL's Holtwood hydroelectric reservoir. Releases to mitigate for this use would be triggered by the flow values at Harrisburg shown in Figure 2-10. Holtwood and the downstream consumptive use are located in the Lower Susquehanna sub-basin, where Susquehanna River flows are significantly larger than at Wilkes-Barre. In addition,

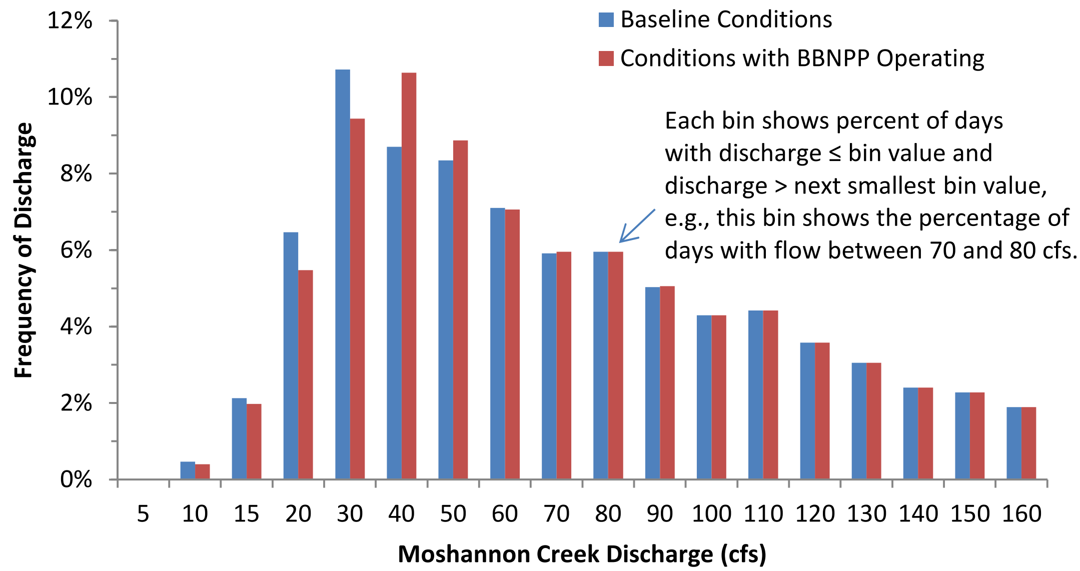

Figure 5-2. Effect of Operation of the Proposed BBNPP Unit on the Distribution of Daily Flows in Moshannon Creek below the Rushton Mine Discharge (1981 to 1993 data)

the amount of consumptive use involved is about 15.5 Mgd (24 cfs) (PPL Bell Bend 2013-TN3541), significantly less than the consumptive use for the proposed BBNPP unit. Because the affected flows are larger and the consumptive use is smaller, the review team concludes that the effects of this portion of PPL's primary plan would be bounded by the effects discussed above for the proposed BBNPP unit's consumptive use and for releases to the Cowanesque River and, therefore, would be minor.

The review team determined that operation of the proposed BBNPP unit would consumptively use only a small proportion of Susquehanna River flow, and the review team's independent analysis determined that consumptive use for the proposed BBNPP unit would not noticeably alter the reliability of downstream water supply. PPL's primary plan for consumptive-use mitigation for the proposed BBNPP would alter flows at several locations in the Susquehanna River Basin. The review team's independent analysis determined that effects of these alterations on river and stream flows would be minor. The effect on water-surface elevations in Cowanesque Lake also would be minor during normal years, but would be noticeable during dry years. However, because Cowanesque Lake does not serve as a water-supply source the lake elevation drawdown would have no downstream water-use impacts. Therefore, the review team concludes that the impacts on surface-water use from the operation of the proposed BBNPP unit would be SMALL, and no additional mitigation would be required.

5.2.2.2 Impacts on Groundwater Use

PPL has indicated that no onsite groundwater would be used for operation of the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). Water for potable and sanitary uses during operation of the proposed BBNPP unit would be supplied by the Pennsylvania American Water Company (PAWC), a public water supplier with wells in Berwick, Pennsylvania. PPL stated that the average usage rate would be 103 gpm (148,000 gpd) and the maximum usage rate would be 236 gpm (340,000 gpd) (Table 3.3-1, PPL Bell Bend 2013-TN3377). As described in Section 2.3, the combined potential yield of the permitted PAWC wells at Berwick is 4.6 million gpd and the average withdrawal from the well system was about 1.6 Mgd during the period from 2004 to 2013. Thus, the average and maximum potable and sanitary demands for operation of the proposed BBNPP unit are about 5 and 11 percent, respectively, of the average unused capacity of the PAWC Berwick well system. Because the only use of groundwater for operation of the proposed BBNPP unit would be provided by the PAWC municipal supply and the PAWC well system has sufficient capacity for this use, the review team concludes that the impacts on groundwater from the operation of the proposed BBNPP unit would be SMALL.

5.2.3 Water-Quality Impacts

This section discusses the impacts on the quality of surface water and groundwater resulting from the operation of the proposed BBNPP unit. Surface-water impacts would include those from discharges of thermal, chemical, and radiological wastes as well as physical changes in the Susquehanna River resulting from effluents discharged by the proposed BBNPP unit. Groundwater impacts would include those from inadvertent chemical spills, infiltration from the stormwater management system, and effects from cooling-tower drift deposition. Information presented in the ER (PPL Bell Bend 2013-TN3377), other information obtained by the review team, and independent analyses performed by the review team were used to assess these impacts.

5.2.3.1 Impacts on Surface-Water Quality

As described in Section 3.4, liquid effluents from the proposed BBNPP unit will be discharged to the Susquehanna River through a single blowdown- and wastewater-discharge structure. Wastewater from the sanitary- and potable-water systems will be discharged to the municipal sewer system for treatment. Stormwater runoff, residual chemicals used to manage the water chemistry in the cooling towers, solutes from the Susquehanna River water that are concentrated through evaporation from the cooling towers, and residual heat in the blowdown water are the factors that the review team considered. The impacts of liquid radiological effluent are discussed in Section 5.9.

Stormwater Runoff

During operation of the proposed BBNPP unit, a PCSM plan would remain in place to manage stormwater runoff and minimize the discharge of contaminants (PPL Bell Bend 2013-TN3377). Water-quality impacts from stormwater runoff would be managed as part of the PADEP NPDES permit, through engineering controls based on BMPs as described in the PCSM plan (PPL Bell Bend 2013-TN3377). Because of the use of BMPs, the stormwater runoff is not expected to noticeably affect the water quality of the receiving streams (Walker Run and Unnamed Tributaries 1 and 5).

Residual Chemicals

The water-treatment methods to be used at the proposed BBNPP unit are described in Section 3.4. Anticipated concentrations of water-treatment chemicals in the discharge of the proposed

BBNPP unit are presented in Table 3-5. Pursuant to 40 CFR Part 423 (TN253), the chemicals in this waste stream will be specifically regulated by the conditions of the NPDES permit.

Concentrated Solutes

As described in Section 3.4, evaporation in the cooling towers would result in the concentration of any solutes present in the makeup water. Anticipated water quality for the effluent assuming three cycles of concentrations (dissolved concentration in the blowdown discharge three times the initial concentration in the makeup water) are provided in Table 3-4. The review team acknowledges that some of the concentrations of some of the constituents listed in Table 3-4 exceed the water-quality standards listed in Table 2-11. However, the constituents will be diluted back to ambient Susquehanna River water-quality levels as the discharge mixes into the rest of the Susquehanna River. As described in Section 3.4.4.1, the average total liquid effluent discharge rate would be 19 cfs, which is 0.1 percent of the mean annual flow and 2.2 percent of the 7Q10 flow (see Table 5-1 for flow values). An NPDES permit is required before blowdown effluent can be discharged, and discharges must be in compliance with the permit.

Residual Heat in Blowdown Water

As described in Section 3.4, cooling-tower blowdown constitutes 98 percent of the total liquid effluent discharge. Evaporation and heating of the air are the mechanisms used to dissipate heat in a closed-cycle cooling-tower design, such as at the proposed BBNPP unit. Water is discharged to control the water chemistry in the cooling-water system and not to dissipate heat to the river. However, the water in the cooling-tower basins is at an elevated temperature when it is discharged. The review team reviewed PPL's summary of the thermal plume impacts contained in Section 5.3.2.1 of the ER (PPL Bell Bend 2013-TN3377) and a detailed description of the thermal plume analysis conducted for PPL (ERM 2008-TN3677).

Temperature standards for fresh waters are contained in Pennsylvania Code, Title 25, Chapter 93.7. The maximum water temperature standard for the NBSR adjacent to the BBNPP site, protected for warm-water fishes, varies throughout the year, from 40°F in January and February to 87°F in July and August. In addition, the proposed BBNPP unit discharge must comply with Pennsylvania Code, Title 25, Chapter 96.6, which specifies that the discharge may not cause a temperature change greater than 2°F during any one-hour period.

The blowdown discharge to the Susquehanna River would be, in most cases warmer than the ambient water. PPL used the Cornell Mixing Zone Expert System (CORMIX) modeling software, version 5, to evaluate the near-field thermal plume from the discharge into the Susquehanna River and a three-dimensional hydrodynamic model to evaluate the far-field plume (PPL Bell Bend 2013-TN3377). The blowdown flow rate and temperature were estimated, and historical Susquehanna water temperatures and flow rates for winter and summer scenarios were used as input to CORMIX. PPL provided the CORMIX input and output files used in their evaluation; the review team verified PPL's results using CORMIX version 7.

The review team independently conducted a thermal plume analysis to conservatively estimate the thermal plume's extent under both summer and winter low-flow conditions. The 7Q10 flow at Wilkes-Barre, 872 cfs (Stuckey and Roland 2011-TN1902), was used to represent the summer low-flow conditions. A river flow rate of 2,290 cfs was used to represent the winter low-flow conditions. This value is the minimum monthly flow in winter (December through February) reported by the USGS at Wilkes-Barre for the period 1981 to 2008. The review team used the same temperature conditions used by PPL, a winter blowdown temperature 33.8°F in excess of the ambient river temperature (32°F), and a summer blowdown temperature 3.5°F in excess of the ambient river temperature (86.5°F). The review team used PPL's maximum effluent discharge flow rate of 24.9 cfs. The review team independently estimated seasonal values of channel width and depth, which resulted in slightly more conservative values than used in PPL's analysis.

For the purpose of assessing impacts on aquatic biota, an excess temperature of 2°F above ambient river temperature is used to provide the extent of the thermal plume (i.e., length, width, and thickness). The results from the review team's CORMIX thermal plume analyses are provided in Table 5-3. All of the results indicate a rapid mixing of the thermal plume, as indicated by the extent of the plume's 2°F isotherm. The maximum extent of the plume downstream (to the 2°F isotherm) is 15.5 m (50.8 ft) from the discharge during winter, with a width of 25.8 m (84.6 ft) and thickness of 3.11 m (10.2 ft).

Table 5-3. Thermal Plume Extent (2°F isotherm) Estimated by the Review Team

	Summer	Winter
Length (m)	<1	15.5
Width[(a)] (m)	32	25.8
Thickness (m)	<0.1	3.11

(a) Effective width based on a uniform temperature distribution.

The CORMIX results show the winter plume continuing to develop downstream beyond the 2°F isotherm. The plume attaches to the right bank 314 m (1,030 ft) downstream of the discharge and becomes laterally fully mixed 628 m (2,060 ft) downstream of the discharge. At the laterally fully mixed locale, the CORMIX results show the excess temperate as 1.1°F and the plume thickness as 1.03 m (3.4 ft). During summer, the CORMIX results show that the thermal plume excess temperature drops below 1°F within 1 m (3.3 ft), largely due to the small temperature excess (3.46°F) of the plume. The specific discharge conditions for the operation of the proposed BBNPP unit will be regulated and monitored under the NPDES permit. Based on the results presented above, the review team concludes that the thermal effects of the plant discharge would be localized and minor.

Based on the information described above and the results of the review team's independent assessment, the review team concludes that impacts on surface-water quality resulting from the operation of the proposed BBNPP unit would be SMALL.

5.2.3.2 Groundwater-Quality Impacts

As discussed in Section 5.2.2.2, no onsite groundwater would be used for operation of the proposed BBNPP unit. In addition, no permanent dewatering systems are proposed for the BBNPP site. As a result, the only impacts to groundwater quality could be from inadvertent chemical spills, the stormwater management system, and the cooling-tower drift.

BMPs would be applied to prevent spills and minimize their effects. The spill prevention, control, and countermeasure plan pursuant to 40 CFR Part 112 (TN1041) will minimize impacts on local groundwater because spills would be quickly cleaned up and infiltration to groundwater would be minimized.

As mentioned in Section 3.2.2.1, the stormwater drainage system would collect through a network of storm sewers and swales and direct stormwater to underground infiltration basins designed to control the rate, volume, and water quality of runoff that would eventually reach surface water. The underground infiltration basins would discharge water to adjacent vegetated areas or wetlands, usually through a level spreader to disperse water as sheet flow (PPL Nuclear Development 2011-TN2254). The review team evaluated the PPL's field studies and calculations pertaining to groundwater infiltration, and found them consistent with the PADEP guidance on stormwater management practices (PADEP 2006-TN3948). Therefore, the review team concludes that alteration in groundwater quality from the stormwater management system would be undetectable.

Recharge of the shallow groundwater as a result of seepage from the safety-related Essential Service Water Emergency Makeup System (ESWEMS) pond would be limited by a thick clay or cohesive soil liner of low permeability. Assuming a 1 m thick clay liner with a permeability of 10^{-9} m/sec and a maximum water level of 17 ft above the liner, the review team calculated a maximum seepage rate of less than 7 in. per year, which is approximately half of the expected groundwater recharge for the undisturbed site (as described in Section 2.3.1). PPL would reevaluate the permeability of the cohesive fill during plant construction (PPL Bell Bend 2013-TN3447). Considering the limited size of the ESWEMS pond, the emphasis placed on the integrity of safety-related structures, and the fact that it would contain predominantly water supplied from the NBSR, the review team concludes that the effect of infiltration from the pond on groundwater quality would be undetectable.

Based on the information described above, the review team concludes that the impacts on groundwater quality from operation of the proposed BBNPP unit would be SMALL.

5.2.4 Water Monitoring

PPL described the operational monitoring programs for thermal, hydrologic, and chemical monitoring in Sections 6.1, 6.3 and 6.6 of the ER (PPL Bell Bend 2013-TN3377).

5.2.4.1 Surface-Water Monitoring

PPL has not finalized specific requirements for thermal, radiological, hydrologic, and chemical monitoring programs during operation of the proposed BBNPP unit. PPL is expected to work with PADEP on the development of a surface-water-quality monitoring program to ensure that water quality will not be degraded as a result of operation of the proposed BBNPP unit. The monitoring plan will be implemented consistent with regulatory requirements. Thermal monitoring of the discharge will be specified as part of the NPDES administered by the PADEP. NPDES permit requirements are expected to be similar to, or more restrictive than, requirements for the existing SSES monitoring program. Water and effluent discharges during plant operation would be monitored in accordance with applicable NPDES permit requirements and PADEP water-quality requirements. PPL anticipates reporting monthly monitoring results to PADEP. Susquehanna River water would also be monitored as part of the radiological environmental monitoring program (REMP) described in Section 6.2 of the ER (PPL Bell Bend 2013-TN3377).

5.2.4.2 Groundwater Monitoring

PPL has committed to develop a groundwater-protection program as part of the radiological monitoring (see Section 5.9.6 of this EIS for additional discussion concerning radiological monitoring). As described in Section 6.2.8 of the ER (PPL Bell Bend 2013-TN3377), groundwater monitoring will be conducted to monitor potential pathways for radiological contaminants to ensure the detection of inadvertent releases. The groundwater-protection program will include a remediation protocol to be followed in the event of detecting contaminants, so that the extent of contamination can be minimized. PPL identified the locations of eight new groundwater monitoring wells to be sampled quarterly as part of the groundwater-protection program (PPL Bell Bend 2013-TN3377).

No monitoring of groundwater chemistry during BBNPP operation is planned (PPL Bell Bend 2013-TN3377).

5.3 Ecology

This section describes the potential impacts to terrestrial and aquatic ecological resources from operation of the proposed BBNPP project facilities, as well as from consumptive-use mitigation activities conducted as part of operation of the facilities. The section is divided into two subsections: terrestrial and wetland impacts and aquatic impacts.

5.3.1 Terrestrial and Wetland Impacts Related to Operation

Impacts on terrestrial communities and species related to operation of the proposed BBNPP may result from cooling-system operations, transmission-line operation and maintenance, and consumptive-use mitigation. Operation of the cooling system can result in local deposition of dissolved solids (commonly referred to as salt deposition); increased local fogging, precipitation, or icing; increased local noise levels; a risk of avian mortality caused by collision with tall structures; and shoreline alteration. Potential impacts on terrestrial and wetland species and habitats from the operation and maintenance of the transmission system include avian collision mortality and electrocution, effects from electromagnetic fields, and the maintenance of vegetation within transmission-line corridors. However, these effects would be localized, as none of the proposed new transmission corridors would extend offsite. The impacts of transmission on terrestrial resources are discussed in Section 5.3.1.2 of this EIS.

As described in Chapter 3, the proposed cooling system at the BBNPP would use two natural draft cooling towers for heat dissipation. Heat would be transferred to the atmosphere in the form of water vapor and drift. Typically, vapor plumes and drift may affect crops, ornamental vegetation, and native plants, and water losses could affect shoreline habitat. In addition, bird collisions and noise-related impacts are possible with natural draft cooling towers and other tall structures.

5.3.1.1 Terrestrial Resources – Site and Vicinity

Cooling-Tower Impacts to Vegetation

As noted above, the proposed cooling system for the proposed BBNPP is a closed-cycle system using two natural draft cooling towers to dissipate heat from the circulating-water system (CWS). These would be round, hyperbolic concrete cooling towers, each approximately 350 ft in diameter and 475 ft above grade. In each tower, heated CWS water would be sprayed through fine nozzles to transfer the heat to the atmosphere by evaporative cooling. Cooled CWS water would be recirculated to complete the closed-cycle cooling loop. The two CWS cooling towers would be located north of the reactor buildings (Figure 3-1). There would also be four smaller safety-related ESWS mechanical draft cooling towers. Each would be approximately 102 ft in diameter and 96 ft above grade (PPL Bell Bend 2013-TN3377).

Through the process of evaporation, the total dissolved solids (TDS) concentration in the CWS increases. A small percentage of the water in the CWS is released into the atmosphere as fine droplets (i.e., cooling-tower drift) containing elevated TDS levels that can be deposited on nearby vegetation. Vapor plumes and drift may affect crops, ornamental vegetation, and native plants, and water losses from cooling-tower operation could affect riparian habitat. Although the cooling towers would be equipped with drift eliminators to minimize the amount of water that is lost via drift, some droplets containing dissolved solids would still be ejected from the cooling towers. Operation of the CWS would be based on three cycles of concentration, which means the TDS in the makeup water would be concentrated to approximately three times the ambient concentration in the North Branch Susquehanna River before being released (PPL Bell Bend 2013-TN3377). The North Branch Susquehanna River is a freshwater body.

Depending on the makeup source waterbody, the TDS concentration in the drift can contain high levels of salts that, under certain conditions and for certain plant species, can be damaging. Vegetation stress can be caused by drift with high levels of TDS deposition, either directly by deposition onto foliage or indirectly from accumulation in the soils. As discussed in Section 5.1.1, the review team estimates the cooling-tower plumes to have a maximum cumulative TDS deposition rate of approximately 0.02 kg/ha/mo (PPL Bell Bend 2013-TN3377), which is about three orders of magnitude below the approximately 10 kg/ha/mo level of possible vegetation damage noted in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 2013-TN2654), in all directions from the CWS cooling towers, during all seasons, and annually. The deposition rates for the ESWS cooling towers are bounded by those of the CWS cooling towers (PPL Bell Bend 2013-TN3377). Thus, potential impacts to native and ornamental vegetation and crops from BBNPP CWS cooling-tower salt drift would be negligible. In addition, the proposed location of the BBNPP CWS cooling towers is approximately 2,600 ft west of the existing two SSES CWS cooling towers. Modeling of cooling-tower plumes indicates no synergistic salt drift or fogging effects from the two sets of cooling towers (PPL Bell Bend 2013-TN3377).

No fogging and icing would occur for the CWS cooling towers because ground-level impacts from tall natural draft cooling towers are not possible (PPL Bell Bend 2013-TN3377). Based on the Seasonal Annual Cooling Tower Impact modeling results for the ESWS towers for the Calvert Cliffs project, which has the same heat-dissipation rate and tower height as that proposed for BBNPP, the impacts from the BBNPP ESWS towers would not be expected to contribute to ground-level fogging and icing in the vicinity of the cooling towers (NRC 2009-TN2862). Thus, potential impacts to native and ornamental vegetation and crops from fogging and icing would be negligible.

As indicated in Section 5.2.2, the volume of water that would be lost from operation of the BBNPP CWS and ESWS cooling towers would be a small percentage of both the mean annual discharge and 7Q10 low-flow discharge of the Susquehanna River. The volume lost, 43 cfs, constitutes less than 0.3 percent of the mean annual discharge (14,400 cfs) and less than 5 percent of the 7Q10 low-flow discharge (872 cfs) of the North Branch Susquehanna River. Thus, no measurable impact of consumptive use on river discharge and shoreline habitat during normal flows is expected.

Transmission-Line Corridor Maintenance

Transmission-line corridor vegetation maintenance would be on a three-year cycle following initial clearing. Maintenance would include tree trimming, danger tree removal, corridors mowing, and herbicide applications. Maintenance, other than the removal of trees greater than 5 in. diameter at breast height (DBH) (addressed below), may occur any time of year (PPL Bell Bend 2012-TN1533). Maintenance is performed according to the integrated vegetation management wire zone-border zone method (PPL Bell Bend 2012-TN1173).

The wire zone-border zone method is described by Miller (2007-TN4006). The wire zone occurs under the transmission lines where a low-growing plant community is established and maintained, consisting of grasses, herbs, and small shrubs. The border zone is the remainder of the transmission-line corridor in which small trees and tall shrubs are allowed to establish. The objective is to establish and maintain diverse plant communities that are resistant to the establishment of tall trees in both wire zones and border zones (Miller 2007-TN4006). Competition with existing plants and wildlife predation on tree seeds in a transmission-line corridor managed via the wire zone–border zone method has proven to keep tree invasion to a minimum (Yahner and Hutnik 2005-TN3891; Yahner and Yahner 2007-TN3892).

PPL's application of the wire zone-border zone method is discussed in *Transmission Line Vegetation Management* (PPL Bell Bend 2012-TN1173). PPL's approach specifies removing large trees and invasive species (e.g., multiflora rose [*Rosa multiflora*] and honeysuckle [*Lonicera spp*.] species [see Section 2.4.1.3]) that can suppress the growth of desirable shrub species, and planting a number of early successional small tree and large shrub species in border zones and small shrub species and native grasses and ferns in wire zones that provide food and cover to enhance wildlife and forest ecology values. In addition, removal of trees greater than 5 in. DBH within transmission-line corridors will be performed from November 16 through March 31 to protect the Indiana bat (see Section 5.3.1.3) (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533).

The wire zone-border zone method has proven to be effective in the Piedmont of eastern Pennsylvania in enhancing butterfly abundance and diversity by providing a forb-grass cover type on the wire zone and a shrub-forb-grass cover type on border zones that flower in succession, accommodating varying butterfly emergence phenology (Bramble et al. 1997-

TN3888). Retention of shrubby borders during different vegetation treatments in wire zone-border zone transmission-line corridors has shown to be a major factor in retaining pre-treatment bird populations in the Allegheny Mountain and Piedmont physiographic provinces in Pennsylvania (Bramble et al. 1992-TN3889). The wire zone-border zone method has been shown to support a diverse community of amphibians and reptiles on a transmission-line corridor in central Pennsylvania (Yahner et al. 2001-TN3890). Although the BBNPP site is located in a different physiographic region than the above-noted studies, PPL's implementation of the wire zone-border zone method would likely similarly favor the development of diverse early successional wildlife populations over more traditional methods of transmission-line corridor maintenance (e.g., mechanical and chemical control of existing vegetation [without plantings and maintenance of structurally and compositionally diverse vegetation assemblages]).

As specified in PPL's policy LA-79827-8 *Specification of Initial Clearing and Control Maintenance on or Adjacent to Electric Line Right-of-Way through Use of Herbicides, Mechanical, or Hand-clearing Techniques* and in accordance with State and Federal environmental regulations and policies, no vegetation disposal (e.g., piling, drop and lop, chipping, or burning) should occur in known or suspected wetland areas. Herbicides should not be applied within 50 ft of a waterbody except for stump treatments and herbicides approved for use near water (PPL Bell Bend 2012-TN1173). Consequently, PPL's use of mechanical, manual, and chemical means of vegetation maintenance in transmission-line corridors is not anticipated to adversely affect wetlands.

Vehicle Traffic

Daily trips (363) generated by the operations workforce would be far fewer than those estimated for the construction period (3,401 trips) (see Section 5.4.1.5). Further, railroad deliveries during the operation phase would be less frequent than during construction. Increased traffic on U.S. Highway 11 could slightly increase traffic-related wildlife mortality, but less so than during the construction period, which was considered negligible (see Section 4.3.1). Consequently, the overall impact on local wildlife populations from increased vehicular traffic during operations would be negligible.

Avian Mortality from Transmission Lines

The proposed onsite transmission lines (see Section 3.2.2.3) will cross several wetlands and waterbodies at the BBNPP site. Larger-bodied bird species are more likely to collide with (e.g., raptors, colonial wading birds,and ducks) or be electrocuted by (e.g., raptors and colonial wading birds) transmission lines (NRC 2013-TN2654). The wetlands and waterbodies that would be crossed by transmission lines do not attract flocks of ducks or wading birds and they are not in areas where raptors would congregate (PPL Bell Bend 2012-TN1173). In a recent report of avian surveys of the BBNPP site, Normandeau (2011-TN490) did not describe congregations of avifauna (either large-bodied or small-bodied) in any areas of the site, including wetlands and waterbodies that would be crossed by transmission lines. At the adjacent SSES, deceased birds beneath existing transmission lines have rarely been observed in the approximately 30 years since construction (PPL Bell Bend 2012-TN1173).

There are no reports of relatively high collision mortality occurring at transmission lines associated with any nuclear power plants in the United States (NRC 2013-TN2654). The same is true for electrocution mortality (NRC 2013-TN2654). Considering several facts—the transmission lines proposed for the BBNPP would be short in length and would be limited to an actively operated power plant site and wetlands that would be crossed by the transmission lines do not attract large congregations of foraging or migrating birds—the review team expects that the likelihood of substantial avian mortality would be low. Thus, mitigation for collisions and electrocutions based on recommendations of the Avian Power Line Interaction Committee (e.g., diverters, separation of phase conductors, and grounded hardware) (APLIC 2006-TN794) is not warranted.

Avian Collisions with Cooling Towers

The NRC evaluated cooling-tower collision mortality data from six operating nuclear power plants, including SSES, and compared those data to estimated avian collision mortality data from all sources in the United States (NRC 2013-TN2654). Avian surveys were conducted at SSES on weekdays during the spring and fall migration periods from 1978 through 1986. SSES Unit 1 began operating in 1983 and Unit 2 in 1985. The plant's natural draft towers are 540-ft tall and illuminated at the top with 480-V aircraft warning strobe lights. About 1,500 dead birds (total for all survey years, an average of 166 per year) representing 63 species were found, the second highest average annual mortality among the six nuclear plants. Most of the species were songbirds. Fewer collisions seemed to occur during plant operation than prior to operations; cooling-tower plumes and noise during operation may frighten birds away from the towers (NRC 2013-TN2654).

NRC's comparison of cooling-tower collision mortality to estimated avian collision mortality from all sources (about 200 million to 1.5 billion) suggests that (1) cooling towers cause only a very small fraction of the total annual bird collision mortality and (2) bird populations are not greatly affected by collisions with nuclear power plant cooling towers. A very high percentage of all collision mortalities occur during the spring and fall bird migration periods and involve primarily songbirds migrating at night. Further, mortalities at the Davis-Besse Nuclear Power Plant cooling-tower (the plant with the highest average annual collision mortality) were reduced by installing low-intensity light sources to illuminate the cooling tower, which apparently allowed birds to see and avoid it (NRC 2013-TN2654).

PPL intends to follow Federal Aviation Administration requirements regarding lighting on the BBNPP cooling towers. Strobe lights and minimal lighting levels dictated by Federal Aviation Administration regulations would be used to reduce the risk of bird collisions (PPL Bell Bend 2012-TN1173). Based on the above collision mortality data and PPL's mitigation, the effect of avian collision mortality on local bird populations is anticipated to be minor, both during the preoperational period following construction and during operation.

Cooling-Tower Noise

There was no discernible noise emanating from SSES facilities as measured at locations in and around the BBNPP site during baseline environmental noise surveys conducted in June 2010 (Hessler Associates 2010-TN1227). Thus, there would be no potential combined cooling-tower noise impacts to wildlife from SSES and BBNPP. Operation of the two BBNPP natural draft cooling towers associated with the CWS would be the main source of continuous noise at the proposed BBNPP. Expected noise levels emanating from the BBNPP natural draft cooling towers were estimated to be 60 to 65 dBA out to about 660 ft from the source (Hessler Associates 2010-TN3893). These noise levels would be well below the 80- to 85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1979-TN3873) and likely would not disturb wildlife in habitats away from the planned facilities, including the closest forest habitat that begins just north of Beach Grove Road, which is located just north of the proposed location for the cooling towers. Any impacts of noise on wildlife behavior are expected to be negligible.

Electromagnetic Fields on Flora and Fauna (Plants, Agricultural Crops, Honeybees, Wildlife, Livestock)

The effects of electromagnetic fields (EMFs) on terrestrial biota are considered to be of minor significance because the overall health, productivity, and reproduction of individual species appear unaffected. The EMFs produced by operating transmission lines up to 1,100 kV have not been reported to have any biologically significant impact on plants, wildlife, agricultural crops, or livestock. Areas under and in the vicinity of the lines have been studied numerous times. Vegetation, foliar damage resulting from EMF-induced corona at leaf margins, agricultural crop production, wildlife population abundance, livestock production, and potential livestock avoidance of the lines have been investigated. In addition, many laboratory experiments with plants and laboratory animals have been conducted, often using electric fields much stronger than those occurring under transmission lines (NRC 2013-TN2654). The results of these studies are summarized below.

<u>Plants</u>

Studies have shown that minor damage to plant foliage and buds can occur in the vicinity of strong electric fields. Damage typically occurs only to the tips and margins of leaves in the uppermost plant parts that are the closest to the lines. The damage in the form of a leaf burn is most prevalent on small pointed leaves and is similar to leaf damage that might occur as a result of drought or other environmental stresses. The damage generally does not interfere with overall plant growth (NRC 2013-TN2654).

<u>Honeybees</u>

Several studies have shown that honeybees in hives under transmission lines are affected by EMF. Adverse effects include increased propolis (a reddish resinous cement) production, reduced growth, greater irritability, and increased mortality. These effects can be greatly reduced by shielding the hives with a grounded metal screen or by moving the hives away from the lines. Thus, these impacts were not caused by direct effects of the electric fields on the bees but by voltage buildup and electric currents within the hives and the resultant shocks to bees. Bees kept in moisture-free nonconductive conditions are not adversely affected (NRC 2013-TN2654). The review team expects that any adverse effects on honeybees from operation of the BBNPP would be localized to areas directly under the project's short transmission lines and the switchyards.

Wildlife and Livestock

Chronic exposure to electric fields is experienced by small birds and mammals that primarily inhabit transmission-line right-of-way corridors and by birds (i.e., primarily raptors) that nest in transmission-line towers. EMF exposures to larger animals and livestock are usually relatively brief because these animals inhabit relatively large areas instead of small areas beneath the lines. Exposures occur as these larger animals pass beneath the lines or as birds fly by the lines. The literature on population studies of small bird and mammal species in transmission-line corridors has expressed virtually no concern for possible impacts of EMFs. These species apparently thrive beneath the lines, where their abundance appears to depend on habitat quality rather than on the strength of the electric fields to which they are exposed or the size of the transmission lines. In addition, livestock in both field and laboratory studies have shown no significant impacts when exposed to EMF (NRC 2013-TN2654).

Conclusion

No substantial impacts of EMFs on terrestrial biota have been identified.

5.3.1.2 Consumptive-Use Mitigation

A summary discussion of PPL's primary mitigation plan for consumptive use of water from the North Branch Susquehanna River is described in Sections 2.2 of this EIS (also see Figure 2-10), and a more detailed discussion is provided by Meyer (2014-TN3566). Terrestrial ecological resources occurring along the waterbodies potentially affected by the consumptive-use mitigation plan are described in Section 2.4.1.2.

Streams and Rivers

Vegetation

There are four broad categories of vegetation community types that occur over an increasing elevation gradient/decreasing moisture gradient perpendicular to streams and rivers in the Susquehanna River Basin: submerged and emergent vegetation, herbaceous vegetation, scrub-shrub vegetation, and floodplain forest (DePhilip and Moberg 2010-TN1652). The structure and species composition of vegetation in the basin depends to a great degree on flow (e.g., inundation frequency and duration) and other factors (see Section 2.4.1.2).

Submerged vegetation communities are discussed in Section 2.4.2.1. Emergent vegetation communities are discussed in Section 2.4.1.2 and occur in areas of river and stream channels that are semi-permanently to permanently inundated and that rely on ice scour and floods for regeneration during winter and spring (DePhilip and Moberg 2010-TN1652). Consumptive-use releases could potentially last from several days up to 3 months during the low-flow period (i.e., May through October) (Meyer 2014-TN3566) and would be most likely to raise water levels in smaller streams such as Cowanesque River and Moshannon Creek. They would have less influence in larger streams such as the Tioga River, Chemung River, North Branch Susquehana River/West Branch Susquehanna River, and mainstem Susquehanna River. For example, consumptive-use releases could increase flow in the Cowanesque River up to fourfold during the growing season (see Section 5.3.2.2). However, emergent communities in the Cowanesque

River are typically exposed to short-duration flows of much higher magnitude that result from summer rain events (see Section 5.3.2.2). Thus, emergent plant communities that typically are semi-permanently to permanently inundated and rely on floods for regeneration, may be beneficially to neutrally affected, respectively, rather than adversely affected by consumptive-use releases during periods of low flow.

Herbaceous communities are discussed in Section 2.4.1.2 and occur within portions of river and stream channels that are temporarily flooded seasonally. These communities are maintained by ice scour associated with high-flow events during the winter months and by inundation from seasonal and high flows in the spring and summer (DePhilip and Moberg 2010-TN1652). Increases in water levels that would result from consumptive-use releases during periods of low flow would tend to maintain herbaceous communities.

Scrub/shrub communities are discussed in Section 2.4.1.2 and are transitional between herbaceous and floodplain forest and occur on flats, bars, and low terraces of islands and banks. They are maintained by limited growth during periods of inundation, structural damage from ice scour and floods, and poorly developed soils (DePhilip and Moberg 2010-TN1652). Increases in water levels in Cowanesque River that would result from consumptive-use releases during periods of low flow would increase periods of growth for scrub/shrub communities.

Sycamore and silver maple floodplain forest communities are found on well-drained coarse gravel and cobble substrate and backwater habitats, respectively. Both communities rely on overbank flows to maintain suitable substrate size and moisture conditions for seedling establishment and dispersal and to reduce competition with upland woody species (DePhilip and Moberg 2010-TN1652). However, because consumptive-use releases would be relatively small (compared to severe rain events) and occur during periods of low flow, they would not be expected to cause overbank flows (PPL Bell Bend 2011-TN3627). Thus, sycamore and silver maple floodplain forest communities would likely not be affected by consumptive-use releases.

Actual occurrence of the above-noted potential effects on the various shoreline vegetation communities would depend on site-specific conditions that would cause a noticeable rise in stream levels (e.g., stream bed topography). Effects would be relatively infrequent, and temporary.

Wildlife

Potential impacts from consumptive-use releases on the groups of reptiles, amphibians, birds, and mammals described in Section 2.4.1.2 are discussed in this subsection. These groups are representative of the flow needs for larger groups of species within the same taxa in the Susquehanna River Basin, and share a sensitivity or response to one or more aspects of the flow regime because of a common life-history trait. Consumptive-use releases would be most likely to raise water levels (and affect associated wildlife) in smaller streams such as Cowanesque River and Moshannon Creek and less likely to affect larger streams such as the Tioga River, Chemung River, North Branch Susquehana River/West Branch Susquehanna River, and mainstem Susquehanna River.

Amphibians and Reptiles. Aquatic-lotic species are described in Section 2.4.1.2 and spend most life stages in flowing water, have stream-dependent feeding habits, or have morphological traits adapted to life in flowing water (stream channel) (DePhilip and Moberg 2010-TN1652). For example, the common musk turtle (*Sternotherus odoratus*) uses small shallow streams for hibernation, mating, and growth (DePhilip and Moberg 2010-TN1652). The species may be adversely affected by consumptive-use releases which could increase the depth of such streams during low-flow periods and make them less suitable for mating and growth. In addition, musk turtles feed on the bottom (DePhilip and Moberg 2010-TN1652). Benthic invertebrates would not likely be dislodged from the bottom and moved from native habitats to downstream areas of uncertain suitability by sudden consumptive-use releases (see Section 5.3.2.2). If any such effects were to occur, they would likely be less severe than those caused by summer floods of much greater magnitude due to rain events (see Section 5.3.2.2). Thus, aquatic-lotic species with stream-dependent feeding habits and which inhabit small streams, such as the common musk turtle, would be unlikely to incur a higher frequency of prey removal than normal due to consumptive-use releases. The above impacts, if any, would be expected to be less for species such as northern map turtles (*Graptemys geographica*), which complete hibernation, mating, and growth in water and feed on mollusks, aquatic insects, and fish. Northern map turtles generally use rivers greater than 50 m wide and more than 1 m deep (DePhilip and Moberg 2010-TN1652), the size of which would mollify any effects of consumptive-use releases. The northern water snake (*Nerodia sipedon sipedon*) and queen snake (*Regina septemvittata*) occupy streams and feed on fish and amphibians and crayfish, respectively (DePhilip and Moberg 2010-TN1652), which also would be unlikely to be removed by consumptive-use releases. Lungless salamanders, such as the dusky salamander (*Desmognathus fuscus*) and other species, also are common in small streams (DePhilip and Moberg 2010-TN1652). Because they require gas exchange through their skin, they are sensitive to changes in surface-water hydrology and water temperature (DePhilip and Moberg 2010-TN1652). Thus, these species may benefit from consumptive-use releases that might noticeably increase water depth and lower temperatures in small streams during low-flow periods.

Semi-aquatic-lotic species are described in Section 2.4.1.2. These species rely on flowing water (stream channel) for one or more life stages and spend the other life stages in floodplains or uplands (DePhilip and Moberg 2010-TN1652). For example, the eastern ribbon snake (*Thamnophis sauritus*) occurs along the shorelines of streams and ponds and feeds on small fish, tadpoles, salamanders, small frogs and toads (DePhilip and Moberg 2010-TN1652), which likely would not be removed because of consumptive-use releases. If any such effects were to occur as a result of consumptive-use releases, they would likely be less severe than those caused by summer floods of much greater magnitude due to rain events (see Section 5.3.2.2). Thus, semi-aquatic-lotic species such as the eastern ribbon snake would be unlikely to incur a higher frequency of prey removal than normal because of consumptive-use releases. The northern leopard frog (*Rana pipiens*) uses the vegetated margins of slow-flowing streams and rivers and hibernates in stream bottoms (DePhilip and Moberg 2010-TN1652). The species uses vernal habitats, which typically occur in floodplains, for breeding and egg-laying (DePhilip and Moberg 2010-TN1652). Thus, the northern leopard frog is not particularly tied to any part of the stream environment during the low-flow period that would be affected by consumptive-use releases. The wood turtle (*Glyptemys insculpta*) is also a representative semi-aquatic-lotic species (DePhilip and Moberg 2010-TN1652). Wood turtles are common in headwater streams and small- to medium-sized rivers. They hibernate in stream banks and bottoms. The species is primarily found in riparian areas but uses streams for refuge during droughts (DePhilip and Moberg 2010-TN1652). The wood turtle is an opportunistic omnivore, consuming vegetable matter and insects, earthworms, mollusks, tadpoles, and dead fish (NatureServe 2014-TN3855). The wood turtle is not particularly tied to any part of the stream environment during the low-flow period that would be affected by consumptive-use releases.

Riparian/floodplain-terrestrial/vernal species (e.g., eastern hognose snake [*Heterodon platirhinos*], eastern gray treefrog (*Hyla versicolor*), Fowler's toad [*Bufo fowleri*], eastern spadefoot [*Scaphiopus holbrookii*], and mole salamander [*Ambystoma* spp.]) are described in Section 2.4.1.2 and do not use flowing water (stream channel) during any life stage, but benefit from overbank flows that maintain vernal habitats and floodplain vegetation succession (DePhilip and Moberg 2010-TN1652). Such species likely would not be affected by consumptive-use releases because they would likely be insufficient to cause overbank flows (PPL Bell Bend 2011-TN3627).

Birds. Some bird species use food resources from streams, and food and habitat along stream banks, islands, and floodplains. These include colonial water birds, fish-eating birds, and bank and riparian nesting birds such as the belted kingfisher (*Megaceryle alcyon*), bank swallow (*Riparia riparia*), and Acadian flycatcher (*Empidonax virescens*) (DePhilip and Moberg 2010-TN1652). Colonial water birds and fish-eating bird species are discussed in the consumptive-use subsection of Section 5.3.1.3 because the representative species are rare. The belted kingfisher and bank swallow nest in vertical banks along watercourses (DePhilip and Moberg 2010-TN1652) and would not be affected by consumptive-use releases, as both species nest in banks high enough above the water so as not to be inundated by consumptive-use releases, which would likely only moderately raise the level of smaller streams, compared to more substantial increases in stream elevation caused by significant rain events (see Section 5.3.2.2). The Acadian flycatcher nests in the fork of a small tree branch (DePhilip and Moberg 2010-TN1652) high enough over water, so it also likely would not to be affected by consumptive-use releases. The kingfisher feeds primarily on fish, but also on amphibians and aquatic insects (DePhilip and Moberg 2010-TN1652). The bank swallow and Acadian flycatcher feed on metamorphosed aquatic insects (DePhilip and Moberg 2010-TN1652). These prey items, including the in-water life stages of aquatic insects, would likely not be removed by consumptive-use releases. However, unlike amphibians and reptiles, if the aquatic life stages of insects were to be removed, these bird species may more readily obtain prey from other nearby streams unaffected by consumptive-use releases.

Mammals. Some mammal species nest in and/or use food resources from streams. These include the muskrat (*Ondatra zibethicus*). Muskrats feed primarily on roots, shoots, stems, and leaves, but also eats crayfish, frogs, fish, and snails. Muskrats nest in stream banks with the den entrance located below water and the nest chamber above (DePhilip and Moberg 2010-TN1652). The animal prey items would likely not be removed by consumptive-use releases. However, unlike amphibians and reptiles, if animal prey were to be removed, mammals may more readily obtain prey from other streams unaffected by consumptive-use releases. Consumptive-use releases would not affect muskrat nest building habitat any more than naturally occurring floods caused by rain events (see Section 5.3.2.2). Other representative mammalian species nest in and/or use food resources from streams (e.g., northern water shrew [*Sorex palustris albibarbis*]). These are also rare species and are thus discussed in the consumptive-use subsection of Section 5.3.1.3.

Actual occurrence of any potential effects on the various amphibian, reptile, bird, and mammal species noted above would depend on site-specific conditions that could cause a noticeable rise in stream levels (e.g., stream bed topography) and scouring. Effects, if any, would likely be greatest for amphibians and reptiles, as they have a greater number of in-water life stages or life-cycle processes than birds and mammals. Effects, if any, are anticipated to be adverse, minor, relatively infrequent, and temporary.

Cowanesque Lake

Vegetation

Consumptive-use releases have the potential to draw down Cowanesque Lake to various levels. As explained in Section 5.2.2.1, the review team's analysis indicated that mitigation for BBNPP consumptive use would occur in about 4 out of 10 years during BBNPP operation. Cumulative mitigation releases would typically be less than 2,000 ac-ft and result in less than 2 ft of drawdown in Cowanesque Lake elevation. For the period of data evaluated by the review team (i.e.,1981 to 2013), cumulative mitigation releases were more significant in about 1 out of 10 years of BBNPP operation. During these years, cumulative mitigation releases for BBNPP were from about 4,000 to 6,000 ac-ft, which would result in about 4 to 6 ft of drawdown in Cowanesque Lake elevation.

Drawdowns of several feet or more would likely dewater 2 emergent wetlands that were developed and 13 naturally occurring emergent wetlands with a direct hydrologic connection to Cowanesque Lake. The two potentially affected developed wetlands cover about 75 ac. The 13 naturally occurring emergent wetlands cover more than 11 ac. Cowanesque Lake is projected to refill, even following substantial drawdowns, by November (Meyer 2014-TN3566). Thus, the wildlife habitat functions (providing breeding areas for waterfowl and amphibians) of these wetlands would be reduced temporarily (a few months at most), and the opportunity for invasion and establishment of invasive plant species (see Section 2.4.1.3) would be short-lived before re-inundation occurred.

Wildlife

Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to Cowanesque Lake (discussed above) for mammals known from the Cowanesque Lake vicinity (see Section 2.4.1.2) that have a semi-aquatic lifestyle and an affinity for shoreline/wetland habitats, such as beaver (*Castor canadensis*), muskrat, and northern water shrew (the northern water shrew is discussed in the consumptive-use subsection of Section 5.3.1.3). Dewatering wetlands would make them unsuitable for nesting by muskrats and beavers because both species build nests/lodges with underwater entrances (DePhilip and Moberg 2010-TN1652). Dewatering wetlands would make them less able to support many muskrat prey items (e.g., mussels, frogs, crayfish, fish, and turtles) (DePhilip and Moberg 2010-TN1652).

Cowanesque Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to Cowanesque Lake for birds known from the Cowanesque Lake vicinity (see Section 2.4.1.2) that have an affinity for shoreline/wetland habitats: great blue heron (*Ardea herodias*), green-backed heron (*Butorides virescens*), mallard (*Anas platyrhynchos*), Canada goose (*Branta canadensis*), American black duck (*Anas rubripes*), and swamp sparrow (*Melospiza georgiana*). Drawdown would reduce habitat suitability for mallards, Canada geese, and American black ducks by removing the interface of water and wetland vegetation, which provides cover to these species which nest on the ground near water (Cornell 2014-TN3837). Likewise, lake drawdown could render a 1-ac duck island (created as part of the mitigation performed by USACE associated with raising the lake elevation in 1990 (USACE 2011-TN3965) unsuitable for nesting ducks. Drawdown also could render wetland habitat less suitable for nesting by the swamp sparrow, which nests in emergent marsh vegetation (Cornell 2014-TN3837). The heron species are considered rare and are discussed in Section 5.3.1.3.

Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to Cowanesque Lake for salamanders known from the Cowanesque Lake vicinity (see Section 2.4.1.2) that have an affinity for shoreline/wetland habitats, such as those that are mostly aquatic (e.g., eastern red-spotted newt) and semi-aquatic (e.g., spotted salamander [*Ambystoma maculatum*] and four-toed salamander [*Hemidactylum scutatum*]). Drawdown may make wetland/shoreline habitats generally less suitable for occupation for the above salamander species by moving open water down-gradient out of vegetated areas. Also, drawdown in late spring could make wetlands unsuitable for egg-laying by red-spotted newts and four-toed salamanders, which lay eggs at that time on underwater plants (FCPS 2014-TN3838; MDFW 2010-TN3894). In contrast, spotted salamander egg-laying would not be affected by drawdown because egg-laying occurs in early spring (NatureWorks 2014-TN3895) when drawdowns would not occur.

Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to the Lake for frogs/toads known from the Cowanesque Lake vicinity (see Section 2.4.1.2) that have an affinity for lake and pond shoreline/wetland habitats during all or part of their life cycle, such as those that are mostly aquatic (e.g., bullfrog [*Rana catesbeiana*]) to those that are semi-aquatic (e.g., American toad [*Bufo americanus americanus*], northern spring peeper [*Pseudacris crucifer crucifer*], gray treefrog, green frog [*Rana clamitans*], northern leopard frog, and pickerel frog [*Rana palustris*]). Drawdown may make wetland/shoreline habitats generally less suitable for occupation for the above frog and toad species by moving open water down-gradient and out of vegetated areas. Also, drawdown in late spring could make wetlands unsuitable for egg-laying by frog and toad species that deposit eggs on underwater plants at that time (i.e., all the species discussed above). Species that hibernate in bottom sediments would not be subject to freezing, as Cowanesque Lake would be in the process of refilling (rather than being drawn down) when these species enter hibernation and is anticipated to refill by November (Meyer 2014-TN3566).

Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to Cowanesque Lake for snakes known from the Cowanesque Lake vicinity (see Section 2.4.1.2) that have an affinity for shoreline/wetland habitats. Drawdown may make wetland/shoreline habitats generally less suitable for occupation for eastern garter snakes

(*Thamnophis sirtalis sirtalis*), eastern ribbon snakes, and northern water snakes by moving open water down-gradient from vegetated areas and by making the habitat less suitable for their water-dependent prey species (e.g., worms, slugs, frogs, toads, salamanders, fish, and tadpoles) (SREL 2014-TN3839).

Lake drawdown would negatively affect the suitability of emergent wetlands with a direct hydrologic connection to Cowanesque Lake for turtles known from the Cowanesque Lake vicinity that have an affinity for shoreline/wetland habitats (all the species noted in Section 2.4.1.2). Drawdown may make wetland/shoreline habitats generally less suitable for occupation—more suitable for aquatic species (snapping turtle [*Chelydra serpentina*], midland painted turtle [*Chrysemys picta marginata*], musk turtle [*Sternotherus odoratus*]) and less suitable for semi-aquatic species (wood turtle [*Glyptemys insculpta*], spotted turtle [*Clemmys guttata*])—by moving open water down-gradient from vegetated areas and by making the habitat less suitable for their water-dependent prey species (e.g., mollusks, aquatic insects, crayfish, aquatic vegetation).

The above-noted potential effects on the various amphibian, reptile, bird, and mammal species are anticipated to be adverse, relatively infrequent, and temporary (because of the projected refilling of Cowanesque Lake by the November time frame).

5.3.1.3 Important Terrestrial Species and Habitats

This section describes the potential impacts to important terrestrial species and habitats, including Federal candidate, proposed, and listed (threatened or endangered) species; species listed by the Commonwealth of Pennsylvania as threatened, endangered, rare, or vulnerable, species that are candidates for listing as threatened or endangered; and other important species described in Section 2.4.1.3. The potential impacts of operation at the BBNPP site, including the impacts of consumptive-use mitigation over the course of affected waterbodies, are described in the following section.

In a letter dated June 12, 2012, the NRC requested that the U.S. Fish and Wildlife Service (FWS) Field Office in State College, Pennsylvania, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the BBNPP site (NRC 2012-TN3842). On March 14, 2013, FWS provided a response letter indicating that the Indiana bat (*Myotis sodalis*) was the only Federally listed, proposed, or candidate species known to occur in or near the BBNPP project area (FWS 2013-TN3847). Surveys for the Indiana bat were conducted on the BBNPP site during the summers of 2008 and 2013, and none were captured (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828). Because the BBNPP site is less than 10 mi from three winter hibernacula and contains suitable Indiana bat (roosting) habitat, FWS assumes the site is used by the species during the fall swarming period (FWS 2009-TN3868) (see Section 2.4.1.3).

Since the response letter of March 14, 2013 (FWS 2013-TN3847), FWS proposed listing the northern long-eared bat (*Myotis septentrionalis*) as endangered (78 FR 61046-TN3207). The northern long-eared bat is known to occur on the BBNPP site (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828).

Impacts to these two bat species are discussed summarily in this section. A more detailed assessment of impacts is provided in the NRC's draft biological assessment, which is located in Appendix F.

BBNPP Site

Federally Listed Species

Indiana Bat *(Myotis sodalis)* — Federal Endangered (FE)

Negative surveys for Indiana bats in summer 2008 and summer 2013 (see Section 2.4.1.3) (Normandeau 2011-TN490; Normandeau 2014-TN3828) indicate that use of the BBNPP site by the species is unlikely during summer, but the possibility of summer use cannot be precluded completely. Further, the FWS assumes that the species uses the BBNPP site for fall foraging, roosting, and swarming because it contains suitable habitat and occurs within a 10-mi radius of a winter hibernaculum occupied by the species (FWS 2009-TN3868).

All plant operation and maintenance activities would occur within portions of the BBNPP site that would have by that time been disturbed by construction and no longer support suitable habitat. Any increases in the volume or concentrations of pollutants in stormwater discharges from BBNPP would be minimized by implementation of BMPs described in the PCSM plan. The BMPs would minimize potential indirect effects on Indiana bats that could arise from ingestion of contaminated aquatic insects. Individuals would be unlikely to suffer mortality via collisions with either the CWS or ESWS cooling towers, because the cooling towers are large and immobile. Studies of bird and bat mortality attributable to collision with the SSES CWS cooling towers between 1984 and 1986 found eight dead bats of three species (little brown myotis [*Myotis lucifugus*], red bat [*Lasiurus borealis*], and big brown bat [*Eptesicus fuscus*]) that did not include the Indiana bat (NRC 1996-TN288). Lighting used for safety and security purposes at night would be incrementally greater than the lighting currently present from SSES. This lighting may have a positive impact on bat species that forage on insects attracted by lights. However, lighting may have a negative impact on bats that avoid lights. It is unclear whether Indiana bats would avoid or be attracted to lights if insects are present. PPL has agreed to a request by FWS to limit removal of trees greater than 5 in. DBH (including removal of trees for maintainance of facilities and removal of danger trees affecting transmission lines to a period between November 16 through March 31. This action will protect the Indiana bat from potential mortality associated with direct impacts to possible maternity and night roost sites from April 1 through November 15, which is the time period when reproduction and swarming occurs (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2012-TN1533). Thus, potential impacts to Indiana bats from operation and maintenance activities are anticipated to be minor.

A more detailed discussion of the above information on operation and maintenance impacts to the Indian bat is provided in the draft biological assessment in Appendix F.

Northern Long-Eared Bat (*Myotis septentrionalis*) – Proposed Federally Endangered (PE)

Four adult male northern long-eared bats were captured during the summer of 2008 at Wetland 11 and where Wetland 12.1 and Wetland 12.2 meet along the eastern tributary to Walker Run (see Section 2.4.1.3) (LandStudies 2011-TN502; Normandeau 2011-TN490).

The northern long-eared bat would be subject to the same potential operation and maintenance impacts discussed above for the Indiana bat. The northern long-eared bat would likewise be protected by all the provisions that would be in place to protect the Indiana bat, as noted above. Thus, potential impacts to northern long-eared bats from operation and maintenance activities are anticipated to be minor.

A more detailed discussion of the above information on operation and maintenance impacts to the northern long-eared bat is provided in the draft biological assessment in Appendix F.

State-Listed and State-Ranked Species

State-Listed and State-Ranked Bat Species

Three State-listed or State-ranked bat species may occur (eastern small-footed myotis [*Myotis leibii*], threatened) or are known to occur (little brown myotis [*Myotis lucifugus*], State Critically Imperiled [S1], tri-colored bat [*Perimyotis subflavus*], State Critically Imperiled [S1]) on the BBNPP site (see Section 2.4.1.3).

These three bat species would be subject to the same potential operation and maintenance impacts discussed above for the Indiana bat. These three species would likewise be protected by all the provisions that would be in place to protect the Indiana bat, as noted above. Thus, potential impacts to these three species of bats from operation and maintenance activities are anticipated to be minor.

Other State-Listed and State-Ranked Species, Ecologically Important Species, and Commercially and Recreationally Important Species

Surveys conducted by PPL (described in Section 2.4.1) indicate that none of the other State-listed or State-ranked species, or ecologically or commercially and recreationally important species, were found in those areas where the review team expects possible effects from plant operations and maintenance. Therefore, there would be no impacts to known State-listed and State-ranked species or ecologically or commercially and recreationally important species from operation of the proposed BBNPP. There are two important habitats (herbaceous vernal pools and red maple [*Acer rubrum*]-black gum [*Nyssa sylvatica*] palustrine forest) on the BBNPP site, but they would not be affected by operation and maintenance. Other wetlands also are important habitats, but the review team expects that wetlands would not generally be affected by operations and maintenance.

Consumptive-Use Mitigation

By letter dated January 29, 2014, the NRC requested that the FWS Field Office in State College, Pennsylvania, provide a listing of Federally listed species and critical habitats in and around the portions of the waterbodies and water courses highlighted and labeled in Figure 2-10 (PNNL 2014-TN3983). On February 25, 2014, FWS provided a listing of Federally listed species known to occur in the counties containing the waterbodies and water courses identified in Figure 2-10 (FWS 2014-TN3968).

Federally Listed Species

Four Federally listed or proposed species may potentially occur along the waterbodies that would be affected by consumptive-use mitigation—Northeastern bulrush (*Scirpus ancistrochaetus*), bog turtle (*Glyptemys muhlenbergii*), northern long-eared bat, and Indiana bat. The two bat species would not be affected by consumptive-use releases during low-flow periods (May through October), as the releases would not likely cause overbank flooding that could affect roost trees. The only counties potentially affected by consumptive-use mitigation plan activities that lie within the range of the bog turtle are areas along the mainstem of the Susquehanna River, where increases in flow due to consumptive use would not produce a measurable change in surface-water elevation or any scouring effects.

The Northeastern bulrush is known to occur in Tioga County (Table 2-16). The species grows in wet areas such as small wetlands, sinkhole ponds or wet depressions with seasonally fluctuating water levels (FWS 2006-TN3896), and thus could occur along the Cowanesque River or in the wetlands around Cowanesque Lake. It may be found at the water's edge, in deep water or in just a few inches of water, and during dry spells when no water is present (FWS 2006-TN3896). Northeastern bulrush appears to have adapted to regular patterns of water-level fluctuation; however, artificial alterations that make a site consistently drier or wetter could adversely impact the species (FWS 2006-TN3896). The Northeastern bulrush would likely not be affected by consumptive-use releases or drawdowns of Cowanesque Lake, because any associated water-level fluctuations would only be temporary (on the order of days, weeks, or up to three months) and infrequent.

State-Listed and State-Ranked Species

A total of 13 State-listed and State-ranked plant species occur along either the mainstem Susquehanna River in Pennsylvania or the Chemung River in New York (Table 2-16). Most of these species occur along shorelines (Table 2-16) and thus could be exposed to fluctuating water levels. Some of these species are tolerant of temporary flooding (Table 2-16). The Chemung River, and to a greater extent the mainstem of the Susquehanna River, are large enough that additions of consumptive-use releases would likely cause minor to immeasurable changes in surface-water elevation. Thus, it is unlikely that these species would be affected by consumptive-use releases (PDCNR 2014-TN3985).

Nine State-listed and State-ranked bird species occur along either the mainstem Susquehanna River in Pennsylvania or the Chemung River in New York (Table 2-16). Only those species that have a life-history process closely tied to water (e.g., heron species, great egret [*Ardea alba*], bald eagle [*Haliaeetus leucocephalus*], osprey [*Pandion haliaetus*]) could possibly be affected by consumptive-use releases. Furthermore, only those species that occur along streams small enough to be measurably affected by consumptive-use releases could be affected. These species include the great blue heron (*Ardea herodias*), osprey, and bald eagle, as they are known to occur along the Cowanesque River and Cowanesque Lake (Table 2-16 and Section 2.4.1.2). These species likely would not lose foraging opportunities in Cowanesque River because fish likely would not be removed by consumptive-use releases (see Section 5.3.2.2). Similar but more severe effects on fish likely occur on a regular but infrequent basis during flooding resulting from rain events (see Section 5.3.2.2), and these avian species may forage in other unaffected streams. Thus, these species likely would not be more than negligibly affected by consumptive-use releases in the Cowanesque River. Also, they likely would not be adversely affected by drawdowns of Cowanesque Lake because fish would yet be present notwithstanding drawdowns (see Section 5.3.2.3).

One New York State-listed salamander species (i.e., longtail salamander [*Eurycea longicauda longicauda*]) occurs a short distance from the Tioga River (Table 2-16). Eggs are laid in winter and larvae would be present during low-flow periods (ODW 2010-TN3897) and could be scoured by consumptive-use releases. However, larvae are likely periodically exposed to greater flooding and scouring resulting from rain events in the Cowanesque River (see Section 5.3.2.2). Thus, the species could be somewhat affected by consumptive-use releases; however, the effects likely would not to exceed those associated with flooding from rain events.

Three State-listed and State-ranked mammal species may potentially occur along waterbodies that would be affected by consumptive-use mitigation: eastern small-footed myotis (*Myotis leibii*), Alleghany woodrat (*Neotoma magister*), and northern water shrew (*Sorex palustris albibarbis*) (Table 2-16). The eastern small-footed myotis would not be affected by consumptive-use releases during low-flow periods because these events would not cause overbank flows (PPL Bell Bend 2011-TN3627) that could affect roost trees. The Alleghany woodrat favors upland rock outcrops (PNHP 2014-TN3885) and thus could not be affected by consumptive-use releases. The northern water shrew may occur along Cowanesque River and Cowanesque Lake (Table 2-16). It forages underwater on aquatic invertebrates (PNHP 2014-TN3885) and would be unlikely to be affected by consumptive-use releases because releases likely would not remove benthic invertebrates from the Cowanesque River (Section 5.3.2.2). However, the northern water shrew may be affected by Cowanesque Lake drawdowns that would remove benthic invertebrates from wetland margins the species may inhabit. A decrease in numbers of aquatic insects may be very detrimental to this species since food is such a limiting factor (PNHP 2014-TN3885).

Two State-ranked natural communities are present along the North Branch Susquehanna River from New York to the BBNPP site (Table 2-16). These communities likely would not be affected by consumptive-use releases, because water levels in the North Branch Susquehanna River would likely not rise measurably because of the size of the river.

Actual occurrence of the above-noted potential effects on the various Federally listed and State-listed and State-ranked species would depend on site-specific conditions in affected streams and rivers that would cause a noticeable rise in stream levels (e.g., stream bed topography) and scouring. Effects, if present, are anticipated to be adverse, but relatively infrequent and temporary (due to the termination of low-flow periods after days, weeks, or up to 3 months, and the projected refilling of Cowanesque Lake by the November time frame [Meyer 2014-TN3566]).

5.3.1.4 Terrestrial Monitoring During Operations

PPL does not plan to conduct any terrestrial ecological monitoring during the period of operation of the proposed BBNPP other than those activities described in Section 4.3.1.4.

5.3.1.5 Potential Mitigation Measures for Operations-Related Terrestrial Impacts

PPL has committed to employing mitigation measures for operations-related terrestrial impacts including the implementation of BMPs associated with transmission-line corridor maintenance practices. As described in Section 5.3.1.1, these BMPs include vegetation management BMPs to avoid impacts to wetlands. PPL has committed to restricting removal of trees greater than 5 in. DBH within transmission-line corridors to November 16 through March 31 to protect the Indiana bat (see Sections 5.3.1.1 and 5.3.1.3).

5.3.1.6 Summary of Operational Impacts on Terrestrial Resources

The potential impacts of operating the proposed BBNPP and the associated cooling system (natural and mechanical draft cooling towers), including consumptive-use mitigation, on upland and shoreline vegetation, birds, mammals, and herpetofauna, including important species and habitats, are likely to be minor. The potential impacts of transmission-line operation, including those from EMFs, on birds, and transmission-line corridor maintenance on important habitats, including wetlands and floodplains, are considered minor, assuming related BMPs are implemented. The potential impacts of increased traffic and nighttime security lighting on wildlife are likely to be minor.

The review team evaluated the potential terrestrial ecological impacts of operating the proposed BBNPP, including the heat-dissipation system, associated consumptive-use mitigation, transmission lines, associated corridor maintenance, and other sources of potential adverse effects. Given the information provided in the ER submitted by PPL (PPL Bell Bend 2013-TN3377), responses to RAIs, interactions with State and Federal agencies, the public comment process, and the review team's own independent assessment, the review team concludes the impacts from operation of the proposed new facilities on terrestrial resources would be SMALL, and additional mitigation beyond that mentioned in this section would not be warranted.

5.3.2 Aquatic Impacts Related to Operation

This section discusses the potential impacts of operating a new nuclear power plant and associated transmission lines at the proposed BBNPP site on the aquatic resources in onsite streams and ponds, in the Susquehanna River, and in associated offsite consumptive-use mitigation areas. A list of permits and certifications required to operate a new plant at the BBNPP site is included in Section 5.2.

5.3.2.1 Aquatic Resources − Site and Vicinity

The potential impacts on aquatic resources through operation of the proposed BBNPP are described below according to operational systems and their respective impacts. Therefore, this section describes potential impacts from the Susquehanna River intake system, cooling-water discharge system, and site maintenance activities.

Susquehanna River Intake System

The primary concerns for aquatic resources related to water intake and consumption are the potential for organisms to be impinged on the intake screens or entrained into the cooling-water system and the relative amount of water drawn from the cooling-water source, the Susquehanna River. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the cooling-water intake structure. The intake system design for BBNPP does not include a fish-return system (PPL Bell Bend 2013-TN3377). However, PADEP (2013-TN2275) specified that the feasibility of adding a fish-return system would be evaluated during the NPDES permit application process. With this system, fish and invertebrates that are impinged on the intake screens would be removed and disposed (PPL Bell Bend 2013-TN3377). Entrainment occurs when organisms are drawn through the cooling-water intake structure into the plant's cooling system. Organisms that become entrained are normally relatively small water-column organisms, including the early life stages of fish and insects, which often serve as prey for larger organisms (66 FR 65256-TN243). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, pressure, thermal, and chemical stresses.

A number of factors, such as the type of cooling system, the design and location of the intake structure, and the amount of water withdrawn from the source waterbody greatly influence the degree to which impingement and entrainment affect aquatic biota. Impingement and entrainment impacts are regulated by the U.S. Environmental Protection Agency (EPA) or its designees (in this case, the PADEP) under Section 316(b) of the CWA (33 USC 1251 et seq.-TN662). Section 316(b) "requires that the location, design, construction, and capacity of cooling-water intake structure reflect the best technology available for minimizing adverse environmental impact." A new nuclear plant at the BBNPP site would be compliant with the Section 316(b) Phase 1 requirements for new facilities and would use a closed-cycle, recirculating water cooling system with two natural draft cooling towers (Sections 3.2.2.2, 3.4.2.2). The adjacent SSES Units 1 and 2 also use a closed-cycle cooling system (PPL Bell Bend 2013-TN3377). Depending on the quality of the makeup water, closed-cycle, recirculating cooling-water systems can reduce water use by 96 to 98 percent of the amount that the facility would use if it used a once-through cooling system (66 FR 65256-TN243). This significant reduction in the water withdrawal rate results in a corresponding reduction in impingement and entrainment losses.

An important factor affecting impingement and entrainment losses is the percentage of the flow of the source waterbody past the site that is withdrawn by the station. To minimize impacts, the EPA determined that the total design intake flow must be less than or equal to 5 percent of the mean annual flow of the river. The intake system for the BBNPP would have a total normal withdrawal rate of 25,729 gpm and a maximum withdrawal rate of 28,179 gpm (Section 3.4.2.2). Therefore, BBNPP would remove less than 1 percent of the average annual flow of the Susquehanna River, 4.8 million gpm (PPL Bell Bend 2013-TN3377).

The intake design through-screen velocity is another factor that greatly influences the rate of impingement of fish and invertebrates at a facility. The EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 fps and applied a safety factor of two to derive the threshold of 0.5 fps, which became established as a national standard for the maximum design through-screen velocity (66 FR 65256-TN243). PPL stated that the intake through-screen velocities would be less than 0.5 fps (PPL Bell Bend 2013-TN3377), which meets the EPA requirement. The intake would have bar grating to prevent large objects from entering the intake structure. The bar grating would consist of 3/8-in. steel bars placed on 2-in. centers for a spacing of 1-5/8 in. between the bars (PPL Bell Bend 2012-TN1173). PPL determined the intake traveling screen mesh size to be 0.08-in. (2-mm) square (PPL Bell Bend 2013-TN3377).

The review team evaluated the potential for impingement and entrainment of the Susquehanna River biota by the proposed BBNPP cooling system by examining data collected during an impingement and entrainment study at SSES Units 1 and 2 in 2008 and 2009 (Normandeau 2010-TN491).

Impingement

The review team used the data collected by Normandeau (2010-TN491) to estimate the potential impingement of Susquehanna River organisms by the proposed BBNPP cooling-water system intake traveling screens. Normandeau (2010-TN491) completed an impingement study at the SSES Units 1 and 2 intake that involved weekly sampling from April 22, 2008, to April 20, 2009, except for June 11 to August 11, 2008, when the intake was undergoing maintenance. Normandeau (2010-TN491) used a standard volume 58.32 Mgd (40,500 gpm) for the total volume of water withdrawn from the river by the two SSES units. Therefore, the normal volume expected to be withdrawn by the new BBNPP plant (25,729 gpm) would be about 0.635 times that withdrawn by the two SSES units during the impingement study. The 398 individuals impinged by SSES Units 1 and 2 during the study belonged to 1 invertebrate taxon, 18 fish species, and 1 unidentified fish taxon (Table 5-4). Crayfish (*Orconectes* spp.) was the most commonly impinged organism, representing 55 percent of the total impingement catch. Bluegill (*Lepomis macrochirus*; 11 percent), Rock Bass (*Ambloplites rupestris;* 9 percent), Channel Catfish (*Ictalurus punctatus;* 8 percent), Tessellated Darter (*Etheostoma olmstedi*; 5 percent), and Spotfin Shiner (*Cyprinella spiloptera*; 4 percent) were the most commonly impinged fish.

Other fish species collected at low numbers included Spottail Shiner (*Notropis hudsonius*), Margined Madtom (*Noturus insignis*), Smallmouth Bass (*Micropterus dolomieu*), White Crappie (*Pomoxis annularis*), and White Sucker (*Catostomus commersonii*). American Shad (*Alosa sapidissima*) and American Eels (*Anguilla rostrata*) did not occur among the impingement samples. Normandeau (2010-TN491) estimated an annual impingement rate of about 1,444 fish and 1,784 crayfish for SSES Units 1 and 2 by calculating the total number of organisms impinged divided by the number of sampling days and then multiplied by 365 to determine annual impingement. The review team verified and used these values and the expected difference in water withdrawal rates between the two plants to estimate the total annual impingement by the proposed BBNPP plant. The proposed BBNPP would withdraw 0.635 times the water of the SSES plant, and therefore, the total annual impingement for BBNPP would be about 913 fish and 1,133 crayfish (Table 5-4).

Table 5-4. Estimated Annual Impingement at SSES Units 1 and 2 and Projected Values for BBNPP Proposed Unit 1 Based on Data Collected from April 2008 through April 2009.

			Estimated Annual Impingement	
		SSES Units 1 & 2 Impinged[(a)]	SSES Units 1 & 2[(a)] (40,500 gpm flow)	BBNPP (25,729 gpm flow)
Common Name	Scientific Name	(Number of Fish)		
Crayfish	*Orconectes* spp.	220	1,784	1,133
Bluegill	*Lepomis macrochirus*	44	357	227
Rock Bass	*Ambloplites rupestris*	34	276	175
Channel Catfish	*Ictalurus punctatus*	31	251	159
Tessellated Darter	*Etheostoma olmstedi*	18	146	93
Spotfin Shiner	*Cyprinella spiloptera*	16	130	83
Spottail Shiner	*Notropis hudsonius*	5	41	26
Margined Madtom	*Noturus insignis*	4	32	20
Smallmouth Bass	*Micropterus dolomieu*	4	32	20
White Crappie	*Pomoxis annularis*	4	32	20
White Sucker	*Catostomus commersonii*	4	32	20
Yellow Perch	*Perca flavescens*	3	24	15
Banded Darter	*Etheostoma zonale*	2	16	10
Pumpkinseed	*Lepomis gibbosus*	2	16	10
Walleye	*Sander vitreus*	2	16	10
Bluntnose Minnow	*Pimephales notatus*	1	8	5
Brown Trout	*Salmo trutta*	1	8	5
Northern Hog Sucker	*Hypentelium nigricans*	1	8	5
Yellow Bullhead	*Ameiurus natalis*	1	8	5
Unidentified Fish		1	8	5
Total		398	3,225	2,046
Total Fish		178	1,441	913

(a) Normandeau (2010-TN491) annual impingement numbers differ from report due to rounding to the nearest whole number nearest whole number.

Because of the planned low through-screen intake velocity, the use of closed-cycle cooling at BBNPP, and the low estimated annual impingement rates for existing SSES Units 1 and 2, the review team concluded that the impacts of impingement on fish and crayfish by the proposed BBNPP would be minor.

Entrainment

The review team used the data collected by Normandeau (2010-TN491) to estimate the potential entrainment of Susquehanna River organisms by the proposed BBNPP cooling-water intake system. Normandeau (2010-TN491) completed an entrainment study at the SSES Units 1 and 2 intake that involved weekly sampling of ichthyoplankton (fish eggs and larvae) from April 22 to August 13, 2008, and March 17 to April 17, 2009. Fish entrainment estimates were calculated for each week of sampling. The estimated weekly entrainment for each taxon was summed for the entire sample period to determine the estimated number of fish entrained. The 3,039 individuals entrained by SSES Units 1 and 2 during the study belonged to 22 fish taxa (Table 5-5). Most of the entrained fish were larvae in the post yolk-sac and yolk-sac life stages. A single sucker (Catostomidae) egg was collected in the entrainment samples in 2009, and no other ichthyoplankton were collected during this 1-month sampling period. Unidentified minnows (Cyprinidae spp.; 22 percent), Channel Catfish (19 percent), Quillback (*Carpiodes cyprinus*; 16 percent), and unidentified darters (Percidae spp.; 12 percent) were the taxa with the highest estimated entrainment values.

Other aquatic species may also be entrained by intake operations. Phytoplankton and zooplankton are diverse plant and animal species (often referred to as holoplankton) that are abundant throughout the Susquehanna River Basin. They have short generation times, so they can rapidly replace the losses due to entrainment and other stresses. The license renewal EIS for SSES concluded that "Based on information in the GEIS, the Commission found that entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term" (NRC 2009-TN1725). Based on this information, any entrainment of plankton by the BBNPP cooling-water system would be expected to be localized and minor. Normandeau (2010-TN491) calculated that the total entrainment by SSES during the 17-week 2008 study period was about 13.3 million ichthyoplankton. It should be noted that most of these species are prolific spawners and a single representative cyprinid female may lay thousands of eggs in a season (Rohde et al. 1994-TN2208). The review team verified and used the April through August 2008 and March through April 2009 data collected for SSES Units 1 and 2 and the expected difference in water withdrawal rates between the two plants to estimate the total potential entrainment by the proposed BBNPP intake system, similar to the calculation for impingement. The review team's projection of ichthyoplankton entrainment by the intake system for the proposed BBNPP plant for April through August was about 8.5 million organisms (Table 5-5).

Because of the planned low through-screen intake velocity, the use of closed-cycle cooling at BBNPP, the low estimated annual entrainment rates for the existing SSES Units 1 and 2, and the high fecundity of the most likely entrained fish species, the review team concludes that the impacts of entrainment on fish by the proposed BBNPP would be minor.

Susquehanna River Discharge System

The effluent from the proposed BBNPP cooling-water system would be discharged directly into the Susquehanna River. Section 3.2.2.2 discusses the location and design of the discharge piping. The normal discharge rate from the cooling-water system would be 8,665 gpm (12,477,600 gpd), with a maximum discharge of 9,367 gpm (PPL Nuclear Development 2011-TN1906). The potential effects on the Susquehanna River aquatic resources from the discharge of cooling water from the proposed BBNPP include thermal, chemical, and physical impacts. System maintenance activities could also affect aquatic resources in the river.

Table 5-5. Estimated Entrainment at SSES Units 1 and 2 and Projected Values for BBNPP Proposed Unit 1 for April through August 2008 and March – April 2009.

			Estimated Entrainment	
		SSES Units 1 & 2 Entrained[(a)]	SSES Units 1 & 2[(a)] (40,500 gpm flow)	BBNPP (25,729 gpm flow)
Common Name	Scientific Name	(Number of Fish)		
Minnows	Cyprinidae spp.	535	2,863,110	1,818,075
Channel Catfish	*Ictalurus punctatus*	367	2,570,361	1,632,179
Quillback	*Carpiodes cyprinus*	828	2,164,020	1,374,152
Darters	Percidae spp.	382	1,644,738	1,044,408
White Sucker	*Catostomus commersonii*	286	1,299,692	825,304
Common Carp	*Cyprinus carpio*	345	894,149	567,785
Smallmouth Bass	*Micropterus dolomieu*	62	427,672	271,571
Perches	Percidae spp.	46	312,507	198,441
Yellow Perch	*Perca flavescens*	52	308,528	195,915
Rock Bass	*Ambloplites rupestris*	41	285,177	181,087
Walleye	*Sander vitreus*	37	171,869	109,137
Spottail Shiner	*Notropis hudsonius*	27	160,030	101,619
Margined Madtom	*Noturus insignis*	10	69,502	44,134
Unidentified Fish	–	7	48,744	309,652
Sunfishes	Centrarchidae spp.	5	42,151	26,766
Brown Bullhead	*Ameiurus nebulosus*	2	13,799	8,762
Banded Darter	*Etheostoma zonale*	2	13,778	8,749
Chain Pickerel	*Esox niger*	2	13,635	8,658
Herrings	Clupeidae spp.	1	7,042	4,472
Shield Darter	*Percina peltata*	1	7,042	4,472
Tessellated Darter	*Etheostoma olmstedi*	1	6,838	4,342
Sucker Egg	Catostomidae spp.	1	7,022	4,459
Total		3,040	13,331,406	8,465,139

(a) Normandeau 2010-TN491

Thermal Impacts from Discharge

Potential thermal impacts on aquatic organisms could include heat stress, cold shock, and the creation of favorable conditions for invasive species. The Pennsylvania Code (25 PA Code § 93.7) establishes that the discharge from heated waste sources may not change the receiving water temperature by more than 2°F during a 1-hour period (PA Code 25-93-TN611). The same section of the Code also establishes monthly or semimonthly maximum allowable temperatures for streams that are designated as warm-water fisheries, such as the Susquehanna River. These temperature maxima under fully mixed conditions range from 40°F in January and February to 87°F in July and August. The review team's evaluation of the discharge plume (Section 5.2) showed that the 2°F above ambient isotherm would extend about 194 ft (59 m) downriver and would be about 233 ft (71 m) wide and about 7 ft (2.2 m) thick. The evaluation indicated that the excess heat from the plume during the summer would not result in a 2°F above ambient isotherm, would extend less than 3 ft (<1 m) downriver, and would be about 105 ft (32 m) wide and about 7 ft (<0.1 m) thick. The evaluation indicated that the excess temperature from the thermal discharge would not raise the ambient river temperature beyond the winter and summer thermal maxima specified for a warm-water fishery. The thermal plume evaluation suggests that the minimal temperature increase and size of the thermal plume from the BBNPP discharge would not expose fish or mussels in the river to water temperatures that would result in an adverse effect. Sufficient unaffected habitat is available for motile species to swim away from any perceptible thermal plume, and the minimal increase above ambient temperatures would not likely cause an adverse effect on mussels in the area.

Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease, which sometimes occurs when power plants shut down suddenly in the winter. Cold shock mortalities at U.S. nuclear power plants are relatively rare and typically involve few fish (NRC 2013-TN2654). Because of the small size of the thermal plume and the small differential between the water temperature in the plume and the ambient temperature, it is not likely that fish would become acclimated to the BBNPP plume temperatures and be subject to cold shock.

Based on the previous discussion, the review team concludes that the effects of the discharge of heated water from the BBNPP on the fish and mussel populations, and other aquatic resources of the Susquehanna River, would be negligible.

Chemical Impacts from Discharge

The effluent discharged by the BBNPP would include several types of chemical constituents, including chemicals already in the Susquehanna River water that enters the cooling-water system and chemicals added to the cooling water to maintain optimum operating conditions (Section 3.4.4.1, Tables 3-4 and 3-5). The latter category includes biocides, anti-scalants, pH adjusters, and neutralizers. PPL stated that it would apply for an NPDES permit before operating a new plant at the BBNPP site, and that the permit would also consider the discharge by SSES (PPL Bell Bend 2013-TN3377). PPL expects that the BBNPP permit generally would be similar to the SSES permit. The effluents would be required to meet NPDES-permitted discharge limits (i.e., 40 CFR Part 423-TN253). The review team used ecological toxicity data from material safety data sheets to evaluate the potential toxicity of expected concentrations of chemical additives in the discharge for each additive. The expected concentrations in the discharge were lower than the toxicity levels identified in the respective material safety data sheets for each additive. Chemicals naturally occurring in the Susquehanna River would be concentrated by cooling-water recirculation and evaporative losses and discharged to the river

(Section 3.4.4.1, Table 3-4). Based on this evaluation, the review team concludes that the chemical impacts from discharges from the proposed BBNPP on the Susquehanna River would be minor.

Physical Impacts from Discharge

The potential physical impacts from the discharge of blowdown water into the Susquehanna River include turbulence from water exiting the diffuser and possible scouring of the river bottom. At the BBNPP site, the potential for turbulence and scouring would be minimal because the discharge vents would be located about 4 ft above the river bottom and directed at a 45-degree angle toward the water surface. Also, in accordance with standard engineering practice, PPL would install riprap around the base of the diffuser (Section 4.3.2.1), which would further reduce the potential for scour (PPL Bell Bend 2013-TN3377).

Based on this evaluation, the review team concludes that the physical impacts from discharges from the proposed BBNPP on the Susquehanna River would be minor.

Maintenance Dredging in the Susquehanna River

PPL stated that periodic dredging of the area in the Susquehanna River in front of the intake area may be required to remove accumulated sediment (PPL Bell Bend 2013-TN3377). Maintenance dredging would likely be necessary every 5 to 10 years, depending on the Susquehanna River flow rates (PPL Nuclear Development 2011-TN1906). PPL anticipates that about 250 to 1,000 yd^3 of sediment would be removed at each dredging event. The material would be used as clean fill on the BBNPP site. PPL would dredge only within the original area that was excavated during construction and would not dredge deeper than the original excavation depth. PPL would use a mechanical dredge for the maintenance dredging and BMPs to minimize the potential effects of the activity (PPL Nuclear Development 2011-TN1906). All maintenance dredging would be performed in accordance with USACE and Commonwealth of Pennsylvania requirements (PPL Bell Bend 2013-TN3377). The principal effects on the aquatic resources of the Susquehanna River would be physical disturbance of organisms inhabiting the area to be dredged and a localized increase in water-column turbidity. Effects from maintenance dredging are expected to be localized and temporary and would have a minor impact on aquatic resources.

Cooling-Water System Intake and Diffuser Maintenance

The cooling-water intake system would require periodic maintenance to remove fine sediment and debris that accumulate on the bottom of the three intake bays. PPL estimates that this would occur about every 18 to 36 months and would involve about 50 yd^3 or less per cleaning event (PPL Nuclear Development 2011-TN1906). The material would be used as clean fill on the BBNPP site. The intake bays would not require dewatering to facilitate the cleaning. This maintenance should not affect aquatic resources in the Susquehanna River.

PPL stated that the cooling-water discharge system diffuser pipe would need to be cleaned about every 18 to 36 months (PPL Nuclear Development 2011-TN1906). The end of the diffuser pipe is equipped with a flap gate that provides access for divers to remove accumulated silt and stones from the diffuser. PPL anticipates that approximately 10 yd^3 or less of material would be flushed from the pipe into the Susquehanna River during each cleaning. The effects of this flushing would be minor, consisting of a localized temporary increase in water-column turbidity and slightly increased sedimentation downstream.

All intake bay cleaning and diffuser maintenance activities would be conducted in accordance with USACE and Commonwealth of Pennsylvania requirements (USACE 2012-TN265).

PPL proposes to use grading, swales, and drainage ditches to direct runoff to detention basins or infiltration beds at several locations around the BBNPP site (Sections 3.2.2.1, 3.4.2.1) (PPL Bell Bend 2013-TN3377). Most runoff would drain to underground infiltration basins that eventually would discharge water to nearby vegetated areas or wetlands, usually through a level spreader to disperse water as sheet flow. Because the stormwater system design would be protective of aquatic resources, the review team concludes that with the use of the stormwater system as described in the stormwater management plan, the impacts on onsite waterbodies and the Susquehanna River from the operation of the proposed BBNPP would be minor.

Bridges

Bridges may affect aquatic habitats by increasing the runoff of road-derived materials, particularly deicing materials in winter, into wetlands and streams (Wagner et al. 2011-TN1831). PPL has stated that bridges would be built so that runoff from the bridge decks would be routed away to a water-quality treatment system that would fulfill NPDES requirements (PPL Nuclear Development 2011-TN1906). The review team concludes that the overall effects of bridges during BBNPP operations on aquatic resources in Walker Run and Unnamed Tributary 1 would be minor.

5.3.2.2 Aquatic Resources – Transmission-Line Corridor and Associated Offsite Consumptive-Use Mitigation Areas

Transmission-Line Corridor Maintenance

The proposed transmission system includes two new 500-kV switchyards, and two new 500-kV lines on individual towers, all within the BBNPP site (PPL Bell Bend 2013-TN3377). These facilities would connect to an existing Susquehanna 500-kV switchyard that would be expanded. The new lines would cross Unnamed Tributary 1 and West Building Pond, but no structures would be placed within the waterbodies (PPL Bell Bend 2013-TN3377). Maintenance activities for the new lines could affect those two waterbodies. Transmission-line corridor maintenance would be done by the transmission-line owner, PPL Electric Utilities. Maintenance would follow standard industry practice and would include pruning or cutting trees and other woody or herbaceous plants. Herbicides may be used occasionally (PPL Bell Bend 2013-TN3377). No direct impacts on the aquatic resources in the Susquehanna River from transmission-line corridor maintenance are expected because the transmission facilities are not near the river (PPL Bell Bend 2013-TN3377). The review team concludes that effects of transmission-line corridor maintenance activities on aquatic resources would be negligible.

Consumptive-Use Mitigation Activities

Consumptive Use of Susquehanna River Water

One possible effect of the BBNPP operations on aquatic resources downstream of the plant would be the lowering of river water levels because of the unmitigated consumptive use of river water during low-flow periods. The SRBC (2012-TN3565) informed PPL in December 2012 that PPL would need "to release water (in an amount equal to the plant's consumptive water use) upstream of the proposed plant when passby flow levels are reached." Such release of water upstream of the BBNPP would reduce the likelihood that sensitive downstream areas would become dewatered or experience unusually low water levels because of the consumptive water use by the plant. Based on this information, the review team concludes that the impacts from consumptive use by the proposed BBNPP on the Susquehanna River downstream of the plant would be negligible.

PPL applied to the SRBC for a maximum consumptive use of 28 Mgd (43 cfs) for the operation of the BBNPP site (PPL Bell Bend 2011-TN3627). In response to the SRBC (2012-TN3565) requirement to mitigate consumptive use by providing for the addition of water upstream of BBNPP and passby flows specifying when mitigation would be necessary, PPL proposed a plan that would involve the release of water from Cowanesque Lake into the Cowanesque River and from Rushton Mine into Moshannon Creek to compensate for consumptive use during defined low-flow periods, as described in Section 5.2.2.1. The major effect of consumptive-use mitigation would be the drawdown of the water level in Cowanesque Lake during periods in which flows are normally low. The maximum water release from Cowanesque Lake would be about 43 cfs, and that from the Rushton Mine would be about 14 cfs.

Drawdown of Cowanesque Lake Water Levels

Releasing water through the Cowanesque Dam to mitigate consumptive use during low-water periods in the Susquehanna River has the potential to reduce the water level in Cowanesque Lake such that animal and plant communities in the lake could be affected. Meyer (2014-TN3566) estimated the occurrence and depth of Cowanesque Lake drawdowns from 1981 to 2013 under the baseline conditions and with operation of the proposed BBNPP unit. During that period, drawdown resulting from the operation of the proposed BBNPP unit would have occurred 13 times with typical drawdown being less than 2 ft. Drawdown resulting from BBNPP consumptive use would have been greater than 4 ft in 1991 (6 ft), 1995 (4.5 ft), and 1999 (6.5 ft). These drawdowns would have reduced the shallow-water habitat area by about 60 to 90 percent. This evaluation suggests that most of the consumptive-use mitigation releases would result in drawdowns that would have minor effects on the shallow-water submerged aquatic vegetation habitats in Cowanesque Lake, and are discussed in more detail in Section 5.3.2.3 (important species section). Drawdowns of 1 ft currently occur as part of routine lake operations and recreational purposes (EA 2012-TN3371).

Consumptive-Use Mitigation Water Releases

As previously discussed in Section 5.2.2.1, consumptive-use mitigation releases from Cowanesque Lake can have a significant effect on river flows below the dam. However, flows in the river have a high natural variability, both seasonally and from year to year. Figure 5-1 indicates that the overall effect of BBNPP consumptive-use mitigation releases on river flows below the Cowanesque Dam would be minor. Consumptive-use mitigation releases would be used to maintain a normalized flow and would be within the banks of the river (PPL Bell Bend 2011-TN3627). Riverine organisms are adapted to variable flow conditions.

A review of Cowanesque River flow data and the rainfall data for the area indicates that natural events have the potential to change river flows much more dramatically that those resulting from consumptive-use mitigation releases. The maximum effect of water releases to compensate for consumptive use by the BBNPP would occur when the Cowanesque River is at its lowest flow, which typically would be about 15 cfs. A consumptive-use mitigation water release for BBNPP during that time would increase flow in the river to no more than 58 cfs (a fourfold increase), a flow increase much less than the increases often encountered in the river because of rainfall events, and would be unlikely to have any negative effect on aquatic resources in the river. Similarly, the minor additional flow from Rushton Mine (about 14 cfs), via Moshannon Creek, would not introduce flow changes different from natural rainfall events.

Based on this information, the review team concludes that consumptive-use mitigation releases would have short-term, localized effects on the biota in Cowanesque Lake and negligible effects on aquatic resources in the Cowanesque River. Therefore, no long-term effects on the respective aquatic systems would be expected. Consumptive-use mitigation releases from the Rushton Mine would also not affect aquatic resources in Moshannon Creek.

5.3.2.3 Important Aquatic Species and Habitats

Federally Listed Species

There are no Federally listed aquatic animal or plant species in the immediate project area or in the associated offsite consumptive-use mitigation areas (Section 2.4.2).

State-Listed Species

Of the State-listed aquatic animal species or Pennsylvania Fish and Boat Commission (PFBC) candidate species identified for Luzerne County (Table 2-21) the Eastern Mudminnow (*Umbra pygmaea*) and brook floater (*Alasmidonta varicosa*) have not been recorded on or near the BBNPP site (Section 2.4.2). In addition, none of the State-listed aquatic plant species (Tables 2.22, 2-23) have been documented in the onsite streams and ponds or in the Susquehanna River at or near the project area or in the offsite consumptive-use mitigation areas (Section 2.4.2). The Pennsylvania endangered brook floater may occur in Tioga County, PA (PNHP 2014-TN3950), and the brook floater and green floater (*Lasmigona subviridis*), both listed as New York State threatened, may occur in Steuben County, NY (NYNHP 2014-TN3988), but neither has been reported in Cowanesque Lake or River. No other State-listed aquatic animal species or PFBC candidate species are known to occur in the areas most likely to be affected by consumptive-use mitigation releases—Cowanesque Lake, the Cowanesque River below the Cowanesque Dam, and Moshannon Creek downstream of the Rushton Mine. Based on this information, the review team concludes that there are no effects from BBNPP operations on Federal and State-listed species or PFBC candidate species.

Recreationally Important Species

Recreational fishing in the Susquehanna River near Bell Bend is primarily for Smallmouth Bass, Muskellunge (*Esox masquinongy*), Channel Catfish, and Walleye (*Sander vitreus*), but also includes Northern Pike (*E. lucius*), Yellow Perch (*Perca flavescens*), and Bluegill (Section 2.4.2). These species would most likely be affected by impingement, entrainment, and the discharge of heated water from the cooling-water system. However, many of these aquatic species are motile and would likely move to adjacent habitat and would not be affected by operational activities. The evaluation of impingement, entrainment, and discharge from the BBNPP indicate that intake and discharge operations are not likely to adversely affect recreationally important species.

Recreational fish species could also be affected by drawdowns of the water level in Cowanesque Lake from water releases during consumptive-use mitigation activities as described above for the general fish community in the lake. The loss of shallow-water habitats during drawdown periods would force fish that live in those habitats to move into deeper parts of the lake. This would increase the susceptibility of some fish, especially juveniles, to predation because of increased predator density in the reduced-volume lake and the reduction of protective submerged aquatic vegetation habitat (USACE 2013-TN3383). Loss of shallow-water habitat could affect spawning of certain fish species, such as Alewife (*Alosa pseudoharengus*), Bluegill, Common Carp (*Cyprinus carpio*), Green Sunfish (*Lepomis cyanellus*), Pumpkinseed (*L. gibbosus*), and Quillback, that use the habitat in mid- to late summer (EA 2012-TN3371). As the lake refills, habitat would be restored (EA 2012-TN3371). Based on this information, the review team concludes that the effects of BBNPP operations on recreational species in Cowanesque Lake would be minor. There are no recreational fishing reports available for the Cowanesque River below the dam, or for Moshannon Creek.

Species of Historic Interest

The American Shad is not known to occur in the Bell Bend region of the Susquehanna River (Section 2.4.2), and was not collected during impingement and entrainment sampling conducted at SSES in 2008 to 2009 (Normandeau 2010-TN491). American Eels occur in the Bell Bend region of the river, albeit in small numbers (Section 2.4.2), but were not collected during impingement and entrainment sampling conducted at SSES in 2008 to 2009 (Normandeau 2010-TN491). The evaluation of the thermal discharge from BBNPP indicated that the thermal plume is not likely to adversely affect the American Eel. Neither species is known to occur in Cowanesque Lake, the Cowanesque River below the Cowanesque Dam, and Moshannon Creek, and therefore, they would not be affected by consumptive-use releases.

Invasive or Nuisance Organisms

Power plant operations (e.g., warm temperatures or high-flow rates that bring food to filter-feeding organisms) may facilitate the establishment of non-native species; the thermal discharge may also provide a warm-water refuge that enables cold-intolerant species to survive the winter (NRC 1996-TN288). Non-native species that occur in the Susquehanna River near the BBNPP site (Section 2.4.2) include the Asian clam (*Corbicula fluminea*), curly pondweed (*Potamogeton crispus*), and Eurasian watermilfoil (*Myriophyllum spicatum*). The zebra mussel, *Dreissena polymorpha*, does not occur in the Bell Bend area of the Susquehanna River, but a few specimens were found in the SSES emergency service spray ponds in August 2011 (Section 2.4.2). All four species live in parts of the river or other waterbodies that are not influenced by thermal discharges, and there is no evidence suggesting that their occurrence in the Bell Bend area is linked to the discharge from the SSES.

Within the consumptive-use mitigation area, Asian clams are known to occur in the North Branch of the Susquehanna River, and zebra mussels and Eurasian watermilfoil are known to occur in Cowanesque Lake (Section 2.4.2). Consumptive-use mitigation flows from Cowanesque Lake to the Cowanesque River may increase the opportunity for introduction of zebra mussels to the North Branch of the Susquehanna River. However, flows from the Cowanesque Lake to the Cowanesque River and downstream occur as a natural consequence of flood control during natural weather events, and an increase in presence of zebra mussels has not been noted in the North Branch of the Susquehanna River.

Based on this information, the review team concludes that the effects of BBNPP operations on invasive and nuisance species would be minor.

5.3.2.4 Aquatic Monitoring

Conditions of a new NPDES permit and compliance with the current Clean Water Act 316(b) Phase I Rule for new facilities may require PPL to monitor aquatic resources in the Susquehanna River, Walker Run, and unnamed tributaries after plant operations commence (PPL Bell Bend 2013-TN3377). Susquehanna River biota monitoring would likely include sampling benthic invertebrates in summer, fish communities monthly from spring through fall, and water quality quarterly (PPL Bell Bend 2013-TN3377). PPL suggests that the sampling locations would be upriver and downriver of the BBNPP diffuser, but the specific locations have not been determined. Monitoring aquatic resources in Walker Run and its unnamed tributaries, if required, would likely include sampling benthic invertebrate and fish communities in spring and fall at or near the locations sampled during the pre-application monitoring (PPL Bell Bend 2013-TN3377). The NPDES permit may also require the monitoring of nutrients, total iron, total manganese, total aluminum, and thermal discharges (PADEP 2013-TN2275).

5.3.2.5 Summary of Operation Impacts on Aquatic Resources

The review team has reviewed the proposed operation activities for BBNPP and associated transmission lines, including consumptive-use mitigation water releases from Cowanesque Lake and the Rushton Mine, and the potential impacts on aquatic biota in the onsite freshwater habitats, the Susquehanna River, and the Cowanesque Lake, Cowanesque River, and Moshannon Creek within the consumptive-use mitigation areas. The addition of an operating plant at the BBNPP site would increase the potential entrainment and impingement of aquatic biota in the Susquehanna River and would increase thermal loading to the river but not to an extent that would noticeably alter the aquatic resources of the Susquehanna River. Other impacts from operational activities, such as in-water maintenance activities (i.e., maintenance dredging, intake bay cleaning, and diffuser maintenance), transmission-line corridor maintenance, and consumptive-use mitigation water releases from Cowanesque Lake and the Rushton Mine, would be minor and temporary. Based on the review of operational activities described in the preceding sections and species' biological information, the review team concludes that the impacts on aquatic biota resulting from operation of BBNPP, associated transmission lines, and consumptive-use mitigation would be SMALL.

5.4 Socioeconomic Impacts

Plant operations can affect the people and the economy of communities, the surrounding region, and minority and low-income populations. The review team examined the ER prepared by PPL and verified the data sources used in its preparation by examining cited references and independently confirming data in discussion with community members and public officials (PPL Bell Bend 2013-TN3377). To verify data in the ER, the review team also requested clarifications and additional information from PPL as needed. Unless otherwise specified in the remainder of this section, the review team has drawn upon verified data from PPL. Where the review team used different analytical methods or additional information for its own analysis, the sections that follow include explanatory discussions and citations for additional sources.

Although the review team considered the entire region within a 50-mi radius of the BBNPP site when assessing socioeconomic impacts, the primary region of interest for physical impacts is within the vicinity of the proposed BBNPP. The region of interest with regard to demographic and economic impacts encompasses the entire 50-mi region, but focuses primarily on the two-county economic impact area of Columbia and Luzerne Counties in Pennsylvania.

The review team assumes that workers would either already live in or relocate to the 50-mi region in the same proportion as the current operations and maintenance workforce at the SSES Units 1 and 2. SSES Units 1 and 2 are located adjacent to the BBNPP site. As shown in Sections 2.5 and 4.4.2, 87.1 percent of all SSES workers reside in Columbia and Luzerne Counties. Therefore, the review team expects that the other counties would receive 12.9 percent of the workers as residents. The impact of workers located outside the economic impact area would be dispersed over a wider, more populated area, and therefore have been excluded from much of the socioeconomic analysis pertaining to construction and operation of the proposed BBNPP.

PPL estimates a commercial operation date of November 2025, with an operations workforce of 363 workers. The BBNPP workforce would increase during scheduled outages by up to an additional 1,000 workers for approximately 15 days every 18 months (PPL Bell Bend 2013-TN3377). Outages at the BBNPP would be planned around SSES outages to ensure they do not overlap.

5.4.1 Physical Impacts

This section identifies and assesses the direct physical impacts of operations-related activities on the community. The potential physical impacts of operating the proposed BBNPP include disturbances from noise, odors, vehicle exhaust, dust, vibration, and visual intrusions. It includes consideration of impacts resulting from plant operations, transmission lines, access roads, and project-related transportation of goods and materials in sufficient detail to assess potential impacts and to show how these impacts should be treated in the licensing process. The following sections assess the potential operations-related physical impacts of the proposed BBNPP on specific segments of the population, plant, and nearby communities.

5.4.1.1 Workers and the Local Public

No residences are located within the BBNPP site boundary. The nearest residence is located more than 2,000 ft (610 m) from the center of the construction site. The BBNPP site is located in Salem Township, Pennsylvania, adjacent to the existing SSES and 1.6 mi (2.6 km) northwest of the north branch of the Susquehanna River. The BBNPP site is located approximately 5 mi (8 km) northeast of the Borough of Berwick (population 10,477 in 2010). Other communities within the vicinity with populations in excess of 1,000 include Conyngham (population 1,958 in 2010), East Berwick (population 1,998 in 2010), Glen Lyon (population 1,888 in 2010), Mifflinville (population 8.41 in 2010), and Nescopeck (population 1,528 in 2010). The nearest recreational resources are the Riverlands Recreation Area located between the SSES power-generation facilities and the Susquehanna River, State Game Land No. 55 west of the BBNPP site, State Game Land No. 260 located east of the BBNPP site, and the two State park parcels named the Theta Lands (PPL Bell Bend 2013-TN3377).

5.4.1.2 Noise

The proposed BBNPP will produce noise from the operation of pumps, transformers, turbines, generators, switchyard equipment, cooling towers, and other onsite activities, including security-related practices, drills, and periodic testing of emergency sirens. In addition, some increase in noise in the area would result from vehicle travel by the permanent workforce.

PPL plans to use two draft cooling towers at the BBNPP site to remove excess heat from water after it passes through plant components. Natural and mechanical draft cooling towers emit broadband noise, which PPL does not expect to be greater than background levels at offsite locations. PPL modeled the noise generated by the cooling towers and found that sound levels generated by the cooling towers would be well below U.S. Department of Housing and Urban Development (HUD) and EPA outdoor guideline levels of 55 dBA. PPL recently completed noise surveys for the SSES, and results indicate there were no observed audible noises recorded offsite, day or night during two recent testing periods. Noise levels from the BBNPP would likely register at similar levels.

PPL must meet all applicable Occupational Safety and Health Administration (OSHA) noise requirements. Workers would use noise protection as required by OSHA when engaging in work subject to noise hazards. For residential areas, noise levels will also be in compliance with the 55-dBA standard administered by the HUD and EPA. The review team does not expect traffic noise levels to be large due to the varying nature of traffic noise and the dispersion of traffic as it moves away from the construction site. Traffic-related noise can also be reduced by lowering the speed limit, shuttling workers, staggering shifts, and using the railroad spur for large deliveries.

The review team concluded that the noise-related effects on workers, residents, and recreational users of nearby areas would be minor.

5.4.1.3 Air Quality

Once the proposed BBNPP has begun operations, air emissions would be generated from (1) emissions from the periodic testing and operation of standby diesel generators and auxiliary power systems, (2) commuter vehicle dust and exhaust, and (3) deposition of water droplets and salt from the two cooling towers. Emergency diesel generators will be tested for approximately 4 hours each month, and 24 to 48 hours every 2 years. Station blackout generators will be tested for 4 hours every quarter and for an extended 12-hour period every 18 months (PPL Bell Bend 2013-TN3377).

Certificates to operate the diesel generators and fire pumps require that air emissions comply with all applicable regulations. Access road maintenance and speed limit enforcement would reduce the amount of dust generated by the commuting workforce. PPL plans to use a staggered shift schedule for its operations workforce, which also will help mitigate the effects of vehicle exhaust (PPL Bell Bend 2013-TN3377). The two cooling towers will emit water vapor and particulate matter. Maximum solid deposition is not expected to exceed NUREG–1555 criteria for the protection of vegetation, and no fogging or icing associated with the tower plumes is predicted (PPL Bell Bend 2013-TN3377). The estimated salt-deposition rate is 0.018 pounds per acre per month during the fall season at a downwind distance of 3,937 ft to the east-northeast of the towers (PPL Bell Bend 2013-TN3377). This value is well below the range of 9 to 18 pounds per acre per month cited in the *Generic Environmental Impact Statement for License Renewal* for the onset of damage to vegetation (NRC 1996-TN288). The BBNPP would not use chemicals in amounts that would generate odors exceeding Federal and State limits. Onsite exposure by plant workers to vapors, dust, and other air contaminants will not exceed standards set forth by OSHA.

The review team concludes that the proposed BBNPP would have only a minimal impact on air quality and, thus, associated impacts would be minor.

5.4.1.4 Buildings

The most significant impact of the operations activities will affect buildings located at the existing SSES site. These buildings are located approximately 1 mi (1.6 km) to the east. Onsite buildings at SSES have been constructed to meet seismic qualification criteria, which will make them resistant to the effects of any shock and vibration from activities associated with operating the BBNPP site (PPL Bell Bend 2013-TN3377). The nearest offsite residences are located over 2,000 ft (610 m) from the center of the construction site. Except for the buildings noted previously within this section, no other industrial, commercial, or recreational structures would be directly affected by BBNPP operations. Therefore, the review team determined the physical impact to buildings from operations-related activities would be minor.

5.4.1.5 Roads

Public roads and railways would be used to transport heavy equipment and plant components to the BBNPP site. The road system would also be affected by 363 operations workers traveling to and from the site each work day. During outages, there could be as many as 1,000 additional workers, thereby increasing traffic and the physical damage to area roads.

There exists a geometric relationship between axle weights and pavement damage. Heavy loads cause several forms of pavement distress, including fatigue cracking. The relative effect of each axle weight varies based on the type of distress, pavement thickness, and various environmental and design variables. The functional class of road system used to haul heavy loads is an important factor in determining impacts to the road system. Higher order systems (e.g., Interstate highway, other freeways and expressways, and other principal arterial) are designed to higher standards and can therefore withstand more stress. Any physical damage to the road system due to operating the BBNPP would be largely offset by the payment of highway user taxes and fees. Most heavy loads would be transported to the BBNPP site on higher order systems, including US 11.

Vehicular traffic is also a source of noise and dust emissions. Maintaining good road conditions and enforcing appropriate speed limits would reduce the noise level and particulate matter generated by the workforce commuting to and from the BBNPP site. Heavy equipment could be taken by railroad to further reduce road impacts.

Daily trips (363) generated by the operations workforce would be far fewer than those estimated during the construction period (3,401 trips). Further, railroad deliveries during the operation phase would be less frequent than during construction. Therefore, the review team has determined the road-related impacts on workers, residents, and other users of the roads within the vicinity of the proposed site would be minor.

5.4.1.6 Aesthetics

Within 1.6km (1 mi) of the BBNPP site, there is a total residential population of 204 persons (PPL Bell Bend 2013-TN3377). The proposed cooling towers and the containment building would be visible from nearby structures. The proposed intake and discharge structures would be clearly visible from the Susquehanna River. Most BBNPP structures would not be visible from the Susquehanna River due to the presence of a tree line along the riverbanks. Vapor plumes, which would resemble cumulus clouds, would be visible from nearby locations as well as locations along the river. The plumes would be most noticeable in the winter months, with a height that could reach 997 ft (304 m) (PPL Bell Bend 2013-TN3377). Given the site is bounded by forests and rolling terrain and has already been affected by the presence of the SSES cooling towers, the review team expects the visual impact of the BBNPP to be minor.

5.4.1.7 Summary of Physical Impacts

Based on information provided by PPL, review team interviews with local public officials, and the review team's independent assessment of the physical impacts of operation, the review team concludes that the physical impacts of operation of the proposed BBNPP would be SMALL.

5.4.2 Demography

The populations of Columbia and Luzerne Counties in 2010 were 67,296 and 320,918, respectively (PASDC 2013-TN2018). Pennsylvania State Data Center baseline population estimates for Columbia County show continued slow growth. The Pennsylvania State Data Center forecasts Luzerne County population to decline between 2010 and 2030. Projected population levels in 2025 for Columbia and Luzerne Counties are 71,411 and 306,167, respectively (see Table 2-26) (PASDC 2010-TN1895). PPL projects an operations workforce of 363 workers. To estimate the potential demographic impacts of operation, the review team made two assumptions. First, of the expected 363 new operations workers, the review team adopts PPL's bounding assumption that all employees would in-migrate into the 50-mi region. The review team also assumes that workers would locate in the 50-mi region in the same proportion as the current operations and maintenance workforce at SSES, which means 163 operations workers (44.8 percent) would in-migrate and choose to live in Columbia County, and 154 operations workers (42.3 percent) would in-migrate and reside in Luzerne County (PPL Bell Bend 2013-TN3377). Using the average household size in Pennsylvania of 2.47 people, operations workers would bring an additional 465 family members with them. Thus, the review team estimates the in-migrating direct workforce population at 781, with 402 locating in Columbia County and 379 residing in Luzerne County (USCB 2011-TN3623). The influx of operations workers and families would represent less than a one percent increase in the populations of Columbia and Luzerne Counties.

In addition to operations workers, the BBNPP would require an outage workforce of approximately 1,000 temporary employees who would be onsite for a period of approximately 15 days every 18 months (PPL Bell Bend 2013-TN3377). The review team expects that outage workers would typically migrate into the area without their families from outside the 50-mi region and stay only during the outage period as close to the site as possible. The temporary nature of the work would generate only a minimal impact on Columbia and Luzerne Counties, with limited effects on the larger region. Outages at the BBNPP would be planned around SSES outages to ensure they do not overlap. Based on the information provided by PPL Bell Bend, interviews with State and local officials, and the review team's own independent analysis, the review team expects the demographic impacts of BBNPP operation would be SMALL.

5.4.3 Economic Impacts to the Community

Although future impacts of the BBNPP operations on the local and regional economy cannot be predicted with certainty, some insight can be obtained for the economy and population by consulting with county planners and reviewing regional population and economic data. The primary economic impacts from operating the proposed BBNPP over the estimated 40-year operating license and employing 363 new workers would be related to taxes and increased demand for goods and services. The review team expects the majority of the economic impacts will occur in the two-county economic impact area.

5.4.3.1 Economy

The review team estimated economic impacts on the surrounding region from operating the proposed BBNPP over a 40-year licensing period. Economic impacts would occur as a result of additional operations workforce jobs, wages paid, and tax revenue impacts.

Characteristics of the economy and workforce in the region are described in Section 2.5.2 of this EIS. PPL estimates the BBNPP operations workforce at 363 workers. When a new job is added to an economy, that new (direct) job supports the creation of other (indirect) jobs. Every new direct job in a given area—in this case, an operations job at the BBNPP—stimulates spending on goods and services within the region. This spending results in the economic need for a fraction of another indirect job, typically in the service industries. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) provided RIMS II regional multipliers for industry employment and earnings in the economic impact area. As noted in Section 4.4.2, the employment multiplier for BBNPP operations jobs is 2.44 (BEA 2014-TN3624). In other words, BEA estimated that each in-migrating operations worker in the economic impact area would support an additional 1.44 indirect jobs (BEA 2014-TN3624). The BEA employment multiplier is applied only to in-migrating workers because the BEA model assumes the direct employment of workers that already live in the area would have no additional impact on employment.

Table 5-6 identifies the total number of jobs created by the proposed project and filled by in-migrating workers during BBNPP operations. As indicated in Section 4.4.2, the review team assumes the place of residence for in-migrating operations workers would be 42.3 percent in Luzerne County and 44.8 percent in Columbia County. This assumption is based on the proportion of current operations and maintenance workers at the SSES Unit 1 and 2 sites who live in Columbia or Luzerne County. Further, the review team has adopted a bounding assumption that all 363 workers would in-migrate into the 50-mi region. Table 5-6 also provides 2010 employment and unemployment numbers for these counties as well. The table demonstrates that direct and indirect employment tied to BBNPP operations would represent a 1.3 percent increase in employment within Columbia County, but would represent only a small percentage (less than 1 percent) of jobs in Luzerne County. Thus, the review team finds that BBNPP operations would have a minor and beneficial effect on employment in Columbia and Luzerne Counties.

Table 5-6. Expected Distribution of In-Migrating BBNPP Operations Workers in the Economic Impact Area

				Employment Information in 2012	
County	Operations Workers	Indirect Jobs	Total Jobs	Employed Workers	Unemployment Rate
Columbia	163	235	397	31,370	6.0%
Luzerne	154	222	375	147,286	10.5%
Economic Impact Area	316	456	772	178,656	

Source: In-migration workforce based on economic impact area in-migrating workers (87.1% of in-migrants) and BEA Multipliers (BEA 2014-TN3624). Employment data obtained from PPL Bell Bend 2012-TN1173, which derived data from the 2006–2010 American Community Survey.

PPL estimated that the annual income for members of the operations workforce would be $24.4 million in the economic impact area, assuming an average salary of $77,135 (PPL Bell Bend 2013-TN3377). In addition to the salaries of in-migrating operations workers, the review team estimates that salaries associated with indirect jobs would generate approximately $8.2 million in additional income annually in the economic impact area. The average salaries for members of the indirect workforce were estimated at $17,870, based on the average salary for service occupations in the Scranton–Wilkes-Barre metropolitan statistical area (PPL Bell Bend 2013-TN3377).

Earnings from the operations and associated indirect workforce residing in the economic impact area would total approximately $32.5 million per year—around four- to five-tenths of one percent of the 2010 earnings in the economic impact area. For Luzerne County, BBNPP-related earnings would total $15.8 million annually or three-tenths of one percent of earnings in the county. In Columbia County, earnings would represent a more significant impact on the local economy, totaling $16.7 million annually or 1.6 percent of county earnings.

The operation of the BBNPP would also require an additional workforce for scheduled outages. Outages would occur at the BBNPP for about 15 days every 18 months, and would be planned to prevent overlap with planned outages at the SSES. Each outage would require approximately 1,000 additional short-term contract employees to perform equipment maintenance, refueling, and special outage projects at the BBNPP (PPL Bell Bend 2013-TN3377). Most of the outage workers would stay in local hotels, would rent rooms in local homes, or bring travel trailers so they can stay as close as possible to the BBNPP site.

Outage workers would likely travel to the site from outside the area, occupying local hotels, motels, and campgrounds. This increases revenues for hotels, restaurants, and other retail establishments that provide services to these temporary workers. Outside the economic impact area, the impacts become more diffuse because of the larger economic base of the area, with more available hotel rooms and temporary housing.

Based on information provided by PPL and the review team's own independent analysis, the review team concludes the overall impact on the economy of the 50-mi region and the economic impact area from operating the proposed BBNPP would be positive and minor.

5.4.3.2 Taxes

The tax structure of the region is discussed in Section 2.5. Several types of taxes would be generated during the operational life of the proposed BBNPP. Employees would pay sales, use, personal property, and income taxes, and vendors selling materials and services to the facility would pay a variety of State, Federal, and local taxes. PPL would be subject to property taxes on the BBNPP site as well as corporate taxes.

Sales, Use, Income, and Corporate Taxes

Pennsylvania levies a 6 percent sales, use, and hotel occupancy tax (PDR 2012-TN2020). Total sales and use tax remittances in Pennsylvania totaled $8.8 billion in State fiscal year 2012 with $112.9 million, or 1.3 percent, collected in the economic impact area (PDR 2012-TN2021). PPL estimates that that within the 50-mi region of the nuclear plant site, it will spend $9 million annually on materials, equipment, and outside services for BBNPP operations. Applying the 6 percent sales tax rate generates annual estimated State sales tax payments of $500,000 over the 40-year operation period. Luzerne and Columbia Counties do not impose local sales taxes.

The Commonwealth of Pennsylvania imposes a 3.07 percent tax against the taxable income of resident and non-resident individuals, S corporations, business trusts, limited liability companies that are not taxed by the Federal Government as corporations, and estates and trusts (PDR 2012-TN2020). In State fiscal year 2012, Pennsylvania collected $10.8 billion in personal income taxes (PDR 2012-TN2021). In 2010, taxable income in the two-county economic impact area ($7.1 billion) made up 2.3 percent of the statewide total ($310.4 billion) (PDR 2012-TN2021). Earnings from the operations and associated indirect workforce residing in the economic impact area would total about $32.5 million per year during the 40-year operations period. The review team estimates that the direct and indirect workforces would contribute up to $1 million in annual State personal income taxes.

At the local level in Pennsylvania, several jurisdictions also impose earned income taxes (EIT) on both residents and non-residents. Salem Township and Berwick both impose 1.0 percent EITs on residents and non-residents, with half of the proceeds from the resident EITs allocated to the Berwick Area School District (PDCED 2014-TN3915). Non-residents working in Salem Township would be subject to the local non-resident EIT unless the resident rate they pay to their local jurisdiction equals or exceeds the non-resident rate in Salem Township. Workers at the BBNPP would also be subject to a $52 annual local services tax, which would be paid to Salem Township. Salem Township would transfer $5 of each local services tax payment to the Berwick Area School District. The review team estimates that the operations workforce will generate $280,000 annually in EIT revenue, which will be allocated to jurisdictions throughout the region based on worker disbursement patterns. The review team further estimates that operations workers will generate an additional $18,876 in annual local services tax revenue for Salem Township, with $1,815 of that amount allocated to the Berwick Area School District. In 2012, Salem Township EIT and local services tax collections were $417,726 and $106,844, respectively (PDCED 2012-TN3916). Collectively, proceeds from these two taxes represented 27.5 percent of total collections in 2012 for Salem Township.

Pennsylvania also levies a 9.99 percent corporate net income tax. Assuming current tax regulations remain in effect, PPL estimates the impact of BBNPP operations on PPL Corporation income tax payments over the first 20 years of plant operations as follows: Federal net income tax liability will increase by $2 billion ($100 million average annual) and State net income tax liability will grow by $500 million ($25 million average annual) (PPL Bell Bend 2012-TN1347).

Property Taxes

Columbia and Luzerne Counties both impose property taxes with amounts based on the assessed value of the property and the millage rates for the local school district, as well as the county and municipality in which the property is located. A millage rate is the amount per $1,000 in assessed value used to calculate taxes on the property. Millage rates for several communities located near the BBNPP site are presented in Section 2.5.2.2. Berwick and Bloomsburg are located in Columbia County, and all other communities highlighted in Table 2-34 are located in Luzerne County. The BBNPP site is located in Salem Township. At a millage rate of 16.544 in Salem Township, the annual tax on a property with an assessed value of $1 million would be $16,544.

PPL property tax payments to Luzerne County, Salem Township, and the Berwick Area School District for the SSES are approximately $4 million annually, of which $2.4 million is allocated to the Berwick Area School District (PPL Bell Bend 2012-TN1348). This amount represents approximately 4.4 percent of the Berwick Area School District’s annual budget of $54.7 million (Berwick Area School District 2011-TN1676). With the completion of the BBNPP, Luzerne County, Salem Township, and the Berwick Area School District would receive additional property tax revenue. PPL estimates that in 2025, the first year of plant operation, the BBNPP would generate an additional $2.4 million in annual property taxes, of which $1.7 million would be paid to the Berwick Area School District (PPL Bell Bend 2012-TN1348).

The review team concludes that building the BBNPP would have minor impacts on tax revenue in the economic impact area, the region, and State, with the exception of the Berwick Area School District, where taxes revenues would have a noticeable and beneficial impact.

5.4.3.3 Summary of Economic Impacts

Based on the information provided by PPL, interviews with local public officials, and the review team's own independent analysis, the review team concludes that the economic impacts of BBNPP operations on the region, Commonwealth of Pennsylvania, and Luzerne County economy and tax base would be SMALL and beneficial. Economic impacts on Columbia County would also be SMALL and beneficial, but the tax impacts of BBNPP operations on the Berwick Area School District would be MODERATE and beneficial.

5.4.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education. The operation of the BBNPP would affect the transportation network as additional workers use the local roads to commute to and from work and truck deliveries are made to support operation of the new unit. These same commuters could also impact recreation in the area. As the workforce in-migrates and settles in the region, there may be impacts on housing, education, and public services.

5.4.4.1 Transportation

Similar to the discussion in Section 4.4.4, the impacts of BBNPP operations on traffic would be most noticeable on the rural roads of Luzerne County, particularly US 11, which is a two-lane highway that provides access to the BBNPP site. As traffic leaves US 11, it will be expected to disperse in several directions.

In 2011, KLD completed a traffic impact study to evaluate the impact of building and operating the BBNPP on the road network in the vicinity of the BBNPP site (KLD Engineering 2011-TN1228). KLD examined 23 key intersections near the BBNPP site. If the construction workforce added 100 daily trips to traffic volumes through an intersection, it became a candidate for inclusion in the study. Intersections selected for the analysis were identified in Berwick, Briar Creek, Nanticoke, Nescopeck, Salem Township, Shickshinny, and South Centre.

Table 5-7 presents the estimated levels of service (LOS) for the 23 key interchanges under future no build (FNB) and future build (FB) conditions during BBNPP operations.

When compared to the FB conditions, the impact of the 363 operations workers traveling to and from the site each day would have a minimal impact falling within the acceptable range of no more than an added 10 seconds of delay. During outages, there could be as many as 1,000 additional workers, thereby increasing traffic and adding congestion on US 11. However, the review team expects staggered shifts, making it unlikely that road capacity will be exceeded. Outage traffic at the BBNPP would not be noticeably different from that experienced during SSES outages. With the presence of the BBNPP, outage-related traffic delays would be roughly twice as frequent compared to current conditions. Traffic associated with replacement heavy equipment and reactor components can be mitigated through rail delivery.

1

Table 5-7. Intersection Levels of Service: Future Build Conditions (2023)

				AM LOS (delay)		PM LOS (delay)	
Int. No.	**County**	**Municipality**	**Intersection**	**FNB AM**	**FB AM**	**FNB PM**	**FB PM**
1	Columbia	South Center	US 11 and SR 2028	B (14.2)	B (14.4)	B (19.4)	B (19.4)
2	Columbia	Briar Creek	US 11 and Briar Creek Plaza	A (6.6)	A (6.6)	B (14.2)	B (15.2)
3	Columbia	Berwick	US 11 (Front Street) and Eaton Street	A (1.1)	A (1.1)	A (1.8)	A (1.8)
4	Columbia	Berwick	US 11 (Front Street) and Poplar Street	C (20)	C (21.3)	D (38.9)	D (39.0)
5	Columbia	Berwick	US 11 (Front Street) and Orchard Street	A (6.5)	A (6.6)	B (15.1)	B (15.2)
6	Columbia	Berwick	US 11 (Front Street) and SR 93 (Orange Street)	A (5.8)	A (5.8)	A (9.9)	B (10.1)
7	Columbia	Berwick	US 11 (Second Street) and LaSalle Street	B (11.7)	B (11.7)	B (13.6)	B (13.7)
8	Columbia	Berwick	US 11 (Second Street) and Oak Street	A (6.2)	A (6.2)	A (8.0)	A (8.0)
9	Columbia	Berwick	US 11 (Second Street) and Mulberry Street	A (4.8)	A (4.8)	A (5.7)	A (5.6)
10	Columbia	Berwick	US 11 (Front Street) and Mulberry Street	A (6.0)	A (6.0)	A (7.9)	A (7.9)
11	Columbia	Berwick	SR 1020 (Market Street) and Third Street	A (9.6)	A (9.6)	B (12.9)	B (12.9)
12	Columbia	Berwick	US 11 (Second Street) and Market Street	A (9.5)	A (9.6)	B (11.6)	B (11.6)
13	Columbia	Berwick	US 11 (Front Street) and Market Street	B (13.7)	B (13.8)	B (15.3)	B (15.3)
14	Columbia	Berwick	US 11 (Second Street) and Pine Street	A (6.0)	A (6.0)	A (8.7)	A (8.7)
15	Luzerne	Nescopeck	SR 93 (Third Street) and SR 339 (Broad Street)	B (13.9)	B (13.9)	B (12.2)	B (12.3)
16	Luzerne	Nescopeck	SR 93 (Third Street) and Dewey Street	A (4.6)	A (4.6)	A (3.7)	A (3.7)
17	Luzerne	Salem Township	US 11 and Bell Bend Site Entrance	--	A (1.6)	--	A (1.7)
18	Luzerne	Salem Township	US 11 and SSES Site Entrance	A (4.4)	A (4.3)	A (3.8)	A (3.7)
19	Luzerne	Shickshinny	US 11 (S. Main Street) and SR 239	A (8.1)	A (7.9)	A (9.1)	A (9.1)
20	Luzerne	Shickshinny	US 11 (Main Street) and SR 239 (Union Street)	B (13.6)	B (14.2)	B (15.3)	B (15.3)
21	Luzerne	Nanticoke	US 11 and SR 29 (Mill Street)	C (23.4)	C (23.5)	C (25.8)	C (25.7)
22	Luzerne	Nanticoke	US 11 and County Bridge	D (48.9)	D (48.9)	C (23.6)	C (24.0)
23	Luzerne	Nanticoke	US 11 (E. Poplar Street) and SR 29	A (2.7)	A (2.7)	D (27.7)	D (28.6)

Notes: A = Free flow, B = Reasonably free flow, C = Stable flow, D = Approaching unstable flow, E = Unstable flow, F = Forced or breakdown flow, FB = Future build, FNB = Future no build scenario, Delay = Average delay in seconds/vehicle,

Source: KLD Engineering 2011-TN1228

In addition to congestion impacts, operations-related traffic will also result in emissions, traffic accidents, injuries, and fatalities. The heavy vehicles that transport equipment and materials and the autos carrying the commuting workforce to the BBNPP site will emit several pollutants, including carbon monoxide, carbon dioxide (CO_2), oxides of nitrogen, fine particulate matter, volatile organic compounds, and sulfur dioxide. Health and other costs associated with air-quality impacts will vary based on fuel type, motor fuel economy, and local climate and air-quality conditions. Operations-related traffic will also result in an increase in the number of accidents, injuries, and fatalities. The costs associated with these incidents include workers' compensation premiums, lost productivity, environmental remediation, property damage, fines and penalties, insurance premiums, and medical costs. Section 5.8.6 presents an estimate of construction-related vehicular impacts on accidents, injuries, and fatalities. The review team expects emissions and the number of traffic accidents associated with plant operation to be minor. Therefore, the socioeconomic impacts of emissions and traffic accidents would also be minor.

Based on the information provided by PPL, interviews with local public officials, and the review team's own independent analysis, the review team concludes that operations-related impacts on traffic will be minor.

5.4.4.2 Recreation

Section 2.5.2.4 provides a detailed description of local recreation resources. The review team concluded that recreational effects experienced near the BBNPP site would be similar to, but smaller than, those described for building the proposed plant in Section 4.4.4.2. The aesthetic impacts of the plant operations from the vantage point of local recreation areas would be minimal. There could, however, be greater impacts at Cowanesque Lake. The sites at Cowanesque Lake, which are detailed in Section 2.5.2.4, would be affected by the SRBC requirement that upstream water sources be used to compensate for BBNPP consumptive use.

As the water resources stored in the lake are accessed during low-flow conditions, lake elevations will fall. As the elevation of the lake falls below certain thresholds, some recreational facilities could face closure. Table 2-38 in Section 2.5.2.4 presents a summary of elevation impacts on Cowanesque Lake recreation facilities. The target operating elevation for the lake is 1,080 ft. When lake elevations drop 2 to 3 ft below the target elevation, several sites are affected, including the Boat Launch Concrete Pad and Beach Swimming Concrete Pad at Thompkins Campground and the Beach Swimming Concrete Pad and Americans with Disabilities Act-compliant fishing pier at the South Shore Day-Use Area. When lake elevations drop below 1,075 ft, most sites identified in Table 2-38 would be closed for recreational use. The review team examined historic data (1981 to 2013) to estimate the impact of BBNPP operations on drawdown frequencies in the lake (Meyer 2014-TN3566). Based on this assessment, sites that close at 1,078 ft would be unavailable 3.3 percent more of the time due to BBNPP mitigation, while sites that close at 1,075 would be unavailable 2.7 percent more often.

The impacts on recreation within 50 mi (80 km) of the BBNPP site are expected to be minor.

5.4.4.3 Housing

Regional housing characteristics and availability are described in Section 2.5.2.5. The BBNPP site is located in Salem Township, Pennsylvania, approximately 5 mi (8 km) northeast of the Borough of Berwick (population 10,477 in 2010). Other communities within the vicinity with populations in excess of 1,000 include Conyngham (population 1,958 in 2010), East Berwick (population 1,998 in 2010), Glen Lyon (population 1,888 in 2010), Mifflinville (population 1,213 in 2010), and Nescopeck (population 1,528 in 2010). The review team expects 87.1 percent of the operations workforce (316 workers) will in-migrate into the two-county economic impact area and that the largest impacts on housing will occur in the Borough of Berwick. However, given the relatively small operations workforce compared to the larger construction workforce, operations workers would be easily absorbed by the local communities.

The BBNPP would need as many as 1,000 additional workers for about 15 days every 18 months (PPL Bell Bend 2013-TN3377) during each refueling outage. The review team expects the majority of these outage workers to stay in hotels or trailers, or rent rooms in homes; it is not expected that they will become permanent residents in the region. This influx of temporary workers is not expected to impact the permanent housing stock or housing market in the region. The local community has already demonstrated the capacity to absorb the demands placed on housing resources by SSES outage workers. Based on this assessment, the review team expects the impact on housing from the operations of the BBNPP would be minor.

BBNPP operations could affect housing values in the vicinity of the BBNPP site. In a review of previous studies on the effect of seven nuclear facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling concluded that assessed valuation and median housing prices have tended to increase at rates above national and State averages (Bezdek and Wendling 2006-TN2748). Clark et al. similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative imagery of the facilities (Clark et al. 1997-TN3000). These findings differ from studies that evaluated undesirable facilities, largely related to hazardous waste sites and landfills, but also included several studies on power facilities (Farber 1998-TN2857) in which property values were negatively affected in the short term. These effects moderated over time. Bezdek and Wendling attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area (Bezdek and Wendling 2006-TN2748). Given the findings from the studies discussed above, the review team determined the impact on housing values from BBNPP operations would be minor.

5.4.4.4 Public Services

This section describes the available public services and discusses the impacts of operating the proposed BBNPP on water supply, waste treatment, police, fire protection, medical services, and education.

Water-Supply Facilities

Section 2.5.2.6 describes the water-supply systems and facilities in the vicinity of the BBNPP site. The BBNPP would likely obtain potable water from the Berwick District of the PAWC. During normal plant operations, water demand at the BBNPP is expected to average 148,320 gallons per day. PPL has indicated that the peak usage rate during shutdown/cool down conditions could reach 339,840 gallons per day (PPL Bell Bend 2013-TN3377). The PAWC district in Berwick has excess capacity of 3.1 million gallons per day (Mgd), well more than enough to meet the demands placed upon it by the BBNPP. Municipal water suppliers in Columbia and Luzerne Counties (see Table 2-45) have an excess capacity of approximately 34 Mgd. As discussed in Section 4.4.4.4, the local water systems in Columbia and Luzerne Counties have the capacity to meet the demand for water from the peak population during development of the BBNPP. Therefore, because the planned operations workforce is considerably smaller than the building workforce, the review team concludes that the local water systems would have no difficulty meeting water demand during the operations phase. Therefore, the review team expects the impacts on the water supply would be minor.

Wastewater-Treatment Facilities

Section 2.5.2.6 describes the public wastewater-treatment systems in Columbia and Luzerne Counties, their permitted capacities, and the current demands. Currently, wastewater-treatment facilities in the two counties have excess capacities (see Table 2-47). The BBNPP will use sanitary wastewater lines that tie into public treatment systems operated by the Berwick Area Joint Sewer Authority (PPL Bell Bend 2013-TN3377). From 2007 to 2011, average loading for the Berwick Area Joint Sewer Authority was 1.85 Mgd; its design capacity is 4.64 Mgd. Because the system is operating at an average of 1.8 Mgd under its design capacity, it has enough excess capacity to meet the demands placed upon it by the BBNPP. As discussed in Section 4.4.4.4, local wastewater-treatment systems in Columbia and Luzerne Counties are expected to have sufficient capacity to meet the demand for wastewater treatment from the peak population during the building phase. Therefore, because the planned operations workforce is considerably smaller than the building workforce, the review team expects local water systems would have no difficulty meeting the demand placed on wastewater facilities during the operations phase. Therefore, the review team concludes the impact on wastewater treatment from BBNPP operations and the in-migration of operations workers and their facilities would be minor.

Police and Fire Services

Based on analysis provided in Section 2.5.2.6, the review team expects that current levels of law enforcement and fire-protection personnel would be adequate to meet the need of the communities throughout the building phase, as discussed in Section 4.4.2. The review team estimates that the in-migrating BBNPP operations workforce would represent less than a 1 percent increase in population within the economic impact area (Section 5.4.2). Therefore, the impact of new operations workers and their families on police and fire services would be well within normal historic population growth levels traditionally addressed through planning by the local governments. Even without adding capacity during construction, the impact on law enforcement and firefighting services from the operation of the BBNPP would be minor.

Medical, Health and Human Services

Section 2.5.2.6 describes the level of medical and human services within Columbia and Luzerne Counties, which the review team determined is sufficient to absorb the building-related influx of workers during the building phase. This conclusion was shared by representatives of the Berwick Hospital Center, who indicated to the review team that the facility could easily accommodate the demands placed upon it by the BBNPP construction workforce (Balducci 2009-TN4027). The review team believes these systems could also support the smaller operations-related influx of workers. New jobs created to operate and maintain the proposed BBNPP would benefit the disadvantaged population served by the State health and human services offices by adding jobs, including indirect service-oriented jobs, to the region that may go to individuals currently underemployed or unemployed. Enhanced employment opportunities could reduce some current social services client lists. While the influx of new workers and their families may also create additional pressure on those same social services, the review team concludes that the net effect of the new permanent operations workforce on local and State health and human services would be minor.

5.4.4.5 Education

Section 5.4.2 discusses the review team's underlying assumptions concerning the distribution of operations workers' families within the 50-mi region around the proposed BBNPP site. These assumptions indicate the expected increase in population for any given county within the 50-mi region would be less than 1 percent. With a population of 388,214, there are approximately 7.0 individuals for every student enrolled in schools within the economic impact area. Applying this ratio, the review team expects an operations-related increase of approximately 112 students. This influx of students would represent approximately two-tenths of one percent of the student population in the economic impact area. Based on the gravity model calculations outlined in Section 4.4.4.5, the review team expects the Berwick Area School District to add 49 students due to BBNPP operations. These rates are well within historic annual changes in student populations, and within the planning capacity of local school districts. Because there would be relatively few new students coming from the families of operations workers, the review team believes the impact of plant operations on public schools would be minor. While the impacts would be larger for the Berwick Area School District, these impacts would be largely, if not entirely, mitigated by the additional $1.7 million in property taxes it would receive as a result of BBNPP operations and the larger State funding apportionment resulting from the increase in student population. The review team expects that school-age children would not accompany temporary outage workers in-migrating into the area to work at the BBNPP site.

5.4.4.6 Summary of Infrastructure and Community Services

Based on information provided by PPL, staff interviews conducted with and information solicited from public officials in Columbia and Luzerne Counties, and NRC staff review of data concerning the current availability of services, the review team concludes that the impacts of BBNPP operations on the regional infrastructure and community services would be SMALL.

5.4.4.7 Summary of Socioeconomic Impacts

Based on information provided by PPL, the review team's independent analysis, and taking into account the BMPs and mitigation measures described in the BBNPP ER, the review team concludes that the overall physical impacts of BBNPP on workers as well as the local public, buildings, roads, and aesthetics near the BBNPP site would be SMALL. Impacts to the economy and tax base for the Commonwealth of Pennsylvania, the 50mi region, and the two-county economic impact area would be SMALL and beneficial, with the exception of the tax impacts of BBNPP operations on the Berwick Area School District, which would be MODERATE and beneficial. Based on the current availability of services and additional taxes that would likely compensate the need for additional services, the staff concludes the operations impacts on local infrastructure and community services would also be SMALL.

5.5 Environmental Justice (BBNPP)

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses any disproportionately high and adverse human health or environmental effects of its programs, policies, or activities on minority or low-income populations (59 FR 7629-TN1450). On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040-TN1009). Section 2.6 discusses the locations of minority and low-income populations near the proposed BBNPP site and within a 50 mi radius.

The scope of the review, as defined in NRC guidance (NRC 2013-TN2597; 69 FR 52040-TN1009), should include an analysis of the impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The analysis presented in this review considers whether the impacts are likely to be disproportionately high and adverse. The review evaluated the significance of such impacts.

The review team evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.6 of this EIS could experience disproportionately high and adverse impacts from operating a nuclear plant at the BBNPP site. To perform this assessment, the review team used the same approach employed in Section 4.5.

The review team identified a total of 1,448 census block groups within a 50 mi radius of the BBNPP site, 102 of which were classified as having aggregate minority populations. Of these minority populations, 17 are located in Luzerne County and 2 are located in adjacent Schuylkill County. The nearest aggregate minority group is located near Nanticoke (7.48 mi from the BBNPP site) in Luzerne County. There are no aggregate minority populations located in adjacent Carbon or Columbia Counties. Of the 17 census block groups with aggregate minority populations in Luzerne County, 9 are located in Hazleton, Pennsylvania, and six are located in Wilkes-Barre, Pennsylvania. The highest concentrations of aggregate minority populations within the 50 mi region are located in Lehigh County (58 census block groups) (USCB 2011-TN2009).

5.5.1 Health Impacts

For all three health-related considerations described in Section 2.6.1, the review team concluded that BBNPP-associated emissions, doses, and other hazards are expected to be well within the protection levels established by NRC and EPA regulations and would not impose a disproportionately high and adverse effect on minority or low-income populations.

Air emissions from diesel generators, auxiliary boilers and equipment, cooling towers, and vehicles would have a small impact on workers and local residents. With the exception of the cooling towers, emissions sources would be operated intermittently. Emissions from all sources would be within Federal, State, and local air-quality limits. The review team expects negligible impacts from sulfur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, and particulate emissions relative to other baseload fossil-fired generation (Sections 5.7).

The results of the normal operation dose assessments (Section 5.9) indicate that the maximum individual dose for these pathways would be insignificant, well below the regulatory guidelines in Appendix I of 10 CFR Part 50 (TN249) and the regulatory standards of 10 CFR Part 20 (TN283). Nonradiological health hazards to the public and occupational workers will be monitored and controlled in accordance with regulatory limits (see Section 5.8). Therefore, there is no evidence that radiological or nonradiological effects from operations will impact any demographic subgroup differently from any other subgroup.

As discussed in Section 2.6, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in different health pathway impacts compared to the general population. Therefore, the review team concludes that there would be no disproportionately high and adverse health impact on minority or low-income members of the public from the release of radiological material from operations or from design basis accidents.

5.5.2 Physical and Environmental Impacts

There are four primary pathways in the environment: soil, water, air, and noise. The following four subsections discuss each of these pathways in greater detail.

5.5.2.1 Soil

As discussed in Section 5.8, the review team does not expect operations-related environmental impacts on soils at the BBNPP site that would affect nearby residents; there are no onsite residents. Because soil impacts attenuate rapidly with distance, the review team expects that there would not be soil-related disproportionately high and adverse impacts on minority or low-income populations. As discussed in Section 2.6.3 of this EIS, the review team did not identify evidence of unique characteristics or practices that may result in different soil-related impacts compared to the general population. Based on information from PPL and the review team's own independent review, the review team concludes that the operations-related impact from pathways related to soils from the BBNPP would not impose disproportionately high and adverse impacts on minority or low-income populations.

5.5.2.2 Water

Based on the analysis in Section 5.4, the review team concludes that water use at the BBNPP site would have little or no effect on the availability of water for other uses. Based on Section 5.3.2, the water use at the BBNPP would have minimal impacts on the fish population of the Susquehanna River. As discussed in Section 2.6, the review team was made aware of anecdotal evidence of common subsistence activities, including fishing; however, none of the social service agencies interviewed by the review team track subsistence users quantitatively or could supply the review team with an estimated level of subsistence use (Balducci 2009-TN4027). The review team reviewed surveys of fisherman conducted by the Pennsylvania Fish and Boat Commission, and identified the primary bodies of water where subsistence fishing may occur. Based on this analysis, the review team did not identify an operational pathway that could result in different water-related impacts compared to the general population. Based on information from PPL and the review team's independent evaluation, the review team concludes that given the relatively minimal impact on water quality and the small consumptive use of the proposed BBNPP, there would be no operations-related disproportionately high and adverse environmental impacts on minority or low-income populations.

5.5.2.3 Air

As discussed in Section 5.7, the total liquid and gaseous effluent doses from the proposed BBNPP would be well within the regulatory limits of the NRC and EPA, implying that impacts on any population are likely to be minimal from this source. The primary air emissions from a nuclear power plant (e.g., the proposed BBNPP) are water vapor and salt, which do not pose health dangers to the general public. The estimated salt-deposition rate is 0.018 pounds per acre per month during the fall season at a downwind distance of 3,937 ft to the east-northeast of the towers (PPL Bell Bend 2013-TN3377). This value is well below the range of 9 to 18 pounds per acre per month cited in the *Generic Environmental Impact Statement for License Renewal* for the onset of damage to vegetation (NRC 1996-TN288). Section 5.7 of this EIS also evaluates the impacts of the operation of engine-driven emergency equipment (e.g., fire water pumps), emergency power supply system diesel generators, and transmission lines on air quality. It concludes that the potential impacts from these sources of air emissions would be minor.

Air emissions are also expected from increased vehicle traffic. The heavy vehicles that transport equipment and materials, and the autos carrying the commuting workforce to the BBNPP site, will emit several pollutants, including carbon monoxide, carbon dioxide (CO_2), oxides of nitrogen, fine particulate matter, volatile organic compounds, and sulfur dioxide. Emissions from vehicles and heavy equipment are unavoidable, but would be localized and temporary.

Air-quality impacts attenuate rapidly with distance from the source. Therefore, the review team believes that due to the distance between the BBNPP site and the closest minority or low-income populations of interest (7.48 mi located near Nanticoke), any airborne pollutants emanating from the BBNPP or the transportation corridors serving the commuting workforce would have rapidly dispersed to near background levels by the time they reached the affected environmental justice population. The review team did not identify any evidence of unique characteristics or practices that may result in different air-quality-related impacts for minorities or low-income people when compared to the general population.

Given that the total effluent doses from the new plant would be well within regulatory limits and airborne pollutants released onsite or by vehicles traveling to the site would disperse to near background levels, the review team concludes that the potential impacts from operations-related sources of radiological and nonradiological air emissions would not result in disproportionately high and adverse impacts on minority or low-income populations within the site vicinity.

5.5.2.4 Noise

As discussed in Section 5.4.1 and 5.8.2, primary noise sources associated with operation of the BBNPP are pumps, transformers, turbines, generators, switchyard equipment, cooling towers, and other onsite activities, including security-related practices, drills, and periodic testing of emergency sirens. In addition, some increase in noise in the area would result from vehicle travel by the permanent workforce. As noted in Section 5.4.1, PPL modeled the noise generated by the cooling towers, and their findings indicate sound levels generated by the cooling towers would be well below U.S. Department of HUD and EPA outdoor guideline levels of 55 dBA. PPL recently completed noise surveys for the Susquehanna Steam Electric Station, and the survey results indicate there were no observed audible noises recorded offsite, either during the day or at night. Noise levels from the BBNPP would likely register at similar levels. Furthermore, PPL must meet all applicable OSHA noise requirements. Workers would use noise protection as required by OSHA when engaging in work subject to noise hazards. For the residential areas, noise levels will also be in compliance with the 55 dBA standard administered by the HUD and EPA. Traffic noise levels are not expected to be large because of the varying nature of traffic noise and the dispersion of traffic as it moves away from the construction site. Traffic-related noise can also be reduced by lowering the speed limit, shuttling workers, staggering shifts, and using the railroad spur for large deliveries. Therefore, the review team has determined there is no noise-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.3 Socioeconomic Impacts

The review team concluded in Section 5.4 that the socioeconomic impacts of BBNPP operations would be minor, with the exception of tax impacts on the Berwick Area School District, which would be noticeable and beneficial. The review team determined that once the proposed BBNPP is operational, any adverse socioeconomic impacts felt by any group within the region would significantly diminish when the construction workforce leaves the region. However, partially offsetting the departure of the construction workforce would be the in-migration of the permanent workforce that would operate and maintain the BBNPP. While the addition of these new employees would place pressure on local infrastructure (e.g., schools, fire and police protection, hospitals), the review team believes that any resulting pressure on minority or low-income populations would be far less than their analogous impacts during the building of BBNPP. Therefore, the review team concludes that socioeconomic impacts would not be disproportionately high or adverse on minority or low-income populations of interest.

5.5.4 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, including Native American settlements. As part of its visits to the site and region, the review team interviewed public officials and community leaders (Balducci 2009-TN4027; McDowell 2014-TN3492; NRC 2012-TN1890).

The review team conducted interviews with local officials and staff of the Berwick Hospital, Columbia County Housing Authority, Columbia County Redevelopment Authority, Luzerne County Commission on Economic Development, and school districts situated near the site. None of these entities track subsistence users quantitatively, nor did any have information specific to the site (Balducci 2009-TN4027). The review team identified hunting levels in the region and the primary bodies of water where subsistence fishing may occur. The review team also reviewed the ER (PPL Bell Bend 2013-TN3377), reviewed surveys of fishermen conducted by the Pennsylvania Fish and Boat Commission, and conducted a search for literature that failed to identify reports documenting subsistence activities near the BBNPP site. Therefore, the review team concludes that there would be no disproportionately high and adverse impacts on the subsistence activities of minority or low-income populations from building the proposed BBNPP.

No other unique characteristics or practices were identified by the review team for the low-income and minority populations that would indicate a dependence on subsistence resources that would be affected by the operation of the proposed BBNPP.

5.5.5 Summary of Environmental Justice Impacts

As discussed in Section 2.6.1, the review team identified several census blocks that meet the criteria for minority populations of interest within the 50 mi region. The review team determined these areas may have a greater potential for disproportionately high and adverse operations impacts on minority and low-income populations. Consequently, the review team further analyzed these areas to determine whether or not such impacts would be significant.

Based on information provided by PPL and review team interviews conducted with public officials in surrounding counties concerning the potential for environmental pathways and unique characteristics or practices, the review team determined there would be no disproportionately high and adverse impact on any minor or low-income population.

5.6 Historic and Cultural Resource Impacts from Operation

The National Environmental Policy Act of 1969, as amended (NEPA; 42 USC 4321 et seq.-TN661) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA; 54 USC 300101 et seq. -TN4157), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of

Historic Places (NRHP). Such resources are referred to as "historic properties" in the National Register. As outlined in 36 CFR 800.8(c) (TN513), "Coordination with the National Environmental Policy Act of 1969," the NRC and the USACE are coordinating compliance with Section 106 of the NHPA in fulfilling their responsibilities under NEPA, with the USACE identified as the lead agency for cultural resources.

Operation of new nuclear power plants can affect either known or undiscovered historic and cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and the USACE are required to make a reasonable and good faith effort to identify historic properties and cultural resources in the project areas of potential effect (APEs) and, if present, determine if any significant impacts are likely. Identification is to occur in consultation with the appropriate State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties or important cultural resources are present or affected, the NRC and USACE are required to notify the appropriate SHPO before proceeding. If it is determined that historic properties or important cultural resources are present, efforts must be made to assess and resolve any adverse effects of the undertaking. As explained in Section 2.7.4, the USACE has determined that there will be no adverse effects from the proposed BBNPP unit (USACE 2013-TN2243) and the Pennsylvania SHPO has concurred (PHMC 2013-TN2237).

5.6.1 Onsite Historic and Cultural Resources Impacts

For a description of the historic and cultural resources information about the BBNPP site, see Section 2.7. As explained in Section 2.7, previous cultural resource identification efforts indicated the presence of numerous archaeological sites and architectural resources within the direct (physical) and indirect (visual) APEs (Table 2-53 in Section 2.7). One archaeological resource, 36LU288, has been determined NRHP-eligible. Any new ground-disturbing activities that might occur during operation would follow procedures that have been developed to specify how these activities will be performed to minimize and avoid impacts to archaeological resources within the BBNPP site. These procedures are detailed in a cultural resource protection plan that PPL has developed, which outlines the necessary course of action, including consultation with the Pennsylvania SHPO, following discovery of new and significant historic resources during operations and maintenance operations (PPL Bell Bend 2012-TN1757). Based on this commitment, the Pennsylvania SHPO has agreed that there will be no adverse effects.

5.6.2 Offsite Historic and Cultural Resources Impacts

As described in Section 2.7.2.2, three aboveground properties located within the indirect (visual) APE have been determined NRHP-eligible. These are the Pennsylvania Canal, North Branch, Key# 141673; the Union Reformed and Lutheran Church, Key# 155049; and the A.K. Harter Farm, Woodcrest, Key# 155052 (Table 2-54 in Section 2.7.2.2). A visit to the properties on September 22, 2011 by GAI Consultants, Inc. (GAI) and the Pennsylvania Historical and Museum Commission (PHMC) concluded that there would be no adverse effect because the visibility of the proposed new cooling tower and the associated plumes from the historic resources will be minimal due to the new tower's proposed location west of, and behind, the existing SSES Unit 1 and 2 cooling towers (PHMC 2011-TN1756).

The Consumptive-Use Mitigation Plan (CUMP) is not expected to have an adverse effect on cultural or historic resources. The USACE evaluated cultural resources at Lake Cowanesque in the *Draft Environmental Assessment Cowanesque Lake Water Supply Releases To Cowanesque, Tioga, Chemung And Susquehanna Rivers, Pennsylvania And New York June 2013* (USACE 2013-TN3383). In Section 3.3.2 of that assessment, the USACE found the following:

> Cowanesque Lake
>
> Various archaeological investigations and predictive models for archaeological sensitivity were conducted at Cowanesque Lake by USACE during the 1980s in conjunction with the proposed reformulation that would raise the lake level. Raising the lake level had the potential to adversely affect historic properties such as archaeological sites. In 1988 a Memorandum of Agreement (MOA) was executed between the Baltimore District and the Pennsylvania State Historic Preservation Office. The MOA outlined procedures to be taken by the Baltimore District to mitigate adverse effects to historic properties (in this case, archaeological sites) that would result from the reformulation. Finalization of the MOA completed the Baltimore District's responsibilities under Section 106 of the National Historic Preservation Act for the reformulation project. Thus, there are no cultural or historic resources of concern at this time in the area of potential effect of Cowanesque Lake from altered water supply releases.
>
> Cowanesque, Tioga, Chemung, and Susquehanna Rivers
>
> Altered low-flow conditions in the receiving rivers would have no effect on cultural/historic resources. Thus, this topic is not given further consideration in this EA (USACE 2013-TN3383).

5.6.3 Conclusion

With operations and maintenance activities, there is always the possibility for inadvertent discovery of cultural resources. Any new ground-disturbing activities that might occur during operation would follow procedures that have been developed to specify how these activities will be performed to minimize and avoid impacts to archaeological resources within the project site. These procedures are detailed in a cultural resource protection plan that PPL has developed that outlines the necessary course of action, including consultation with the Pennsylvania SHPO, following discovery of new and significant historic resources during operations and maintenance operations (PPL Bell Bend 2012-TN1757).

For the purposes of NHPA Section 106 consultation, the USACE as the lead agency for Section 106 consultation concludes that a finding of no historic properties adversely affected during the operation of the proposed BBNPP unit. This finding is based on (1) the cultural resource analysis (PHMC 2011-TN1756; Wise 2012-TN1755), (2) PPL's commitment to follow its procedures if ground-disturbing activities lead to the discovery of historic or cultural resources during operations (PPL Bell Bend 2012-TN1757), and (3) consultation by the USACE with the Pennsylvania SHPO that concluded a finding of no adverse effect on the historic properties affected (USACE 2013-TN2243; PHMC 2013-TN2237).

For the purposes of the NEPA analysis, the review team does not expect any significant impacts to historic and cultural resources during operation of the proposed BBNPP unit based on (1) one eligible resource within the direct effects APE, for which a protection plan has been prepared and concurred with by the PHMC (Wise 2012-TN1755); (2) three eligible resources located within the architectural APE for which PHMC has determined there will be minimal visual effects and therefore no adverse effects (PHMC 2011-TN1756); (3) the review team's cultural resource analysis and consultation; (4) PPL's commitment to follow its cultural resource protection plan (PPL Bell Bend 2012-TN1757) should ground-disturbing discover historic or cultural resources, the review team concludes that that the potential impacts on historic and cultural resources from operations would be SMALL.

5.7 Meteorological and Air-Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality of the BBNPP site. The primary impacts of operation of the new BBNPP unit on local meteorology and air quality would be from releases to the environment of heat and moisture from the natural draft cooling towers, operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. The potential meteorological impacts from operation of the cooling system are discussed in Section 5.7.1. Section 5.7.2 covers potential air-quality impacts from nonradioactive effluent releases at the BBNPP site, and Section 5.7.3 covers the potential air-quality impacts of transmission lines during plant operation.

5.7.1 Cooling-Tower Impacts

Two natural draft cooling towers would be used to dissipate waste heat from the BBNPPCirculating Water System (CWS) during normal plant operation. The cooling towers would be approximately 475 ft tall and visually appear similar to the existing cooling towers for SSES Units 1 and 2 (PPL Bell Bend 2013-TN3377). Natural draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air, and this process can lead to condensation and the formation of a visible plume. Aesthetic impacts from the visible plume as well as land-use impacts from fogging, icing, and drift from dissolved salts found in the cooling water can result.

PPL analyzed impacts associated with the proposed BBNPP cooling towers using the Seasonal and Annual Cooling Tower Impacts (SACTI) computer code. To perform the analysis, select engineering data for the cooling towers (e.g., type, height, diameter, heat-dissipation rate) and 7 years of meteorological data (2001 through 2007) were used as input for the SACTI model. Results from the SACTI analysis are presented in Section 5.3.3 of PPL's ER (PPL Bell Bend 2013-TN3377). The NRC staff performed its own confirmatory runs and found the applicant's results to be acceptable.

The SACTI model results indicate that the median visible plume length would range between 0.29 mi during the summer and 0.64 mi during the winter (PPL Bell Bend 2013-TN3377). The predominant plume direction is toward the east-northeast in the winter and toward the south-southwest in the summer (PPL Bell Bend 2013-TN3377). The median plume is not expected to reach the site boundary, except during the winter season (PPL Bell Bend 2013-TN3377). Ground-level fogging or icing is likely to be infrequent because of the height of the cooling towers and the resulting plume. Deposition of salts from cooling-tower drift would occur in all directions from the towers. The maximum estimated salt-deposition rate is 0.018 lb/ac per month during the fall season at a downwind distance of 3,937 ft to the east-northeast of the towers (PPL Bell Bend 2013-TN3377); this value is well below the threshold described by NUREG-1555 as being generally damaging to plants (NRC 1999-TN289). Predicted liquid-equivalent precipitation from drift deposition would not be measurable. Meteorological conditions conducive to induced snowfall could occur at the BBNPP site, but accumulations would likely be very small because of the predicted immeasurabe precipitation amounts as well as likely meandering wind directions. In addition, any cooling-tower-induced snowfall accumulations would be small when compared to the normal annual average snowfall (40 to 47 in.) for the area (NCDC 2012-TN2091; NCDC 2012-TN2093).

Four smaller mechanical draft cooling towers are planned for the ESWS. During normal operations, only two of the ESWS towers operate at a time, and the ESWS heat load is about 3 percent of the CWS cooling-tower heat load (PPL Bell Bend 2013-TN3377). On this basis, the NRC staff concludes that the environmental impacts of the ESWS cooling towers would be negligible.

5.7.2 Air-Quality Impacts

5.7.2.1 Criteria Pollutants

The principal air emission sources associated with a new nuclear power plant at the Bell Bend site would be cooling towers, engine-driven emergency equipment (fire water pumps), and emergency power supply system diesel generators. Standby diesel generators, including four emergency diesel generators and two station blackout diesel generators, would be used for emergency power purposes. These systems would be used on an infrequent basis and discharged pollutants (e.g., particulate matter, sulfur oxide [SO_x], carbon monoxide [CO], volatile organic compounds, and nitrogen oxide [NO_x]) would be permitted in accordance with the Pennsylvania Department of Environmental Protection Bureau of Air Quality (PADEP BAQ) and Federal regulatory requirements (PPL Bell Bend 2013-TN3377). Low-sulfur fuels would be used for these systems, minimizing SO_x emissions (PPL Bell Bend 2013-TN3377). Cooling towers would be a source of PM. There also would be auxiliary boilers onsite, but they would not affect air quality because they would be electrically heated (PPL Bell Bend 2013-TN3377). Air permits for operational activities required by the PADEP BAQ are identified in Table 1.3-1 of the ER (PPL Bell Bend 2013-TN3377), including the Title V operating permit (PA Code 25-127-TN2130). Prior to operation, PPL would apply for these permits.

Table 5-8 lists the estimated cumulative annual emissions (tons/year) for the standby diesel generators that will be used to support operations at BBNPP (PPL Bell Bend 2013-TN3377). Estimated emissions conservatively assume 100 hours of operation for each generator.

However, these systems would be used on an infrequent basis (i.e., typically a few hours per month), and therefore, the resulting emissions for each pollutant are likely to be less than emissions that would result from operating for 100 hours annually.

Table 5-8. Estimated Yearly Emissions for Standby Diesel Generators Associated with BBNPP[(a)]

	Diesel Generators[(b)]		
Pollutant	Four EDGs[(c)] (T/yr)	Two SBOs[(d)] (T/yr)	Total Emissions (T/yr)
Particulates	0.67	0.55	1.22
Sulfur oxides	0.53	0.00	0.53
Carbon monoxide	-	5.51	5.51
Nitrogen oxides	7.15	10.80	17.95

(a) Adapted from Table 3.6-5 ER (PPL Bell Bend 2013-TN3377)
(b) Based on 100 operational hours for each generator per year
(c) EDGs = emergency diesel generators, 10,130-kW each
(d) SBOs = station blackout generators, 5,000-kW each

As noted in Section 2.9, the BBNPP site is in Luzerne County, which is a maintenance area with respect to the 8-hour 1997 ozone standard (72 FR 64948-TN2084). Pursuant to the Clean Air Act Section 176 (42 USC 7401 et seq.-TN1141) and 40 CFR Part 93, Subpart B (TN2495), Federal actions taking place within maintenance areas are subject to the EPA's General Conformity Rule. The General Conformity Rule ensures that actions taken by Federal agencies in nonattainment and maintenance areas do not interfere with a state's implementation plan for meeting the National Ambient Air Quality Standards. PPL has developed ozone precursor (NO_x and volatile organic compound) emission estimates for plant operations to support the conformity determination for the proposed BBNPP (Miller and Groot 2011-TN2124; PPL Bell Bend 2012-TN2838; PPL Bell Bend 2012-TN2839). Emissions from permitted stationary sources (i.e., sources listed in Table 5-8) are not subject to the conformity determination per 40 CFR 93.153(d)(1) (TN2495). The NRC will evaluate and document the need for a conformity determination for the activities within its authority that require an NRC license.

Additional operations-related traffic would also result in vehiclular air emissions. NO_x is of particular concern, because it contributes to ozone formation, and Luzerne County is in a maintenance area for the 8-hour ozone standard. As discussed in Section 5.4, commuter traffic on roads within the vicinity of the BBNPP site would increase at the beginning and the end of each operational shift and the beginning and end of each outage support shift. Maintaining good road conditions and enforcing appropriate speed limits would reduce the particulate matter generated by BBNPP workforce commuters.

As discussed in Section 2.9, there are no Class 1 Federal Area designations in Pennsylvania (40 CFR Part 81 Subpart D [TN255]); Class I areas are considered of special national or regional natural, scenic, recreational, or historic value and are afforded additional air-quality protection. Brigantine Wilderness Area, in New Jersey, is the closest Class 1 Federal Area (40 CFR 81.420 [TN255]) and is approximately 150 mi south-southeast of the BBNPP site. Considering the distance to the Class I areas and the minor nature of air emissions from the

BBNPP site, there is little likelihood that activities at the BBNPP could adversely affect air quality and air-quality-related values (e.g., visibility or acid deposition) in any Class I area.

5.7.2.2 Greenhouse Gases

The operation of a nuclear power plant involves the emission of some greenhouse gases (GHG), primarily carbon dioxide (CO_2). The review team has estimated that the total GHG footprint for actual plant operations of the BBNPP for 40 years is on the order of 317,000 metric tons of CO_2 equivalent (MT CO_2e) (an emission rate of about 7,930 MT CO_2e annually, averaged over the period of operation), compared to a total annual emission rate of 107,000,000 MT CO_2e in the State of Pennsylvania (EPA 2013-TN3784) and 2,090,000,000 MT CO_2e in the United States (EPA 2013-TN3785) mainland for calendar year 2012 from power plants. The value of 317,000 MT CO_2e includes the emissions from a nuclear power plant operating (181,000 MT CO_2e) and the associated emissions from the operations workforce (136,000 MT CO_2e). Periodic testing of the standby diesel generators and workforce transportation account for most of the CO_2 operational emissions. These estimates are based on GHG footprint estimates in Appendix I of this EIS.

The EPA promulgated the Prevention of Significant Deterioration requirements and the Title V GHG Tailoring Rule on June 3, 2010 (75 FR 31514-TN1404). Beginning January 2, 2011, operating permits issued to major sources of GHG under the Prevention of Significant Deterioration requirements or Title V Federal permit programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs if those sources would be subject to Prevention of Significant Deterioration requirements or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 T/yr of CO_2 equivalents (CO_2e). As noted in the ER, PPL intends to operate each of the six standby diesel generators no more than 100 hr/yr (PPL Bell Bend 2013-TN3377). Based on the review team's estimate of 7,930 MT CO_2e emitted annually from operation of BBNPP, the power plant could be exempted from GHG emission limits related to Prevention of Significant Deterioration requirements or a Title V permit.

Based on its assessment of the relatively small plant operations GHG footprint compared to the State of Pennsylvania and United States annual GHG emissions, the review team concludes that the atmospheric impacts of GHGs from plant operations would not be noticeable and additional mitigation would not be warranted.

5.7.3 Transmission-Line Impacts

Impacts of existing transmission lines on air quality are addressed in NUREG-1437, Revision 1 (NRC 2013-TN2654). Small amounts of ozone and even smaller amounts of NO_x are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1,200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

In its ER, PPL states that the BBNPP would be connected to two new, onsite 500-kV switchyards and the existing 500-kV switchyard that serves SSES; no additional offsite transmission lines would be needed to connect the BBNPP to the electrical grid (PPL Bell Bend 2013-TN3377). Because the size is within the range of the transmission lines evaluated in the GEIS, the NRC staff therefore concludes that air-quality impacts from transmission lines would not be noticeable and mitigation would not be warranted.

5.7.4 Summary of Meteorological and Air-Quality Impacts

The review team evaluated potential impacts on air quality associated with criteria pollutants and GHG emissions from operating the proposed BBNPP. The review team also evaluated potential impacts of cooling-system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of the proposed BBNPP on air quality from emissions of criteria pollutants, GHG emissions, cooling-system emissions, and transmission-line impacts would be SMALL and no further mitigation would be warranted.

5.8 Nonradiological Health Impacts

This section addresses nonradiological health impacts of operating the proposed BBNPP unit, including impacts to the public from operation of the cooling system, noise generated by unit operations, exposure to EMFs, and transporation of operations and outage workers. Nonradiological health impacts are also evaluated for workers at the proposed BBNPP unit. Section 5.9 discusses health impacts from radiological sources during operations.

5.8.1 Etiological (Disease-Causing) Agents

Operation of the proposed BBNPP unit would result in a thermal discharge to the Susquehanna River (PPL Bell Bend 2013-TN3377). Such discharges of warmer water have the potential to increase the growth of thermophilic microorganisms (i.e., microorganisms that favor temperatures in the range of 45 to 80°C), including etiological agents, both in the CWS and the Susquehanna River. Thermophilic microorganisms include enteric (intestinal) pathogens (e.g., *Salmonella* spp., *Pseudomonas aeruginosa*, and thermophilic fungi), bacteria (e.g., *Legionella* spp.), and free-living amoeba (e.g., *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms can lead to potentially serious human health concerns, particularly at high exposure levels.

As stated in Section 2.10.1.3, available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1999 to 2008 (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557; CDC 2011-TN558) indicate only 15 occurrences of waterborne outbreaks of disease from recreational water (i.e., not pools or spas) in the State of Pennsylvania. Outbreaks of Legionellosis, Salmonellosis, or Shigellosis were within the range of national trends. Although *Naegleria fowleri* is common in freshwater ponds, lakes, and reservoirs throughout the southern states, no cases have ever been reported in Pennsylvania (CDC 2002-TN2444; CDC 2004-TN2435; CDC 2006-TN2445; CDC 2008-TN557; CDC 2011-TN558; CDC 2014-TN4025). While it is possible that the thermal discharges from the SSES units and the proposed unit could have an impact on the abundance of etiological agents present in the receiving waters (the Susquehanna River), the combined thermal plumes only extend 15 m downstream of the BBNPP discharge resulting in an increase in ambient temperature of less than 2°C under low-flow conditions (PPL Bell Bend 2013-TN3377). Section 5.2.3.1 provides a complete description of thermal plume data for the proposed discharge. In addition, because no swimming beaches are located near the discharge and public access to the area is limited, the likelihood of recreational exposure is expected to be minimal. Based on the historically low risk of diseases from etiological agents in Pennsylvania, the limited extent of thermal impacts in the Susquehanna River, and the limited opportunities for public exposure, the review team concludes that the impacts on human health would be minimal, and mitigation would not be warranted.

5.8.2 Noise Impacts

In NUREG-1437 (NRC 2013-TN2654), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, transformers, turbines, and the operation of pumps along with intermittent contributions from loud speakers and auxiliary equipment (e.g., diesel generators). In addition, there would be noise from corona discharge associated with high-voltage transmission lines (PPL Bell Bend 2013-TN3377). These noise sources are discussed in this section.

The primary sources for background noise at the proposed BBNPP unit location are SSES Units 1 and 2 operations and general highway traffic noise (PPL Bell Bend 2013-TN3377). The primary source of noise expected once the proposed BBNPP unit is operational would likely be cooling-tower operation.

The proposed unit at the BBNPP site would use ESWS mechanical draft cooling towers (PPL Bell Bend 2013-TN3377). PPL states that noise levels 800 ft from the cooling towers are predicted to be approximately 54 dBA, which is lower than the EPA protective guideline of 55 dBA (PPL Bell Bend 2013-TN3377; EPA 1974-TN3941). The nearest residence to the site is 1,800 ft away; thus, noise levels at that location are expected to be far below the EPA protective guideline (PPL Bell Bend 2013-TN3377).

As stated in Section 2.10.2, a supplemental noise survey was conducted after a change in the proposed location of the cooling towers (i.e., the towers were moved 900 ft northward from their original proposed position) (Hessler Associates 2010-TN1227). The supplemental noise survey included two new receptor locations north of the proposed plant and replication of measurements from Location 2 from the earlier studies for comparison of results (see Figure 2-45) (Hessler Associates 2010-TN1227). Monitoring locations included one onsite station (i.e., Location 1) located on the BBNPP site near existing SSES Units 1 and 2, the three nearest residential receptors (i.e., Locations 2, 3, and 4), and two stations north and northwest of the BBNPP site and proposed cooling towers (i.e., Locations 6 and 7) (PPL Bell Bend 2013-TN3377). Results from the noise studies determined the 24-hour logarithmic average background L_{dn} noise levels at the nearest residential receptors (Locations 2, 3, and 4) were 48, 59, and 59 dBA, respectively (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Location 5, which was located close to the highway (US 11), had L_{dn} values of 57 dBA during leaf-on measurements and 65 dBA during leaf-off measurements (Hessler Associates 2008-TN485; Hessler Associates 2008-TN486). Locations 6 and 7, north of the proposed cooling towers, had L_{dn} values of 49 and 52 dBA, respectively (Hessler Associates 2010-TN1227).

The day-night noise levels anticipated from the plant's cooling system are less than 65 dBA at the site boundary, which is considered to be of small significance to the public. Thus, no mitigation is necessary.

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 1999-TN3548). Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems regulated by the Pennsylvania Public Utility Commission. In its ER, PPL states that two new 500-kV transmission lines would connect the BBNPP switchyard with an expanded SSES 500-kV switchyard and new Susquehanna 2 switchyard. Further, PPL indicates that all new structures would be designed and constructed to meet NESC criteria for construction and operation of transmission lines at the time of construction and to comply with NESC provisions that limit the induced current due to electrostatic effects to 5 mA (PPL Bell Bend 2013-TN3377).

With PPL's commitment to design new transmission lines to conform to NESC standards in effect at the time of construction, the staff concludes that the impact on the public from acute effects of EMFs would be negligible, and further mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce EMFs of nonionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF) EMF. Research on the potential for chronic effects of EMFs from energized transmission lines was reviewed and addressed by the NRC in NUREG-1437 (NRC 1996-TN288). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. An NIEHS report (NIEHS 1999-TN78) contains the following conclusion:

> The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

The review team reviewed available scientific literature about the chronic effects on human health from ELF-EMF published since the NIEHS report, and found that several other organizations reached the same conclusions (AGNIR 2006-TN3906; WHO 2007-TN1272). Additional work under the auspices of the World Health Organization updated the assessments of a number of scientific groups reflecting the potential for transmission-line EMF to cause adverse health impacts in humans. The report summarized the potential for ELF-EMF to cause disease such as cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, and neurological disease. The results of the review by the World Health Organization (WHO 2007-TN1272) found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive.

The review team reviewed available scientific literature about chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts.

5.8.5 Occupational Health

In general, occupational health risks for new units are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and plant modifications. In 2011, the annual incidence rate (the number of injuries and illnesses per 100 full-time workers) for the United States and the State of Pennsylvania for electrical power production workers was 0.4 (BLS 2012-TN3908). Historically, injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates (BLS 2012-TN3908).

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards (29 CFR Part 1910 [TN654]), practices, and procedures. Appropriate State and local regulations must also be considered when assessing the occupational hazards and health risks for new nuclear unit operation. The staff expects PPL would adhere to NRC, OSHA, and State safety standards, practices, and procedures during operation of the new unit.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. PPL reports that it maintains a safety and medical program (discussed in Section 4.8) to protect workers from industrial safety risks at existing SSES Units 1 and 2 would implement the program for the proposed BBNPP unit (PPL Bell Bend 2013-TN3377). Health impacts on workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be minimal. Additional mitigation would not be warranted.

5.8.6 Impacts of Transporting Operations Personnel to and from the Proposed Site

This EIS assesses the impact of transporting workers to and from the proposed BBNPP site from the perspective of three areas of impact: (1) the socioeconomic impacts, (2) the air-quality impacts of fugitive dust and particulate matter emitted by vehicular traffic, and (3) the potential health impacts related to additional traffic-related accidents. Human health impacts are addressed in this section; socioeconomic and air-quality impacts are addressed in Sections 5.4.1.3 and 5.7.1, respectively (PPL Bell Bend 2013-TN3377).

The general approach used to calculate the impacts of transportating construction workers is also used to calculate the impacts of transporting operations personnel to and from the BBNPP site (see Section 4.8.3). However, preliminary PPL estimates are the only data available to estimate these impacts. The impacts evaluated in this section for the proposed BBNPP unit are appropriate for characterizing the alternative sites discussed in Section 9.3. The assumptions made by the review team to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are listed below.

- A total of 363 workers (PPL Bell Bend 2013-TN3377) was estimated for operation of one U.S. Evolutionary Pressurized Reactor (U.S. EPR) at the proposed BBNPP site (KLD 2011-TN1228). An additional 1,400 temporary workers were estimated for refueling outages (KLD 2011-TN1228) scheduled to occur at 18-month intervals. The NRC staff assumed that outages for the BBNPP and SSES would not occur simultaneously. However, the staff assumed that two outages could occur during the same year.
- The average commuting distance for operations and outage workers was assumed by the NRC staff to be 13.2 mi one way, based on the gravity model in Section 4.4. This assumption is based on U.S. Department of Transportation (DOT) data used to estimate a typical commute of 16 mi (DOT 2003-TN297).
- To develop representative commuter traffic impacts, DOT data (PennDOT 2009-TN3940) were used to provide a Pennsylvania-specific fatality rate for all traffic from 2005 through 2009.

The estimated impacts of transporting operations and outage workers to and from the proposed BBNPP site and alternative sites are listed in Table 5-9. The total annual traffic fatalities during operations, including those of both operations and outage personnel, represent about a 0.2 percent increase above the average 32 traffic fatalities that occurred in Luzerne County, Pennsylvania in 2008 (DOT 2013-TN3930). These percentages represent negligible increases relative to the current traffic fatality risks in the areas surrounding the proposed BBNPP site.

Based on the information provided by PPL and the NRC staff's independent evaluation, this increase would be small relative to the current traffic fatalities in the affected counties. The NRC staff concludes that the nonradiological impacts of transporting operations and outage workers to and from the proposed BBNPP site and alternative sites would be SMALL, and mitigation would not be warranted.

Table 5-9. Nonradiological Impacts of Transporting Workers to and/or from the proposed BBNPP Site

	Accidents Per Year Per Unit	Injuries Per Year Per Unit	Fatalities Per Year Per Unit
Permanent workers	1.7E+01	9.8E-01	3.4E-02
Outage workers	7.6E+00	4.5E-01	1.6E-02

5.8.7 Summary of Nonradiological Health Impacts

The staff evaluated health impacts on the public and workers from operation of the BBNPP cooling system, noise generated by BBNPP operations, acute and chronic impacts of EMFs from transmission lines, transport operations, and the transport of outage workers to and from the BBNPP site. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts on the public and workers from etiological agents, noise generated by BBNPP operations, and acute impacts of EMF are expected to be minimal. On the basis of the information provided by PPL and the review team's independent review, the review team concludes that the potential nonradiological health impacts, with the exception of EMFs, resulting from the operation of BBNPP would be SMALL and that mitigation would not be warranted. Scientific evidence regarding the chronic impacts of EMFs on public health is inconclusive.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed BBNPP, including a discussion of the estimated radiation dose to a member of the public and to the non-human biota inhabiting the area around the BBNPP site. Estimated doses to workers at the proposed unit also are discussed. Radiological impacts were determined using the AREVA U.S. Evolutionary Power Reactor (U.S. EPR) design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation (see discussion in Section 3.4) considering operating parameters proposed by PPL (AREVA 2014-TN3722).

It is important to note that the NRC staff's safety review of the BBNPP COL application is still ongoing, so the final results from the review are not completed. Therefore, the doses presented in this section are subject to further review and RAIs from the NRC staff. The final results of the NRC staff's safety review will be documented in the Final Safety Evaluation Report. PPL will not be issued a COL for the proposed BBNPP site unless all safety requirements have been satisfactorily demonstrated to the NRC staff.

5.9.1 Exposure Pathways

The public and non-human biota would be exposed to increased ambient background radiation from a nuclear unit via the liquid effluent, gaseous effluent, and direct radiation pathways. PPL estimated the potential exposures to the public and non-human biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the proposed BBNPP site. PPL considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (PPL Bell Bend 2013-TN3377). For example, factors such as the locations of homes in the area and the consumption of meat, vegetables and fish from the area, were considered.

For the liquid effluent release pathway, PPL considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., fish and invertebrates), ingestion of drinking water, ingestion of irrigated crops, and direct radiation exposure from shoreline activities (see Figure 5-3). The analysis for population dose considered the following exposure pathways: ingestion of aquatic food, ingestion of drinking water, and direct radiation exposure from shoreline, swimming, and boating activities. Drinking water was evaluated in the population exposure because the Susquehanna River is a source of drinking water. However PPL found no significant use of Susquehanna River as a water source for irrigation, therefore irrigated crops were not considered as an exposure pathway for the population dose. Liquid effluents were assumed to be released into the Susquehanna River from the proposed discharge line.

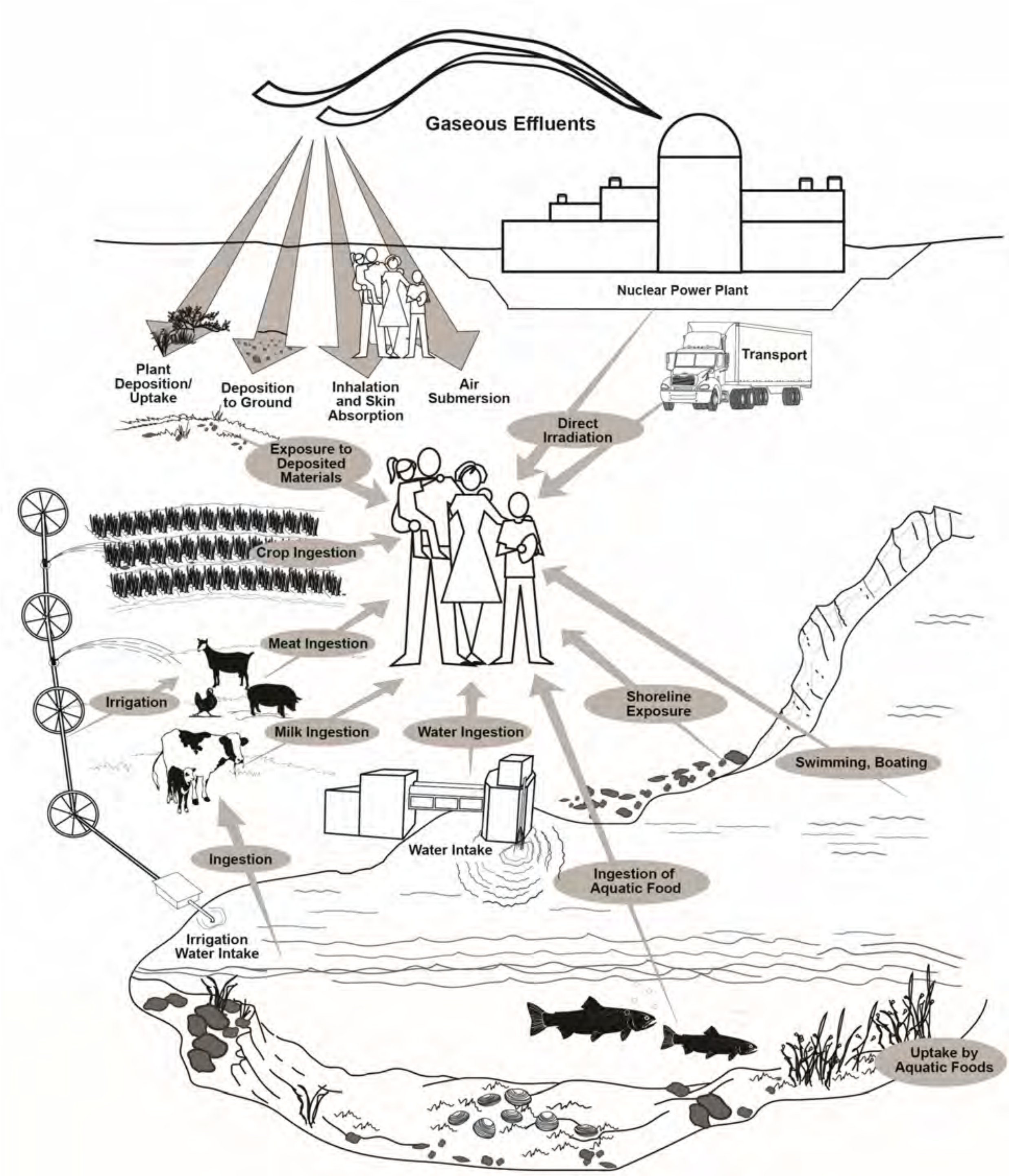

Figure 5-3. Exposure Pathways to Man (adapted from Soldat et al. 1974-TN710)

As discussed in the design control document (DCD), the proposed BBNPP design includes a number of features to prevent and mitigate leakage from system components such as pipes and tanks that may contain radioactive material (AREVA 2014-TN3722). In addition, PPL committed to using the guidance of Nuclear Energy Institute 08-08 (NEI 2009-TN1277), "Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," to the extent practicable in the development of operating programs and procedures (NRC 2012-TN1914). However, the potential still exists for leaks of radioactive material, such as tritium, into the ground. Based on the discussion above, the NRC staff expects that the impacts from such potential leakage for the proposed BBNPP would be minimal.

For the gaseous effluent release pathway, PPL considered the following exposure pathways in evaluating the dose to the MEI: (1) immersion in the radioactive plume, (2) direct radiation exposure from deposited radioactivity on the ground, (3) inhalation of airborne activity in the plume, (4) ingestion of garden fruit and vegetables, (5) milk ingestion, (6) fish and invertebrate ingestion, and (7) ingestion of meat. For population doses from the gaseous effluents, PPL used the same exposure pathways as those used for the individual dose assessment (Figure 5-4). All agricultural products grown within 50 50 mi of the proposed BBNPP were assumed to be consumed by the population within 50 mi of the proposed unit.

PPL states that the Fuel Building, the Nuclear Auxiliary Building, and the Radioactive Waste Processing Building would be the primary sources of direct radiation exposure to the public from the proposed BBNPP (PPL Bell Bend 2013-TN3377). However, PPL asserts that the radioactive sources and systems at the proposed BBNPP would be enclosed within shielded structures and would not contribute significantly to the external dose to the MEI or the population.

Exposure pathways considered by PPL in evaluating dose to the non-human biota are shown in Figure 5-4 and include the following:

- ingestion of aquatic food,
- ingestion of water,
- external exposure from water immersion or shoreline sediments,
- inhalation of airborne radionuclides,
- external exposure to immersion in gaseous effluent plume,
- surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977-TN90).

The NRC staff reviewed the exposure pathways for the public and non-human biota identified by PPL and found them to be appropriate based on a review of documentation, a tour of environs, and interviews with PPL staff and contractors during the environmental site audits in April 2009 and May 2012.

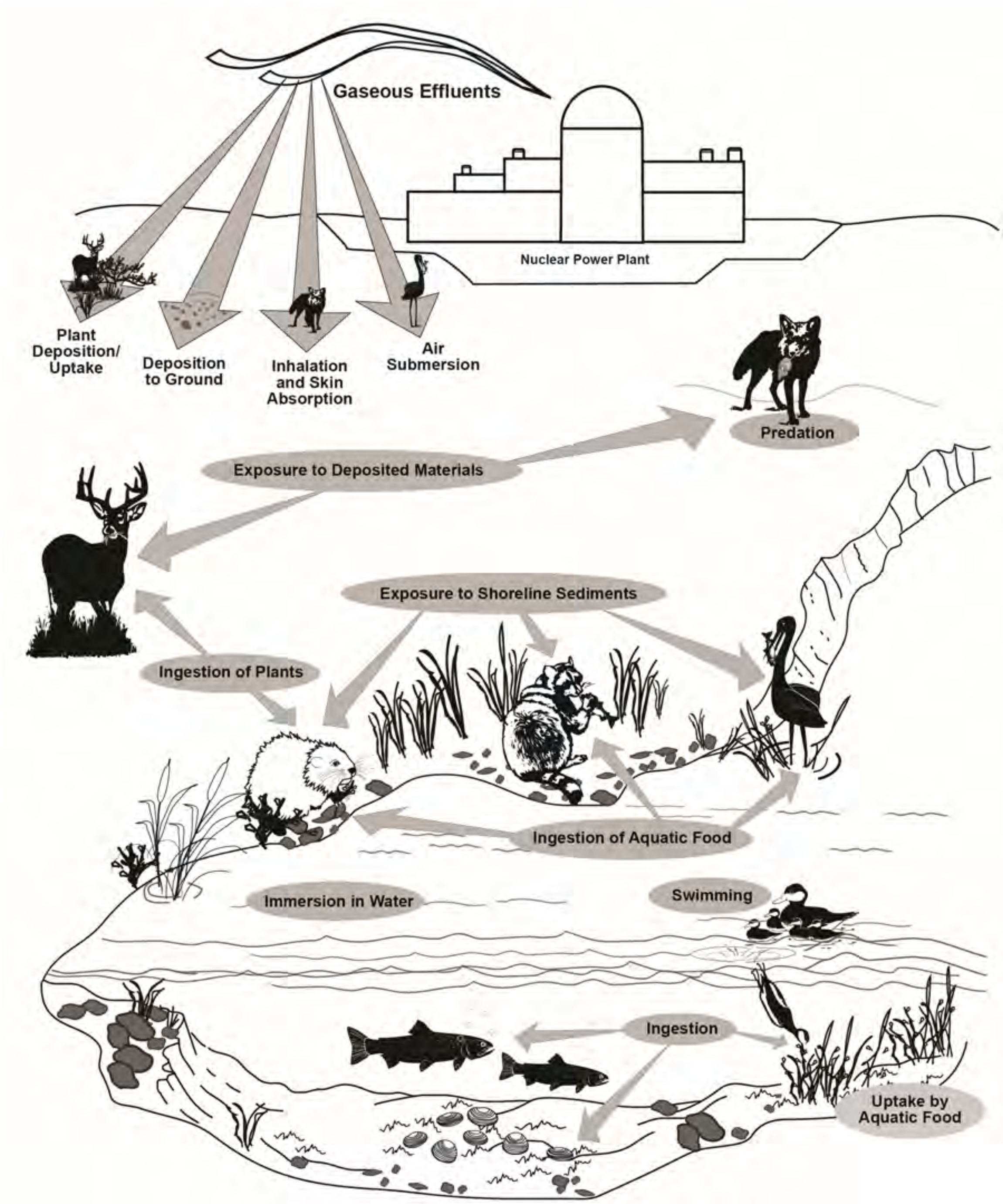

Figure 5-4. Exposure Pathways to Biota Other Than Man (adapted from Soldat et al. 1974-TN710)

5.9.2 Radiation Doses to Members of the Public

PPL calculated the dose to the MEI individual and the population living within a 50-mi radius of the site from both the liquid and gaseous effluent release pathways (PPL Bell Bend 2013-TN3377). As discussed in the previous section, direct radiation exposure to the MEI from sources of radiation at the proposed BBNPP would be negligible.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses to the MEI were calculated by PPL using the LADTAP II computer program (Strenge et al. 1986-TN82). The following activities were considered in the dose calculations: (1) consumption of drinking water contaminated by liquid effluents, (2) consumption of fish and invertebrates from water sources contaminated by liquid effluents, (3) direct radiation from swimming, boating, and shoreline activities on waterbodies contaminated by liquid effluents, and (4) ingestion of irrigated crops.

The liquid effluent releases used in the estimates of dose are from Table 3.5-9 of the ER (PPL Bell Bend 2013-TN3377). Other parameters used as inputs to the LADTAP II program include effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., shoreline usage, fish consumption and drinking water consumption), and are found in Tables 5.4-1, 5.4-2, 5.4-3, 5.4-4, and 5.4-5 of the ER [PPL Bell Bend 2013-TN3377]).

PPL calculated liquid pathway doses to the MEI and population as shown in ER Tables 5.4-16, 5.4-17, 5.4-18, and 5.4-19 (PPL Bell Bend 2013-TN3377). The MEI was a child with the majority of the dose from ingestion of irrigated crops and consumption of drinking water. The maximally exposed organ was the child thyroid, and as with the total body dose, the majority of the dose was received from ingestion of irrigated crops and consumption of drinking water. Liquid pathway doses to the MEI calculated by PPL are provided in Table 5-10.

The NRC staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the MEI for liquid effluent releases. The NRC staff also performed an independent evaluation of liquid pathway doses using input parameters from the ER and found similar results. All input parameters used in PPL's calculations were judged by the NRC staff to be appropriate. The results of the NRC staff's independent evaluation are found in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the MEI were calculated by PPL using the GASPAR II computer program (Strenge et al. 1987-TN83) at the nearest residence, garden, meat animal, and at the exclusion area boundary. The GASPAR II computer program also was used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating grass affected by gases and particulates deposited on the ground, (4) ingestion of milk from animals eating grass affected by gases and particulates deposited on the ground, and (5) ingestion of garden vegetables affected by gases and particulates deposited on the ground. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 3.5-11 of the ER (PPL Bell Bend 2013-TN3377). Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 5.4-7, 5.4-8 (consumption factors), 5.4-13 (receptor locations), 5.4-14 (dispersion factors), and 5.4-15 (population dose) of the ER (PPL Bell Bend 2013-TN3377). Gaseous pathway doses to the MEI calculated by PPL are provided in Table 5-11.

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff reviewed the input parameters and values used by PPL for appropriateness. The NRC staff concluded that the assumed input parameters and values used by PPL were appropriate. The NRC staff performed an independent evaluation of gaseous pathway doses and obtained similar results for the MEI (see Appendix G for details).

Table 5-10. Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from the Proposed BBNPP

Pathway	Age Group	Total Body (mrem/yr)	Maximum Organ (Thyroid) (mrem/yr)
Potable Water	Adult	3.59E-01	6.32E-01
	Teen	2.53E-01	4.89E-01
	Child	4.85E-01	1.07
	Infant	4.76E-01	1.39
Fish and Other Organisms	Adult	1.37E-01	1.29E-01
	Teen	8.10E-02	1.19E-01
	Child	3.71E-01	1.25E-01
	Infant	0.0	0.0
Irrigation	Adult	3.92E-02	8.74E-01
	Teen	3.17E-02	7.69E-01
	Child	3.85E-02	1.22
	Infant	0.0	0.0
Shoreline	All	3.0E-04	3.0E-04
Swimming	Adult	3.78E-06	3.78E-06
	Teen	2.11E-05	2.11E-05
	Child	4.41E-06	4.41E-06
	Infant	3.78E-06	3.78E-06
Boating	Adult	3.05E-05	3.05E-05
	Teen	3.05E-05	3.05E-05
	Child	1.70E-05	1.70E-05
	Infant	3.05E-05	3.05E-05
Total	Adult	5.35E-01	1.64
	Teen	3.66E-01	1.3
	Child	5.61E-01	2.41
	Infant	4.76E-01	1.39

Source: PPL Bell Bend 2013-TN3377

Table 5-11. Doses to the Maximally Exposed Individual from Gaseous Effluent Pathway for BBNPP[(a)]

Location	Age Group	Total Body Dose (mrem/yr)	Max Organ (mrem/yr)	Skin Dose (mrem/yr)
Plume (0.16 mi WSW)	All	1.26	1.26	3.93
Ground (0.79 mi NNE)	All	5.28E-04	5.28E-04	6.20E-04[(b)]
Inhalation				
Nearest residence (0.79 mi NNE)	Adult	5.83E-03	1.35E-02 (thyroid)	5.81E-03
	Teen	5.88E-03	1.57E-02 (thyroid)	5.86E-03
	Child	5.20E-03	1.70E-02 (thyroid)	5.18E-03
	Infant	2.99E-03	1.38E-02 (thyroid)	2.98E-03
Nearest Garden[(c)] (0.25 mi SSW)	Adult	1.64E-01	7.67E-01	1.63E-01
	Teen	2.66E-01	1.27	2.65E-01
	Child	6.32E-01	3.08	6.31E-01
Meat[(c)] (0.33 mi WSW)	Adult	7.30E-02	3.53E-01	7.29E-02
	Teen	6.11E-02	2.99E-01	6.11E-02
	Child	1.14E-01	5.61E-01	1.14E-01
Cow Milk[(c)] (0.74 mi SSW)	Adult	1.69E-02	7.86E-02	1.67E-02
	Teen	3.04E-02	1.45E-01	3.03E-02
	Child	7.35E-02	3.56E-01	7.32E-02
	Infant	1.52E-01	6.97E-01	1.52E-01

(a) Source: ER Table 5.4-20 (PPL Bell Bend 2013-TN3377). No infant doses were calculated for the vegetable or meat pathway because the doses that infants receive from this diet would be bounded by the dose calculated for the child.
(b) The applicant's calculation packages are correct, but wrong numbers were put into Table 5.4-20 for the skin dose to the nearest resident north northeast of the site and maximum organ dose to the nearest resident west northwest of the site.
(c) PPL only included cow milk in the MEI dose calculation; goat milk only accounts for 0.03% of the milk production with 50 mi of BBNPP (PPL Bell Bend 2013-TN3377).

5.9.3 Impacts to Members of the Public

This section describes the NRC staff's evaluation of the estimated impacts from radiological releases and direct radiation from the proposed BBNPP. The evaluation addresses dose from operations to the MEI located at the proposed BBNPP Owner Controlled Area boundary and the population dose (collective dose to the population within 50 mi) around the proposed BBNPP site.

5.9.3.1 Maximally Exposed Individual

PPL (PPL Bell Bend 2013-TN3377) states that total body and organ dose estimates to the MEI from liquid and gaseous effluents for the proposed BBNPP would be within the design objectives of 10 CFR Part 50, Appendix I (TN249). Doses to total body and maximum organ from liquid effluents were well within the respective 3-mrem/yr and 10-mrem/yr design objectives in Appendix I. Doses from gaseous effluents were well within the Appendix I design objectives of 10 mrad/yr air dose from gamma radiation, 20 mrad/yr air dose from beta radiation, 5 mrem/yr to the total body, and 15 mrem/yr to the skin. In addition, dose to the thyroid was within the 15 mrem/yr Appendix I design objective. A comparison of the PPL dose estimates for the proposed new unit to the Appendix I design objectives is provided in Table 5-12. The NRC staff completed an independent evaluation of compliance with Appendix I design objectives and found similar results, as shown in Appendix G

Table 5-12. Comparison of MEI Annual Dose Estimates from Liquid and Gaseous Effluents to 10 CFR Part 50, Appendix I Design Objectives

Radionuclide Releases/Dose	PPL Assessment	Appendix I Design Objectives
Gaseous effluents (noble gases only)		
Beta air dose (mrad/yr)	4.5	20
Gamma air dose (mrad/yr)	2.0	10
Total body dose (mrem/yr)	1.3	5
Skin dose (mrem/yr)	3.9	15
Gaseous effluents (radioiodines and particulates)		
Organ dose (mrem/yr) (child, bone)	4.0	15
Liquid effluents		
Total body dose (mrem/yr) (child)	0.561	3
Maximum organ dose (mrem/yr) (child, thyroid)	2.41	10

Source: PPL Bell Bend 2013-TN3377 (Tables 5.4-18 and 5.4-21)

PPL (PPL Bell Bend 2013-TN3377) compared the combined dose estimates from direct radiation and gaseous and liquid effluents from the existing SSES Units 1 and 2 and the proposed BBNPP against the 40 CFR Part 190 (TN739) standards. Table 5-13 shows that the total doses to the MEI from liquid and gaseous effluents as well as direct radiation at the BBNPP site are below the 40 CFR Part 190 (TN739) standards. The NRC staff completed an independent evaluation of compliance with 40 CFR Part 190 (TN739) standards and found similar results, as shown in Appendix G.

Table 5-13. Comparison of Doses to 40 CFR Part 190 (TN739)[(a)]

	SSES Units 1 & 2	BBNPP		
	Combined liquid, direct and gaseous (mrem/yr)	Combined liquid, direct and gaseous (mrem/yr)	Site Total (mrem/yr)	40 CFR Part 190 Dose Standards (mrem/yr)
Whole body dose	7.76	4.52	12.3	25
Thyroid	7.78	6.80	14.6	75
Maximum organ (child bone)	12.9	7.32	20.3	NA

Source: PPL Bell Bend 2013-TN3377 (Table 5.4-24)

5.9.3.2 Population Dose

PPL estimated the collective total body dose within a 50-mi radius of the proposed BBNPP site to be 8.54 person-rem/yr based on ER Tables 5.4-15 and 5.4-19 (PPL Bell Bend 2013-TN3377). The estimated collective dose to the same population from natural background radiation is estimated to be 821,154 person-rem/yr. The dose from natural background radiation was calculated by multiplying the 50-mi population estimate for the year 2080 of approximately 2,640,368 people by the average annual background dose rate of 311 mrem/yr (NCRP 2009-TN420).

Collective dose was estimated for the gaseous and liquid effluent pathways using the GASPAR II and LAPTAP II computer codes, respectively. The NRC staff performed an independent evaluation of population doses and obtained similar results (see Appendix G).

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006-TN296), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, non-fatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv) equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007-TN422).

Both National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (i.e., less than 1/0.00057, which is less than 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 2009-TN420; ICRP 2007-TN422). The estimated collective whole body dose value of 8.54 person-rem/yr to the population living within 50 mi of the proposed BBNPP site is much less than the 1,754 person-rem value that ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 2009-TN420; ICRP 2007-TN422).

In addition, at the request of the U.S. Congress, the National Cancer Institute conducted a study and published the report *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990-TN1257). This report included an evaluation of health statistics around all nuclear power plants as well as several other nuclear fuel cycle facilities in operation in the United States in 1981 and found "… no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al. 1990-TN1257).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The NRC staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from the proposed BBNPP unit. Based on the information provided by PPL and NRC's own independent evaluation, the NRC staff concludes there would be no observable health impacts on the public from normal operation of the new unit; the health impacts would be SMALL; and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

At SSES Units 1 and 2, the annual collective dose for 2012 was 176 person-rem (NRC 2014-TN4030). The estimated occupational doses for advanced reactor designs, including the AREVA U.S. EPR at the proposed BBNPP site, is 50 person-rem, less than the annual occupational doses for current light-water reactors (AREVA 2014-TN3722). This collective dose was based on an 18-month fuel cycle and would be bounding for a 24-month fuel cycle.

The licensee of a new plant would need to maintain individual doses to workers within 0.05 Sv (5 rem) annually as specified in 10 CFR 20.1201 (TN283) and incorporate provisions to maintain doses as low as reasonably achievable (ALARA).

The NRC staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 (TN283) limits and collective occupational doses being typical of doses found in current operating light-water reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Impacts on Non-Human Biota

PPL estimated doses to non-human biota species in the BBNPP site environs, in many cases using surrogate species. Surrogate species, as used in the ER, are well-defined and provide an acceptable method for evaluating doses to the non-human biota. Surrogate species analyses were performed for aquatic species (e.g., fish, invertebrates, algae) and for terrestrial species (e.g., muskrats, raccoons, herons, and ducks). For aquatic species on the BBNPP site, freshwater mollusks and crayfish are represented by invertebrates as a surrogate species, Smallmouth Bass, Channel Catfish, and Walleye are represented by fish as a surrogate species; and aquatic plants are represented by algae as a surrogate species. For terrestrial species, white-tailed deer, raccoon, mice, meadow vole, black bear, woodrat, deer mouse, and bats are represented by raccoon and muskrat as surrogate species. The Indiana bat, eastern small-footed myotis, northern myotis, peregrine falcon, bald eagle, osprey, wild turkey, and scarlet tanager are represented by the heron as a surrogate species. Exposure pathways considered in evaluating dose to the non-human biota were discussed in Section 5.9.1 and shown in Figure 5-4. The NRC staff reviewed and performed an independent evaluation (see Appendix G) using the surrogate species, but used more conservative gaseous effluent exposure assumptions and found higher results than those reported by PPL but still a small fraction of the national and international guidelines,, as shown in Appendix G.

5.9.5.1 Liquid Effluent Pathway

PPL used the LADTAP II computer code to calculate doses to the non-human biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in the Susquehanna River, PPL used the Cornell Mixing Zone Expert System (CORMIX) for determining dilution factors near the discharge and the Generalized Environmental Modeling System for Surface Waters for estimating dilution farther downstream (PPL Bell Bend 2013-TN3377). Liquid pathway doses were higher for non-human biota than for humans because of considerations related to the bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and shoreline compared to humans. The liquid effluent releases used in estimating non-human biota dose are found in Table 3.5-7 of the ER (PPL Bell Bend 2013-TN3377). Table 5-14 presents PPL's estimates of the doses to non-human biota from the liquid and gaseous pathways from the proposed BBNPP unit.

Table 5-14. Non-Human Biota Doses From the Proposed BBNPP Unit

	Liquid Pathway (mrad/yr)		Gaseous Pathway (mrem/yr)		Total Body Biota Dose All Pathways (mrad/yr)
	Internal Dose	External Dose	Internal Dose	External Dose	
Fish	1.09E-01	7.85E-02	NA	NA	1.88E-01
Invertebrate	5.00E-01	1.55E-01	NA	NA	6.55E-01
Algae	2.13E-00	1.77E-03	NA	NA	2.13E-00
Muskrat	5.59E-01	5.18E-02	7.29E-03	1.26E-00	3.75E-00
Raccoon	1.25E-01	3.07E-02	7.29E-03	1.26E-00	3.33E-00
Heron	1.61E-00	4.11E-02	7.29E-03	1.26E-00	4.93E-00
Duck	5.15E-01	7.72E-02	7.29E-03	1.26E-00	3.79E-00

NA = not applicable

Source: PPL Bell Bend 2013-TN3377 (Table 5.4-29)

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrats, raccoons, herons, and ducks). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. The dose calculated to the MEI from gaseous effluent releases in Table 5.4-20 of the ER was modified by PPL to be applicable to terrestrial surrogate species by doubling the ground deposition factor to account for terrestrial species being closer to the ground than humans (PPL Bell Bend 2013-TN3377). It is also assumed that inhalation doses for humans are equivalent to the inhalation doses to the terrestrial surrogate species. The gaseous effluent releases used in estimating dose are found in Table 3.5-9 of the ER (PPL Bell Bend 2013-TN3377). Estimates of total body dose to the surrogate species from the gaseous pathway are shown in Table 5.4-29 of the ER (PPL Bell Bend 2013-TN3377). As discussed in Appendix G, the NRC staff examined the potential for higher doses closer to the plant, and found that the reported dose is still significantly below the dose guidelines for non-human biota.

5.9.5.3 Summary of Impact of Estimated Non-Human Biota Doses

Radiological doses to non-human biota are expressed in units of absorbed dose (rad) because dose equivalent (rem) only applies to human radiological doses. The ICRP (ICRP 1977-TN713; NCRP 1991-TN729; ICRP 2007-TN422) states that if humans are adequately protected, other living things are also likely to be sufficiently protected. The International Atomic Energy Agency (IAEA) (IAEA 1992-TN712) and the National Council on Radiation Protection and Measurement (NCRP) (NCRP 1991-TN729) reported that a chronic dose rate of no greater than 10 mGy/d (1,000 mrad/d) to the MEI in a population of aquatic organisms would ensure protection of the population. The IAEA (1992-TN712) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations.

Table 5-15 compares estimated total body dose rates to surrogate non-human biota species that would be produced by releases from BBNPP to the IAEA/NCRP non-human biota dose guidelines (IAEA 1992-TN712; NCRP 1991-TN729). As presented in Appendix G, the NRC staff dose estimates from the gaseous pathway are higher because the NRC staff used a bounding calculation that assumed an organism could be inside the site boundary at 0.16 mi for an entire year. Daily dose rates for no surrogate species exceeded the IAEA and NCRP guidelines. The non-human biota dose estimates for the proposed unit is also conservative because they do not consider decay of liquid effluents during transit. Actual doses to the non-human biota are likely to be much less.

Table 5-15. Comparison of Non-Human Biota Doses from the Proposed BBNPP to Relevant Guidelines for Non-Human Biota Protection[(a)]

Biota	Total Body Dose – PPL (mrad/d)[(b)]	IAEA/NCRP Guidelines for Protection of Non-Human Biota Populations (mrad/d)[(b)]
Fish	5.2E-04	1,000
Invertebrate	1.8E-03	1,000
Algae	5.8E-03	1,000
Muskrat	1.0E-02	100
Raccoon	9.0E-03	100
Heron	1.3E-02	100
Duck	1.0E-02	100

(a) Total dose from liquid and gaseous effluents and direction radiation from ER Table 5.4-29.
(b) For comparison purposes, PPL's reported dose in mrad/yr (PPL Bell Bend 2013-TN3377 ER Table 5.4-29) was converted to mrad/d by dividing by 365 d/yr. Published guidelines reported mGy/d (1 mGy equals 100 mrad).

Doses to non-human biota calculated by both PPL and the NRC staff are far below the 100-mrad/d (0.1- rad/d) IAEA guidelines for non-human terrestrial biota and the 1-rad/d IAEA guideline for aquatic biota (IAEA 1992-TN712).

Based on the information provided by PPL and the NRC's independent evaluation, the NRC staff concludes that the radiological impact on non-human biota from the routine operation of the proposed BBNPP unit would be SMALL, and additional mitigation would not be warranted.

5.9.6 Radiological Monitoring

A REMP has been in place for the adjacent SSES Units 1 and 2 since operations began for Unit 1 in 1982, with preoperational sample collection activities beginning in 1972 (PPL Susquehanna 2010-TN748). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway from the Susquehanna River, and the ingestion exposure pathway in a 7-mi radius of the two stations, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi. An annual land-use census is conducted for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including the receptor locations. The preoperational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the units began operation. The preoperational program included collection and analysis of samples of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. After operation of SSES Unit 1 began in 1982 and

Unit 2 in 1984, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. Radiological releases are summarized in the two annual reports: The SSES *Annual Radiological Environmental Operating Report* (PPL Susquehanna 2011-TN716) and the SSES *Annual Radioactive Effluent Release Report* (PPL Susquehanna 2011-TN714). The limits for all radiological releases are specified in the SSES *Offsite Dose Calculation Manual* (PPL Susquehanna 2011-TN715). BBNPP will prepare separate reports once Unit 1 is operational.

BBNPP will have its own REMP, but the existing REMP for SSES will be used to provide the baseline information for BBNPP. No additional monitoring program has yet been established for the BBNPP. PPL indicated the REMP for the proposed BBNPP would incorporate the procedures and sampling locations used by the existing SSES site to the greatest extent practical. The NRC's *Liquid Radioactive Release Lessons Learned Task Force Final Report* (NRC 2006-TN1000) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, the NEI developed the Industry Ground Water Protection Initiative (NEI 2007-TN1913; NEI 2009-TN1277). PPL states in Section 6.2.8 of its ER that a groundwater-protection program for the BBNPP will be developed before fuel loading (PPL Bell Bend 2013-TN3377). The groundwater-protection program will allow for timely detection and response to unexpected radiological releases to groundwater. The groundwater-protection program will contain (1) an analysis of site hydrology and geology, (2) a site risk assessment of all systems, structures or components, (3) sampling and analysis protocols, (4) remediation protocols, (5) a recordkeeping program, and (6) a communication plan for NRC, State, and local officials. Based on reviews of the documentation for the existing REMP, the *Offsite Dose Calculation Manual*, and recent monitoring reports from the SSES site, the NRC staff determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the construction and operation of the proposed new unit at the BBNPP site.

5.10 Nonradioactive Waste Impacts

This section describes the potential impacts on the environment from the generation, handling, and disposal of nonradioactive waste and mixed waste during the operation of the proposed BBNPP unit. As discussed in Section 3.4.4, the types of nonradioactive waste that would be generated, handled, and disposed of during operational activities include solid wastes, liquid effluents, and air emissions. Solid wastes include municipal waste, sewage-treatment sludge, and industrial wastes. Liquid wastes include NPDES-permitted discharges such as effluents containing chemicals or biocides, wastewater effluents, site stormwater runoff, and other liquid wastes (e.g., used oils, paints, and solvents) that require offsite disposal. Air emissions would primarily be generated by vehicles and diesel generators. In addition, small quantities of hazardous waste and mixed waste, which is waste that has both hazardous and radioactive characteristics, may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts on Land

Management practices regarding solid-waste handling at the BBNPP site would be similar to those used at SSES Units 1 and 2 (PPL Bell Bend 2013-TN3377). Operational solid wastes (e.g., office waste, cardboard, wood, and metal) would be recycled or reused to the extent possible (PPL Bell Bend 2013-TN3377). PPL would dispose of municipal solid waste (e.g., resins and debris from trash racks and screens collected from the water-intake structure) in offsite, licensed commercial disposal facilities (PPL Bell Bend 2013-TN3377). PPL would follow all applicable Federal, State, and local requirements and standards for handling, transporting, and disposing of solid waste (PPL Bell Bend 2013-TN3377).

Based on the plans to manage solid and liquid wastes in a manner similar to the existing SSES Units 1 and 2 in accordance with all applicable Federal, State, and local requirements and standards and the effective practices for reusing, recycling, and minimizing waste, the review team expects that impacts on land from nonradioactive wastes generated during the operation of BBNPP would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts on Water

Water withdrawn from the Susquehanna River for cooling and other operational purposes for the proposed BBNPP unit would be discharged to the Susquehanna River. These discharges would contain both chemicals and biocides and be controlled by the NPDES wastewater permit. Other potential nonradioactive liquid effluents from operation of the proposed BBNPP unit are stormwater runoff and sanitary wastewater discharges (PPL Bell Bend 2013-TN3377). Stormwater at the BBNPP site would be routed through swales and infiltration beds located throughout the property to minimize runoff (PPL Bell Bend 2013-TN3377). A sanitary sewer system would be constructed to serve the proposed BBNPP, and the sewage would ultimately be conveyed to the Berwick Area Sewer Authority (PPL Bell Bend 2013-TN3377). The NPDES permit would limit the volume and constituents concentrations. Sections 5.2.3.1 and 5.2.3.2 of this EIS discuss impacts on surface-water and groundwater quality from operation of the proposed BBNPP unit.

Based on the regulated practices for managing liquid discharges containing chemicals or biocides, wastewater, and the plans for managing stormwater, the review team expects that impacts on water from nonradioactive effluents during the operation of the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

5.10.3 Impacts on Air

Operation of the proposed BBNPP unit would result in gaseous emissions from the intermittent operation of emergency diesel generators. Air-quality impacts are discussed in Section 5.7.2. In addition, increased vehicular traffic associated with personnel necessary to operate the proposed BBNPP unit would increase vehicle emissions in the area. Increases in air emissions from the operation of the proposed BBNPP unit would require compliance with the Federal and State air-quality control laws and regulations (PPL Bell Bend 2013-TN3377).

Based on the regulated practices for managing air emissions from stationary sources, the review team expects that impacts on air from nonradioactive emissions during the operation of the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

5.10.4 Mixed-Waste Impacts

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by the Atomic Energy Act of 1964 (42 USC 2011 et seq.-TN663); the Solid Waste Disposal Act of 1965 (42 USC 82 et seq.-TN1032), as amended by the Resource, Conservation, and Recovery Act (RCRA) in 1976 (42 USC 6901 et seq.-TN1281); and the Hazardous and Solid Waste Amendments (42 USC 6921 et seq.-TN1033) (which amended RCRA in 1984). Operation of the proposed BBNPP unit is expected to produce waste in quantities bounded by those produced at SSES Units 1 and 2 (PPL Bell Bend 2012-TN1173; PPL Bell Bend 2013-TN3377). For example, from 2003 to 2007, only four shipments were made to offsite treatment facilities (PPL Bell Bend 2013-TN3377). In addition, PPL would implement a source-reduction plan that was developed for SSES Units 1 and 2 to reduce the amount of mixed waste produced onsite. PPL would also institute a waste-minimization plan that would reduce the accumulation of mixed waste at the BBNPP site (PPL Bell Bend 2013-TN3377). PPL stated that the treatment, storage, and disposal of mixed wastes generated by the proposed BBNPP unit would be managed as the existing SSES Units 1 and 2 mixed wastes are managed (PPL Bell Bend 2013-TN3377).

Based on the mixed-waste source-reduction plan currently in place for SSES Units 1 and 2; the plans to manage mixed wastes in a similar manner at the proposed BBNPP unit in accordance with all applicable Federal, State, and local requirements and standards; and the proposed waste-minimization plan, the review team expects that impacts from the generation of mixed waste at the proposed BBNPP unit would be minimal, and no further mitigation would be warranted.

5.10.5 Summary of Nonradioactive Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of the proposed BBNPP unit would be handled according to State and Federal regulations. State permits and regulations for handling and disposal of solid waste would be obtained and implemented. Discharges to the Susquehanna River of liquid effluents used for operations, including wastewater and stormwater, would be controlled and limited via an NPDES permit. Air emissions from operations would comply with Federal, State, and local air-quality standards and regulations. Mixed-waste generation, storage, and disposal impacts during operation of proposed would comply with requirements and standards.

Based on the information provided by PPL; the effective practices for recycling, minimizing, managing, and waste disposal planned to be used at the BBNPP site; the expectation that regulatory approvals would be obtained to regulate the additional waste generated from proposed BBNPP unit; and the independent evaluations as discussed in the referenced sections of this EIS, the review team concludes that the potential impacts from nonradioactive waste resulting from the operation of the proposed unit at the BBNPP site would be SMALL, and no further mitigation would be warranted.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at the proposed BBNPP unit. PPL based its COL application on the proposed installation of the AREVA U.S. EPR standard design, which is being evaluated for design certification by the NRC staff. The PPL application references Revision 0 of the U.S. EPR DCD FSAR in Section 7.3 of the BBNPP COL ER and Revision 4 of the U.S. EPR DCD FSAR in Section 1 of the BBNPP COL FSAR. The NRC staff is currently reviewing Revision 7 of the U.S. EPR DCD. Where the NRC staff identified differences during this COL environmental review between versions of the U.S. EPR DCD and the BBNPP COL, RAIs were issued to PPL to account for the DCD and COL differences. The NRC staff's confirmatory analysis also factored in technical information from the latest available U.S. EPR DCD when appropriate.

The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially greater than permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2 (TN283).

Many safety features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from nuclear plants. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50, Appendix I (TN249). Additional measures are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100 (TN282), which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG-0654/FEMA-REP-1 (NRC 1980-TN512). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

On March 11, 2011, and for an extended period of time thereafter, several nuclear power plants in Japan experienced the loss of important equipment necessary to maintain reactor cooling after the combined effects of severe natural phenomena (i.e., an earthquake followed by the tsunami it caused). In response to these events, the Commission established a task force to review the current regulatory framework in place in the United States and to make recommendations for improvements. The task force reported the results of its review (NRC 2011-TN684) and presented its recommendations to the Commission on July 12 and July 19, 2011, respectively. As part of the short-term review, the task force concluded that, while improvements are expected to be made as a result of the lessons learned, the continued operation of nuclear power plants and licensing activities for new plants do not pose an imminent risk to public health and safety. A number of areas were recommended to the Commission for long-term consideration. Collectively, these recommendations are intended to clarify and strengthen the regulatory framework for protection against severe natural phenomena, mitigation of the effects of such events, coping with emergencies, and improving the effectiveness of NRC programs. PPL references a U.S. EPR design that already incorporates many features intended to reduce severe accident core damage frequencies (CDFs) and the risks associated with severe accidents. Due to the already robust design with respect to prevention and mitigation of severe accidents, the U.S. EPR design has many of the design features and attributes necessary to address the task force recommendations (NRC 2011-TN684).

On March 12, 2012, the NRC issued three orders and a request for information (RFI) to holders of U.S. commercial nuclear reactor licenses and construction permits to enhance safety at U.S. reactors based on specific lessons learned from the event at Japan's Fukushima Dai-ichi nuclear power plant as identified in the task force report.

The first order (EA-12-049) and the third order (EA-12-051) apply to every U.S. commercial nuclear power plant, including recently licensed new reactors (77 FR 16091-TN2476; 77 FR 16082-TN1424). The first order requires a three-phase approach for mitigating beyond-design-basis external events. Licensees are required to use installed equipment and resources to maintain or restore core, containment, and spent fuel pool cooling during the initial phase. During the transition phase, licensees are required to provide sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. During the final phase, licensees are required to obtain sufficient offsite resources to sustain those functions indefinitely (77 FR 16091-TN2476). The second order (EA-12-050) requires reliable hardened vent systems at boiling water reactor facilities with "Mark I" and "Mark II" containment structures (77 FR 16098-TN2477). The third order requires reliable spent fuel pool level instrumentation (77 FR 16082-TN1424). The RFI addressed five topics: (1) seismic reevaluations, (2) flooding reevaluations, (3) seismic hazard walkdowns, (4) flooding hazard walkdowns, and (5) a request for licensees to assess their current communications system and equipment under conditions of onsite and offsite damage and prolonged station blackout as well as perform a staffing study to determine the number and qualifications of staff required to fill all necessary positions in response to a multiunit event (NRC 2012-TN2198; NRC 2012-TN2903). The RFI requested reactor licensees reevaluate seismic and flooding hazards using present-day methods to determine if the plant's design basis needs to be changed.

The NRC staff issued RAIs to PPL requesting information to address the appropriate orders and RFI topics (NRC 2012-TN3803; NRC 2012-TN3799; NRC 2013-TN3801). All of the containment designs differ from those identified in the second order; therefore, the actions addressed in that order are not applicable to the BBNPP site. The NRC's evaluation of PPL's responses will be addressed in the NRC's Final Safety Evaluation Report, and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR.

The severe accident evaluation presented later in this section draws from the analyses developed in the staff's safety review, which includes consideration of severe accidents initiated by external events and those that involve fission product releases. The staff evaluation discusses the environmental impacts of severe accidents in terms of risk, which considers the likelihood of both a severe accident and its consequences. For several reasons discussed below, the staff has determined that the Fukushima accident and the NRC's implementation of the task force recommendations do not change the staff's conclusions on the environmental impacts of design basis accidents or severe accidents.

Each new reactor application evaluates the natural phenomena pertinent to the site for the proposed reactor design by applying present-day regulatory guidance and methodologies. This includes the determination of the characteristics of the flood and seismic hazards. With respect to flooding, the NRC issued several letters to PPL requesting further flood hazard analysis information be included in the FSAR consistent with existing guidance and methodologies. Through a process of reviewing PPL's response to staff requests and the associated technical information, staff determined that PPL performed an acceptable evaluation of the flood hazard analyses for the BBNPP site. PPL's responses to the staff's requests and results of the NRC staff's review were appropriately incorporated into the FSAR (PPL Bell Bend 2013-TN3447).

With respect to the consideration of severe accidents initiated by seismic events, PPL submitted its response (PPL Bell Bend 2012-TN3794) to the NRC staff's seismic hazard RAI (stemming from the first RFI topic) (NRC 2012-TN3803). In this RAI, the applicant was requested to evaluate the impacts of the newly released Central and Eastern United States Seismic Source Characterization model, as documented in NUREG–2115 (NRC 2012-TN3810), on the BBNPP site-specific seismic hazard calculation. This model considers the latest seismic source information for the Central and Eastern United States. Based on this model, the updated seismic hazard analysis results were submitted by PPL to the NRC for review. The NRC staff will evaluate its impact to determine if the required safety criteria have been accounted for with an acceptable safety margin. The BBNPP COL cannot be issued to PPL until this portion of the safety review has been satisfactorily completed.

In addition to the above seismic and flooding considerations, the safety features of the reactor design being considered for the BBNPP site further support the conclusion that the Fukushima accident does not warrant a change in the consideration of environmental risks of severe accidents in this EIS analysis. In particular, the potential design-related vulnerabilities raised by the event at Fukushima (e.g., the impact of the beyond-design-basis extended loss of alternating current to the essential and nonessential switchgear buses) would not materially affect the current bounding analysis of severe accidents for the BBNPP site. This is because the U.S. EPR reactor design must demonstrate prior to certification the necessary capabilities as well as mitigating strategies to withstand such a loss of power and to prevent and mitigate severe accidents as required by the orders issued to construction permit holders and licensees under 10 CFR Parts 50 and 52 (77 FR 16091-TN2476; 77 FR 16082-TN1424). The mitigation strategies for beyond-design-basis external events proposed for any new reactor application would be evaluated by the NRC staff against the functional requirements of NRC Order EA-12-049 as described in Interim Staff Guidance JLD-ISG-2012-01 (NRC 2012-TN3163). The NRC staff issued RAIs to AREVA, the U.S. EPR design certification applicant, requesting that each of the provisions for mitigating strategies as described in Attachment 2 to NRC Order EA-12-049 and that Attachment 3 to NRC Order EA-12-051 be addressed, including any proposals for changes to the current U.S. EPR DC application (NRC 2012-TN3796; NRC 2012-TN3797). In particular, AREVA was asked to describe the extent to which it intends to follow JLD-ISG-2012-01, or any alternative approaches to satisfy these provisions (NRC 2012-TN3796). AREVA submitted the U.S. EPR mitigation strategies for an extended loss of alternating current power event (AREVA 2013-TN3723) and for monitoring spent fuel pool water level (AREVA 2012-TN3795) to the NRC staff those strategies are currently under review. In accordance with the Interim Staff Guidance, AREVA has proposed and analyzed the overall implementation of active safety systems and additional coping capabilities (e.g., direct current load shedding used to extend coping time), along with the industry's "FLEX" and station blackout mitigating strategies. The NRC staff will evaluate AREVA's response to determine if the requirements of the NRC Order EA-12-049 and EA-12-051 have been met. The U.S. EPR design certification cannot be issued to AREVA and the BBNPP COL cannot be issued to PPL until this portion of the DC application safety review has been satisfactorily completed.

In sum, none of the information the staff has identified about the Fukushima accident or the steps taken by the NRC to date to implement the task force recommendations suggests that the seismic and flooding hazards or the available mitigation capability assumed in the BBNPP COL EIS analysis of severe accidents would be affected. For these reasons, the NRC's analysis of the environmental impacts of design basis and severe accidents presented herein remains valid.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, a significant amount of material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and therefore lower tendencies to escape from the fuel than the noble gases and isotopes of iodines.

Radiation dose to individuals is determined by their proximity to radioactive material; the amount of radioactive material inhaled, ingested, or absorbed through the skin; the duration of their exposure; and the extent to which they are shielded from the radiation. Predominant pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water; (2) inhalation of radioactive material; and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council, the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses (National Research Council 2006-

TN296). This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rad over a short period of time (hours). Doses of about 250 to 500 rad received over a relatively short period of time (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

PPL evaluated the potential consequences of postulated accidents to demonstrate that a U.S. EPR design could be constructed and operated at the BBNPP site without undue risk to the health and safety of the public (PPL Bell Bend 2013-TN3377; PPL Bell Bend 2013-TN3447). These evaluations used site-specific meteorological data and a set of surrogate DBAs that are representative for the reactor design being considered at the BBNPP site. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability of occurrence with high consequences.

The DBA review focuses on the U.S. EPR design at the BBNPP site. The bases for analyses of postulated accidents for this design are well established because they have been considered as part of the NRC's reactor design-certification process. Potential consequences of DBAs are evaluated by following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the U.S. EPR design and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000-TN517).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as relative concentration (χ/Q; units of s/m^3). Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983-TN279).

Table 5-16 lists χ/Q values the NRC staff considers pertinent to the environmental review of DBAs for the BBNPP site (PPL Bell Bend 2013-TN3377). Smaller χ/Q values are associated with greater dilution capability. The first column in Table 5-16 identifies the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short term (i.e., 2 hours). For the low population zone, they are calculated for the course of the accident (i.e., 30 days composed of five time periods). The second column in Table 5-16 lists the corresponding χ/Q values for the BBNPP site (PPL Bell Bend 2013-TN3377); these values were calculated using seven (7) years of onsite meteorological data (2001–2007) and the exclusion area boundary and low population zone distances. No credit was taken for the enhanced dispersion caused by building wake effects, and the release point was conservatively assumed to be at ground level.

Table 5-16. Atmospheric Dispersion Factors for BBNPP Site DBA Calculations

Time Period and Boundary/Zone	χ/Q (s/m^3)[(a)]
0 to 2 hr or worst 2-hr period, exclusion area boundary	1.44×10^{-4}
0 to 2 hr, low population zone	2.35×10^{-5}
2 to 8 hr, low population zone	1.93×10^{-5}
8 to 24 hr, low population zone	1.62×10^{-5}
1 to 4 d, low population zone	1.24×10^{-5}
4 to 30 d, low population zone	8.48×10^{-6}

(a) Values are rounded to three significant figures.

Source: PPL Bell Bend 2013-TN3377

The NRC staff completed an independent evaluation of the χ/Q values and found similar results. Based on these reviews, the staff concludes that the atmospheric dispersion factors for the BBNPP site are reasonable for use in evaluating potential environmental consequences of postulated DBAs for the U.S. EPR design at the BBNPP site.

Table 5-17 lists the set of DBAs considered by PPL and presents estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988-TN68) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993-TN8) were used to calculate the deep dose equivalent.

The NRC staff reviewed PPL's selection of DBAs by comparing the accidents listed in the COL application with the DBAs considered in the U.S. EPR DCD (AREVA 2014-TN3722), which is being reviewed during the design-certification process. The DBAs in the ER and the FSAR are the same as those considered in the design certification; therefore, the NRC staff considers that the set of DBAs in PPL's ER is consistent with the U.S. EPR DCD. As noted before, the U.S. EPR design certification is still under review and cannot be issued to AREVA and the BBNPP COL cannot be issued to PPL until this portion of the DC application safety review has been satisfactorily completed.

The review criteria used in the NRC's safety review of DBA doses are included in Table 5-17 to illustrate the magnitude of the calculated environmental consequences (TEDE doses) because no environmental criteria exist related to potential consequences of DBAs. In all cases, the calculated TEDE values are considerably smaller than those used as safety review criteria.

The NRC staff reviewed the DBA analysis in PPL's ER, which is based on analyses performed for design certification of the U.S. EPR design with adjustment for site-specific characteristics at the BBNPP site. The NRC staff also performed an independent DBA analysis with consideration of the latest version of the U.S. EPR DCD. The results of the PPL and NRC staff analyses indicate that the environmental risks associated with DBAs from a U.S. EPR design built at the BBNPP site would be below the acceptance criteria. On this basis, the staff concludes that the environmental consequences of DBAs at the BBNPP site would be SMALL for a U.S. EPR design.

Table 5-17. Design Basis Accident Doses for a U.S. EPR at the BBNPP Site

		TEDE in rem[a]		
Accident	Standard Review Plan Section[b]	EAB[c]	LPZ[d]	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		0.035	0.0085	25[e]
Accident-initiated iodine spike		0.039	0.029	2.5[f]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		0.16	0.048	25[e]
Accident-initiated iodine spike		0.1	0.14	2.5[f]
Loss-of-coolant accident	15.6.5	1.8	2	25[e]
Rod ejection (26% clad failure)	15.4.8			
Primary containment leakage		0.53	0.17	6.25[f]
Secondary-side leakage		0.54	0.28	6.25[f]
Reactor Coolant Pump Rotor Seizure (locked rotor) (8% clad failure)	15.3.3	0.23	0.085	2.5[f]
Failure of Small Lines Carrying Primary Coolant Outside Containment	15.6.2	0.086	0.014	2.59[f]
Fuel handling (72-hr decay)	15.7.4	0.51	0.085	6.25[f]

(a) To convert rem to Sv, divide by 100.
(b) NUREG-0800 (NRC 2007-TN613).
(c) EAB = exclusion area boundary.
(d) LPZ = low population zone.
(e) 10 CFR 52.79 (a)(1) (TN249) and 10 CFR 100.21 (TN282) criteria.
(f) Standard review plan criterion (NRC 2007-TN613).

Source: PPL Bell Bend 2013-TN3377

5.11.2 Environmental Impacts of Postulated Severe Accidents

In its ER (PPL Bell Bend 2013-TN3377), PPL considers the potential consequences of severe accidents for a U.S. EPR at the BBNPP site. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air; (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

PPL's consequence assessment (PPL Bell Bend 2014-TN3724) is based on the probabilistic risk assessment (PRA) for the U.S. EPR design described in Chapter 19 of the U.S. EPR DCD, FSAR, Revision 6 (AREVA 2014-TN3574). The NRC staff has received U.S. EPR DCD, Revision 7 (AREVA 2014-TN3722), which is currently being evaluated for design certification by the NRC staff, and the NRC staff has determined that the PRA is similar between the two DCD revisions. The NRC staff is evaluating the current PRA model and its results using "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications" (DC/COL-ISG-3; NRC 2008-TN671), and the NRC staff will not certify the design until all safety criteria including the PRA have been satisfied. In addition, PPL is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects that the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA.

PPL's evaluation of the potential environmental consequences for the atmospheric and surface-water pathways incorporates the results of the MELCOR Accident Consequences Code System (MACCS) computer code Version 1.12 (Chanin et al. 1990-TN2056; Chanin and Young 1998-TN66; Jow et al. 1990-TN526) run using U.S. EPR source-term information and the BBNPP site-specific meteorological, population, and land-use data. The NRC staff reviewed PPL's input and output files, performed confirmatory calculations, and determined that PPL's results are reasonable.

Environmental consequences of some potential surface-water pathways (e.g., swimming and fishing) are not evaluated by MACCS. PPL relied on generic analyses in the GEIS—Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437 (NRC 1996-TN288)—for these pathways. Similarly, the MACCS code does not address the potential environmental consequences of the groundwater pathway. PPL relied on generic analyses in the NUREG-1437 and earlier analyses to evaluate the potential consequences of releases to groundwater.

The MACCS computer codes were developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990-TN525). The MACCS code evaluates the consequences of atmospheric releases of material after a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and re-suspended from the ground, and ingestion of contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS analysis: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS estimates both early fatalities and latent cancer fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990-TN526). Latent cancer fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farm land decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than 0.5 rem/yr if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.5 rem/yr. Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for a U.S. EPR is estimated to be 3.2×10^{-7} per reactor year (Ryr^{-1}) (PPL Bell Bend 2014-TN3724), and the cumulative population dose associated with a severe accident without loss of containment at the BBNPP site is calculated to be 6.6×10^{4} person-rem. The population dose risk for this class of accidents is the product of 3.2 x 10^{-7} Ryr^{-1} and 6.6 x 10^{4} person-rem, or 2.1 x 10^{-2} person-rem/Ryr. The following sections discuss the estimated risks associated with each pathway. The risks presented in the tables that follow are risks per year of reactor operation.

5.11.2.1 Air Pathway

The MACCS code directly estimates consequences associated with releases to the air pathway. The results of the PPL's MACCS runs (PPL Bell Bend 2013-TN3377) are presented in Table 5-18. The release category frequencies (which are based on the CDFs from the Level 1 PRA) given in the following tables are for internally initiated accident sequences, internal fires, and internal floods, while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. The release frequencies used by PPL are those from the FSAR submitted as part of the application for certification of the U.S. EPR design (AREVA 2014-TN3722).

Release frequencies for other at-power events (external events), including tornadoes and hurricanes, are discussed in the U.S. EPR DCD FSAR (AREVA 2014-TN3722) and the FSAR for proposed BBNPP (PPL Bell Bend 2013-TN3447). Section 19.1.5 of the FSAR discusses external initiating events. Section 19.1.5.1 discusses a PRA-based seismic margins analysis in which PRA methods are used to identify potential vulnerabilities in the design so corrective measures can be taken to reduce risk. Similarly, BBNPP FSAR Section 19.1.5.4 addresses risks associated with high winds, tornado missiles, external flooding, external fires, and other external events. AREVA considers risks associated with these events to be insignificant because the U.S. EPR provides a robust design against these potential events. However, the NRC staff has not completed its safety review of the U.S. EPR and has not accepted this statement by AREVA.

Table 5-18 shows that the probability-weighted consequences (i.e., risks) of severe accidents for a U.S. EPR located on the BBNPP site are small for all risk categories considered. For perspective, Table 5-19 and Table 5-20 compare the health risks from severe accidents for a U.S. EPR at the BBNPP site with the risks for current-generation reactors at various sites and with the health risks for a U.S. EPR at the Calvert Cliffs site.

In Table 5-19, the health risks estimated for a U.S. EPR at the BBNPP site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990-TN525). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-20. The health risks shown for a U.S. EPR design at the BBNPP site are significantly lower than the risks associated with current-generation reactors presented in NUREG–1150 (NRC 1990-TN525).

Table 5-18. Mean Environmental Risks from a U.S. EPR Severe Accident at the BBNPP Site

			Environmental Risk[a]					
				Fatalities (Ryr^{-1})				
Release Category Description[b] (Accident Class)		Release Category Frequency (Ryr^{-1})	Population Dose (person-rem Ryr^{-1})[c]	Early[d]	Latent[e]	Cost[f] ($ Ryr^{-1})	Farm Land Decontamination[g] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-rem Ryr^{-1})[c]
RC101	No containment failure	3.2×10^{-7}	2.1×10^{-2}	0	9.8×10^{-6}	8	1.5×10^{-4}	1.9×10^{-5}
RC203	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI,[h] melt not flooded ex-vessel, without containment sprays	1.6×10^{-9}	2.9×10^{-2}	2.7×10^{-13}	2.2×10^{-5}	10	1.3×10^{-4}	5.6×10^{-5}
RC204	Containment fails before vessel breach due to isolation failure, melt released from vessel, without MCCI,[h] melt flooded ex-vessel with containment sprays	9.7×10^{-10}	4.5×10^{-3}	0	2.7×10^{-6}	4	6.7×10^{-5}	1.1×10^{-5}
RC205	Containment fails before vessel breach due to isolation failure, melt released from vessel, without MCCI,[h] melt flooded ex-vessel without containment sprays	2.5×10^{-9}	1.3×10^{-2}	2.9×10^{-13}	7.9×10^{-6}	11	2.0×10^{-4}	5.2×10^{-5}
RC206	Small containment failure due to failure to isolate 2–in. or smaller lines	4.6×10^{-8}	7.2×10^{-2}	2.0×10^{-9}	4.0×10^{-5}	70	1.7×10^{-3}	3.4×10^{-4}
RC304	Containment fails before vessel breach due to containment rupture, without MCCI,[h] melt flooded ex-vessel, without containment sprays	5.3×10^{-10}	1.0×10^{-2}	5.1×10^{-13}	7.6×10^{-6}	3	4.5×10^{-5}	2.7×10^{-5}
RC404	Containment failures after breach and up to melt transfer to spreading area, without MCCI,[h] with debris flooding, without containment spray	1.1×10^{-9}	3.0×10^{-3}	0	1.6×10^{-6}	4	8.3×10^{-5}	3.6×10^{-5}
RC504	Long-term containment failure during and after debris quench, due to rupture, without MCCI,[h] with debris flooding, without containment sprays	2.9×10^{-8}	1.2×10^{-2}	0	5.6×10^{-6}	3	5.1×10^{-4}	7.1×10^{-6}
RC602	Long-term containment failure due to basemat failure, without debris flooding, without containment sprays	2.7×10^{-8}	1.7×10^{-2}	0	7.6×10^{-6}	6	4.4×10^{-4}	1.5×10^{-5}
RC701i	Steam generator tube rupture (one failed tube) with fission product scrubbing	2.6×10^{-8}	2.7×10^{-2}	0	1.3×10^{-5}	19	8.9×10^{-4}	4.7×10^{-5}

Table 5-18. (contd)

	Release Category Description[b] (Accident Class)	Core Damage Frequency (Ryr^{-1})	Environmental Risk[a]					
			Population Dose (person-rem Ryr^{-1})[c]	Fatalities (Ryr^{-1})		Cost[f] ($ Ryr^{-1})	Farm Land Decontamination[g] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-rem Ryr^{-1})[c]
				Early[d]	Latent[e]			
RC702i	Steam generator tube rupture (one failed tube) without fission product scrubbing	6.1 x 10^{-9}	3.7 x 10^{-2}	5.3 x 10^{-9}	2.7 x 10^{-5}	31	5.4 x 10^{-4}	4.7 x 10^{-4}
RC702k	Steam generator tube rupture (20 failed tubes) without fission product scrubbing	8.1 x 10^{-9}	1.6 x 10^{-1}	5.6 x 10^{-8}	1.6 x 10^{-4}	57	6.3 x 10^{-4}	4.5 x 10^{-3}
RC801	Interfacing system loss-of-coolant accident with fission product scrubbing	7.8 x 10^{-9}	1.5 x 10^{-2}	8.4 x 10^{-14}	7.9 x 10^{-6}	17	4.5 x 10^{-4}	6.8 x 10^{-5}
RC802	Interfacing system loss-of-coolant accident without fission product scrubbing	8.1 x 10^{-9}	1.3 x 10^{-1}	1.4 x 10^{-8}	1.4 x 10^{-4}	54	6.4 x 10^{-4}	3.2 x 10^{-3}
Total		4.9 x 10^{-7}	5.6 x 10^{-1}	7.8 x 10^{-8}	4.6 x 10^{-4}	304	6.7 x 10^{-3}	8.9 x 10^{-3}

(a) All values in the table are based on data supplied by PPL (AREVA 2014-TN3722).
(b) Release categories contributing less than 3% of the risk in all categories are not shown. Totals include all release categories. In all cases, the risk shown exceeds 97% of the total risk.
(c) To convert person-rem to person-Sv, divide by 100.
(d) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(e) Latent cancer fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(f) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(g) Farm land decontamination risk relates to the area where the average whole body dose rate for the 4-year period following the accident exceeds 0.5 rem/yr but can be reduced to less than 0.5 rem/yr by decontamination.
(h) MCCI –molten core to concrete interaction

Table 5-19. Comparison of Environmental Risks for a U.S. EPR at the BBNPP Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG−1150 (NRC 1990-TN525) and for the U.S. EPR at the Calvert Cliffs Site (NRC 2011-TN1980)

	Core Damage Frequency (Ryr^{-1})	50-mi Population Dose Risk (person-rem Ryr-1)[a]	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent	Early	Latent Cancer
Grand Gulf[b]	4.0×10^{-6}	5×10^{1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[b]	4.5×10^{-6}	7×10^{2}	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[b]	5.7×10^{-5}	1×10^{3}	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[b]	4.0×10^{-5}	5×10^{2}	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[b]	3.4×10^{-4}	5×10^{3}	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
U.S. EPR[c] at the Calvert Cliffs site	5.3×10^{-7}	4×10^{-1}	5×10^{-8}	2×10^{-4}	1×10^{-11}	2×10^{-10}
U.S. EPR[d] at the BBNPP site	4.9×10^{-7}	6×10^{-1}	8×10^{-8}	5×10^{-4}	3×10^{-11}	4×10^{-10}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990-TN525).
(c) Calculated with MACCS code using Calvert Cliffs site-specific input for internal and external at-power initiating events (NRC 2011-TN1980).
(d) Calculated with MACCS code using BBNPP site-specific input for internal at-power initiating events (PPL Bell Bend 2014-TN3724).

Table 5-20. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for a U.S. EPR at the BBNPP Site with Risks Initiated by Internal Events for Current Nuclear Power Plants Undergoing Operating License Renewal Review, Including SSES Units 1 or 2

	Core Damage Frequency (yr^{-1})	50-mi Population Dose Risk (person-rem Ryr-1)[(a)]
Current Reactor Maximum[(b)]	2.4×10^{-4}	6.9×10^{1}
Current Reactor Mean[(b)]	3.1×10^{-5}	1.5×10^{1}
Current Reactor Median[(b)]	2.5×10^{-5}	1.3×10^{1}
SSES Unit 1 or 2[(c)]	2.0×10^{-6}	1.9
Current Reactor Minimum[(b)]	1.9×10^{-6}	3.4×10^{-1}
U.S. EPR[(d)] at BBNPP	4.9×10^{-7}	5.6×10^{-1}

(a) To convert rem to Sv, divide by 100.
(b) Based on MACCS calculations for over 70 current plants at over 40 sites.
(c) NUREG-1437 Supplement 35 (NRC 2009-TN1725).
(d) Calculated with MACCS code using BBNPP site-specific input (PPL Bell Bend 2014-TN3724).

The last two columns of Table 5-19 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the NRC staff compares these estimates to the NRC safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028-TN594). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Safety Goal Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power station of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
- The risk to the population in the area near a nuclear power station of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into the following two numerical objectives:

- The individual risk of a prompt fatality from all "...other accidents to which members of the U.S. population are generally exposed...." is about 4.1×10^{-4}/yr, including a 1.6×10^{-4}/yr risk associated with transportation accidents (NSC 2011-TN3008). One-tenth of 1 percent of these figures implies that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7} per Ryr.
- "The sum of cancer fatality risks that result from all other causes" for an individual is taken to be the U.S. cancer fatality rate, which is about 1 in 500 or 2×10^{-3}/yr (Reed 2007-TN523). One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{-6}/Ryr.

MACCS calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG-1150 (NRC 1990-TN525), these risks were well below the Commission's safety goals. Risks calculated for the U.S. EPR design at the BBNPP site are lower than the risks associated with the current-generation reactors considered in NUREG-1150 and are also well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for a U.S. EPR at the BBNPP site with statistics summarizing the results of contemporary severe accident analyses performed for over 70 reactors at over 40 sites. The results of these analyses are included in the final site-specific Supplements 1 through 52 to the GEIS for license renewal (NRC 2013-TN4007), and in the ERs included with license renewal applications for the plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990-TN525), and the analyses for most of the reactors used MACCS, which was released in 1997. Table 5-20 shows that the CDF estimated for the U.S. EPR is significantly lower than those of current-generation reactors. Similarly, the population doses estimated for a U.S. EPR at the BBNPP site are well below the mean and median values for current-generation reactors undergoing license renewal.

Finally, the population dose risk from a severe accident for a U.S. EPR at the BBNPP site (5.6×10^{-1} person-rem/Ryr) may be compared with the dose risk for normal operation of a single U.S. EPR design at the BBNPP site (8.5 person-rem/Ryr) (see Section 5.9.3.2); comparatively, the population dose risk for a severe accident is small.

5.11.2.2 Surface-Water Pathways

Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water and include the ingestion of water and aquatic foods as well as water submersion and activities occurring near the water. Of these surface-water pathways, the ingestion of contaminated water was evaluated by the MACCS codes. The risks associated with this pathway were calculated for the BBNPP site and are included in the last column of Table 5-18. The water-ingestion dose risk of 8.9×10^{-3} person-rem/Ryr is small compared to the total population dose risk of 5.6×10^{-1} person-rem/Ryr (PPL Bell Bend 2013-TN3377).

Although surface-water pathways beyond water ingestion are not considered in the MACCS code, they have been examined in the GEIS for license renewal in the context of renewal of licenses for current-generation reactors (NRC 2013-TN2654). The existing two units at the Susquehanna site (SSES Units 1 and 2), which are adjacent to the BBNPP site, are classified as being on a small river; therefore, the BBNPP can also be classified as a small-river site. Table 5.17 in the GEIS indicates that, at small-river sites, water ingestion is the dominant liquid pathway rather than seafood ingestion and shoreline exposure (NRC 1996-TN288). In addition, if a severe accident occurred at a U.S. EPR located at the BBNPP site, it is likely that Federal, State, and local officials would restrict access to the Susquehanna River below the site and in contaminated areas above the site, thereby greatly reducing these surface-water pathway exposures. On this basis, the NRC staff believes that the overall surface-water pathway risk remains small when compared to the total air pathway population dose risk.

5.11.2.3 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the concrete floor (basemat) below the reactor vessel. Ultimately, core debris reaches the groundwater where soluble radionuclides are transported with the groundwater. In the GEIS for license renewal (NRC 2013-TN2654), the staff assumed that the probability of a severe accident with basemat penetration was 1×10^{-4} Ryr^{-1} and concluded that the groundwater-pathway risks were small. The PPL ER summarizes the discussion in the 1996 version of NUREG-1437 (NRC 1996-TN288) and reaches a similar conclusion that the risk is lower than the existing SSES facility's risk (PPL Bell Bend 2013-TN3377).

The NRC staff has re-evaluated its assumption of a 1×10^{-4} Ryr^{-1} probability of a basemat melt-through. The staff believes that the 1×10^{-4} probability is too large for new power plants. Design elements have been included in the U.S. EPR design to minimize the potential for reactor core debris to reach groundwater. These elements include a spreading room beneath the reactor vessel, external reactor vessel cooling, and external-vessel core debris cooling. Furthermore, the probability of core melt with basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-20 gives a total CDF estimate of 4.9×10^{-7} for the U.S. EPR design. NUREG-1150 (NRC 1990-TN525) indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. If the CDF for the U.S. EPR severe accidents in which containment remains intact is subtracted from the total U.S. EPR CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the CDF is on the order of 2×10^{-7} Ryr^{-1}. On this basis, the staff believes that a basemat melt-through probability of 2×10^{-7} Ryr^{-1} is reasonable and still conservative. The groundwater pathway is also more tortuous and affords more time for implementing protective actions than the air pathway, and therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on the overall plant risk.

5.11.2.4 Externally Initiated Events

In addressing the potential environmental impacts of external hazards on the BBNPP site, PPL referenced the risk assessments provided in the BBNPP COL FSAR and U.S. EPR FSAR to demonstrate the adequacy of its plant design against the external events. In BBNPP COL FSAR Section 19.1.5, "Safety Insights from the External Events PRA for Operations at Power," PPL evaluated the risks posed by external events listed in Appendix A of the ANSI/ANS 58.21-2003 Standard, "External Events in PRA Methodology," in conformance with the guidance provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants – LWR Edition". Based on the identified hazards applicable to the BBNPP site, PPL either qualitatively or quantitatively assessed the risks posed by these hazards as discussed in the BBNPP COL FSAR (PPL Bell Bend 2013-TN3447).

As presented in the BBNPP COL FSAR, the safety-related structures are designed to meet or withstand the externally initiated natural phenomena events expected to occur at the proposed site (PPL Bell Bend 2013-TN3447). Such natural phenomena events include seismic, high winds, tornado wind loads and missiles, external fires, external flooding, lighting strikes, and more. PPL also evaluated various man-made hazards that would be nearby or had the potential for affecting the BBNPP site. These hazards include nearby highways, waterway, aircraft crash, pipelines, railroad lines, and nearby facilities.

The NRC staff's acceptance of BBNPP externally initiated hazards assessments will be contingent on the completion of the U.S. EPR FSAR review and the BBNPP COL FSAR review. The NRC staff will evaluate the impacts from externally initiated events and hazards to determine if the required safety criteria have been accounted for with any necessary acceptable safety margin. The NRC staff reviews of the U.S. EPR FSAR and BBNPP COL FSAR are ongoing and its conclusion regarding acceptability of the risks posed by external hazards at BBNPP site will be documented in the NRC staff's Final Safety Evaluation Report for each review. The BBNPP COL cannot be issued to PPL until this portion of each safety review has been satisfactorily completed.

5.11.2.5 Summary of Severe Accident Impacts

The NRC staff reviewed the risk analysis in the ER and conducted confirmatory analysis of the probability-weighted consequences of severe accidents for the proposed U.S. EPR design using the MACCS code. The results of both the PPL analysis and the NRC evaluation indicate that the environmental risks associated with severe accidents if a U.S. EPR were to be located at the BBNPP site would be small compared with risks associated with operation of the current-generation reactors at the Susquehanna site and other sites. These risks are well below the NRC safety criteria. On these bases, the NRC staff concludes that the probability-weighted consequences of severe accidents at the BBNPP site would be SMALL for a U.S. EPR design.

It is worth noting that a significant effort has been made to re-quantify realistic severe accident source terms under the State-of-the-Art Reactor Consequence Analysis project (NRC 2012-TN3089; NRC 2012-TN3092). The results of the State-of-the-Art Reactor Consequence Analysis project indicate that source-term timing progresses more slowly, and release much smaller amounts of radioactive material than calculated in earlier studies. As a result, public health consequences from severe nuclear power plant accidents modeled in the State-of-the-Art Reactor Consequence Analysis project are smaller than previously calculated.

5.11.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are severe accident mitigation design alternatives (SAMDAs) or procedural modifications or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000-TN614). PPL based its COL application on a U.S. EPR design, which incorporates many engineered features intended to reduce severe accident CDFs and the risks associated with severe accidents. The expected effectiveness of the U.S. EPR design features in reducing risk is evident in Table 5-19 and Table 5-20, which compare CDFs and severe accident risks for the U.S. EPR with the CDFs and risks for current-generation reactors, including Units 1 and 2 at the Susquehanna site co-located with the BBNPP site. CDFs and risks have generally been reduced considerably when compared to existing current-generation reactors.

Consistent with the direction from the Commission to consider the SAMDAs at the time of certification, the AREVA U.S. EPR vendor (AREVA 2014-TN3722) has considered 167 design alternatives for a U.S. EPR at a generic site, and 69 candidate alternatives are already included in the design (see Appendix M for examples). The U.S. EPR already has numerous plant features designed to reduce CDF and risk; as a result, the benefits and risk reduction potential of any additional plant improvements are significantly reduced from those of existing reactors. This reduction is true for both internally and externally initiated events. Moreover, with the engineered features already incorporated in the U.S. EPR design, the ability to estimate CDF and risk approaches the limits of probabilistic techniques. Specifically, when CDFs are estimated to be on the order of 1 in 1,000,000 years, it is possible that areas of the PRA where modeling is least complete, or supporting data are sparse or even nonexistent, may include important contributors to the remaining risk. Areas not modeled or incompletely modeled included human reliability, sabotage, rare initiating events, construction and design errors, and system interactions. However, the NRC staff does not expect that either improvements in modeling or data would change its conclusions.

In its ER (PPL Bell Bend 2013-TN3377), PPL assesses 167 SAMDAs that were considered in the U.S. EPR DCD (AREVA 2014-TN3722) using the BBNPP site-specific information, and as indicated above and described in Appendix M, 69 candidate alternatives are already included in the design. Based on sensitivity studies, PPL determined that the maximum averted cost risk for a single U.S. EPR at the BBNPP site is so low that none of the remaining candidate SAMDA alternatives is cost-beneficial. A more realistic assessment would show that the potential reductions in cost risk are substantially less than the maximum averted cost risk because no SAMDA can reduce the remaining risk to zero. The NRC staff has updated the PPL analysis based on Revision 1 of the AREVA SAMDA analysis (AREVA 2009-TN576).

For example, as part of its SAMDA sensitivity analyses, PPL evaluated the sensitivity of the maximum attainable benefit at the BBNPP site using replacement power costs based on an expected higher plant capacity factor of 95 percent for the U.S. EPR design, rather than 60 percent (the capacity factor that is the basis of NUREG/BR-0184 (NRC 1997-TN676). PPL found (PPL Bell Bend 2013-TN3377), and the staff agreed, that although the maximum attainable benefit would be higher, it would still not be cost-beneficial to implement additional U.S. EPR SAMDAs at the BBNPP site. This is addressed in more detail in Appendix M.

SAMDAs are a subset of the SAMA review. The other attributes of the SAMA review include procedural modifications and training activities. Alternatives in those areas were not addressed in the generic SAMDA analysis conducted by AREVA for design certification (AREVA 2009-TN576). However, PPL has stated that risk insights would be considered in development of procedures and training (PPL Bell Bend 2013-TN3377).

Appendix M contains a detailed review of the AREVA and PPL BBNPP SAMA analyses and presents the NRC staff conclusions related to the PPL BBNPP site-specific analysis applying updated PRA information from U.S. EPR DCD Revision 7 (AREVA 2014-TN3722) and revised BBNPP severe accident analysis (PPL Bell Bend 2014-TN3724). After performing confirmatory analysis, the NRC staff concludes that there are no additional U.S. EPR SAMDAs that would be cost-beneficial at the BBNPP site. This conclusion will be verified for the final EIS based on expected updates to the SAMDA analysis by AREVA and PPL (AREVA 2014-TN3790).

As discussed in Appendix M, because the maximum attainable benefit is so low, a SAMA based on procedures or training for an U.S. EPR at the BBNPP site would have to reduce the CDF or risk to near zero to become cost-beneficial. Based on its evaluation, the staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk that much. Therefore, the staff further concludes it is unlikely that these SAMAs would be cost-effective. In addition, based on PPL statements in its ER (PPL Bell Bend 2013-TN3377), the staff expects that PPL will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the staff's conclusions because the staff already concluded that procedural and training SAMAs would be unlikely to be cost-effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered in the context of current NRC regulations.

5.11.4 Summary of Postulated Accident Impacts

The staff evaluated the environmental impacts from DBAs and severe accidents for a U.S. EPR at the BBNPP site. Based on the information provided by AREVA, PPL, and NRC's own independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed BBNPP would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of the proposed BBNPP unit, the review team relied on PPL's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts
- compliance with applicable requirements of permits or licenses required for operation of the new unit (e.g., NPDES permit)
- compliance with existing SSES processes and/or procedures applicable to the proposed BBNPP unit operational environmental compliance activities for the BBNPP site
- compliance with existing SSES procedures for environmental control and management applicable to the proposed BBNPP unit
- implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-21, which the staff adapted from sections of PPL's ER Table 5.10-1 (PPL Bell Bend 2013-TN3377), lists a summary of measures and controls to limit adverse impacts during operation proposed by PPL.

Table 5-21. Summary of Proposed Measures and Controls to Limit Adverse Impacts during Operation

Resource Area	Specific Measures and Controls
Land Use	Operations are not expected to result in substantial land-use changes
Water-Related	
Hydrologic Alterations	Implement PCSM plan; maintain stormwater drainage and infiltration system.
	Implement low intake velocity design.
Water-Use Impacts	Comply with SRBC requirements for surface-water withdrawal and consumptive-use mitigation.

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Table 5-21. (contd)

Resource Area	Specific Measures and Controls
Water-Quality Impacts	Implement PCSM plan, comply with NPDES permit requirements for stormwater discharges to surface water.
	Comply with NPDES permit requirements for discharge of BBNPP cooling-tower blowdown and other plant effluents to surface water.
	Use BMPs, including a spill prevention plan, to minimize the occurrence and effects of inadvertent spills.
Ecology	
Terrestrial Ecosystems	Implement BMPs for established vegetation management in transmission-line corridors, to avoid impacts to wetlands.
	Restrict removal of trees greater than 5 in. DBH in transmission-line corridors during November 16 through March 31, to protect the Indiana bat and northern long-eared bat.
Aquatic Ecosystems	Use closed-cycle cooling technology and EPA Phase I regulations, properly sized intake screens, and low approach velocity of traveling screens to minimize impingement and entrainment.
	Use BMPs to minimize sediment loading during maintenance dredging activities.
	Obtain an NPDES permit to regulate discharges to the Susquehanna River and follow requirements such as ensuring that chemical concentrations remain below criteria protective of aquatic life.
	Use BMPs for transmission-line corridor maintenance activities that comply with Federal and State permits to prevent degradation of water quality.
	Use a multiport diffuser to mitigate thermal and physical impacts.
Socioeconomic Impacts	
Physical Impacts	Follow the OSHA, HUD, and the EPA noise standards.
	Maintain air emissions to State permit limitations.
Community Impacts	Increased property and worker-related taxes can help offset some of the problems related to increased population (e.g., community facilities and infrastructure, police, fire protection, and schools).
Environmental Justice	No mitigation required beyond that listed above.
Historic and Cultural Resources	Follow PPL's procedures if ground-disturbing activities discover historic or cultural resources during operation (PPL Bell Bend 2012-TN1757).
Air Quality	Obtain air permits, operate systems within permit limits, and monitor emissions as required.

Table 5-21. (contd)

Resource Area	Specific Measures and Controls
Nonradiological Health Impacts	Limit public access to area in order to avoid exposure to etiological agents (thermophilic organisms). No mitigation required for day-night noise levels, because anticipated noise levels from the plant's cooling system are less than 65 dBA at the site boundary. Conform to National Electric Safety Code standards to minimize the potential for acute effects of electromagnetic fields from transmission lines (PPL Bell Bend 2013-TN3377). Adhere to NRC, OSHA, and State safety standards, practices, and procedures during operation of the new unit and implement a safety and medical program to protect workers from industrial safety risks. No further mitigation of transportation impacts is warranted.
Radiological Impacts of Normal Operation	
Radiation Doses to Members of the Public	Implement radiological effluent and environmental monitoring programs. Maintain radiation doses to members of the public from liquid and gaseous releases and direct radiation within NRC and EPA standards (10 CFR Part 20 [TN283]; Appendix I of 10 CFR Part 50 [TN249]; and 40 CFR Part 190 [TN739]).
Occupational Radiation Doses	Maintain occupational doses to within NRC standards and implement a program to maintain doses ALARA (10 CFR Part 20 [TN283]).
Radiation Doses to Non-Human Biota	Implement radiological effluent and environmental monitoring programs. Doses to non-human biota would be well below NCRP and IAEA guidelines.
Nonradioactive Waste	
Nonradioactive Waste System Impacts	Handle solid, liquid, and gaseous wastes generated during operation of the proposed BBNPP unit according to State and Federal regulations. Recycle or reuse operational solid wastes (e.g., office waste, cardboard, wood, and metal) to the extent possible (PPL Bell Bend 2013-TN3377). • Dispose of municipal solid waste (e.g., resins and debris from trash racks and screens collected from the water-intake structure) in offsite, licensed commercial disposal facilities (PPL Bell Bend 2013-TN3377). Maintain discharges to the Susquehanna River of liquid effluents used for operations, including wastewater and stormwater, at limits per a NPDES permit. • Install equipment with appropriate emission controls and comply with all applicable Federal, State, and local air-quality requirements.

Table 5-21. (contd)

Resource Area	Specific Measures and Controls
Mixed-Waste Impacts	Institute a waste-minimization plan that would reduce the accumulation of mixed waste at the BBNPP site (PPL Bell Bend 2013-TN3377).
	Implement a source-reduction plan that was developed for SSES Units 1 and 2 to reduce the amount of mixed waste produced onsite.
Accidents	
Design Basis Accidents	Calculated dose consequences of DBAs for the U.S. EPR at the BBNPP site are within regulatory limits.
Severe Accidents	No additional design mitigation alternatives were found to be cost-beneficial.
	Consider procedural and training alternatives when construction has been completed and the plant is approaching operation.

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations of the proposed BBNPP unit is summarized in Table 5-22. Impact levels are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level column.

Table 5-22. Summary of Operational Impacts at the Proposed BBNPP Site

Resource Area	Comments	Impact Level
Land-Use Impacts	Operational activities would generally not change land uses onsite. The only potential for land-use impacts at the site would be localized salt deposition from cooling-tower drift and the shadowing effects from the two cooling towers and their evaporation plumes. Due to the varying directions and short average plume length, effects on properties located outside the project boundary would be minimal. Operational activities to maintain vegetation within new towers and transmission lines required to connect the new switchyard for the proposed unit to the existing Susquehanna 500-kV switchyard and the proposed 500-kV Susquehanna Switchyard 2, would be performed in accordance with BMPs, such as tree trimming and herbicide chemicals.	SMALL

Table 5-22. (contd)

Resource Area	Comments	Impact Level
	Consumptive-use mitigation could result in infrequent temporary drawdowns in Cowanesque Lake, temporarily interfering with recreational land uses on the shore. Infrequent temporary increases in downstream water levels caused by consumptive-use mitigation releases, could temporarily affect shoreline land uses (typically recreation and conservation).	
Water-Related Impacts		
Water Use – Surface Water	Operational activities would not noticeably alter surface-water availability. Consumptive use would be mitigated by upstream releases during periods of very low flow.	SMALL
Water Use – Groundwater	Operational activities would have minimal impacts on groundwater availability. Average BBNPP potable and sanitary water demand during operation represents 5 percent of unused capacity of the Pennsylvania American Water Supply Company's Berwick well system.	SMALL
Water Quality – Surface Water	Operational activities would have minor impacts on surface-water quality. Stormwater and effluent discharges would be regulated and monitored under the NPDES permit; thermal impacts would be localized and minor.	SMALL
Water Quality – Groundwater	Operational activities would have negligible impacts on groundwater quality.	SMALL
Ecological Impacts		
Terrestrial Ecosystems	Operational activities and the associated cooling system (natural and mechanical draft cooling towers), including the fluvial effects of consumptive-use mitigation, on upland and shoreline vegetation, birds, mammals, and herpetofauna, including important species and habitats, are likely to be minor. Operational activities of the transmission lines, including those from EMFs, on birds, and transmission-line corridor maintenance on important habitats, including wetlands and floodplains, are considered minor, assuming related BMPs are implemented. The potential impacts of increased traffic and nighttime security lighting on wildlife are also considered minor. Temporary infrequent drawdowns of Cowanesque Lake during the growing season could temporarily dry out shoreline wetlands making them temporarily less suitable for wetland wildlife. However, the wetlands are expected to be re-inundated by fall. Thus, the drawdowns are not expected to be long	SMALL

Table 5-22. (contd)

Resource Area	Comments	Impact Level
	enough to permanently alter the character of the affected wetlands.	
Aquatic Ecosystems	Operational activities of the cooling-water intake and discharge systems, in-water maintenance activities (e.g., maintenance dredging, diffuser maintenance), and transmission-line corridor maintenance would have minor impacts on aquatic ecosystems. Operational impacts on aquatic organisms from consumptive-use mitigation water releases would be minor and temporary.	SMALL
Socioeconomic Impacts		
Physical	Physical impacts of operation on workers and the local public, buildings, and transportation would be minor.	SMALL
Aesthetics	Operational aesthetic impacts would be minor, given that the site is bounded by forests and rolling terrain, and that it has already been affected by the presence of the SSES cooling towers.	SMALL
Demography	Operational activities would have minor impacts to demography. Operations workers would constitute a less than 1 percent increase over the baseline population of Columbia and Luzerne Counties. Outage workers would be onsite for approximately 15 days every 18 months.	SMALL
Economic Impacts on Community	Economic impacts of BBNPP operations on the regional and State economy would be minor and beneficial.	SMALL (beneficial)
Taxes	Tax impacts on the State and Columbia and Luzerne Counties would be minor and beneficial. Impacts on the Berwick Area School District would be noticeable and beneficial.	SMALL to MODERATE (beneficial)
Infrastructure and Community Services	Operations workforce would be considerably smaller than the building peak employment and would have a minor impact.	SMALL
Environmental Justice	There would be no disproportionately high and adverse impact on minority or low-income populations in the region during operation of the BBNPP.	NONE
Historic and Cultural Resources	Although archaeological and historical sites were identified as a result of the Phase I and Phase II cultural resource investigations conducted in the direct and indirect APEs, it has been determined, and the Pennsylvania SHPO has concurred, that because of measures that will be put in place by the applicant, there will be no impacts on these resources from operation.	SMALL

Table 5-22. (contd)

Resource Area	Comments	Impact Level
Meteorology and Air Quality Impacts	Intermittent operation of various diesel generators would result in minor emissions sources for air pollutants and greenhouse gases. Operation of the proposed cooling towers would result in minor impacts from fogging, icing, and drift from dissolved salts in the cooling-tower plume.	SMALL
Nonradiological Health Impacts	Operational impacts from etiological agents would be minimal. Noise impacts would be minimal, and comply with all Federal, State, and county regulations. Occupational safety and health impacts would be limited by compliance with OSHA standards. Acute effects of EMFs would be avoided by compliance with NESC standards. Transportation impacts would be minimal.	SMALL
Radiological Health Impacts		
Members of the Public	Doses to members of the public would be below NRC and EPA standards and there would be no observable health impacts (10 CFR Part 20 [TN283]; Appendix I to 10 CFR Part 50 [TN249]; 40 CFR Part 190 [TN739]).	SMALL
Plant Workers	Occupational doses to plant workers would be below NRC standards and program to maintain doses ALARA would be implemented.	SMALL
Biota other than Humans	Doses to biota other than humans would be well below NCRP and IAEA guidelines.	SMALL
Nonradioactive Waste Impacts	Solid, liquid, gaseous, and mixed wastes generated during operation of the proposed BBNPP unit would be handled according to State and Federal regulations. Discharges to the Susquehanna River of liquid effluents used for operations, including wastewater and stormwater, would be controlled and limited via an NPDES permit. Air emissions from operations would be compliant with Federal, State, and local air-quality standards and regulations. Mixed-waste generation, storage, and disposal impacts during operation of proposed would be compliant with Federal, State and local regulations.	SMALL

Table 5-22. (contd)

Resource Area	Comments	Impact Level
Impacts of Postulated Accidents		
Design Basis Accidents	Impacts of DBAs would be well below regulatory limits.	SMALL
Severe Accidents	Probability-weighted consequences (risks) of severe accidents would be lower than the probability-weighted consequences (risks) for currently operating reactors.	SMALL

6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of the Bell Bend Nuclear Power Plant (BBNPP).

In its evaluation of uranium fuel cycle impacts from a proposed unit at the BBNPP site, PPL Bell Bend, LLC (PPL) used the U.S. Evolutionary Power Reactor (U.S. EPR) advanced light-water reactor (LWR) design, assuming a capacity factor of 95 percent (PPL Bell Bend 2013-TN3377). This chapter presents the U.S. Nuclear Regulatory Commission (NRC) staff's assessment of the environmental impacts from fuel cycle, transportation, and decommissioning activities in relation to the AREVA U.S. EPR design that PPL is proposing for BBNPP.

6.1 Fuel Cycle Impacts and Solid Waste Management

This section discusses the environmental impacts from the uranium fuel cycle and solid waste management for the U.S. EPR reactor design. The environmental impacts of this design are evaluated against specific criteria for LWR designs in Title 10 of the *Code of Federal Regulations* 51.51 (10 CFR 51.51 [TN250]).

The regulations in 10 CFR 51.51(a) state that

> Under § 51.50, every environmental report prepared for the construction permit stage or early site permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The U.S. EPR proposed for BBNPP is an LWR that would use uranium dioxide fuel; therefore, Table S–3 in10 CFR 51.51(b) (TN250) can be used to assess the environmental impact of the uranium fuel cycle.

Table S–3 values are normalized for a reference 1,000-MW(e) LWR at an 80-percent capacity factor. The 10 CFR 51.51(b) (TN250) Table S–3 values are reproduced in Table 6-1.

Table 6-1. Table S–3 from 10 CFR 51.51(b) (TN250), Table of Uranium Fuel Cycle Environmental Data[(a)]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[(b)]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 100-MW(e) coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to a 95-MW(e) coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1,000-MW(e) LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MWh)	323	<5 percent of model 1,000 MW(e) LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45-MW(e) coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1,000 MW(e) energy output.
Effluents – Chemical (MT)		
Gases (including entrainment):[(c)]		
SO_x^{-1}	4,400	
NO_x^{-1}[(d)]	1,190	Equivalent to emissions from 45 MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of state standards – below level that has effects on human health.
HCl	0.014	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are as follows: NH_3—600 cfs, NO_3—20 cfs, fluoride—70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10	
Fe	0.4	
Tailings solutions (thousands of MT)	240	From mills only – no significant effluents to environment.
Solids	91,000	Principally from mills – no significant effluents to environment.
Effluents – Radiological (curies)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling – included tailings liquor and returned to ground – no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	
Th-234	0.01	From fuel fabrication plants – concentration 10 percent of 10 CFR Part 20 (TN283) for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried onsite):		
Other than high-level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning − buried at land burial facilities. 600 Ci comes from mills − included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^7	Buried at Federal Repository.
Effluents − thermal (billions of British thermal units)	4,063	<5 percent of model 1,000-MW(e) LWR.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Transportation (person-rem):		
Exposure of workers and general public....	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

(a) In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S–3 does not include health effects from the effluents described in the table, or estimates of releases of radon-222 from the uranium fuel cycle or estimates of technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248 (AEC 1974-TN23); the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976-TN292); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248) (NRC 1977-TN1255); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium-only and no-recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S–4 of Section 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S–3A of WASH-1248.

(b) The contributions to temporarily committed land from reprocessing are not prorated over 30 years, because the complete temporary impact accrues regardless of whether the plant services 1 reactor for 1 year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2 percent from natural gas use and process.

Specific categories of environmental considerations are included in Table S–3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high-level wastes (HLW) and low-level wastes (LLW), and radiation doses from transportation and occupational exposures. In developing Table S–3, the NRC staff considered two fuel-cycle options that differed in the treatment of spent fuel removed from a reactor. The "no-recycle" option treats all spent fuel as waste to be stored at a Federal waste repository, whereas the "uranium-only recycle" option involves reprocessing spent fuel to recover unused uranium and return it for use in new fuel. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium-only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, use, and ultimate disposition of fuel for nuclear power reactors.

The Nuclear Non-Proliferation Act of 1978 (22 USC 3201 et seq.-TN737) significantly affected the disposition of spent nuclear fuel by deferring indefinitely the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. Even though the ban on reprocessing spent fuel was lifted in October 1981 by the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry in the United States provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 (42 USC 15801 et seq.-TN738) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel recycling technology research and development program to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional government and commercial efforts would be necessary before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could commence.

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in open-pit or underground mines or by an in situ leach solution mining process. In situ leach mining, presently the primary form of uranium mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or in situ leach solution is transferred to mills where it is processed to produce “yellowcake” (U_3O_8). A conversion facility prepares the U_3O_8 by converting it to uranium hexafluoride (UF_6), which is then processed by an enrichment facility to increase the percentage of the more fissile isotope uranium-235 and decrease the percentage of the non-fissile isotope uranium-238. At a fuel fabrication facility, the enriched uranium, which is approximately 5 percent uranium-235, is then converted to uranium dioxide (UO_2). The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After onsite storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

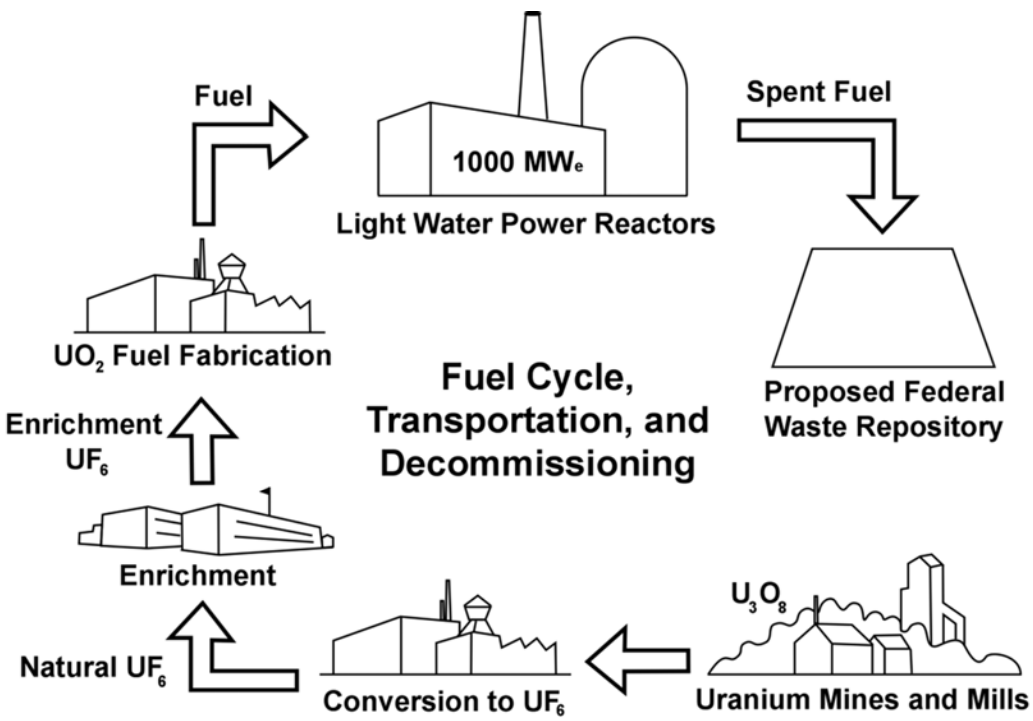

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (Derived from NRC 1999-TN289)

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (Table 6-1) and the

NRC staff's analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996-TN288; NRC 1999-TN289; NRC 2013-TN2654),[1] the NRC staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design considered here uses the same type of fuel as that considered in the staff's evaluation in NUREG-1437. The NRC staff's analyses in NUREG-1437 are summarized here.

The power rating for the proposed BBNPP is 4,590 MW(t) (PPL Bell Bend 2013-TN3377). With a capacity factor of 95 percent, this corresponds to 1,625 MW(e).

The fuel-cycle impacts in Table S–3 are based on a reference 1,000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). In the following review and evaluation of the environmental impacts of the fuel cycle, the staff considered the capacity factor of 95 percent with a total net electric output of 1,625 MW(e) for the proposed new unit at the BBNPP site (PPL Bell Bend 2013-TN3377); this is about 2 times (i.e., 1,625 MW(e) divided by 800 MW(e) yields 2.03) the impact values in Table S–3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1,000-MW(e) LWR-scaled model, reflecting 1,625 MW(e) for the site and, for simplicity, the Table S–3 results are scaled by a factor of 2 rather than 2.03.

Recent changes in the uranium fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel-cycle impacts are below those identified in Table S–3. This is especially true in light of the following recent uranium fuel-cycle trends in the United States:

- Increasing use of in situ leach uranium mining, which does not produce mine tailings and would lower the release of radon gas. A detailed discussion of this subject is provided in Section 6.1.5.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifugation. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion. (U.S. gaseous diffusion plants relied on electricity derived mainly from burning coal.)
- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent fuel assemblies per reactor year are discharged, hence the waste storage/repository impact is lessened.

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[1] The GEIS for license renewal (NUREG-1437) was originally issued in 1996 (NRC 1996-TN288). Addendum 1 was issued in 1999 (NRC 1999-TN289). NUREG-1437, Revision 1, was issued in June 2013 (NRC 2013-TN2654). The version cited, whether 1996 or 2013, is the version in which the relevant technical information is discussed. Revision 1 is cited in cases in which the relevant technical information is discussed in both documents.

The values in Table S–3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to confirm that the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. The NRC staff recognizes that many of the fuel-cycle parameters and interactions vary in small ways from the estimates in Table S–3; the NRC staff concludes that these variations would have no impacts on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S–3, the NRC staff defined the model reactor as a 1,000-MW(e) LWR operating at 80 percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/metric ton uranium (MTU). This is a "reference reactor year" (Table S–3 or GEIS, Revision 1 (NRC 2013-TN2654).

If approved, the combined construction permit and operating license (combined license or COL) for the proposed BBNPP unit would allow for 40 years of operation. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This approach was followed in the original GEIS (NRC 1996-TN288) and carried forward into Revision 1 (NRC 2013-TN2654) for both boiling water reactors and pressurized water reactors; the higher annual requirement, 35 metric tons (MT) of uranium made into fuel for a boiling water reactor was chosen in the GEIS, Revision 1, as the basis for the reference reactor year (NRC 2013-TN2654). The average annual fuel requirement presented in the GEIS, Revision 1, would only be increased by 2 percent if a 40-year lifetime was evaluated). However, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative-work (enrichment) requirements. Since the time when Table S–3 was promulgated, these improvements have reduced the annual fuel requirement, which means the Table S–3 assumptions remain bounding as applied to the proposed BBNPP unit.

Another change supporting the bounding nature of the Table S–3 assumptions with respect to the impacts of a new nuclear power plant is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored use of foreign uranium at the expense of the domestic uranium industry. In the 1980s, the economic conditions of the uranium market resulted in the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from uranium mining activities. More recently, there is renewed interest in uranium recovery in the United States. The NRC has received seven license applications for uranium recovery facilities since 2007 and anticipates receiving a dozen more in 2014 (NRC 2013-TN2835). The majority of these applications are expected to be for facilities using the in situ recovery process, which does not produce mill tailings that would have released radon to the environment. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S–3; however, Table S–3 estimates remain bounding as applied to the proposed BBNPP unit.

In summation, these reasons highlight why Table S–3 is likely to overestimate impacts from the proposed unit and, therefore, the information in Table S–3 remains adequate for use in the bounding approach for this analysis.

Section 4.12.1.1 of the GEIS, Revision 1 (NRC 2013-TN2654) and Section 6.2 of the GEIS (NRC 1996-TN288) discuss in greater detail the sensitivity to changes in the uranium fuel cycle since issuance of Table S–3 on the environmental impacts.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1,000-MW(e) LWR-scaled model is about 230 ac. Approximately 26 ac are permanently committed land, and 200 ac are temporarily committed land. A “temporary” land commitment is a commitment for the life of the specific fuel cycle plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. “Permanent” commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E (TN283), for release of that area for unrestricted use. Of the approximately 200 ac of temporarily committed land, 160 ac are undisturbed and 44 ac are disturbed. In comparison, a coal-fired power plant using the same MW(e) output as the LWR-scaled model and strip-mined coal requires the disturbance of about 360 ac per year for fuel alone. The staff concludes that the impacts on land use to support the 1,000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1,000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S–3, of the total annual water use of 2.3×10^{10} gal, about 2.2×10^{10} gal are required for the removal of waste heat, assuming that a new unit uses once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 3.2×10^{8} gal/yr and water discharged to the ground (e.g., mine drainage) of about 2.6×10^{8} gal/yr (PPL Bell Bend 2013-TN3377).

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1,000-MW(e) LWR-scaled model using once-through cooling. The consumptive-use is about 2 percent of the 1,000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive-use (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be approximately 6 percent of the 1,000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The NRC staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil Fuel Impacts

As indicated in Appendix I of this environmental impact statement (EIS), the largest source of greenhouse gas (GHG) emissions associated with nuclear power is from the fuel cycle, not operation of the plant. The largest source of GHGs in the fuel cycle is production of electric energy and process heat required during various phases of the fuel-cycle process, such as enrichment. The electric energy is often produced by the combustion of fossil fuel at conventional power plants.

Table S–3 in 10 CFR 51.51 (TN250) presents data for evaluating the environmental effects of a reference 1,000-MW(e) light-water-cooled nuclear power reactor resulting from the uranium fuel cycle. Table S–3 does not provide an estimate of GHG emissions associated with the uranium fuel cycle, but does state that 323,000 MWh is the assumed annual electric energy use associated with the uranium fuel cycle for the reference 1,000-MW(e) nuclear power plant and this 323,000 MWh of annual electric energy is assumed to be generated by a 45-MW(e) coal-fired power plant burning 118,000 MT of coal. Table S–3 also assumes approximately 135,000,000 standard cubic feet of natural gas is also required per year to generate process heat for certain portions of the uranium fuel cycle.

In Appendix I of this EIS, the NRC used these fossil fuel use assumptions presented in Table S–3 to estimate that the GHG footprint of the fuel cycle to support a reference 1,000-MW(e) LWR with an 80 percent capacity factor for a 40-year operational period is on the order of 10,100,000 MT of carbon dioxide (CO_2) equivalent. Scaling this footprint to the power level and capacity factor of the proposed BBNPP unit using the scaling factor of 2 discussed earlier, the review team estimates the GHG footprint for 40 years of fuel-cycle emissions to be approximately 20,200,000 MT of CO_2 equivalent. This rate of GHG production equals 505,000 MT of CO_2 equivalent per year, less than 0.5 percent of Pennsylvania's annual CO_2 emission rate (EPA 2013-TN3784).

The largest use of electricity in the fuel cycle comes from the enrichment process. The development of Table S–3 assumed that the gaseous diffusion process is used to enrich uranium. The gaseous diffusion technology is no longer used for uranium enrichment. The last gaseous diffusion enrichment facility in the United States ceased operations recently (USEC 2013-TN2765). Current enrichment facilities use gas centrifuge technologies, and recent applications for new uranium enrichment facilities are based on gas centrifuge and laser separation technologies. The same amount of enrichment from gas centrifuge and laser separation facilities uses less electricity and therefore results in lower amounts of air emissions such as CO_2 than a gaseous diffusion facility. In addition, electric utilities in the United States have begun to switch from coal to cheaper, cleaner-burning natural gas (DOE/EIA 1995-TN2996); therefore, the Table S–3 assumption that a 45-MW(e) coal-fired plant is used to generate the 323,000 MWh of annual electric energy for the uranium fuel cycle also results in conservative air emission estimates. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

On this basis, the NRC staff concludes that the fossil fuel impacts, including GHG emissions, from the direct and indirect consumption of electric energy for fuel-cycle operations would be SMALL.

6.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents with fuel-cycle processes are given in Table S–3 for the reference 1,000-MW(e) LWR and, according to WASH-1248 (AEC 1974-TN23) result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table S–3 states that the fuel cycle for the reference 1,000-MW(e) LWR requires 323,000 MWh of electricity. The fuel cycle for the 1,000-MW(e) LWR-scaled model would therefore require 646,000 MWh of electricity, or less than 0.016 percent of the 4.1 billion MWh of electricity generated in the United States in 2012 (DOE/EIA 2013-TN1951). Therefore, the gaseous and particulate chemical effluents from fuel-cycle processes to support the operation of the 1,000-MW(e) LWR-scaled model would add less than 0.016 percent to the national gaseous and particulate chemical effluents for electricity generation.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table 6-1 specifies the amount of dilution water required for specific constituents. In addition, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations would be subject to requirements and limitations set by an appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process, but as Table S−3 indicates, effluents are not released in quantities sufficient to have a significant impact on the environment.

The staff determined that the impacts of these chemical effluents (gaseous, particulate and liquid) would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the fuel-cycle process are set forth in Table S–3 (Table 6-1). The GEIS (NRC 2013-TN2654) provides the 100-year environmental dose commitment to the U.S. population from the fuel cycle of 1 year of operation of the model 1,000-MW(e) LWR using the radioactive effluents in Table 6-1. Excluding reactor releases and dose commitments because of the exposure to radon-222 and technetium-99, the total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle were calculated to be approximately 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 2 for the 1,000-MW(e) LWR-scaled model results in whole body dose commitment estimates of 800 person-rem for gaseous releases and 400 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1,200 person-rem for the 1,000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. PPL provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (PPL Bell Bend 2013-TN3377). This evaluation relied on the information discussed in NUREG-1437 (NRC 1996-TN288).

In Section 6.2 of the 1996 version of the GEIS (NRC 1996), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operations of the reference 1,000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1,000-MW(e) LWR-scaled model, or for the total electric power rating for the proposed BBNPP unit for a year, total approximately 10,400 Ci. Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the staff assumed that the LWR-scaled model would result in an emission of 2 Ci per site year, (i.e., about 2 times the NUREG-1437 (NRC 1996-TN288) estimate for the reference reactor year). The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 (TN283) were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each site year (assuming the 1,000-MW(e) LWR-scaled model) would be approximately 1,840 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 36 person-rem to the whole body. Additional insights regarding Federal policy/resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996-TN288).

Also, as discussed in NUREG-1437, the NRC staff considered the potential health effects associated with the releases of technetium-99 (NRC 2013-TN2654). The estimated releases of technetium-99 for the reference reactor year for the 1,000-MW(e) LWR-scaled model are 14 mCi from chemical processing of recycled uranium hexafluoride before it enters the isotope enrichment cascade and 10 mCi into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose-weighting factors from 10 CFR Part 20 (TN283) to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 200 person-rem for the 1,000-MW(e) LWR-scaled model.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council (2006-TN296), the Biological Effects of Ionizing Radiation VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007-TN422).

The nominal probability coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 3,300 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 1.9 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Both National Council on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP) suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (i.e., less than 1/0.00057, which is less than 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995-TN728; NCRP 2009-TN420; ICRP 2007-TN422). The estimated collective whole body dose value of 3,330 person-rem/yr to the U.S. population is not significantly larger than the 1,754 person-rem value that the ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995-TN728; NCRP 2009-TN420; ICRP 2007-TN422). Thus, it is not expected that the 1.9 expected health effects would be observable.

Radon releases from tailings are indistinguishable from background radiation levels at a few kilometers from the tailings pile (at less than 1 km in some cases) (NRC 1996-TN288). The public dose limit issued by the U.S. Environmental Protection Agency (EPA) (40 CFR 190-TN739) is 25 mrem/yr to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr (61 FR 65120-TN294).

In addition, at the request of the U.S. Congress, the National Cancer Institute conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990-TN1257). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel-cycle facilities, in operation in the United States in 1981 and found "… no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al. 1990-TN1257). The contribution to the annual average dose received by an individual from fuel-cycle-related radiation and other sources as reported in a report published by the NCRP (2009-TN420) is listed in Table 6-2. The nuclear fuel-cycle contribution to an individual's annual average radiation dose is extremely small (less than 0.1 mrem/yr) compared to the annual average background radiation dose (i.e., 311 mrem/yr).

Based on the analyses presented above, the NRC staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are SMALL.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

	Source	Dose (mrem/yr)[(a)]	Percent of Total
Ubiquitous background	Radon and thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	**311**	**50**
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	**300**	**48**
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[(b)]	0.1
	Nuclear fuel cycle	0.05[(c)]	0.01
Total		**624**	**100**

(a) The NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Estimated using 153 person-Sv/yr from Table 6.1 of NCRP 160 and a 2006 U.S. population of 300 million.

Source: NCRP 2009-TN420

6.1.6 Radiological Wastes

The estimated quantities of buried radioactive waste material (LLW, HLW, and transuranic wastes) generated by the reference 1,000-MW(e) LWR are specified in Table S–3 (Table 6-1). For LLW disposal at land burial facilities, the Commission notes that there would be no significant radioactive releases to the environment. PPL LLC, the operator of Susquehanna Steam Electric Station Units 1 and 2, can no longer dispose of Class B and C LLW from the units at the Energy Solutions site in Barnwell, South Carolina. However, Class A LLW can be shipped to facilities in Tennessee for processing, treatment and volume reduction and sent to the Energy Solutions site in Clive, Utah (PPL Bell Bend 2014-TN3537).

The Waste Control Specialists, LLC, site in Andrews County, Texas, is licensed to accept Class A, B, and C LLW from the Texas Compact (Texas and Vermont). Effective September 1, 2011, Waste Control Specialists, LLC, may accept Class A, B, and C LLW from outside the Texas Compact for disposal subject to established criteria, conditions, and approval processes (Tex. Admin Code 31-675.23-TN731). Because PPL would likely have to choose one or a combination of options, the NRC staff considered the environmental impacts of each of these options.

In NUREG-1437, the NRC staff concluded that there should be no significant issues or environmental impacts associated with interim storage of LLW generated by nuclear power plants (NRC 1996-TN288; NRC 2013-TN2654). Interim storage facilities would be used until these wastes could be safely shipped to licensed disposal facilities. NUREG-1437 also discusses an evaluation of the impacts of extending onsite storage of LLW. Extended storage also is covered by the existing regulatory framework. PPL's resolution of LLW disposal issues for existing Susquehanna Steam Electric Station Units 1 and 2 could also be implemented for the proposed BBNPP (PPL Bell Bend 2014-TN3537).

Table S–3 addresses the environmental impacts if PPL enters into an agreement with a licensed facility for disposal of LLW, and Table S–4 addresses the environmental impacts from transportation of LLW as discussed in Section 6.2. The use of third-party contractors was not explicitly addressed in Tables S–3 and S–4; however, such third-party contractors are already licensed by the NRC or an agreement state and currently operate in the United States. Experience from the operation of these facilities shows that the additional environmental impacts are not significant compared to the impacts described in Tables S–3 and S–4.

Measures to reduce the generation of Class B and C wastes, such as reducing the service run length of resin beds, could increase the volume of LLW, but would not increase the total activity (in curies) of radioactive material in the waste. The volume of waste still would be bounded by or very similar to the estimates in Table S–3, and the environmental impacts would not be significantly different.

In most circumstances, the NRC's regulations (10 CFR 50.59-TN249) allow licensees operating nuclear power plants to construct and operate additional onsite LLW storage facilities without seeking approval from the NRC. Licensees are required to evaluate the safety and environmental impacts before constructing the facility and make those evaluations available to NRC inspectors. A number of nuclear power plant licensees have constructed and operate such facilities in the United States. Typically, these additional facilities are constructed near the power block inside the security fence on land that has already been disturbed during initial plant construction. Therefore, the impacts on environmental resources (e.g., land use and aquatic and terrestrial biota) would be minimal. All of the NRC (10 CFR Part 20-TN283) and EPA (40 CFR Part 190-TN739) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate such facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be below 25 mrem/yr, the dose limit of 40 CFR Part 190 (TN739). The NRC staff concludes that doses to members of the public within the NRC and EPA regulations are a minimal impact. Therefore, the impacts from radiation would be minor.

In addition, the NRC staff assessed the impacts of onsite LLW storage at currently operating nuclear power plants and concluded that the radiation doses to offsite individuals from interim LLW storage are insignificant (NRC 2013-TN2654). The types and amounts of LLW generated by the proposed reactors at the proposed BBNPP would be very similar to those generated by currently operating nuclear power plants, and the construction and operation of these interim LLW storage facilities would be very similar to the construction and operation of the currently operating facilities. Also, in NUREG-1437 (NRC 2013-TN2654), the NRC staff concluded that there should be no significant issues or environmental impacts associated with interim storage of LLW generated by nuclear power plants. Interim storage facilities would be used until these wastes could be safely shipped to licensed disposal facilities.

Current national policy, as found in the Nuclear Waste Policy Act (42 USC 10101 et seq.-TN740) mandates that HLW and transuranic waste are to be buried at a deep geologic repository. No release to the environment is expected to be associated with deep geologic disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel would have been released to the atmosphere before disposal of the waste. In NUREG-0116 (NRC 1976-TN292), which provides background and context for the Table S–3 values established by the Commission, the NRC staff indicates that these HLWs and transuranic wastes will be buried and will not be released to the environment.

As part of the Table S–3 rulemaking, the NRC staff evaluated, along with more conservative assumptions, the zero-release assumption associated with waste burial in a repository, and the reached an overall generic determination that fuel-cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC position that the zero-release assumption was reasonable in the context of the Table S–3 rulemaking to generically address the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas and Electric Co. v. Natural Resources Defense Council, Inc. 1983-TN1054).

Environmental impacts from onsite spent fuel storage have been studied extensively and are well understood. In the context of license renewal for continued operations, the NRC staff provides descriptions of the storage of spent fuel during the licensed lifetime of reactor operations (NRC 2013-TN2654). Radiological impacts are well within regulatory limits; thus, radiological impacts of onsite storage during operations meet the standard for a conclusion of small impact. Nonradiological environmental impacts have been shown to be not significant; thus, they are classified as small. The overall conclusion for onsite storage of spent fuel during the licensed lifetime of reactor operations is that the environmental impacts will be minor (NRC 2013-TN2654).

On August 26, 2014, the Commission issued a revised rule at 10 CFR 51.23 (TN250) and associated *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NUREG-2157) (NRC 2014-TN4117). The revised rule adopts the generic impact determinations made in NUREG-2157 and codifies the NRC's generic determinations regarding the environmental impacts of continued storage of spent nuclear fuel beyond a reactor's operating license (i.e., those impacts that could occur as a result of the storage of spent nuclear fuel at at-reactor or away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available).

In CLI-14-08, the Commission held that the revised 10 CFR 51.23 (TN250) and associated NUREG-2157 (NRC 2014-TN4117) cure the deficiencies identified by the court in *New York v. NRC*, 681 F.3d 471 (D.C. Cir. 2012) and stated that the rule satisfies the NRC's NEPA obligations with respect to continued storage for actions such as the BBNPP COL application. As directed by 10 CFR 51.23(b), the impacts assessed in NUREG-2157 are deemed incorporated into this EIS.

The staff's evaluation of the potential environmental impacts of continued storage of spent fuel presented in NUREG-2157 (NRC 2014-TN4117) identifies an impact level, or a range of impacts, for each resource area for a range of site conditions and timeframes. The timeframes analyzed in NUREG-2157 include the short-term timeframe (60 years beyond the licensed life of a reactor), the long-term timeframe (an additional 100 years after the short-term timeframe), and an indefinite timeframe (see Section 1.8.2 of NUREG-2157).

The analysis in Section 4.20 of NUREG-2157 (NRC 2014-TN4117) concludes that the potential impacts of spent fuel storage at the reactor site in both a spent fuel pool and in an at-reactor independent spent fuel storage installation (ISFSI) would be SMALL during the short-term timeframe. However, for the longer timeframes for at-reactor storage, and for all timeframes for away-from-reactor storage, Sections 4.20 and 5.20 of NUREG-2157 have determined a range of potential impacts in some resource areas. These ranges reflect uncertainties that are inherent in analyzing environmental impacts to some resource areas over long timeframes. Those uncertainties exist, however, regardless of whether the impacts are analyzed generically or site-specifically.

Appendix B of NUREG-2157 (NRC 2014-TN4117) provides an assessment of the technical feasibility of a deep geologic repository and continued safe storage of spent fuel. That assessment concluded that a deep geologic repository is technically feasible and that a reasonable timeframe for its development is approximately 25 to 35 years. The assessment in NUREG-2157 noted that DOE’s goal is to have sited, constructed and commenced operations of a repository by 2048. If the current proposed action is approved and no renewals are granted in the future, the short-term period will end 60 years after the end of the licensed period. The licensed period plus the short-term timeframe is more than twice as long as the time estimated to develop a deep geologic repository.

The most likely impacts of the continued storage of spent fuel are those considered for at-reactor storage in the short-term timeframe. In the unlikely event that fuel remains on site into the long-term and indefinite timeframes, the ranges in NUREG-2157 (NRC 2014-TN4117) reflect factors that lead to uncertainties regarding the potential impacts over these very long periods of time. Based on the analysis and impact determination in NUREG-2157, and taking into account the impacts that the NRC can predict with certainty, which are SMALL; the uncertainty reflected by the ranges in the long-term and indefinite timeframes; and the relative likelihood of the timeframes, the staff finds that the impacts for at-reactor storage for BBNPP are likely to be minor.

Spent fuel could also be moved to an away-from-reactor storage facility. However, there is uncertainty whether an away-from-reactor storage facility would be constructed, uncertainty where it might be located, and uncertainty regarding the impacts in the short-term and the longer timeframes. As a result, these impacts provide limited insights to the decision-maker in the overall picture of the environmental impacts from the proposed action and do not change the staff’s overall conclusion regarding the environmental impacts of radiological wastes from the fuel cycle (which includes the impacts associated with spent fuel storage).

The NRC staff concludes, based on Table S–3 and the above conclusions regarding storage of LLW and spent fuel, that the environmental impacts from radioactive waste storage and disposal associated with the operation of BBNPP would be SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1,000-MW(e) LWR-scaled model is about 1,200 person-rem. This is based on a 600 person-rem occupational dose estimate attributable to all phases of the fuel cycle for the model 1,000 MW(e) LWR (NRC 2013-TN2654). The NRC staff concludes that the environmental impact from this occupational dose is considered SMALL because the dose to any individual worker would be maintained within the 5-rem/yr limit established in 10 CFR Part 20 (TN283).

6.1.8 Transportation

The transportation dose to workers and the public totals about 2.5 person-rem annually for the reference 1,000-MWe LWR according to Table S–3 (see Table 6-1). Scaling the data for the U.S. EPR, this corresponds to a dose of approximately 5.0 person-rem for the 1,000-MW(e) LWR-scaled model. For comparative purposes, the population within 50 mi of the BBNPP site is estimated to be approximately 1.78 million (PPL Bell Bend 2013-TN3377). Using 0.311 rem/yr as the average dose to a U.S. resident from natural background radiation (NCRP 2009-TN420), the collective dose to that population is estimated to be approximately 554,000 person-rem/yr. On the basis of this comparison, the NRC staff concludes that environmental impacts of transportation would be SMALL.

6.1.9 Conclusions

The NRC staff evaluated the environmental impacts of the uranium fuel cycle, as given in Table S–3 (Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1,000-MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of GHG emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1,000 MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of storage of LLC and spent fuel. Based on this evaluation, the staff concludes that the impacts from the fuel cycle and solid waste management would be SMALL.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the proposed BBNPP site and three alternative sites, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain site in Nevada as a surrogate destination for a monitored retrievable storage facility or permanent repository. The impacts evaluated in this section for a new nuclear power plant at the BBNPP site are appropriate for characterizing the alternative sites discussed in Section 9.3 of this EIS. The three alternative sites evaluated in this EIS include the Montour site, Seedco Industrial Park, and Humboldt Industrial Park, all of which are within the Commonwealth of Pennsylvania. There is no meaningful differentiation among the proposed site and the alternative sites regarding the radiological and nonradiological environmental impacts from normal operations and accident conditions; therefore, such impacts are not discussed further in this chapter.

The NRC staff performed a generic analysis of the environmental effects of transporting fuel and waste to and from LWR in the *Environmental Survey of the Transportation of Radioactive Materials to and from Nuclear Power Plants*, WASH–1238 (AEC 1972-TN22) and in a supplement to WASH–1238, NUREG–75/038 (NRC 1975-TN216), and found the impact to be small. These documents provided the basis for Table S–4 in 10 CFR 51.52 (TN250) that summarizes the environmental impacts of transporting fuel and waste to and from one LWR of 3,000 to 5,000 MW(t) (1,000 to 1,500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1,100-MW(e) LWR. The transportation impacts associated with the proposed BBNPP site were normalized for a reference 1,100-MW(e) LWR at an 80 percent capacity factor for comparison with Table S–4.[(2)] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor year. The combined dose to the public along the route and to onlookers was estimated to result in a collective dose of 3 person-rem per reference reactor year.

Environmental risks of radiological effects during accident conditions, as stated in Table S–4 in 10 CFR 51.52 (TN250), are small. Nonradiological impacts from postulated accidents were estimated as 1 fatal injury in 100 reactor years and 1 nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG–0170 (NRC 1977-TN417) and by Sprung et al. (2000-TN222) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a) (TN250), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed to be bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level not exceeding 3,800 MW(t).
- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and pellets are encapsulated in zircaloy-clad fuel rods.
- The average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after discharge from the reactor.
- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

[(2)] Note that the basis for Table S-4 is an 1,100-MW(e) LWR at an 80 percent capacity factor (AEC 1972-TN22). The basis for Table S-3 in 10 CFR 51.51(b) (TN250), which is discussed in Section 6.1 of this EIS, is a 1,000-MW(e) LWR with an 80 percent capacity factor (NRC 1976-TN292). However, because fuel-cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

The environmental impacts of transporting fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52 (TN250), provided that the specific conditions in the rule (see above) are met; if not, then a full description and detailed analysis is required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, higher burnups (greater than 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3,800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) must be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b) (TN250). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

In its application, PPL requested a combined construction permit and operating license (COL) for a new reactor at its site in Luzerne County, Pennsylvania. The proposed new reactor would be an AREVA U.S. Evolutionary Power Reactor (U.S. EPR) advanced LWR. The U.S. EPR reactor has a thermal power rating of 4,590 MW(t) and a design net electrical output of 1,600 MW(e). This thermal power rating exceeds the 3,800 MW(t) condition given in 10 CFR 51.52(a) (TN250). The U.S. EPR design is expected to operate with a 95 percent capacity factor, so the net electrical output (annualized) is approximately 1,520 MW(e) (PPL Bell Bend 2013-TN3377). Fuel for the plants would be enriched up to approximately 4.62 weight percent uranium-235, which exceeds the 10 CFR 51.52(a) condition. In addition, the expected irradiation level of approximately 52,000 MWd/MTU (PPL Bell Bend 2013-TN3377) exceeds the 10 CFR 51.52(a) (TN250) condition. Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (PPL Bell Bend 2013-TN3377), PPL provided a full description and detailed analyses of transportation impacts. In these analyses, the radiological impacts of transporting fuel and waste to and from the proposed BBNPP site were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008-TN302). For this EIS, the NRC staff conducted a confirmatory analysis of the radiological impacts of transporting fuel and waste to and from the proposed BBNPP site and the alternative sites using the updated version RADTRAN 6.02 (Weiner et al. 2013-TN3390) computer code. RADTRAN is the most commonly used transportation impact analysis computer code in the nuclear industry, and the NRC staff concludes that the code is an acceptable analysis method.

Comments on previous new reactor EISs also were considered when developing the scope of this EIS. Based on these comments, this EIS includes an explicit analysis of the nonradiological impacts of transporting workers and construction materials to or from the proposed BBNPP site and alternative sites. Nonradiological impacts of transporting construction workers and materials and operations workers are addressed in Sections 4.8.3 and 5.8.6, respectively. Publicly available information about traffic accident, injury, and fatality rates was used to estimate nonradiological impacts. In addition, the radiological impacts to maximally exposed individuals (MEIs) are evaluated.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the proposed BBNPP site and alternative sites. Radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts on populations and MEI are presented. Because the specific fuel fabrication plant for BBNPP unirradiated fuel is not known at this time, the NRC staff's analysis assumes a "representative" route between the fuel fabrication facility and the proposed BBNPP site or alternative sites. This means that one analysis was done using a route that is considered to be "representative" with one set of route characteristics (distances and population distributions), and the results of that analysis were used to conclude that the impact from radiation dose would be small for the proposed BBNPP site and each of the alternative sites. Once the location of the fuel fabrication site is known, there would likely be small differences in the route and dose estimates for the proposed BBNPP site and alternative sites. However, the radiation doses from transporting unirradiated fuel to the proposed BBNPP site and alternative sites would still be small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive material to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping containers. Radiation exposures would occur to the following individuals: (1) persons residing along the transportation corridors between the fuel fabrication facility and the proposed BBNPP site or alternative sites; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons at vehicle stops for refueling, resting, and inspecting vehicles; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides an estimate of the number of truck shipments of unirradiated fuel for the AREVA U.S. EPR design compared to those of the reference 1,100-MW(e) reactor specified in WASH–1238 (AEC 1972-TN22) operating at 80 percent capacity (880 MW[e]). After normalization, the number of truck shipments of unirradiated fuel to the proposed BBNPP site or alternative sites would be fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH–1238 (AEC 1972-TN22).

Shipping Mode and Weight Limits

In 10 CFR 51.52 (TN250), a condition is identified in which all unirradiated fuel is shipped to the reactor by truck. PPL specifies that unirradiated fuel would be shipped to the proposed reactor site by truck. Section 10 CFR 51.52 (TN250), Table S-4 includes a condition that truck shipments will not exceed 73,000 lb as governed by Federal or State gross vehicle weight restrictions. PPL states in its ER that the unirradiated fuel shipments to the proposed BBNPP site would comply with applicable weight restrictions (PPL Bell Bend 2013-TN3377).

Table 6-3. Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and an AREVA U.S. EPR

Reactor Type	Number of Shipments per Reactor Total[a]	Unit Electric Generation, MW(e)[b]	Capacity Factor[b]	Normalized, Shipments per 1,100 MW(e)[c]
Reference LWR (WASH–1238)	252	1,100	0.8	252
BBNPP AREVA U.S. EPR	298	1,600	0.95	173

(a) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).(PPL Bell Bend 2013-TN3377).
(b) Unit capacities and capacity factors were taken from WASH–1238 for the reference LWR and the ER (PPL Bell Bend 2013-TN3377) for the AREVA U.S. EPR.
(c) Normalized to net electric output for WASH–1238 (AEC 1972-TN22) reference LWR (i.e., 1,100-MW(e) plant at 80 percent or net electrical output of 880 MW(e)).

Radiological Doses to Transport Workers and the Public

10 CFR 51.52, Table S–4 (TN250), includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and the number of shipments to which the individuals are exposed. For this EIS, the NRC staff independently calculated the radiological dose impacts on transport workers and the public from the transportation of unirradiated fuel for the worker and the public using the RADTRAN 6.02 (Weiner et al. 2013-TN3390) computer code, and verified PPL's results presented in the ER. These NRC staff results are conservative or comparable to the PPL results using the prior version of RADTRAN 5.6 (Weiner et al. 2008-TN302).

One of the key assumptions in WASH–1238 (AEC 1972-TN22) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 3.3 ft from the transport vehicle is approximately 0.1 mrem/hr, which is 1 percent of the regulatory limit. This assumption also was used in the NRC staff's analysis of the AREVA U.S. EPR unirradiated fuel shipments. This assumption is reasonable because the AREVA U.S. EPR fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to that described in WASH–1238 (AEC 1972-TN22) (i.e., inside a shipping container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of reactor operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

PPL's ER (PPL Bell Bend 2013-TN3377) assumed unirradiated fuel would be transported to the proposed BBNPP site from the fuel fabrication plant near Richland, Washington, and the NRC staff assumed the same for this analysis. PPL calculated the radiological dose impacts on transport workers and the public from the transportation of unirradiated fuel using the RADTRAN 5.6 (Weiner et al. 2008-TN302). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the Transportation Routing Analysis Geographic Information System (TRAGIS) routing code (Johnson and Michelhaugh 2003-TN1234). The NRC staff performed a confirmatory analysis of the radiological impacts of transportation of spent fuel using RADTRAN 6.02 (Weiner et al. 2013-TN3390) to independently verify the results of PPL's ER calculations, with routing and population data obtained from TRAGIS 5.02 beta, where appropriate. Population data in the TRAGIS 5.02 beta code have been updated to the 2010 Census. The results of PPL's analysis were comparable to the results obtained by the NRC staff. Therefore, the NRC staff concludes that PPL prepared a reasonable and comprehensive analysis of the impacts of transporting unirradiated fuel to the proposed BBNPP site.

The results for the unirradiated fuel shipments based on the input values in Table 6-4 are as follows:

- worker dose: 2.26×10^{-3} person-rem/shipment (2.26×10^{-5} person-Sv/shipment)
- general public dose (onlookers/persons at stops and sharing the highway): 8.69×10^{-3} person-rem/shipment (8.69×10^{-5} person-Sv/shipment)
- general public dose (along route/persons living near a highway or truck stop): 1.54×10^{-4} person-rem/shipment (1.54×10^{-6} person-Sv/shipment).

Table 6-4. RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	4,230	PPL Bell Bend 2009-TN1563 [(a)]
Travel Distance – Rural	0.791	PPL Bell Bend 2009-TN1563
Travel Fraction – Suburban	0.192	PPL Bell Bend 2009-TN1563
Travel Fraction – Urban	0.017	PPL Bell Bend 2009-TN1563
Population Density – Rural, persons/km^2	11.4	PPL Bell Bend 2009-TN1563
Population Density – Suburban, persons/km^2	288	PPL Bell Bend 2009-TN1563
Population Density – Urban, persons/km^2	2,259	PPL Bell Bend 2009-TN1563
Vehicle speed – km/hr	88.49	Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	530	DOE 2002-TN418
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2,400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC 1972-TN22
Packaging length, m	9.1	Approximate length of two U.S. EPR fuel assemblies placed on end (Areva 2011-TN1419)
Number of truck crew	2	AEC 1972-TN22; NRC 1977-TN417; DOE 2002-TN418
Stop time, hr/trip	4	Based on one 30-min stop per 4 hr driving time (Griego et al. 1996-TN69)
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) (AEC 1972-TN22) provides a range of shipping distances between 40 km (25 mi) and 4,800 km (3,000 mi) for unirradiated fuel shipments. The actual 4,230 km shipping distance used in the PPL RADTRAN analysis (PPL Bell Bend 2009-TN1563) was assumed here.

These values were combined with the average annual shipments of unirradiated fuel for the AREVA U.S. EPR to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts calculated by the NRC staff to workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 0.5 mi of the highway) for transporting unirradiated fuel to the BBNPP site and alternative sites. The cumulative annual dose estimates in Table 6-5 were normalized to 1,100 MW(e) (880 MW(e) net electrical output). The NRC staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr) to onlookers, and 3 person-rem/yr to members of the public along the route.

Table 6-5. Radiological Impacts under Normal Conditions of Transporting Unirradiated Fuel to the Proposed BBNPP Site and Alternative Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-rem/yr per 1,100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH–1238)	6.3	1.1E-02	2.2E-02	1.9E-04
BBNPP and Alternative Sites U.S. EPR[(b)]	4.3	9.8E-03	3.8E-02	6.7E-04
10 CFR 51.52 (TN250), Table S–4 Condition	<1 per day	4	3	3

(a) Multiply person-rem/yr times 0.01 to obtain doses in person-Sv/yr.
(b) Based upon the number of shipments determined by the Reference COL (i.e., Calvert Cliffs COL) for the U.S. EPR, as documented in NUREG–1936 (NRC 2011-TN1980).

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council (2006-TN296), the Biological Effects of Ionizing Radiations VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from ICRP Publication 103 (ICRP 2007-TN422).

Both the National Council on Radiation Protection and Measurements (NCRP) and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (i.e., less than 1/0.00057, which is less than 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995-TN728; ICRP 2007-TN422). The largest annual collective dose estimate for transporting unirradiated fuel to the proposed BBNPP site and alternative sites was 2.3×10^{-2} person-rem, which is less than the 1,754 person-rem value that the ICRP and NCRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives approximately 311 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 2009-TN420). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be approximately 2.5×10^5 person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the proposed BBNPP site and alternative sites are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

Maximally Exposed Individuals Under Normal Transport Conditions

The NRC staff conducted a scenario-based analysis to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the proposed BBNPP site and the alternative sites. An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the proposed BBNPP site. The following discussion applies to unirradiated fuel, spent fuel, and radioactive shipments from any of the alternative sites. The analysis is based on information published by the U.S. DOE in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002-TN1236) and incorporates data about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the normalized fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 6.6 ft from the side of the transport vehicle. This assumption is conservative, in that the assumed dose rate is the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations (10 CFR Part 71-TN301). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (DOE 2002-TN418). The analysis is described below.

<u>Truck Crew Member</u>

Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. The NRC staff's analysis assumed that crew member doses are limited to 2 rem/yr, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005-TN1235). This limit is anticipated to apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. Because the substantial radiation shielding and accident resistance requirements of spent fuel shipping casks limit their capacities, there would be more shipments of spent nuclear fuel from the proposed BBNPP site and the alternative sites than there would be shipments of unirradiated fuel and radioactive waste other than spent fuel from these sites. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002-TN418). As a result, crew doses from unirradiated fuel and radioactive waste shipments would be lower than the doses from spent nuclear fuel shipments. The DOE administrative limit of 2 rem/yr (DOE 2009-TN1426) is less than the NRC limit for occupational exposures of 5 rem/yr (10 CFR Part 20-TN283).

The DOT does not regulate annual occupational exposures. It does recognize that air crew members are exposed to elevated cosmic radiation levels and recommends dose limits to air crew members from cosmic radiation (10 CFR Part 71-TN301). Air passengers are less of a concern because they do not fly as frequently as air crew members. The recommended limits are a 5-year effective dose of 2 rem/yr, with no more than 5 rem in a single year (10 CFR Part 71-TN301). As a result, a 2-rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the proposed BBNPP site and alternative sites.

Inspectors

Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. DOE (DOE 2002-TN1236) assumed that inspectors would be exposed for 1 hour at a distance of 3.3 ft from the shipping containers. At 3.3 ft, the dose rate is approximately 14 mrem/hr; therefore, the dose per shipment is approximately 14 mrem. This is independent of the location of the reactor site. Based on this conservative value and the assumption that the same person inspects all shipments of fuel and waste to and from the proposed BBNPP site and alternative sites, the annual doses to vehicle inspectors were calculated to be approximately 1.4 rem/yr, based on a combined total of 101 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is less than the 2 rem/yr DOE administrative control level (DOE 2005-TN1235) on individual doses and one-third of the 5 rem/yr NRC occupational dose limit.

Resident

The analysis assumed that a resident lives adjacent to a highway where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were extracted from PPL's RADTRAN 5.6 output files. These dose estimates are based on an individual located 100 ft from the shipments that are traveling 15 mph. For shipments of fuel and waste to and from the proposed BBNPP site and alternative sites, the potential radiation dose to the maximally exposed resident is approximately 0.06 mrem/yr.

Individuals Stuck in Traffic

This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hour at a distance of 4 ft. The analysis assumed this exposure scenario would occur only one time to any individual, and the dose rate was at the regulatory limit of 10 mrem/hr at 6 ft from the shipment. The dose to the MEI was calculated to be 16 mrem by DOE (DOE 2002-TN1236).

Persons at a Truck Service Station

This scenario estimates doses to an employee at a service station where all truck shipments to and from the proposed BBNPP site and alternative sites are assumed to stop. The NRC staff's analysis assumed this person would be exposed for 49 minutes at a distance of 52 ft from the loaded shipping container (DOE 2002-TN1236). The exposure time and distance were based on the observations discussed by Griego et al. (1996-TN69). This results in a dose of approximately 0.34 mrem/shipment and an annual dose of approximately 34 mrem/yr for the proposed BBNPP site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the proposed BBNPP site and alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Because of improvements in highway safety and security and an overall reduction in traffic accident, injury, and fatality rates since WASH–1238 (AEC 1972-TN22) was published, accident frequencies for transporting unirradiated fuel to the proposed BBNPP site and alternative sites are expected to be lower than those used in the analysis in WASH–1238, which forms the basis for Table S–4 of 10 CFR 51.52 (TN250). There is no significant difference in consequences of accidents severe enough to result in a release of unirradiated fuel particles to the environment between the AREVA U.S. EPR and current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH–1238. Consequently, consistent with the conclusions of WASH–1238 (AEC 1972-TN22), the impacts of accidents during transport of unirradiated fuel to an AREVA U.S. EPR at the proposed BBNPP site and alternative sites are expected to be smaller than the impacts listed in Table S–4 for current-generation LWRs.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the proposed BBNPP site and alternative sites; the analysis does not consider radiological or hazardous characteristics of the cargo. Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-kilometer traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is:

Impacts = (unit rate) × (round-trip shipping distance) × (annual number of shipments)

In this formula, impacts are presented in units of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-kilometer traveled) are used in the calculations.

For nonradiological related impacts, more recent accident, injury, and fatality rates from Table 2-23 of National Transportation Statistics 2013 (DOT 2013-TN3930). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the proposed BBNPP site and alternative sites.

The nonradiological accident impacts calculated by the NRC staff for transporting unirradiated fuel to (and empty shipping containers from) the proposed BBNPP site and alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH–1238 reference

LWR also are shown for comparison purposes. Note that, due entirely to the smaller number of shipments, only small differences exist between the impacts calculated for an AREVA U.S. EPR at the proposed BBNPP site and alternative sites and the reference LWR in WASH–1238 (AEC 1972-TN22).

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the Proposed BBNPP Site and Alternative Sites, Normalized to the Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Round-Trip Distance, km/yr	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
WASH–1238	6.3	3,200	4.0E+04	2.3E-01	1.4E-02	4.7E-04
BBNPP and Alternative Sites U.S. EPR	4.3	4,247	3.7E+04	1.4E-01	8.6E-03	3.0E-04

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the proposed BBNPP site and alternative sites to a spent fuel disposal repository. For the purposes of these analyses, the NRC staff considered the proposed geologic HLW repository at the Yucca Mountain site in Nevada as a surrogate destination. Currently, the NRC has not made a decision on the DOE application for the geologic HLW repository at Yucca Mountain. However, the NRC staff considers an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts on a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological and nonradiological environmental impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts, are discussed in this section. The NRC Yucca Mountain adjudicatory proceeding is currently suspended; however, on August 13, 2013, the U.S. Court of Appeals for the District of Columbia Circuit directed the NRC staff to continue the license review process until available funds are depleted or until Congress directs otherwise (In re Aiken County v. Nevada -TN3953). Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case Pennsylvania to Nevada.

This NRC staff analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Because of the large size and weight of spent fuel shipping casks, each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with those made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG–1437 (NRC 1999-TN289). Because the alternative transportation methods involve rail transportation or heavy-haul trucks that would reduce the overall number of spent fuel shipments (NRC 1999-TN289), thereby reducing impacts, these assumptions are conservative. In addition, the use of current shipping cask designs for this analysis results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (more than 5 years out of reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thus reducing the numbers of shipments and associated impacts.

In its ER, PPL used RADTRAN 5.6 (Weiner et al. 2008-TN302) to calculate the radiological impacts of transportation of spent fuel. Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2003-TN1234). The NRC staff performed a confirmatory analysis of the radiological impacts of transportation of spent fuel using RADTRAN 6.02 (Weiner et al. 2013-TN3390), with routing and population data obtained from TRAGIS 5.02 beta, where appropriate. Population data in the TRAGIS 5.02 beta code have been updated to the 2010 Census. In both the PPL and the NRC staff analyses, radiological impacts use the accident, injury, and fatality rates[(3)] from Table 4 in ANL/ESD/TM-150, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999-TN81). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the proposed BBNPP site. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999-TN81) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (Blower and Matteson 2003-TN410). The data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999-TN81), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as “incident-free” transportation, are transportation activities in which shipments reach their destination without an accident occurring en route. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation exposures would occur to the following individuals: (1) persons residing along the transportation corridors between the proposed BBNPP site and the alternative sites and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent fuel shipment; (3) persons at vehicle stops for refueling, resting, and vehicle inspections; and (4) transportation crew workers (drivers). For the purpose of this analysis, the NRC staff assumed that the destination for the spent fuel shipments is the proposed Yucca Mountain disposal facility in Nevada. This assumption is

[(3)] These data, although not the most current, are preferable for assessing radiological impacts because the state-by-state routes for these scenarios are well defined and the impacts are directly related to the routes.

conservative because it tends to maximize the shipping distance from the proposed BBNPP site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the AREVA U.S. EPR. Information in *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003-TN71) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, current shipping cask designs were used for the analysis of AREVA U.S. EPR spent fuel shipments. The NRC staff assumed the capacity of a truck shipment of AREVA U.S. EPR spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH–1238 (AEC 1972-TN22). In its ER (PPL Bell Bend 2013-TN3377), PPL assumed a shipping cask capacity of 1.8 MTU/shipment.

Input to RADTRAN includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code for highway routes from the proposed BBNPP site and alternative sites to the proposed geologic HLW repository at Yucca Mountain. The resulting route characteristics information is shown in Table 6-7. Note that for truck shipments, all the spent fuel is assumed to be shipped to the proposed Yucca Mountain site over designated highway-route controlled-quantity routes. In addition, TRAGIS data were loaded into RADTRAN on a state-by-state basis, which increases precision and allows the results to be presented for each state along the route between the proposed BBNPP site and alternative sites and Yucca Mountain, if desired.

Table 6-7. Transportation Route Information for Shipments from the Proposed BBNPP Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain, Nevada

Assumed Reactor Site	One-Way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
BBNPP and Alternative Sites	4,089.5	3,246.7	756.0	87.0	11.1	295.7	2,348.3	5

Note: This table presents aggregated route characteristics provided by TRAGIS (Johnson and Michelhaugh 2003-TN1234), including estimated distances from the alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN computer code was disaggregated to a state-by-state level.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number in the truck crew, stop time, and population density at stops. A list of the values for these and other parameters used in the NRC staff's analysis and the sources of the information is provided in Table 6-8.

For this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escort vehicles and drivers were considered, but they were not included in the analysis because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers and would be negligible. Stop times for refueling and resting were assumed to accrue at a rate of 30 minutes per 4-hour driving periods. TRAGIS outputs were used to estimate the number of stops. For this analysis, doses to the public at refueling and rest stops (also referred to "stop doses") are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is similar to that used by Sprung et al. (2000-TN222). Population densities and shielding factors were also taken from those of Sprung et al., which were based on the observations of Griego et al. (1996-TN69).

Table 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in DOE 2002-TN1236. Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	530	Weiner et al. 2008-TN302
Traffic count – Suburban, vehicles/hr	760	
Traffic Count – Urban, vehicles/hr	2,400	
Vehicle Occupancy, persons/vehicle	1.5	DOE 2002-TN1236
Dose Rate at 1 m from Vehicle, mrem/hr	14	DOE 2002-TN1236 – Approximate dose rate at 1 m that is equivalent to the maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle).
Packaging Dimensions, m	Length – 5.2 Diameter – 1.0	DOE 2002-TN1236
Number of Truck Crew	2	AEC 1972-TN22; NRC 1977-TN417; DOE 2002-TN1236
Stop Time, hr/trip	Route-specific	See Table 6-7
Population Density at Stops, persons/km^2	30,000	Sprung et al. 2000-TN222. Nine persons within 10 m of vehicle. See Figure 6-2.
Min/Max Radii of Annular Area Around Vehicle at Stops, m	1 to 10	Sprung et al. 2000-TN222
Shielding Factor Applied to Annular Area Surrounding Vehicle at Stops	1 (no shielding)	Sprung et al. 2000-TN222
Population Density Surrounding Truck Stops, persons/km^2	340	Sprung et al. 2000-TN222
Min/Max Radius of Annular Area Surrounding Truck Stop, m	10 to 800	Sprung et al. 2000-TN222
Dimensionless Shielding Factor Applied to Annular Area Surrounding Truck Stop	0.2	Sprung et al. 2000-TN222

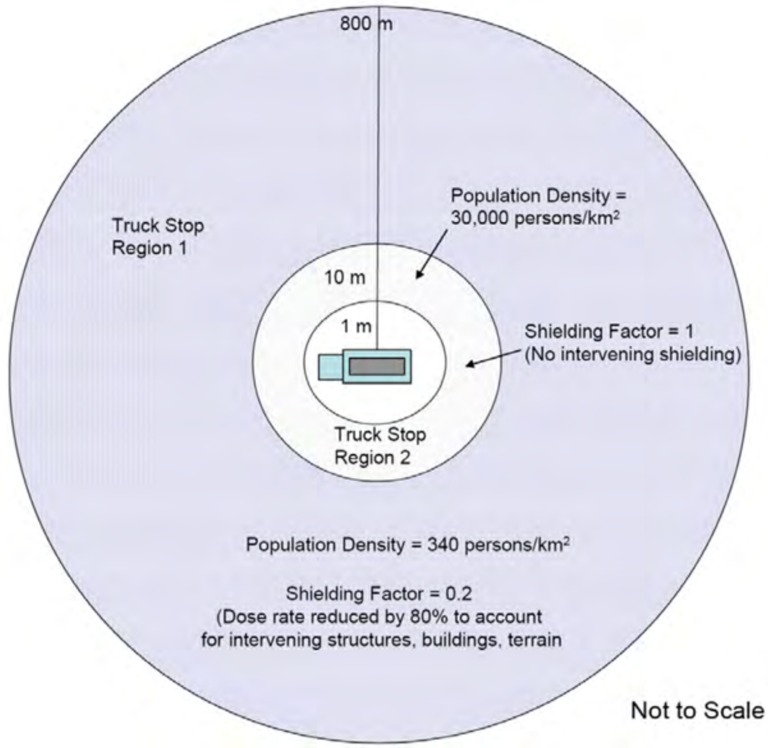

Figure 6-2. Illustration of Truck Stop Model

The results for these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed BBNPP site and alternative sites. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent fuel shipment), and persons along the route (persons living near the highway). Annual doses were calculated assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements. Shipping schedules for spent fuel generated by the proposed new unit have not been determined; therefore, this assumption was judged by the staff to be reasonable. Population doses were normalized to the reference LWR in WASH–1238 [880 net MW(e)] (AEC 1972-TN22). This corresponds to an 1,100-MW(e) LWR operating at 80 percent capacity.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the Proposed BBNPP Site and Alternative Sites to the Proposed HLW Repository at Yucca Mountain

	Normalized Impacts, Person-rem/yr[(a)]		
	Worker (Crew)	**Along Route**	**Onlookers**
Reference LWR (WASH–1238),	5.9	0.48	19
BBNPP and Alternate Sites [(b)]	4.3	0.35	14
Table S–4 Condition,	4	3	3

(a) To convert person-rem to person-Sv, divide by 100.
(b) PPL RADTRAN results from RAI T-1 (PPL Bell Bend 2009-TN1563).

Population doses were normalized to the reference LWR in WASH–1238 (880 net MW(e)) (AEC 1972-TN22). This corresponds to a 1,100-MW(e) LWR operating at 80 percent capacity. The normalized rounded-up number of annual spent fuel shipments is 44, compared to 60 for the reference LWR. This difference in annual shipment numbers is solely responsible for the differences in the radiation doses for the reference LWR and the AREVA U.S. EPR at the proposed BBNPP site as reported in Table 6-9.

There are only small differences in transportation impacts among the proposed BBNPP site and the three alternative sites. In general, the proposed BBNPP site has the same impacts as the alternative sites, primarily because all routes have approximately the same shipping distance to the proposed geologic HLW repository at Yucca Mountain. However, the differences among sites are minor and are less than the uncertainty in the analytical results.

The bounding cumulative doses to the exposed population given in Table S–4 are

- 4 person-rem/reactor year to transport workers
- 3 person-rem/reactor year) to general public (onlookers) and members of the public along the route.

The calculated population doses to the crew for the reference LWR and the BBNPP and alternative site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 are the longer shipping distances assumed for this analysis (i.e., to a repository in Nevada) than the distances used in WASH–1238 (AEC 1972-TN22). WASH–1238 assumed that each spent fuel shipment would travel a distance of 1,000 mi, whereas the shipping distances used in this assessment were approximately 2,481 mi. If the shorter distance was used to calculate the impacts for the BBNPP spent fuel shipments, the doses could be reduced by more than 50 percent. Other important differences are the model related to vehicle stops described above and the additional precision that results from incorporating State-specific route characteristics.

Where necessary, the NRC staff made conservative assumptions to calculate impacts associated with the transportation of spent fuel. Some of the key conservative assumptions are described below.

- *Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations.* The shipping casks assumed in the EIS prepared by DOE in support of the application for a geologic repository at the proposed Yucca Mountain repository (DOE 2002-TN1236) would transport spent fuel that has cooled for 5 years. Most spent fuel would have cooled for much longer than 5 years before being shipped to a geologic repository. Based on this, shipments from the proposed BBNPP site and alternative sites are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose rate projections and shipping cask capacities were used.
- *Use of shipping cask capacity used in WASH–1238.* The WASH 1238 analyses that form the basis for Table S–4 assumed that spent fuel would be shipped at least 90 days after discharge from a current LWR (AEC 1972-TN22). The spent fuel shipping casks described in WASH–1238 were designed to transport 90-day-cooled fuel, so their shielding and

containment designs must accommodate this highly radioactive cargo. Shipping cask capacities assumed in WASH–1238 were approximately 0.5 MTU per truck cask. DOE (DOE 2008-TN1237) assumed a 10-year cooling period for spent fuel to be shipped to a repository. This allowed DOE to increase the assumed shipping cask capacity to about 1.8 MTU per truck shipment of uncanistered spent fuel. The NRC staff believes this is a reasonable projection for future spent fuel truck shipping cask capacities. If this assumption were used in this EIS, the number of shipments of spent fuel would be reduced by about one-third with similar reductions in incident-free radiological impacts.

- *Use of 30 minutes as the average time at a truck stop in the calculations.* Many stops made for actual spent fuel shipments are of short duration (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided in Griego et al. (1996-TN69) indicate that a stop time of 30 minutes is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996-TN69) are on the order of 18 minutes. More realistic stop times would further reduce the population doses in Table 6-9.

A sensitivity study was performed to demonstrate the effects of using more realistic dose rates and stop times for the incident-free population dose calculations. For this sensitivity study, the dose rate was reduced to 5 mrem/hr, the approximate 50-percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000-TN222) for future spent fuel shipments. The stop time was reduced to 18 minutes per stop. All other RADTRAN 5.6 input values were unchanged. The result is that the annual crew doses were reduced to 1.5 person-rem/yr, or approximately 36 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 3.5 person-rem/yr (27 percent), and the annual doses to persons along the route were reduced to 0.11 person-rem/yr (37 percent). The NRC staff concludes that using more realistic parameters for shipment capacities, stop times, and dose rates would reduce the annual doses in Table 6-9 to below the Table S–4 values.

Using the linear, no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimate for transporting spent fuel from the proposed BBNPP site and alternative sites to the proposed geologic HLW repository at Yucca Mountain is approximately 14 person-rem/yr, which is less than the 1,754 person-rem value that ICRP (2007-TN422) and NCRP (1995-TN728) suggest would most likely result in zero excess health effects. Note that, because the route characteristics are different, estimated population doses from natural background radiation along the route from the proposed BBNPP site to Yucca Mountain are different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS. A generic route was used in Section 6.2.1.1 for unirradiated fuel shipments, and an actual highway route was used in this section for spent fuel shipments.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Transportation Accidents

In the ER, PPL used RADTRAN 5.6 (Weiner et al. 2008-TN302) to calculate the radiological impacts of accidents involving transportation of spent fuel. Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2003-TN1234). The NRC staff performed a confirmatory analysis of the radiological impacts of accidents involving transportation of spent fuel using RADTRAN 6.02 (Weiner et al. 2013-TN3390), with routing and population data obtained TRAGIS 5.02 beta, where appropriate to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN considers a spectrum of postulated transportation accidents, ranging from those with high frequencies and low consequences (e.g., "fender benders") to those with low frequencies and high consequences (i.e., accidents in which the shipping container is subjected to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from PPL's ER (PPL Bell Bend 2013-TN3377). Spent fuel inventories used in the NRC staff analysis are presented in Table 6-10. The list of radionuclides set forth in the table includes all the radionuclides that were included in the analysis conducted by Sprung et al. (2000-TN222). The NRC staff's analysis also included the inventory of crud, or radioactive material deposited on the external surfaces of LWR spent fuel rods. Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on AREVA U.S. EPR spent fuel are not available at this time. Accident impacts associated with transport of BBNPP AREVA U.S. EPR spent fuel were calculated assuming the cobalt-60 inventory in the form of crud is 76 Ci/MTU, based on information in Sprung et al. (2000-TN222).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71 (TN301). Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe postulated accident conditions with essentially no loss of containment or shielding capability. These casks are also designed with fissile material controls to ensure the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000-TN222), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The NRC staff assumed that shipping casks approved for transportation of spent fuel from an AREVA U.S. EPR would provide equivalent mechanical and thermal protection of the spent fuel cargo.

Accident frequencies are calculated in RADTRAN using user-specified accident rates and conditional shipping cask failure probabilities. State-specific accident rates taken from Saricks and Tompkins (1999-TN81) were used in the RADTRAN calculations. The State-specific accident rates were adjusted to account for under-reporting, as described in Section 6.2.2. Conditional shipping cask failure probabilities (i.e., the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000-TN222).

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for an AREVA U.S. EPR

Radionuclide	Ci/MTU[(a)]	Bq/MTU	Physical-Chemical Group
Am-241	1.25E+03	4.6E+13	Particulate
Am-242m	2.38E+01	8.8E+11	Particulate
Am-243	3.22E+01	1.2E+12	Particulate
Ce-144	1.52E+04	5.6E+14	Particulate
Cm-242	4.35E+01	1.6E+12	Particulate
Cm-243	3.19E+01	1.2E+12	Particulate
Cm-244	4.84E+03	1.8E+14	Particulate
Cm-245	6.19E-01	2.3E+10	Particulate
Co-60	7.59E+01	2.8E+12	Crud
Cs-134	5.84E+04	2.2E+15	Cesium
Cs-137	1.42E+05	5.3E+15	Cesium
Eu-154	1.16E+04	4.3E+14	Particulate
Eu-155	5.73E+03	2.1E+14	Particulate
I-129	4.65E-02	1.7E+09	Gas
Kr-85	1.05E+04	3.9E+14	Gas
Pm-147	3.54E+04	1.3E+15	Particulate
Pu-238	6.95E+03	2.6E+14	Particulate
Pu-239	4.24E+02	1.6E+13	Particulate
Pu-240	7.24E+02	2.7E+13	Particulate
Pu-241	1.17E+05	4.3E+15	Particulate
Pu-242	2.28E+00	8.4E+10	Particulate
Ru-106	2.05E+04	7.6E+14	Ruthenium
Sb-125	5.35E+03	2.0E+14	Particulate
Sr-90	1.03E+05	3.8E+15	Particulate
Y-90	1.03E+05	3.8E+15	Particulate

(a) Divide becquerel per metric ton uranium (Bq/MTU) by 3.7×10^{10} to obtain curies per MTU (Ci/MTU).

Source of spent fuel inventories: PPL Bell Bend 2013-TN3377, Table 7.4-3

In the ER, PPL used RADTRAN 5.6 to calculate accident risk using the radionuclide inventories given in Table 6-10. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments to derive estimates of the annual accident risks associated with spent fuel shipments from the proposed BBNPP site and the alternative sites to the proposed repository in Nevada.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000-TN222) were used to approximate the impacts from the AREVA U.S. EPR spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

RADTRAN calculates the population dose from the released radioactive material from four of five possible exposure pathways.[(4)] These pathways are described below:

- External dose from exposure to the passing cloud of radioactive material (cloudshine).
- External dose from radionuclides deposited on the ground by the passing plume (groundshine). The NRC staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.
- Internal dose from inhalation of airborne radioactive contaminants (inhalation).
- Internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The staff's analysis included the radiation exposures from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.

The NRC staff performed a confirmatory analysis using RADTRAN 6.02.[(5)] Because the results of the RADTRAN 5.6 are more conservative than RADTRAN 6.02, Table 6-11 presents the environmental consequences as calculated by PPL in the ER for transportation accidents when shipping spent fuel from the proposed BBNPP site and alternative sites to the proposed repository at Yucca Mountain. The NRC staff confirmed that the methodology and results in the ER are correct and conservative and are presented as the results in this section. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (see Section 6.2.2.1). The results are normalized to the WASH–1238 (AEC 1972-TN22) reference reactor (880-MW(e) net electrical generation, 1,100-MW(e) reactor operating at 80 percent capacity). The calculated population doses for the proposed BBNPP and alternative site shipments exceed the reference LWR values. The longer shipping distances assumed for this analysis (i.e., transport to a repository in Nevada) than the distances used in WASH–1238 are a key reason for the higher population doses. WASH–1238 (AEC 1972-TN22) assumed that each spent fuel shipment would travel a distance of 1,000 mi, whereas the shipping distances used in this assessment were approximately 2,481 mi. If the shorter distance was used to calculate the impacts for the BBNPP spent fuel shipments, the doses could be reduced by more than 50 percent.

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(4) Internal dose from ingestion of contaminated food was not considered because the staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

(5) RADTRAN 6.02, which is the only version available for use in this EIS and uses a less conservative approach than RADTRAN 5.6 for calculating population dose from an accident. RADTRAN 6.02 only reports ground shine doses over the evaluation time period of 1 day, which may be adjusted by the user. RADTRAN 5.6 calculates ground shine doses for three periods: the evaluation time, the evacuation period, and a longer period out to 50 years after necessary cleanup has occurred. For RADTRAN 6.02, this is equivalent to saying that either: 1) people are evacuated after the accident and never return (people are exposed for only the evaluation period), or 2) 1 day after an accident, the contaminated area is cleaned up to background. Depending on the half-life of the released radionuclide, this could result in RADTRAN 6.02 reporting groundshine doses that are about 3 orders of magnitude different than RADTRAN 5.6.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an AREVA U.S. EPR at the Proposed BBNPP Site and the Alternative Sites, Normalized to the Reference 1,100-MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, Person-rem/yr[(a)]
Reference LWR (WASH–1238)	1.8E-04
BBNPP and Alternate Sites[(b)]	1.28E-04

(a) Multiply person-rem/yr times 0.01 to obtain person-Sv/yr.
(b) PPL RADTRAN results from RAI T-1 (PPL Bell Bend 2009-TN1563)

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimates for transporting spent fuel from the proposed BBNPP site and the alternative sites to the proposed repository at Yucca Mountain are on the order of 1.0E-04 person-rem, which is less than the 1,754 person-rem value that the ICRP (2007-TN422) and the NCRP (1995-TN728) suggest would most likely result in zero excess health effects. This risk is very small compared to the estimated 1.6×10^5 person-rem that the same population along the route from the proposed BBNPP site to the proposed repository at Yucca Mountain would incur annually from exposure to natural sources of radiation.

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. Accident, injury, and fatality rates were taken from Table 2-23 of National Transportation Statistics 2013 (DOT 2013-TN3930). Nationwide median rates were used for shipments of spent fuel from the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport spent fuel from the proposed BBNPP site and alternative sites. The results calculated by the NRC staff are shown in Table 6-12.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the Proposed BBNPP Site and the Alternative Sites to Yucca Mountain, Normalized to the Reference LWR

		Nonradiological Impacts, per year		
Site	One-Way Shipping Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
BBNPP and alternate sites	4,090	3.3E-01	1.9E-02	6.7E-04

Note: The number of shipments of spent fuel assumed in the calculations is 44 shipments/yr after normalizing to the reference LWR.

6.2.3 Transportation of Radioactive Waste

The environmental effects of transporting waste other than spent fuel from the proposed BBNPP site and alternative sites are discussed in this section. The environmental conditions listed in 10 CFR 51.52 (TN250) that apply to shipments of radioactive waste are described below:

- Radioactive waste (except spent fuel) would be packaged and in solid form.

- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or rail.
- The weight limitation of 73,000 lb per truck and 100 T per cask per railcar would be met.
- The traffic density condition would be less than one truck shipment per day or three railcars per month.

Radioactive waste (other than spent fuel from the AREVA U.S. EPR) is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents estimates of annual waste volumes and annual waste shipment numbers for an AREVA U.S. EPR, normalized to the reference 1,100-MW(e) LWR defined in WASH–1238 (AEC 1972-TN22). The expected annual waste volumes for the AREVA U.S. EPR are estimated to be 7,345 ft^3/yr (PPL Bell Bend 2013-TN3377). The annual waste volume would exceed the volume for the 1,100-MW(e) reference reactor that was the basis for Table S–4. The annual number of waste shipments was estimated by PPL to be 15 shipments per year (PPL Bell Bend 2013-TN3377). The number of radioactive waste shipments estimated by PPL is smaller than the reference LWR because PPL assumed higher-capacity shipments than were assumed in WASH–1238. The NRC staff reviewed the shipment capacities assumed by PPL and concluded that these are reasonable assumptions based on current LWR operating experience. Therefore, even though the estimated annual waste volumes for the proposed BBNPP AREVA U.S. EPR may exceed those for the reference LWR, the number of shipments of radioactive waste to disposal facilities is anticipated be smaller than the number of shipments for the reference LWR in WASH–1238 (AEC 1972-TN22).

Table 6-13. Summary of Radioactive Waste Shipments from the Proposed BBNPP Site and the Alternative Sites

Reactor Type	Waste Generation Information, ft^3/yr	Annual Waste Volume, m^3/yr	Electrical Output, MW(e)	Normalized Rate, m^3/1,520 MW(e) Unit (880 MW(e) Net)[(a)]	Shipments/ 1,100 MW(e) (880 MW(e) Net) Electrical Output[(b)]
Reference LWR (WASH–1238)	3,800	108	1,100	108	46
BBNPP AREVA U.S. EPR	7,345[(c)]	208[(c)]	1,600[(c)]	120.4	52[b]

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972-TN22) and 95 percent for the AREVA U.S. EPR(PPL Bell Bend 2013-TN3377). Waste generation for the AREVA U.S. EPR is normalized to 880 MW(e) net electrical output (1,100-MW(e) unit with an 80 percent capacity factor.

(b) The number of shipments per 1,100 MW(e) was calculated by dividing the normalized rate by the assumed shipment capacity used in WASH–1238 (AEC 1972-TN22) (2.34 m^3/shipment). ER Table 5.11-4 (PPL Bell Bend 2013-TN3377) presents the number of shipments as 15 shipments/yr based on different container volumes than assumed in WASH–1238 (AEC 1972-TN22).

(c) Values from the ER (PPL Bell Bend 2013-TN3377).

Conversion: 1 m^3 = 35.31 ft^3

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste for an AREVA U.S. EPR located at the proposed BBNPP site and the alternative sites is less than the one truck shipment per day condition given in 10 CFR 51.52, Table S–4 (TN250).

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach as unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972-TN22). Because the actual destination is uncertain, national accident, injury, and fatality rates were taken from Table 2-23 of National Transportation Statistics 2013 (DOT 2013-TN3930). Nationwide median rates were used for shipments of radwaste from the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport radwaste from the proposed BBNPP site and alternative sites. The results are presented in Table 6-14.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the Proposed BBNPP Site

	Normalized Shipments per Year	One-Way Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
WASH–1238	46	800	6.7E-02	4.0E-03	1.4E-04
BBNPP AREVA U.S. EPR	52	800	7.6E-02	4.5E-03	1.6E-04

Note: The shipments and impacts have been normalized to the reference LWR (AEC 1972-TN22); expected waste volumes and shipments from the AREVA U.S. EPR (PPL Bell Bend 2013-TN3377) were used.

6.2.4 Conclusions

The NRC staff conducted an independent confirmatory analysis of the impacts under normal operating and accident conditions of transporting fuel and wastes to and from an AREVA U.S. EPR reactor proposed to be located at the proposed BBNPP site and at alternative sites considered in this EIS. To make comparisons to Table S–4 of 10 CFR 51.52 (TN250), the environmental impacts are normalized to a reference reactor year. The reference reactor is an 1,100-MW(e) reactor that has an 80 percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electric output for the proposed AREVA U.S. EPR at the proposed BBNPP site and the alternative sites to the electric output of the reference reactor.

Because of the conservative approaches and data used to calculate impacts, actual environmental effects are not likely to exceed those calculated in this EIS. Thus, the staff concludes that the environmental impacts of transporting fuel and radioactive wastes to and from the proposed BBNPP site and alternative sites site would be SMALL, and would be consistent with the environmental impacts associated with transporting fuel and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52 (TN250).

The NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case Pennsylvania to Nevada. The distance from the proposed BBNPP site or any of the alternative sites to any new planned repository in the contiguous United States would be no more than double the distance from the proposed BBNPP site or alternative sites to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent reactor fuel, as presented in this section, would provide a reasonable bounding estimate of the impacts to meet the needs of NEPA (42 USC 4321 et seq.-TN661). The NRC staff concludes that the environmental impacts of these doubled estimates would not be significant and, therefore, would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, NRC regulations require that the facility undergo decommissioning. The NRC defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75 and 10 CFR 50.82 (TN249). The radiological criteria for termination of the NRC license are in 10 CFR Part 20, Subpart E (TN283). Minimization of contamination and generation of radioactive waste requirements for facility design and procedures for operation are addressed in 10 CFR 20.1406 (TN283).

An applicant for a COL is required to certify that sufficient funds will be available to provide for radiological decommissioning at the end of power operations. As part of its COL application for the proposed BBNPP, PPL included a decommissioning funding report (PPL Bell Bend 2013-TN3377). PPL will establish a parent company guarantee to fund decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors (GEIS-DECOM)*, NUREG-0586, Supplement 1 (NRC 2002-TN665). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the U.S. EPR are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the U.S. EPR.

The GEIS-DECOM does not specifically address the GHG footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the GHG footprint of decommissioning to be of the order of 5.4×10^4 MT (i.e., 2.7×10^4 MT for the reference 1,000-MW(e) LWR multiplied by the scaling factor of 2) for one unit without SAFSTOR. This footprint is about one-third decommissioning workforce transportation and two-thirds equipment usage. The details of the NRC staff's estimate are presented in Appendix I for a single unit. A 40-year SAFSTOR period would increase the GHG footprint of decommissioning by about 40 percent. These GHG footprints are roughly three orders of magnitude lower than the GHG footprint presented in Section 6.1.3 for the uranium fuel cycle.

Therefore, the staff relies upon the bases established in GEIS-DECOM and concludes the following:

1. Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in GEIS-DECOM is used.
2. Occupational doses would be well below applicable regulatory standards during the license term.
3. The quantities of Class C or greater than Class C wastes generated would be comparable to or less than the amounts of solid waste generated by reactors licensed before 2002.
4. Air-quality impacts of decommissioning are expected to be negligible at the end of the operating term.
5. Measures are readily available to avoid potential significant water-quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
6. The ecological impacts of decommissioning are expected to be negligible.
7. The socioeconomic impacts would be short term and could be offset by decreases in population and economic diversification.

For the proposed BBNPP unit, the impacts from decommissioning are expected to be within the bounds described in the GEIS-DECOM for both the Bell Bend site and the alternative sites. On the basis of the GEIS-DECOM, and the evaluation of air-quality impacts from GHG emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

7.0 Cumulative Impacts

The review team, which includes staff from the U.S. Nuclear Regulatory Commission (NRC) and U.S. Army Corps of Engineers (USACE), evaluated the potential impacts of construction and operation of one new nuclear unit at the Bell Bend Nuclear Power Plant (BBNPP) site proposed by PPL Bell Bend, LLC (PPL) in its application for a combined construction permit and operating license (COL) (PPL Bell Bend 2008-TN396) and subsequent revisions (PPL Bell Bend 2009-TN432; PPL Bell Bend 2010-TN3616; PPL Bell Bend 2012-TN3617; PPL Bell Bend 2013-TN2625). In doing so, the review team considered potential cumulative impacts on resources that could be affected by the combination of construction, preconstruction, and operation of one AREVA NP Inc. (AREVA) U.S. Evolutionary Power Reactor (U.S. EPR) at the BBNPP site, and other past, present, and reasonably foreseeable future actions.

The National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq.-TN661), requires Federal agencies to consider the cumulative impacts of proposed actions under their review. Cumulative impacts may result when the environmental effects associated with the proposed action are compounded with temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. For purposes of this analysis, past actions are those prior to the receipt of the combined construction permit and operating license application. Present actions are those related to resources from the time of the combined construction permit and operating license application until the start of NRC-authorized construction of the proposed unit. Future actions are those that are reasonably foreseeable through the building and operation of the proposed BBNPP, including decommissioning. The review team considered cumulative effects of the proposed BBNPP with past, present, and reasonably foreseeable future actions. The geographic area over which these actions could contribute to cumulative impacts is dependent on the type of resource considered, and is described below for each resource area. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time on the same resources.

In accordance with Title 10 of the *Code of Federal Regulations* (CFR) Part 51 (TN250), impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned by the review team to each impact category, as presented in Chapter 1. The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions in the general area surrounding the BBNPP site that would affect the same resources affected by the proposed unit, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined as “cumulative” in 40 CFR 1508.7 (TN428), and include individually minor but collectively potentially significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past and present actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a) [TN249]) are described and characterized in Chapter 4 and those related to operations are described and characterized in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area.

This chapter includes an overall cumulative-impact assessment for each resource area. The specific resources that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operations for the proposed new unit as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could affect the same resources as the proposed action.

The review team visited the BBNPP site in April and May 2009, in May 2012, and in March 2014. The team then used the information provided in PPL's environmental report (ER), responses to requests for additional information, information from other Federal and State agencies, and information gathered during the BBNPP site visit to evaluate the cumulative impacts of building and operating a nuclear facility at the proposed site. To inform the cumulative analysis, the review team researched U.S. Environmental Protection Agency (EPA) databases for recent environmental impact statements (EISs) within Pennsylvania and for water discharge permits in the area to identify water-use projects. In addition, the review team used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5, 26 USC 1-TN1250). Other actions and projects that were identified during this review, and considered in the review team's independent analysis of the cumulative effects, are described in Table 7-1. Distances listed in Table 7-1 are from the planned power block location except as otherwise noted.

Table 7-1. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the BBNPP Cumulative Analysis

Project Name	Summary of Project	Location	Status
Nuclear Projects			
Susquehanna Steam Electric Station (SSES) Units 1 and 2	Two 1,140-MW(e) boiling water reactors, Unit 1 was issued an operating license in 1982, Unit 2 was issued an operating license in 1984. Extension of operations of SSES Units 1 and 2 for an additional 20-year period beyond the end of the current license term, or until 2042 and 2044, respectively. Power uprates - currently operating at 3,952 MW(t), 1,300 MW(e).	Adjacent	Operational (NRC 2014-TN3964). Renewed operating licenses issued November 2009 (NRC 2014-TN3964). Units 1 and 2 approved for combined 48-MW(t) (1.4%) power uprate in 2001 and combined 463-MW(t) (13%) power uprate in 2008 (NRC 2012-TN1538; NRC 2012-TN1900).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Susquehanna Steam Electric Station (SSES) Independent Spent Fuel Storage Installation	Dry spent fuel storage at the SSES site	Adjacent	Operational (NRC 2014-TN3964).
Limerick Generating Station, Units 1 and 2	Two 3,514-MW(t), 1,134-MW(e) boiling water reactors; Unit 1 was issued an operating license in 1985, Unit 2 was issued an operating license in 1989	65 mi SE of the BBNPP site	Operational (NRC 2014-TN3964). License renewed October 2014 (NRC 2012-TN1181; NRC 2012-TN1180). Units 1 and 2 approved for combined 260-MW(t) (17%) power uprate in 2011 (NRC 2012-TN1538). Water withdrawals from the Schuylkill River and Wadesville Mine pool were approved in May 2013 (DRBC 2013-TN3345).
Limerick Generating Station Independent Spent Fuel Storage Installation	Dry spent fuel storage at the Limerick site	65 mi SE of the BBNPP site	Operational (NRC 2014-TN3964).
Three Mile Island Nuclear Station, Unit 1	One 2,568-MW(t), 786-MW(e) pressurized water reactor; Unit 1 was issued an operating license in 1974	73 mi SW of the BBNPP site	Operational (NRC 2014-TN3964); renewed operating license issued in October 2009 (NRC 2014-TN3964).
Three Mile Island Nuclear Station, Unit 2	Unit 2 was issued an operating license in 1978. Unit 2 is currently in non-operating status	73 mi SW of the BBNPP site	Shut down (NRC 2014-TN3964). Shut down following an accident in 1979. Defueling was completed in April 1990 (NRC 2014-TN3285).
Peach Bottom Atomic Power Station, Unit 1	200-MW(t) high temperature, gas-cooled reactor operated from June 1967 to final shutdown on October 31, 1974	92 mi S of the BBNPP site	Shut down (NRC 2014-TN3964). All spent fuel has been removed and the spent fuel pool is drained and decontaminated; Unit 1 is in SAFSTOR status (NRC 2014-TN3346).
Peach Bottom Atomic Power Station, Units 2 and 3	Two 3,514-MW(t), 1,112-MW(e) boiling water reactors; Unit 2 was issued an operating license in 1973, Unit 3 was issued an operating license in 1974	92 mi S of the BBNPP site	Operational (NRC 2014-TN3964); renewed operating licenses issued in 2003 (NRC 2014-TN3964).
Peach Bottom Atomic Power Station Independent Spent Fuel Storage Installation	Dry spent fuel storage at the PBAPS site	92 mi S of the BBNPP site	Operational (NRC 2014-TN3964).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Other Energy Projects			
Hunlock Power Station	130-MW natural gas combined cycle (NGCC) facility	9 mi NE of the BBNPP site	Operational, switched from coal in 2010 (EPA 2014-TN3506).
PPL Martins Creek LLC, Harwood Oil Plant Pennsylvania	Oil-fired generation facility	12 mi SE of the BBNPP site	Operational (EPA 2014-TN3743).
PPL Martins Creek LLC, Jenkins Oil Plant Pennsylvania	Oil-fired generation facility	22 mi NE of the BBNPP site	Operational (EPA 2014-TN3742).
PPL Montour Electric Steam Station	1,550-MW coal -fired generation facility	27 mi W of the BBNPP site	Operational (PPL Corporation 2012-TN1191).
Intelliwatt Renewable Energy	13 MW biomass (wood) energy	27 mi SW of the BBNPP site	Proposed, secured 4.9 million state loan for construction in 2010 (IntelliWatt 2014-TN4037).
Good Spring	Two 337-MW NGCC units	33 mi SW of the BBNPP site	Proposed. Construction is scheduled to begin in June 2014 for NGCC1 (EmberClear 2014-TN3325).
Koppers Susquehanna Waste Plant	Pressure-creosoted timber products and cogeneration facility	36 mi NW of the BBNPP site	Operational (EPA 2014-TN3745).
Panda Patriot Power Plant	829-MW combined cycle natural gas-fired generating facility	36 mi W of the BBNPP in Lycoming County	Proposed. Formerly Moxie Patriot Power Plant, was acquired by Panda Power in 2013; projected commercial operations start date is 2016 (PPF 2013-TN3374).
Viking Energy of Northumberland Waste Plant	Biomass power-generation facility	37 mi SW of the BBNPP site	Operational (EPA 2014-TN3738; Biomass Magazine 2014-TN3923).
Shamokin Dam Project	4.5-MW hydroelectric power, added to the already existing USACE Shamokin Dam	38 mi SW of the BBNPP site	Proposed, Application for preliminary permit submitted August 2011 to Federal Energy Regulatory Commission (FERC) (76 FR 52656-TN1218).
White Deer Energy Project	7 MW tire derived energy	38 mi W of the BBNPP	Proposed, Application submitted Oct. 2011 to the Pennsylvania Department of Environmental Protection (White Deer Energy 2012-TN1188; White Deer Energy 2013-TN4035).
Bucknell University Gas Combined Heat and Power Plant	5-MW dual-fuel turbine generator set (natural gas- and oil-fired)	39 mi SW of the BBNPP site	Operational (Bucknell University 2014-TN3737).
Eureka Resources Wastewater Treatment Facilities	Fracking wastewater treatment	Two sites: 47 mi N of BBNPP (new construction) and 49 mi W of BBNPP (operational since 2008)	Construction began in March of 2013 (Eureka Resources 2013-TN2615). Became operational in October 2013 (Williams 2013-TN3613; Eureka 2014-TN3673). Industrial waste permit (PA Bulletin 2014-TN3501; Lowenstein 2013-TN3510).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Panda Liberty Power Plant	829-MW NGCC facility	48 mi N of the BBNPP in Bradford County	Proposed. Projected commercial operations start date early 2016. Formerly Moxie Liberty. Air permit received in 2012 and revised in 2013 (PPF 2013-TN3373).
Tenaska Lebanon Valley Generating Station	Up to 950-MW natural gas-fired facility	50 mi S of the BBNPP site	Proposed. Construction to begin in 2015; expected online in 2018 (Tenaska 2014-TN3533).
Blossburg Generating Station	24-MW natural gas-fired facility	63 mi NW of the BBNPP site	Operational (EPA 2014-TN3744).
Brunner Island Power Plant	1,490-MW three-unit, coal-fired facility (PPL owned)	73 mi SW of the BBNPP site	Operational (EPA 2014-TN3531; PPL Corporation 2014-TN3672).
Susquehanna-Roseland 500 kV transmission line and other transmission lines in the region	500-kV power transmission lines	Throughout the region	Proposed. Draft EIS submitted December 2011 (NPS 2012-TN1209; FERC 2008-TN1510). Construction started in 2012. Projected to be in service in June 2015 (PSEG 2014-TN3635).
Marcellus gas pipeline	Natural gas transmission pipeline	Will originate in Lycoming County, proceeding south to Maryland	Proposed; completion planned for 2015 (The Times Tribune 2012-TN1210; FERC 2006-TN1511; MDN 2014-TN3488; PADEP 2013-TN1935).
Atlantic Sunrise Project	Natural gas transmission pipeline	Throughout the region in Columbia and Luzerne Counties	Includes Central Penn pipeline; FERC process has begun and construction is anticipated for summer 2016 (Williams 2014-TN3614).
Other fossil fuel operational energy projects	Numerous operating fossil fuel power generating facilities (e.g., Wheelabrator Frackville Energy Coal Plant, Foster Wheeler Mt Carmel Cogen Coal Plant, Northeastern Power Co/McAdoo Cogen, Lakeside, Saint Nicholas Cogeneration Project, Gilberton Power Co., Kline Township)	Throughout the region	Operational (EPA 2012-TN1193; EPA 2012-TN1192; EPA 2014-TN3341; EPA 2014-TN3500; EPA 2014-TN3735; EPA 2014-TN3736; EPA 2014-TN3928; Lakeside Energy 2013-TN3534).
Wind energy projects	Various wind power generating projects (e.g., Locust Ridge Wind Farm, Locust Ridge II, Bear Creek Wind Farm, Laurel Hill Wind Farm, Mehoopany Wind Farm, and Mahanoy Mountain Wind Farm)	Throughout the region	Operational (Community Energy 2012-TN1195; Iberdrola Renewables 2012-TN1194; Sempra 2013-TN3343; Duke Energy 2014-TN3338). Proposed (TFCPL 2012-TN3342).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Solar energy projects	Various solar power generating projects (e.g., Romark PA Solar, Masser Farms Realty Solar)	Throughout the region	Operational (EPA 2014-TN3339; Masser 2014-TN3340).
Hydropower energy projects	Various water power projects (e.g., Goodyear Lake Hydroelectric Project, Safe Harbor Water Power Corporation, York Haven Hydroelectric Project, Muddy Run Pumped Storage Facility, and PPL Holtwood) and proposed water projects (i.e., Francis Walter Hydroelectric Project)	Throughout the region	Operational (Enel 2012-TN1603; Safe Harbor 2012-TN1604; Olympus 2012-TN1600; Exelon 2012-TN1595; Exelon 2012-TN1596; PPL Corporation 2012-TN1594). Proposed (76 FR 73619-TN3621; FERC 2013-TN3622).
Mining Projects			
Spike Island operation	Coal refuse removal	3.5 mi N of the BBNPP site	Application pending. Water permit pending from the Susquehanna River Basin Commission (SRBC 2012-TN1196).
Various surface and subsurface mining projects	Numerous operating anthracite and stone/quarry mining facilities such as: Bear Gap Stone/Quarry, UAE Coal Corp/Harmony Mine	Throughout the region	Operational (EPA 2012-TN1289; EPA 2012-TN1290; EPA 2012-TN1197; EPA 2012-TN1198).
Mt. Pisgah uranium deposit	Uranium mines	23 mi SE of the BBNPP site	Test mines carried out in the 1950's, never developed commercially (Klemic and Baker 1954-TN1998).
Various Marcellus natural gas projects	Natural gas-extraction sites	13 plus mi N and NW of the BBNPP site	Operational and Proposed (PDCNR 2012-TN3505; SRBC 2013-TN1999).
Various acid mine drainage and abandoned mine remediation	Mine remediation	Throughout the region	Ongoing (PADEP 2014-TN3503).
Nescopeck Outfall	Mine drainage, mine runoff	About 5 mi SW of the BBNPP site	Requires Total Maximum Daily Loads (pollutant budget) be maintained (PADEP 2005-TN690; PADEP 2014-TN3504).
Transportation Projects			
Susquehanna River transportation projects	Bridge replacements, road, traffic, and pedestrian projects	Throughout the region	Ongoing (PennDOT 2011-TN1221).
Parks and Aquaculture Facilities			
Ricketts Glen State Park	Activities include picnicking, boating, swimming, camping, fishing, and hiking	15 to 18 mi N of the BBNPP site	Development unlikely in this park (PDCNR 2012-TN1199).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Nescopeck State Park	Activities include hunting, fishing, and hiking	13 to 15 mi E of the BBNPP site	Development unlikely in this park (PDCNR 2012-TN1200).
Other State Parks	Various other State parks such as Lehigh Gorge, Hickory Run, Locust Lake, Frances Slocum, Tuscarora, Shikellamy, Beltzville, Loyalsock Township Riverfront Park	Throughout the region	Development unlikely in these parks (PDCNR 2012-TN1201; PDCNR 2012-TN1202; PDCNR 2012-TN1203; PDCNR 2012-TN1204; PDCNR 2012-TN1205; PDCNR 2012-TN1207; PDCNR 2014-TN3517; Van Auken 2014-TN3986).
State Game Land 260	Public recreational activities	2 mi NW of the BBNPP site	Development unlikely in this area (PGC 2012-TN1223).
Cherry Hill National Wildlife Refuge	Hiking, wildlife viewing	46 mi SE of the BBNPP site	Development unlikely in this refuge (FWS 2012-TN1208).
Other State Game Lands	Public recreational activities	Throughout the region	Development unlikely in these areas (PGC 2012-TN1223).
Other Actions/Projects			
Assorted flood control projects	Construction of levees, floodwalls, closure structures, and interior drainage structures	Throughout the region	Ongoing (PADEP 2014-TN3502).
Sandy/Longs Run	Abandoned mine drainage restoration	Throughout the region	Ongoing (USACE 2012-TN1222).
Various waste water treatment facilities	Sewage treatment	Throughout the region	Operational
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Throughout the region	Operational
Safety Light Corporation	Manufacturing, former user of radioactive materials	14 mi SW of the BBNPP site	Superfund site, cleanup of radioactive waste in process (NRC 2012-TN1211).
Procter and Gamble Mehoopany Mill	Paper products and natural gas power generation for facility use	33 mi N of the BBNPP site	Operational (EPA 2012-TN1212).
US Gypsum	Wallboard manufacturing facility	28 mi W of the BBNPP site	Operational (EPA 2014-TN3499; Walbridge 2012-TN1213).
Cherokee Pharmaceutical Plant	Steam generation (natural gas) facility for pharmaceutical production	28 mi SW of the BBNPP site	Operational (EPA 2012-TN1214).
Great Dane Trailers	Trailer manufacturing	26 mi SW of the BBNPP site	Operational (Great Dane 2014-TN3514).
Benton Foundry	Iron Foundry	17 mi NW of the BBNPP	Operational (EPA 2012-TN1215).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Foam Fabricators Inc. Bloomsburg Plant	Plastics and foam products	10 mi W of the BBNPP site	Operational (EPA 2012-TN1216).
KYDEX LLC	Plastics manufacturing	12 mi W of the BBNPP site	Operational (EPA 2012-TN1217).
Corixa Corporation	Pharmaceutical preparations	75 mi SW of the BBNPP site	Operational (EPA 2012-TN1590).
Hershey Foods Corporation	Chocolate and cocoa products	63 mi SW of the BBNPP site	Operational (EPA 2012-TN1293).
Jersey Shore Steel Company	Blast furnace/steel works/rolling	60 mi W of the BBNPP site	Operational (EPA 2012-TN1291).
Seedco Industrial Park	Various industry and energy projects	28 mi SW of the BBNPP site	Operational and proposed (Jones Lang Laselle 2012-TN1292).
Adam T. Bower Memorial Dam	Inflatable dam used in summer to make reservoir	39 mi SW of the BBNPP site	Seasonal (Sunbury 2014-TN3516).
Various other large scale industrial and manufacturing facilities	Industrial facilities	Throughout the region	Operational (EPA 2012-TN1592; EPA 2012-TN1590; EPA 2012-TN1589; EPA 2012-TN1588; EPA 2014-TN3489; EPA 2014-TN3490; EPA 2014-TN3491; EPA 2014-TN3739; EPA 2014-TN3740).
Misc. golf courses	Golf courses	Throughout the region	Operational.
Future urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; and water and/or wastewater treatment and distribution facilities and associated pipelines as described in local land-use planning documents	Throughout the region	Construction would occur in the future, as described in state and local land-use planning documents.

7.1 Land-Use Impacts

The description of the affected environment in Section 2.2 serves as a baseline for the cumulative impacts assessment for land use. As described in Section 4.1, the NRC staff concludes that the impacts of NRC-authorized construction on land use would be SMALL and no further mitigation would be warranted. As described in Section 5.1, the review team concludes that the impacts of operations on land use would also be SMALL and no further mitigation would be warranted.

As described in Section 4.1, the combined impacts from construction and preconstruction were determined to be SMALL and no further mitigation would be warranted. In addition to land-use impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts.

For this cumulative impacts analysis, the geographic area of interest is the area within a 25-mi radius of the BBNPP site. The review team determined that a 25-mi radius would represent the area that would be most likely influenced by the proposed BBNPP because it includes the primary counties (i.e., Luzerne and Columbia) and communities (i.e., Berwick, Bloomsburg, Hazleton, Wilkes-Barre, and Scranton) that would be affected. The geographic area of interest also includes lands bordering or otherwise closely associated with water features (such as shorelines, riparian zones, floodplains, and water-based recreation areas) affected by PPL's proposed consumptive-use mitigation plan activities described in Sections 2.2.2 and 2.3.2.1.

Historically, mining and agriculture have been the primary land uses within the 25-mi geographic area of interest surrounding the BBNPP site. The area has developed with residential, commercial, and industrial uses in and around cities and boroughs. Many of the region's communities are located near the Susquehanna and Lackawanna Rivers. These communities include Scranton and Wilkes-Barre, the region's largest urban centers. Settlement in the region began in 1769 with colonists drawn to the fertile Wyoming Valley in Luzerne County (McCormack Taylor et al. 2011-TN2226).

The region remained mostly agricultural or forested until the 1830s when the mining industry established a major presence. The presence of coal and iron ore deposits combined with completion of a canal system and installation of railroad service resulted in an industrial boom that brought large numbers of workers and their families to the region. Growth extended to smaller outlying towns and villages and mining companies developed and operated small villages near their coal mines. In the 1850s, mills and factories began operation along the Susquehanna and Lackawanna Rivers, as well as in other areas in the region (McCormack Taylor et al. 2011-TN2226).

The regional economy began to wane by the 1930s and, except for a short period during World War II, continued to decline into the 1950s. With the popularity of the automobile in the late 1950s, residential and retail development began to occur outside of the region's valleys and into its rural townships. Improvements to the transportation system, including completion of the interstate highway system, furthered this pattern of dispersion of population from major urban centers (McCormack Taylor et al. 2011-TN2226).

Moderate growth and development has continued across the region, converting agricultural land and forests to urban uses. At the same time, a counter trend in the region has been the conversion of agricultural land to forest. The economic downturn of the late 2000s has resulted in a decreased rate of growth and development throughout most of the region. Population growth has continued in Carbon County to the east and Columbia County to the west; however, most other counties surrounding the BBNPP site have experienced a slow population decline since 2000 (PDCED 2011-TN2225).

Based on review of the other reasonably foreseeable future projects considered in the cumulative analysis (Table 7-1), the only specific project within the 25-mi radius of the BBNPP site with the potential to have noticeable cumulative impacts on land use is the Susquehanna to Roseland 500-kV transmission-line project, which is currently being built. This project involves building a new 145-mi transmission line between the proposed 500-kV switchyard on the SSES site and the Roseland Substation in New Jersey. Approximately 95 percent of the new transmission line will follow the path of an existing transmission line. Most of the new transmission-line right-of-way within the 25-mi region of interest would cross a low-density rural landscape that is primarily agricultural land and forest. In addition, the new transmission line would cross several roads and highways. Where new transmission-line right-of-way would cross farmland, agricultural activities would be allowed to continue and the effect of these corridors on land usage would be minimal. The new transmission line is expected to be in service before the summer peak electricity demand period of 2015 (PPL Electric Utilities Corporation 2012-TN1892). The route crosses the northern part of the BBNPP project area, but it would not conflict with land-use changes proposed as part of the BBNPP project.

Ongoing urbanization in the geographic area of interest could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increase in residential and industrialized areas. However, if recent trends described for the surrounding area (PDCED 2011-TN2225) continue, the region is likely to experience continued slow rates of development.

Future climate change could result in changes in land use in the geographic area of interest. Recent studies (PADEP 2009-TN2228) project that the climate in the State of Pennsylvania will become warmer and wetter over the next 20 years. While the amount of forest cover is not expected to change due to climate change, the composition of the forest is expected to change as cooler climate-oriented species decline. Agriculture in the region may benefit and be more productive due to the increased length of the growing season. On the other hand, crops may suffer from longer periods of drought interspersed with an increased frequency of extreme precipitation events. The increased frequency of extreme precipitation events could discourage further development in flood-prone areas.

The lands associated with water features potentially affected by consumptive-use mitigation plan activities have been substantially altered by historical activities intended to control water flow and enhance navigation as well as by the same patterns of land settlement described for the landscape surrounding the BBNPP site. These areas are also subject to the same patterns of effects described above regarding continued future urbanization and climate change. But the review team is not aware of any specific ongoing or reasonably foreseeable projects that, when considered cumulatively with the expected consumptive-use mitigation plan activities, would noticeably alter land-use patterns in the affected areas.

Based on its evaluation, the review team concludes that the cumulative land-use impacts associated with construction, preconstruction, and operations of the proposed BBNPP and other past, present, and reasonably foreseeable projects in the geographic area of interest would be SMALL and no mitigation would be warranted.

7.2 Water Use and Quality

The section addresses the cumulative water-use and water-quality impacts from building and operating the proposed BBNPP and other past, present, and reasonably foreseeable future projects.

7.2.1 Water-Use Impacts

The section describes the cumulative water-use impacts from construction, preconstruction, and operation of the proposed BBNPP and other past, present, and reasonably foreseeable projects.

7.2.1.1 Surface-Water-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for surface-water use. As described in Section 4.2.2.1, the impacts from NRC-authorized construction of surface-water uses would be SMALL. As described in Section 5.2.2.1, the review team concludes that the impacts of operations on surface-water use also would be SMALL.

The combined surface-water-use impacts from construction and preconstruction are described in Section 4.2.2.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water use also considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. For the cumulative analysis of impacts on surface-water use, the geographic area of interest is considered to be the drainage basin of the Susquehanna River upstream and downstream of the BBNPP site because other actions within this region could result in a cumulative impact.

Dams have been installed on the river to provide flood control, increase the reliability of the water supply to the region, and provide hydropower. The major reservoirs in the Susquehanna River Basin upstream of the BBNPP site are listed in Table 2-6. These dams, all of which were designed for flood control, were completed by 1980, and have thus been altering flows in the basin for over 30 years. Because the evaluations of the effects of hydrologic alterations described in Sections 4.2 and 5.2 were based on stream and river flows observed after 1980, the contributions of the dams to these evaluations are implicitly included in the review team's impact assessments, and do not require additional consideration here.

Past and present surface-water use in the Susquehanna River Basin is described in Section 2.3.2. Historically, the Susquehanna River has provided water for agriculture, industrial, and municipal uses since the 1700s. The Susquehanna River Basin Commission (SRBC), formed in 1971, has regulatory authority over withdrawals and consumptive use in the basin. As described in Section 2.3.2, the SRBC has adopted a comprehensive plan to guide its water-resource-management and -development activities (SRBC 2013-TN3568). Public water supply and power generation are currently the major water uses in the basin, comprising 84 percent of the total use approved by SRBC (SRBC 2008-TN699). Based on a review of the history of water-use and water-resources planning in the Susquehanna River Basin, the review team determined that past and present use of the surface waters in the basin has been noticeable, necessitating consideration, development, and implementation of careful planning.

In its comprehensive plan, the SRBC identified water-resources needs in the basin related to (1) sustainable water-resources development, (2) improved water quality, (3) improved flood-hazard mitigation, (4) achievement of healthy ecosystems, and (5) restoration of Chesapeake

Bay, including the implementation of measures to address minimum flow requirements from the river to the bay (SRBC 2013-TN3568). According to SRBC projections, population in the basin will increase 4.4 percent between 2010 and 2030, with this growth occurring almost entirely in the Lower Susquehanna sub-basin. Growth is projected to decrease about 2 percent during the same period in the Middle and Upper Susquehanna sub-basins and about 7 percent in the Chemung sub-basin. Consumptive use in the basin is projected to increase by about 320 Mgd (495 cfs) between 2005 and 2025 (SRBC 2013-TN3568), with a substantial portion of this occurring in the Middle Susquehanna sub-basin (SRBC 2008-TN699). Areas designated by the SRBC as potentially stressed or water challenged are primarily located in the Lower Susquehanna sub-basin. The SRBC currently does not have adequate storage to meet the mitigation needs of the projected future consumptive use, and is considering development of new storage and changes to the consumptive-use fee structure, among other approaches to address consumptive-use mitigation throughout the Susquehanna River Basin (SRBC 2013-TN3568).

Of the projects listed in Table 7-1, those that were considered for cumulative impacts to the surface-water resource are natural gas extraction, and the continued operation of the SSES and other power-generation facilities. Other projects listed in Table 7-1 either do not affect the surface-water resource or their surface-water use is insignificant.

Natural gas power plants planned as future projects within the watershed will not require a significant water supply to operate. However, unconventional gas extraction typically requires water for hydraulic fracturing, and the use of this practice is reasonably foreseeable within the watershed. As described in Section 2.3.2, the SRBC estimates that the unconventional gas industry currently uses 10.4 Mgd of water basin-wide, and expects unconventional gas production to use as much as 30 Mgd when the industry is mature. The SRBC has developed new regulations for unconventional gas extraction, including requiring a permit for any water use, no matter how small (SRBC 2013-TN3568). The total projected consumptive use of water for unconventional gas extraction is less than 10 percent of current basin-wide consumptive use (excluding public water supply diversions), and is expected to remain a relatively small proportion of total consumptive use in the future. Unconventional gas development is distributed throughout the basin and has primarily occurred in small watersheds, where the water use may significantly impact the small streams affected. It is these localized impacts that are of the greatest concern and not the cumulative impacts from the total unconventional gas industry water use. Recently developed waterless fracturing technology also may reduce future consumptive use for gas extraction. The review team concludes that the cumulative impacts of unconventional gas extraction on the surface-water resources of the Susquehanna River Basin would be minor.

As described in Section 4.2.2, surface water would not be used to support building activities for the proposed BBNPP. The surface-water-use impacts for the proposed BBNPP are dominated by the demands that would occur under normal operation. The projected normal and maximum consumptive use by the proposed BBNPP is expected to be approximately 38 and 42 cfs (24.5 and 27 Mgd), respectively (see Chapter 3). As described in Section 5.2.2, the consumptive-use rate used by the review team to assess impacts from operation of the proposed BBNPP was 43 cfs (28 Mgd), the rate requested in PPL's application to the SRBC for water withdrawal and consumptive use. This rate is about 0.3 percent of the mean annual Susquehanna River discharge at Wilkes-Barre of 14,400 cfs. This mean annual discharge is for the period after the construction of all major upstream dams, and it reflects the cumulative consumptive use of current users. Total consumptive use of water in the Susquehanna River Basin upstream of the BBNPP site is anticipated to increase by about 160 cfs between 2005 and 2025 (SRBC 2008-TN699). This amount of consumptive use is about 1 percent of the mean annual flow at Wilkes-Barre and would result in minor cumulative impacts at that flow rate. However, during low-flow conditions, cumulative impacts from an additional 160 cfs of consumptive use would be significant without mitigation. Addressing the need for additional consumptive-use mitigation in the basin is a primary concern of the SRBC (SRBC 2008-TN699; SRBC 2012-TN2453; SRBC 2013-TN3568).

PPL's primary plan for consumptive-use mitigation for the proposed BBNPP is described in Sections 2.2.2 and 2.3.2.1. Under PPL's plan, the source of water for consumptive-use mitigation for the proposed BBNPP would be Cowanesque Lake, which also would continue to be used as the source of water for consumptive-use mitigation for SSES Units 1 and 2. The impacts arising from the implementation of PPL's primary plan are discussed in Section 5.2.2.1. The effect of the combined mitigation releases for the proposed BBNPP and SSES Units 1 and 2 on flows in the Cowanesque River downstream of Cowanesque Lake were evaluated by the review team and found to be minor. Because the combined releases were considered, the review team concludes that the cumulative impacts on the Cowanesque River from the operation of the proposed BBNPP and SSES Units 1 and 2 would be minor.

The review team also evaluated the cumulative impact on Cowanesque Lake from the combined operation of the proposed BBNPP and SSES Units 1 and 2 (Meyer 2014-TN3566). As described in Section 5.2.2.1, with the proposed BBNPP operating, the review team's analysis used releases of 62 cfs from Cowanesque Lake for consumptive-use mitigation for SSES Units 1 and 2, and releases of 43 cfs for consumptive-use mitigation for the proposed BBNPP. Mitigation releases for SSES Units 1 and 2 were triggered by P95 flows at Wilkes-Barre (shown in Table 2-10). Releases for the proposed BBNPP were triggered by flows at Wilkes-Barre specified by the SRBC (shown in Table 5-2). The combined cumulative mitigation releases would typically be less than 2,000 ac-ft and result in less than 2 ft of drawdown in Cowanesque Lake elevation. However, during relatively dry years, combined cumulative-use mitigation releases would be from about 7,000 to 11,000 ac-ft, which would result in about 8 to 12 ft of drawdown in the surface elevation of Cowanesque Lake. Drawdown of this magnitude would be noticeable and would adversely affect recreational use of Cowanesque Lake. Water conditions were sufficiently low in about 1 out of 10 years during the period of data evaluated by the review team (1981 to 2013) to produce cumulative impacts on the lake of this magnitude.

No cumulative effects to Moshannon Creek would accrue from the combined operation of the proposed BBNPP and SSES Units 1 and 2. In addition, consumptive-use mitigation for the proposed BBNPP would eliminate any impacts of that use downstream of the BBNPP site during low-water conditions. Therefore the review team concludes that the incremental contribution to the cumulative impacts on the Susquehanna River from operation of the proposed BBNPP would be minor.

The review team also is aware of the potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. A recent compilation of the state of the knowledge in this area (GCRP 2014-TN3472) was considered in the preparation of this EIS. Projected changes in the climate for the northeast region of the United States during the life of the proposed BBNPP include an increase in average temperature of 3 to 6°F by the 2080s if global emissions of heat-trapping gases are reduced substantially (and an increase of 4.5 to 10°F with continued increasing global emissions). The review team anticipates that an increase in average surface air temperatures would lead to increases in average stream and river water temperatures. Along with the higher average temperatures, increases are expected in the frequency, intensity, and duration of heat waves. Increases in winter and spring precipitation are projected; averaged over the entire region, winter precipitation is projected to increase from 5 to 20 percent. Projected changes in summer and fall precipitation at the end of the century are small compared to natural variation. Annual precipitation is projected to increase as is the annual runoff and associated stream discharge. The amount of precipitation falling in heavy events is expected to increase. Risk of drought conditions in summer and fall is projected to increase as a result of higher temperatures. The hydrologic changes that are attributed to climate change in this study (GCRP 2014-TN3472) are not insignificant. However, while these changes may noticeably alter the resource, the review team did not identify anything that suggests the cumulative impacts would destabilize the water resources with the Susquehanna River Basin.

Mainly, because of extensive past and present use of surface water in the Susquehanna River Basin, the review team determined that the cumulative impacts to surface-water resources in the geographic area of interest would be MODERATE. However, the review team further concludes that the incremental impact on surface-water use from NRC-authorized activities would be SMALL.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as the baseline for the cumulative-impact assessment for groundwater use. As described in Section 4.2.2.2, the impacts on groundwater resources from NRC-authorized construction activities would be SMALL. As described in Section 5.2.2.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL.

The combined groundwater-use impacts from construction and preconstruction are described in Section 4.2.2.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for groundwater use also considers other past, present, and reasonably foreseeable future actions that could potentially affect groundwater use. For the cumulative analysis of impacts on groundwater, two geographic areas of interest have been identified: (1) the proposed BBNPP site and the surrounding area that could be affected by dewatering activities during preconstruction and construction, and (2) the area contributing to the Pennsylvania America Water Company well system that is the source of water for site activities during preconstruction and construction and for potable and sanitary uses during operations.

During preconstruction and construction activities, dewatering operations would temporarily lower groundwater levels in the vicinity of the BBNPP site, primarily in the Glacial Outwash aquifer. As discussed in Section 4.2.2.2, the review team determined that dewatering activities would have a minor effect on nearby groundwater supply wells because of the distance to these wells, the location of these wells in the bedrock aquifer, or the location of the wells outside of the Walker Run watershed. In addition, none of the projects listed in Table 7-1 are located in the region of interest influenced by the dewatering activities.

PPL has indicated that no onsite groundwater would be used during construction or operation of the proposed BBNPP. As described in Sections 4.2.2.2 and 5.2.2.2, the water needed for construction and operation (non-cooling) uses would be provided by a pipeline from the Pennsylvania America Water Company well system in Berwick. The amounts required would be less than 11 percent of the available unused capacity of the Pennsylvania America Water Company system. As described in Section 7.2.1.1, population in the Middle Susquehanna sub-basin is anticipated to decrease 2 percent between 2010 and 2030. The review team considered water use by the adjacent SSES as the only likely past and present activity in the vicinity that could affect the groundwater resource. As described in Section 2.3.2, the SSES uses groundwater for plant operation from two onsite wells screened in the Glacial Outwash aquifer, with a combined potential production capacity of approximately 200 gpm. However, this groundwater use is to the east of Confers Lane, outside the Walker Run watershed, and unlikely to interact with groundwater use in the regions of interest. Therefore, the review team concludes that cumulative impacts of both the proposed BBNPP and other current and future permitted groundwater users would be minor.

The review team is also aware of the potential climate changes that could affect the groundwater resources in the Susquehanna River Basin. A recent compilation of the state of the knowledge in this area (GCRP 2014-TN3472) was considered in the preparation of this EIS. Annual soil moisture in the basin between 1988 and 2010 has increased slightly in the northern part of the basin and decreased slightly in the southern part of the basin. In general, soil moisture has decreased in the winter and increased in the summer. No pronounced climate change-induced effects on the groundwater resources of the basin are identified.

Because the source of groundwater for building and operating the proposed BBNPP has adequate capacity, temporary dewatering operations during preconstruction and construction activities would have limited spatial effect, and no other past, present, or reasonably foreseeable actions with significant impacts were identified, the review team concludes that cumulative impacts on the groundwater resource would be SMALL.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts results from construction, preconstruction, and operation of the proposed BBNPP and impacts from other past, present, and reasonably foreseeable projects.

7.2.2.1 Surface-Water-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for this resource area. As described in Section 4.2.3.1, the impacts from NRC-authorized construction on surface-water quality would be SMALL. As described in Section 5.2.3.1, the review team concludes that the impacts of operations on surface-water quality would also be SMALL.

The combined surface-water-quality impacts from construction and preconstruction are described in Section 4.2.3.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water quality also considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. The geographic area of interest is the Susquehanna River Basin, the same as that described for surface-water use (see Section 7.2.1.1).

The impacts from building and operating the proposed unit was determined to be minimal, and was evaluated using the current conditions in the Susquehanna River. The current conditions include the impact of operations of SSES Units 1 and 2. The hydrological conditions described in Sections 4.2 and 5.2 also include the impact of the activities listed as current operations in Table 7-1 that are distinct from the activities at the SSES and BBNPP sites. Those activities include facilities with National Pollutant Discharge Elimination System (NPDES) permits to discharge water to the river and its tributaries, including SSES (Permit No. PA0047325), which discharges about 11,200 gpm (25 cfs) under this permit (Table 5.3-3 of the ER, PPL Bell Bend 2013-TN3377). The 2012 Pennsylvania NPDES program covers over 9,000 industrial and sewage dischargers (PADEP 2013-TN2432) of which the SSES is located nearest to the BBNPP site. Other than the SSES, the impacts of other projects listed in Table 7-1 are either considered in the analysis included in Sections 4.2 and 5.2, or would have little or no impact on surface-water quality near the BBNPP site.

The water quality of the Susquehanna River in the vicinity of the BBNPP site is described in Section 2.3.3. Section 2.3.3 also describes the water-quality assessment reports published by the SRBC and the SRBC's planning and regulation of water quality in the Susquehanna River Basin. Although there have been significant improvements in water quality in the basin (e.g., reductions in iron concentrations), because of the careful planning and management policies put in place by the SRBC, water quality remains a priority. For example, the continuing effects on water quality throughout the Susquehanna River Basin from mine drainage and the potential risks to aquatic life and human health from emerging contaminants are areas of special interest for the SRBC (SRBC 2013-TN3568). Therefore, the review team concludes that water-quality impacts in the Susquehanna River Basin from past and present actions have been noticeable.

The review team performed an independent assessment of the primary water-quality impacts on the Susquehanna River in its analysis of the estimated blowdown discharge of the proposed BBNPP (see Section 5.2.3). The review team determined that both the thermal impacts and the impact of the discharging solutes and solids concentrated through evaporation in the cooling towers would be minimal and localized to the region defined by the thermal plume. Discharge from operation of SSES Units 1 and 2 is located about 300 ft upstream of the discharge from the proposed BBNPP. As described in Section 5.2.3.1, the review team determined that, under conservative conditions, the proposed BBNPP discharge would create a thermal plume in winter with a length of 15.5 m (51 ft), as defined by an excess temperature 2°F above ambient river temperature. With a comparable discharge rate and a slightly lower discharge temperature increase above ambient temperature, the thermal plume from SSES Units 1 and 2 would be of similar size to that resulting from discharge from the proposed BBNPP. Therefore, the two plumes defined by an excess temperature 2°F above ambient temperature would not interact.

As noted in Section 5.2.3.1, PPL used the Cornell Mixing Zone Expert System modeling software, version 5, to evaluate the near-field thermal plume from the discharge into the Susquehanna River and a three-dimensional hydrodynamic model to evaluate the far-field plume (PPL Bell Bend 2013-TN3377). The Cornell Mixing Zone Expert System software does not model the interaction of multiple discharges. However, PPL used a three-dimensional hydrodynamic model to evaluate the combined plume of discharges from SSES Units 1 and 2 and the proposed BBNPP. Modeled excess temperatures at the river surface (shown in Figures 5.3.1 and 5.3.2 of the ER, PPL Bell Bend 2013-TN3377) were less than 1°F in both August and January. As described in Section 5.2.3.1, conservative values for discharge rates, discharge temperature rise, and river flows were used by PPL, similar to the review team's analysis.

Based on the review team's independent analysis, the review team determined that the excess temperature of the thermal plume from SSES Units 1 and 2 would be less than 2°F at the location of the discharge for the proposed BBNPP. The two thermal plumes would likely interact downstream of the discharge for the proposed BBNPP as the buoyancy of the proposed BBNPP's plume causes it to rise. PPL's hydrodynamic modeling indicates that the interaction of the plumes will be detectable, but will not significantly expand the extent of the thermal plume for the proposed BBNPP, as defined by an excess temperature 2°F above ambient river temperature. In addition, while reviewing the NPDES application for the discharge from the proposed BBNPP to the Susquehanna River, the Pennsylvania Department of Environmental Protection (PADEP) would have the opportunity to require discharge rules that would protect the aquatic environment.

Because of extensive past and present use and contamination of surface water, the review team concludes that the cumulative impacts to surface-water quality in the Susquehanna River Basin would be MODERATE. However, the effects on surface-water quality of building and operating the proposed BBNPP would not noticeably alter the resource. Therefore, the review team concludes that the incremental impact to surface-water quality from NRC-authorized activities would be SMALL.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 of this document serves as the baseline for the cumulative impacts assessments in this resource area. The groundwater-quality impacts for NRC-authorized construction are described in Section 4.2.3.2 and were determined to be SMALL. As described in Section 5.2.3.2, the review team concludes the groundwater-quality impacts from operation of the proposed unit would also be SMALL.

In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable projects that could affect groundwater quality, including the potential impacts of global climate change. The geographic area of interest is the same as that described in Section 7.2.1.2 for groundwater use.

As discussed in Section 4.2.3.2, impacts on groundwater quality would be localized and temporary during construction and preconstruction of the proposed BBNPP. The review team concludes that the extent of the zone of influence of dewatering during construction or changes to infiltration patterns because of site alteration would be limited by design and control measures. Permits for pumping and discharge of groundwater would be required by the SRBC and PADEP.

Groundwater would not be used for plant operations, and no dewatering is planned during operations. There would be no planned releases of contaminants to the groundwater. During site preparation, construction activities, and operation of the proposed BBNPP, it is possible that spills could transport pollutants (e.g., gasoline) to groundwater. Accidental releases of pollutants during construction or operation of the proposed BBNPP will be controlled by emergency plans and best management practices. The PADEP would require cleanup of any spills that may occur at the BBNPP site. Therefore, any impacts on the quality of the aquifer that exists beneath the site from activities associated with construction, preconstruction and operation of the proposed BBNPP would be minor.

The review team did not identify any other past, present, or reasonably foreseeable actions in Table 7-1 that will interact with the minor potential groundwater-quality impacts described above. The review team therefore concludes that cumulative impacts to groundwater quality during construction, preconstruction, and operation would be SMALL.

7.3 Ecological Impacts

This section addresses the cumulative impacts on terrestrial and aquatic ecological resources as a result of activities associated with the proposed BBNPP and other past, present, and reasonably foreseeable future activities within the geographic area of interest for each resource.

7.3.1 Terrestrial Ecology and Wetlands

The description of the affected environment in Section 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial and wetland ecological resources. As described in Section 4.3.1, the impacts from NRC-authorized construction on terrestrial ecology and wetlands ecology would be SMALL, and no further mitigation would be warranted. As described in Section 5.3.1, the impacts of operations on terrestrial and wetlands ecology would be SMALL, and no further mitigation would be warranted.

The combined impacts from preconstruction and NRC-authorized construction were also described in Section 4.3.1 and determined by the review team to be MODERATE, primarily because of impacts on wetlands, forests, and other terrestrial habitats and associated impacts on wildlife, particularly Federally listed, State-listed, and State-ranked species. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could affect terrestrial resources. For the cumulative analysis of potential impacts on terrestrial and wetland ecology, the geographic area of interest is a 21-mi radius around the proposed BBNPP site, as well as water features and associated riparian zones (including shorelines and fringing wetlands and floodplains) affected by proposed consumptive-use mitigation plan activities. The geographic area of interest of 21 mi was selected to encompass closely interrelated nearby terrestrial habitats and ensure inclusion of all associated pipelines and transmission lines. The geographic area of interest surrounding the BBNPP site is located within the Ridge and Valley ecoregion (USGS 2012-TN1800; Woods et al. 1999-TN1805; Woods et al. 2003-TN1806). This area is expected to encompass the ecologically relevant landscape features, habitats, and species potentially affected by the proposed BBNPP.

7.3.1.1 Terrestrial Habitats

The BBNPP site is located adjacent to the SSES and North Branch Susquehanna River in Salem Township, Luzerne County, Pennsylvania. The site lies within the Northern Shale Valley subdivision of the Ridge and Valley ecoregion. The Ridge and Valley ecoregion extends from southeastern New York southwest through northeastern Alabama and is characterized by alternating forested ridges and agricultural valleys (USGS 2012-TN1800; Woods et al. 1999-TN1805; 2003-TN1806). Three land-cover types dominate the ecoregion: forest (56 percent), agriculture (about 30 percent), and developed areas (about 9 percent). The greatest land-cover change has been the conversion of forest to disturbed lands, followed by disturbed lands reverting back to forest. Forest and disturbed land are also both being converted to developed land (USGS 2012-TN1800). The Northern Shale Valley subdivision is characterized by rolling valleys and low hills and is underlain mostly by shale, siltstone, and fine-grained sandstone. Local relief varies from about 50 to 500 ft. Natural vegetation varies from north to south, and in the north is characterized as mostly Appalachian oak forest dominated by white oak (*Quercus alba*) and red oak (*Q. rubra*). Today, farming is prevalent over much of the landscape, and woodland occurs on steeper sites (Woods et al. 1999-TN1805; Woods et al. 2003-TN1806).

The number of farms and the amount of land devoted to farming has decreased since about 1900 (Casalena 2006-TN3817; PGC and PFBC 2005-TN3815). Acreage of cropland and pastureland has declined, with much of it having been abandoned and allowed to revert to forest (PGC and PFBC 2005-TN3815). Associated with this decrease has been a decline in farmland wildlife that may be due to a shift from smaller to larger farms under more intense mechanized production. Small farms that are less intensively managed than their larger-farm counterparts provide a mix of open habitat, abandoned fields, hedgerows, and woods that provide food and cover for grassland-associated species (PGC and PFBC 2005-TN3815). Logging and mining have also changed the landscape. Old-growth forests are virtually nonexistent, although occasional old trees may be encountered. Mining has altered topography and vegetation, but is not as prevalent as it once was. However, reclaimed mine lands can still provide valuable habitat, especially for many bird species. Temporal shrub/thicket and grassland habitats result primarily from farmland abandonment, reclamation and/or succession of reclaimed strip-mines, and forest clear cutting (PNHP 2006-TN1570). The above anthropogenic disturbances have resulted in forest fragmentation, consisting of a mosaic of habitat types in various stages of succession, a greater amount of forest edge habitat, and a lesser amount of forest interior habitat and forest interior wildlife (PGC and PFBC 2005-TN3815).

Natural disturbances that shape natural communities include flooding, deer browsing, beaver activities, and the spread of invasive species. The Susquehanna River watershed is one of the most flood-prone areas in the United States, experiencing a major flood on average every 14 years (SRBC 2012-TN1791). These flood events have played a key role in shaping the forest and wetland communities found in the river floodplain along the Susquehanna River, which mainly comprises a mixture of agriculture and young forest (PNHP 2006-TN1570; PPL Bell Bend 2013-TN3377). Over-browsing by white-tailed deer (*Odocoileus virginianus*) has influenced flora and fauna communities by reducing understory vegetation, impeding regeneration of some species, and decreasing songbird diversity and rare plants. Beavers alter the local landscape by creating and maintaining a variety of open upland and wetland habitats. An increasing threat to natural habitats is the introduction and spread of non-native, invasive species (PNHP 2006-TN1570).

Overlaying the historic impacts described above, current projects within the geographic area of interest include urban, suburban (e.g., residential development), and commercial development (e.g., various types of manufacturing); operation and decommissioning of the SSES; various mining operations (e.g., uranium, natural gas, anthracite and stone/quarry); abandoned mine reclamation projects (e.g., acid mine drainage, coal refuse); transportation projects (e.g., to the Wilkes-Barre/Scranton area); transmission-line projects (e.g., Susquehanna-Roseland 500-kV transmission line); State parks (e.g., Rickets Glen State Park and Nescopeck State Park); State Game Lands (e.g., Numbers 58 and 226); the Susquehanna River; and agriculture, farming, and silviculture (Table 7-1). The development of most of these projects has further reduced, fragmented, and degraded natural forests and decreased their connectivity beyond that caused by the historic impacts described above. In contrast, the State Game Lands and State parks also protect local terrestrial resources in perpetuity, and abandoned mine reclamation projects enhance terrestrial resources at least temporarily.

The geographic area of interest of today consists of rural areas with agriculture fields and small, privately owned farms interspersed with deciduous woodlands on steeper, less arable land; abandoned farmland; parcels of regenerating hardwood forest in various stages of succession; the Susquehanna River lowland, comprising a mixture of agriculture and young forest; commercial, residential, and urban development; the cities of Berwick, Bloomsburg, Nanticoke, and Hazelton; and open water (e.g., Susquehanna River and its tributaries). The landscape, which once was almost continuously forested, now exhibits fragmentation and degradation. Reasonably foreseeable projects and land uses within the geographic area of interest that could affect wildlife habitat include ongoing commercial, residential, and urban development; limited agriculture, farming, silviculture; and persistent mining-related impacts (e.g., ongoing anthracite strip mining [PPL Bell Bend 2012-TN1173]).

Site preparation and development of the proposed BBNPP would disturb a total of about 663 ac, of which approximately 222 ac are forest that supports one Federally endangered bat species, one proposed Federally endangered bat species, and two State-ranked bat species (see Section 4.3.1.3). In addition, a regionally important bird conservation area (Important Bird Area No. 72 [IBA No. 72]) that supports State-listed and State-ranked and forest interior bird species, and an environmental preserve, would be disturbed by site development (see Section 4.3.1.3). The loss of habitat, particularly forest habitat, would noticeably reduce, fragment, and degrade natural forest habitat and decrease its connectivity in the geographic area of interest.

Although the habitat in the geographic area of interest has been significantly altered since the time of European settlement, habitat impacts from the projects and activities listed above, with the exception of the State parks and State Game Lands and abandoned mine reclamation, combined with building and operating the proposed BBNPP, would be noticeable but not destabilizing to terrestrial resources.

7.3.1.2 Wetlands

In Luzerne County and elsewhere in Pennsylvania, wetlands have formed in the depressions that were the result of glacial scouring and the deposition of ice blocks (kettleholes), as well as glacial deposits that blocked drainage channels and altered stream flow. Wetlands are found throughout the formerly glaciated portion of Luzerne County and many of these are shallow ice-block basins (PNHP 2006-TN1570). Most wetlands are palustrine, mostly forested with lesser amounts of emergent and shrub/scrub wetlands. Ephemeral/fluctuating or vernal pools are a special type of wetland that fill annually as a result of precipitation, surface-water runoff, and rising groundwater, and become completely dry through evaporation by late spring or summer. Between 1956 and 1979, Pennsylvania had an estimated net loss of about 28,000 ac, or 6 percent, of its vegetated wetlands (Tiner 1990-TN3820). Many wetland habitats have been filled or altered resulting in the loss of some of the native plants and animals of these sites. In recent decades, there has been a greater proportional loss of emergent wetlands than forested or shrub/scrub wetlands. The major causes of emergent wetland loss include conversion to lakes, ponds, and reservoirs; channelization or draining for development; conversion to farmland; urban development; and succession to other vegetated wetland types (e.g., forested and shrub/scrub wetlands) (PGC and PFBC 2005-TN3815). Currently available wetlands in the geographic area of interest are primarily scattered along streams and rivers.

Site preparation and development of the proposed BBNPP site potentially would disturb approximately 11.1 ac of jurisdictional wetlands, including 9.5 ac of forested wetlands, and 1.6 ac of emergent wetlands. To the extent practicable, the construction footprint was sited to limit impacts on wetlands. Disturbance of forested wetlands on the BBNPP site would also disturb an ecological association of concern to the Commonwealth of Pennsylvania. Losses of jurisdictional wetlands because of development of the BBNPP site would be mitigated (see Section 4.3.1.5).

Much wetland habitat in the geographic area of interest has been removed and will continue to be removed by present and reasonably foreseeable future activities, but the rate of removal has been diminished due to protective regulations (e.g., avoidance and minimization practices associated with siting the proposed BBNPP). Created wetlands may not accomplish the same purpose or same function as natural wetlands, so wetland quality may continue to decline even if wetland acreage remains the same. Consequently, the review team considers the cumulative loss of wetlands to be noticeable in the geographic area of interest.

7.3.1.3 Wildlife

The wildlife that occupies an area at any given time is indicative of the habitat that supports it. As noted in Section 7.3.1.1, Appalachian oak forest dominated the Ridge and Valley ecoregion prior to European settlement. Pre-settlement oak forests experienced natural fires that created openings maintained by aboriginal people for farming, villages, and hunting. The passage of time resulted in a mosaic of habitat in various stages of succession, which ranged from prairie to mature forest. Consequently, it is likely that wildlife species adapted to all stages of succession are present, including those that require large blocks of forest habitat (i.e., avian forest interior specialists such as the scarlet tanager [*Piranga olivacea*]), as well as habitat generalists that occupy and interspersion of cover types (e.g., raccoon [*Procyon lotor*], opossum [*Didelphus virginiana*]) (PGC and PFBC 2005-TN3815).

The extensive forest clearing and low-intensity agriculture that accompanied early settlement dramatically increased the amount of early successional (prairie-like) and edge habitat (forest/open habitat interface), which peaked around 1900 (Casalena 2006-TN3817; PGC and PFBC 2005-TN3815). However, during the second half of the twentieth century, the quantity and quality of forested and early successional habitats diminished as a result of fire suppression, fragmentation of habitat into small isolated units due to the establishment of smaller-scale farming, agriculture, silviculture and mining operations, increasing land development, and encroachment of invasive vegetation. Populations of species requiring specialized forest habitats (e.g., large blocks of unfragmented forest, early successional forest, old-growth forest, and riparian forests) also declined during this time period. Consequently, the current landscape habitat mosaic in the geographic area of interest favors wildlife adapted to mid-successional hardwood forest conditions. Current habitat does not favor prairie or mature forest wildlife, or wildlife that require large blocks of habitat. The species most at risk in Pennsylvania are associated with wetlands, riparian areas, old-field-shrub/grasslands, contiguous blocks of old-growth forests, and special habitats such as vernal pools (PGC and PFBC 2005-TN3815).

Reasonably foreseeable projects and land uses within the geographic area of interest that could affect wildlife populations include ongoing commercial, residential, and urban development, and limited agriculture, farming, silviculture, and persistent mining-related activities (e.g., ongoing anthracite strip mining [PPL Bell Bend 2012-TN1173]), including related losses of wetland habitat, described in Section 7.3.1.1 and Section 7.3.1.2. These influences would perpetuate reduction, fragmentation, and degradation of deciduous hardwood forests and decrease habitat connectivity. The resulting habitat mosaic would tend to continue to favor wildlife adapted to mid-successional hardwood forest conditions and generally worsen conditions for wildlife adapted to prairie and late-successional conditions and wetlands.

The removal and fragmentation of large blocks of deciduous hardwood forest, old-field/former agricultural, and shrub/scrub habitat for the proposed BBNPP would cause direct and indirect wildlife mortality, disturbance, and displacement. Direct disturbances below lethal levels may adversely affect wildlife behaviors, such as movement, feeding, sheltering, and reproduction. Wetland wildlife species (e.g., amphibian species) would be lost as a result of construction impacts and wetland- and stream-mitigation activities. Riparian species would be lost as a result of the disturbance of habitats surrounding Walker Run and its tributaries and along the Susquehanna River. Forest interior wildlife (e.g., forest interior birds) and wildlife adapted to old-field/former agricultural habitats (e.g., avian grassland specialists) would be lost as a result of the disturbance of large contiguous tracts of such habitat. Less mobile animals would incur greater mortality than more mobile animals that would be displaced into nearby undisturbed habitat where increased competition for resources may result in population reductions. Forest edge species may disperse into similar adjacent areas during construction, but afterward also use additional edge habitat created by forest clearing for BBNPP. Thus, the proposed BBNPP would impose short-term temporary adverse impacts on some wildlife species that use edge environments because more such habitat would be created by the project. However, it is expected that long-term mortality, disturbance, and displacement would be incurred by forest interior specialists, grassland specialists, and wetland species because there would be a net loss of these habitats onsite (except for wetlands, in which there would be a net gain, but only after decades while created and enhanced wetlands are becoming established).

Although wildlife resources in the geographic area of interest have been significantly altered since the time of European settlement, impacts on wildlife resulting from ongoing and reasonably foreseeable future activities, including the proposed BBNPP, would not be destabilizing, but would be noticeable, and would foster the continuation of some trends already present in the geographic area of interest and the Commonwealth (i.e., a reduction of wildlife closely tied to mature forest, large blocks of forest, grasslands, riparian areas, and wetlands).

7.3.1.4 Important Species and Habitats

One Federally endangered species, the Indiana bat (*Myotis sodalis*); one Federally proposed endangered species, the northern long-eared bat (*Myotis septentrionalis*); the little brown myotis (*Myotis lucifugus*) (critically imperiled [S1]); the tri-colored bat (*Perimyotis subflavus*) (critically imperiled [S1]); numerous State-listed and State-ranked bird species (see Section 4.3.1.3); one State-ranked snake species; the eastern box turtle (*Terrapene carolina carolina*) (vulnerable/apparently secure [S3/S4]); the black dash (*Euphyes conspicua*) (vulnerable [S3]); and the silver-bordered fritillary (*Boloria selene myrina*) (vulnerable [S3]) would be affected by the proposed BBNPP. IBA No. 72 and one State-ranked ecological association would be affected by the proposed BBNPP: red maple (*Acer rubrum*)-black gum (*Nyssa sylvatica*) palustrine forest. The State-endangered northern cricket frog (*Acris crepitans*), wood turtle (*Glyptemys insculpta*) (vulnerable/apparently secure [S3/S4]), and eastern ribbon snake (*Thamnophis sauritus)* (vulnerable [S3]) would be affected by wetland- and stream-mitigation activities. A total of 67 other Federally listed, State-listed, or State-ranked plant and animal species are also known to occur in the geographic area of interest, although they were not found within the project footprint (Table 2-16 in Section 2.4.1.3). A total of 16 other ecological associations are also known to occur in the geographic area of interest, although they were not found within the project footprint (Table 2-16 in Section 2.4.1.3). Although the past, present, and reasonably foreseeable future activities described in Sections 7.3.1.1 and 7.3.1.2, including the proposed BBNPP, have affected and would continue to affect individual populations of these species and occurrences of these communities, cumulative effects in the geographic area of interest would likely have a minor impact on State-listed and State-ranked species and communities statewide, and Federally listed and proposed species range wide.

7.3.1.5 Consumptive-Use Mitigation Plan Activities

The development and operation of reservoirs (e.g., Cowanesque Lake, Lake Aldred) (Table 7-1) have affected and continue to affect water levels along shorelines and adjacent riparian areas and fringing wetlands and floodplains of consumptive-use mitigation plan waterbodies (see Section 2.2.2 and Meyer 2014-TN3566), and potentially affect associated plants and wildlife. Energy (e.g., coal, gas, waste) and manufacturing plants (Table 7-1) that use water likely cause smaller fluctuations in surface-water elevations of consumptive-use mitigation plan waterbodies (Meyer 2014-TN3566) and may, but are less likely to, affect associated biota. Potential effects are likely more pronounced along smaller rivers and streams (e.g., Cowanesque River, Tioga River, Moshannon Creek) than along main-stem rivers (e.g., North Branch, West Branch, and main-stem Susquehanna River). In addition, natural gas development (Table 7-1) uses water to mine natural gas and some of the contaminants contained in wastewater and sediments, if released into consumptive-use mitigation plan waterbodies, may be harmful to the food web, including terrestrial plants and wildlife (IAEA 2014-TN3898; Warner et al. 2013-TN3899). Some State and local parks and hunting areas (Table 7-1) located along consumptive-use mitigation plan waterbodies tend to preserve riparian areas and wetlands and floodplains and associated plants and wildlife, but do not provide protection from the potential effects of periodic changes in water elevation or exposure to waterborne or sediment-borne contaminants. Although the above-noted projects collectively have caused and continue to cause noticeable changes in water levels in some consumptive-use mitigation plan waterbodies and potentially affect associated plants and wildlife, the contribution of consumptive-use mitigation plan activities to such changes are considered relatively minor (see Sections 5.3.1).

7.3.1.6 Global Climate Change

Global climate change has the potential to affect terrestrial resources in the geographic area of interest over the long term. The future impact of global climate change on habitats and plant and wildlife species is not precisely known. Projected changes in the climate for the northeast region of the United States during the life of the proposed BBNPP include an increase in average temperature of 3 to 6°F by the 2080s if global emissions of heat-trapping gases are reduced substantially (and an increase of 4.5 to 10°F with continued increasing global emissions). Along with the higher average temperatures, increases are expected in the frequency, intensity, and duration of heat waves. Increases in winter and spring precipitation are projected; averaged over the entire region, winter precipitation is projected to increase from 5 to 20 percent. Projected changes in summer and fall precipitation at the end of the century are small compared to natural variation. Annual precipitation is projected to increase. The amount of precipitation falling in heavy events is expected to increase. Risk of drought conditions in summer and fall is projected to increase as a result of higher temperatures (GCRP 2014-TN3472). Such changes could lead to increased incidence of insect pests that could result in shifts in forest tree species ranges (predicted to be northward in the eastern United States), diversity, and abundance (GCRP 2009-TN18; NABCI 2010-TN3874). Many birds in forests and wetlands likely have relatively low vulnerability to climate change. Because of their large ranges and high reproductive potential, forest birds are predicted to fare better in a changing climate than birds in other habitats, with the exception of those with highly specialized habitat and foraging affinities. Likewise, birds of forested wetlands would also be expected to fare better; however, those with an affinity for shallow (e.g., emergent) and mountain wetlands that are more likely to incur substantive habitat and temperature changes due to drought are expected to be more vulnerable (NABCI 2010-TN3874).

7.3.1.7 Summary

Cumulative impacts on terrestrial and wetland resources from construction, preconstruction, and operation of the proposed BBNPP and other past, present, and reasonably foreseeable projects are estimated based on the information provided by PPL, the U.S. Fish and Wildlife Service (FWS), the Pennsylvania Department of Conservation and Natural Resources, the Pennsylvania Game Commission, and the Pennsylvania Fish and Boat Commission, and through the review team's independent evaluation. Terrestrial resources in the geographic area of interest have been significantly altered since the time of European settlement. Ongoing commercial, residential, and urban development, and limited agriculture, farming, silviculture, and persistent mining-related impacts, would continue to reduce, fragment, and degrade terrestrial resources in the geographic area of interest.

The loss of habitat associated with building the proposed BBNPP, especially upland deciduous forest, palustrine forested wetland, and old-field/former agricultural habitat, would noticeably affect but not destabilize terrestrial resources in the geographic area of interest. Impacts on State-listed and State-ranked species and the Federally endangered Indiana bat and Federally proposed endangered northern long-eared bat would range from minor to noticeable, but would not be destabilizing.

Based on this evaluation, the review team concludes that cumulative impacts from past, present, and reasonably foreseeable future actions, including construction, preconstruction, and operation of the proposed BBNPP on terrestrial ecology and wetland resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from the BBNPP project would be substantial. Impacts on the Federally endangered Indiana bat and Federally proposed endangered northern long-eared bat from disturbance of upland deciduous forest and palustrine forested wetlands, as well as disturbance of IBA No. 72 that supports State-listed and State-ranked and forest interior bird species, are principal contributors to the MODERATE rating. The recent history of surface and subsurface coal mining and regional development and possible future impacts on wetlands and forests from climate change could also be substantial contributors. Incremental impacts from NRC-authorized activities (which are limited to the BBNPP site) would be SMALL, and would not noticeably alter the terrestrial ecology within the geographic area of interest.

7.3.2 Aquatic Ecosystem Impacts

The description of the affected environment in Section 2.4.2 serves as a baseline for the cumulative impacts assessment for aquatic ecological resources. The combined impacts on aquatic resources from construction and preconstruction, including installing the cooling-water intake and discharge systems, installing a rail extension, building bridges, installing a culvert, dewatering during installation of the Essential Service Water Emergency Makeup System pond and cooling towers, eliminating the North Branch Canal Outlet, abandoning two segments of Walker Run and creating/enhancing new reaches of Walker Run, and restoring the North Branch Canal, are described in Section 4.3.2 and were determined to be SMALL for aquatic resources. As described in Section 4.3.2, the NRC staff concludes that impacts of NRC-authorized construction on aquatic resources would be SMALL. As described in Section 5.3.2, the review team concludes that the impacts of operations and maintenance on aquatic resources would be SMALL.

In addition to the impacts from construction, preconstruction, and operation, the cumulative analysis also considers other past, present, and reasonably foreseeable future projects that could affect aquatic resources. The proposed BBNPP would rely on the Susquehanna River for cooling water and involve much of the river basin in a consumptive-use mitigation plan. Therefore, the geographic area of interest for the assessment of the potential cumulative aquatic ecosystem impacts of building and operating the proposed BBNPP is the North Branch and West Branch of the Susquehanna River Basin to their confluence and south to Conowingo

Dam. The Conowingo Dam is in Maryland approximately 3 mi upriver from Deer Creek, which is the general location of the tidal extent in the river (Normandeau and Gomez and Sullivan 2011-TN3681).

The major actions identified in Table 7-1 that would contribute to the potential cumulative impacts affecting the aquatic resources within the area of interest include historic anthropogenic activities, abandoned mine drainage, the operation of the existing SSES Units 1 and 2 and other power-generation facilities within the defined geographic area of interest, increased urban/suburban development (creating increased runoff, increased sewage effluent, and consumptive use), agricultural runoff, Marcellus Shale gas extraction, and climate change. The primary activities associated with the construction, preconstruction, and operation of the proposed BBNPP that could interact with these actions include the impingement and entrainment of the Susquehanna River biota, thermal discharges and chemical releases into the river, and the consumptive use of river water. The review team considered these potential sources of impact in its evaluation of the cumulative aquatic ecosystem impacts. The evaluation of cumulative impacts on aquatic resources from these actions is described below.

Historic anthropogenic actions that have affected the geographic area of interest include the building of several large dams within the watershed to generate power or to provide for water storage and flood control, which has strongly affected the Susquehanna River watershed and its aquatic biota. The Rivers and Harbors Appropriations Act of 1890 (33 USC 403 et seq.-TN660) designated several major rivers in the United States, including the Susquehanna River, as rivers of commerce and deemed them navigable (Stranahan 1995-TN3682). In 1904, the Secretary of War declared the river upstream of Maryland to be unnavigable, which allowed the York Haven Dam to be built across the river (Stranahan 1995-TN3682). This event was followed by the building of the Holtwood Dam in 1910, the Conowingo Dam in 1928 creating Conowingo Pond, and the Safe Harbor Dam in 1931 (Steffy 2013-TN3418). In addition to creating upstream reservoirs, the major ecological effect of these dams was the interruption of the migratory pathway of the anadromous American Shad (*Alosa sapidissima*) and the catadromous American Eel (*Anguilla rostrata*). Major water storage or flood control dams in the Susquehanna River Basin include the Cowanesque, Tioga-Hammond, and Whitney Point Dams built in the North Branch Susquehanna River watershed and the Curwensville Dam built on the West Branch Susquehanna River. One of the major effects of these dams has been a reduction in extreme high- and low-flow events in the waters below the dams as Meyer (2014-TN3566) demonstrated for the Cowanesque Dam and the Cowanesque River.

7.3.2.1 Abandoned Mine Drainage

The drainage of acidic water from abandoned coal mines is probably one of the most important stressors on streams in the Susquehanna River Basin (SRBC 2013-TN2942). Abandoned mine drainage impairs waterbodies by increasing acidity and elevating levels of sulfate, iron, manganese, and aluminum. These increases render aquatic habitats unsuitable to support aquatic life, such as macroinvertebrates, plants, native Brook Trout (*Salvelinus fontinails*), and other fishes (SRBC 2013-TN2942). Approximately 2,000 mi of streams and rivers in the Susquehanna River Basin are affected by abandoned mine drainage, although there are recent efforts under way and future plans to restore some selected watersheds to remediate the adverse environmental effects (SRBC 2013-TN2942).

7.3.2.2 SSES Operation and Other Power Generation

Impingement and entrainment of aquatic organisms represent important potential cumulative impacts. The NRC concluded that the impingement of organisms by the intake system of SSES Units 1 and 2 (closed-cycle cooling) has not significantly affected the aquatic resources in the Susquehanna River (NRC 2009-TN1725). Normandeau (2010-TN491) estimated that at the flow rate permitted at that time (40,500 gpm), the total annual impingement by SSES Units 1 and 2 was approximately 1,442 fish. However, the SRBC approved an increase in the maximum daily water withdrawal by SSES Units 1 and 2 to 66 Mgd (45,833 gpm) (2007-TN2073) in anticipation of a 13 percent extended power uprate that the NRC granted in 2008 (NRC 2008-TN3683). Assuming that the relationship between flows is linear, the annual impingement estimated by Normandeau (2010-TN491) would increase by 13 percent to about 1630 fish. Because the expected intake system flow for BBNPP is 25,729 gpm (approximately 56 percent of the currently permitted withdrawal for SSES Units 1 and 2), the estimated annual impingement at BBNPP would be about 913 fish.

The other primary potential sources of impingement within the geographic area of interest that would affect species that would be impinged by the BBNPP are other power plants that withdraw cooling water from the river (i.e., Hunlock, Three Mile Island, Peach Bottom, Brunner Island, Montour, and Sunbury). The NRC has determined that impingement at the Three Mile Island and Peach Bottom nuclear power plants was not significant (NRC 2003-TN3685; NRC 2009-TN3684). The only additional impingement data available were for the Hunlock Power Station and the Brunner Island Steam Electric Station.

The Hunlock Power Station is located about 10 mi upriver from the Bell Bend area. The maximum water withdrawal by the plant, which uses once-through cooling, is about 58.2 Mgd (PPL Bell Bend 2013-TN3377). This is about 1.4 times greater than the requested withdrawal of 42 Mgd for the BBNPP. The most commonly impinged species were Gizzard Shad (*Dorosoma cepedianum*; 39 percent), Bluegill (*Lepomis macrochirus*; 23 percent), and Channel Catfish (*Ictalurus punctatus*; 20 percent).

Brunner Island Steam Electric Station, which is approximately 100 mi downriver from the proposed BBNPP (PPL Bell Bend 2013-TN3377), provides some context for the incremental effect of impingement by the BBNPP within the Susquehanna River Basin. The Brunner Island plant (once-through cooling) has a much larger permitted water withdrawal rate (835 Mgd; SRBC 2007-TN3687) than the combined withdrawal for the proposed BBNPP and SSES Units 1 and 2, and impinges a substantially larger number of fish. PPL (PPL Bell Bend 2013-TN3377) reported that 9,987 fish per day, or approximately 299,617 fish per month, were impinged at Brunner Island during a study from 2005 to 2006. Gizzard Shad accounted for about 93 percent of the impinged fish.

No entrainment data were available for the other power plants on the Susquehanna River other than SSES. As described Section 5.3.2, SSES entrainment sampling in 2008-2009 did not indicate that significant abundances of ichthyoplankton were being entrained from intake operation, because fish communities in the area have not been significantly reduced (NRC 2009-TN1725). The NRC has determined that entrainment at the Three Mile Island (closed-cycle cooling) and Peach Bottom (once-through cooling) nuclear power plants does not present a significant environmental issue (NRC 2003-TN3685; NRC 2009-TN3684). Because the review team concluded that fish entrainment by a plant on the BBNPP site would be minor (Section 5.3.2) and the proposed BBNPP would use a relatively small volume of water, it is unlikely that entrainment by BBNPP would add significantly to the entrainment of fish species by the existing plants on the river.

7.3.2.3 Thermal/Chemical Discharge

The review team also considered the potential cumulative impacts related to thermal discharges. The review team evaluated the effects of the thermal discharge from the BBNPP on the Susquehanna River biota as described in Section 5.3.2 and concluded that the effects would be minor. Jacobsen (2009-TN3679) presented the results of a temperature monitoring study conducted in August and September 2008 that showed the 0.5°F isotherm was much larger in September than in August, and extended approximately 300 ft downriver from the SSES diffuser. Because the BBNPP diffuser would be located about 380 ft downriver of the SSES Units 1 and 2 diffuser (PPL Bell Bend 2013-TN3377), the review team's evaluation of the BBNPP thermal discharge included any temperature increase attributable to the SSES discharge. This evaluation suggested that the BBNPP thermal discharge would not add significantly to cumulative thermal effects in the river because the discharge is restricted to the Bell Bend area of the river, and there are no other thermal discharges immediately downstream.

The review team considered the potential cumulative impacts from chemical releases. SSES Units 1 and 2 are in compliance with the Clean Water Act Section 316(a) (thermal discharges) impacts from cooling-water systems. Chemical releases from the existing SSES Units 1 and 2 currently comply with Pennsylvania NPDES permit requirements, and would continue to be monitored in the future. Pennsylvania also would consider the cumulative chemical releases and thermal discharges from SSES and BBNPP before approving an NPDES permit for BBNPP (PPL Bell Bend 2013-TN3377). Therefore, chemical releases by BBNPP would not add significantly to cumulative chemical effects in the river.

7.3.2.4 Consumptive Use

In addition to intake and discharge operations of other power plants, both current and planned in the region, consumptive use of water is another factor for consideration of cumulative effects. To balance water use and instream flow protection, the SRBC considers any consumptive use important, and requires that the use be mitigated. During low-flow periods, the SRBC (2012-TN3565) would require PPL to provide compensating water releases from upstream storage in an amount equal to the BBNPP consumptive use. This requirement would negate the effects of BBNPP operations on Susquehanna River flows downstream of BBNPP during low-flow periods. As described in Section 2.2.2, PPL's primary plan for consumptive-use mitigation uses compensating water releases from Cowanesque Lake.

Water releases for BBNPP to mitigate for consumptive use (43 cfs) that co-occurred with those for SSES (62 cfs) would increase the total discharge from Cowanesque Lake to 105 cfs and would result in a drawdown of lake elevation level (Section 7.2.1.1). The combined BBNPP and SSES releases are expected to be considerably less than those occurring because of natural events, such as rainstorms, but new passby conditions may be proposed to maintain instream flow conditions that are protective of aquatic biota in the future as defined by the SRBC (2012-TN2453). Therefore, the cumulative effects of consumptive-use mitigation releases for BBNPP and SSES on the Cowanesque Lake and River would be expected to be temporary and would not have a long-term effect on these aquatic resources.

7.3.2.5 Urban/Suburban/Rural Development

Urban and suburban development, particularly the addition of runoff from impervious surfaces and an increase in treated and untreated sewage effluent, has contributed to increased degradation within the Susquehanna River Basin (SRBC 2013-TN2942). Impervious surfaces prevent rainwater from percolating into the ground, and cause water to rapidly drain into nearby waterbodies, carrying many pollutants from land into the waters and increasing the risk of flooding. Increases in consumptive use of water for drinking water and sanitation systems within the geographic area of interest will continue to necessitate coordinated regulation of consumptive water availability and quality (SRBC 2013-TN2942). Agricultural practices continue to introduce sediment and nutrients into Susquehanna River watersheds where higher levels of some nutrients increase aquatic vegetation and algae, which reduce the amount of dissolved oxygen available to support other aquatic life (SRBC 2013-TN2942).

7.3.2.6 Marcellus Shale Gas Extraction

The burgeoning development of natural gas extraction from deep shale layers (Marcellus Formation; Section 2.8) within the Susquehanna River Basin has introduced a significant new source of consumptive use. The extraction process involves using water to fracture rock layers to facilitate the gas removal. During drilling, a typical well requires approximately 3 to 5 Mgd for a 2- to 5-day period (SRBC 2012-TN3498). During 2011, the average consumptive use by the gas-extraction industry in the Basin was approximately 10 Mgd. The expected annual use when the industry is fully developed is about 30 Mgd (SRBC 2012-TN3498), which may reduce the quality and availability of water for other uses in the Basin and subsequently affect aquatic resources.

7.3.2.7 Climate Change

Within the northeast region, climate models predict increasing average annual temperatures that foster increased heavy precipitation, reduced snowpack, and earlier spring peak river flows (GCRP 2014-TN3472). The impacts of climate change on aquatic communities within the Susquehanna River Basin may be substantial, and subsequently may affect aquatic resources in the region. For example, seasonal spawning may begin sooner to coincide with earlier spring flows from higher temperatures melting any snowpack earlier in the season. Further degradation of water quality from increased runoff and sediment deposition following heavy precipitation events may compromise sensitive life stages of aquatic species in associated watersheds, and may have noticeable effects on aquatic populations.

7.3.2.8 Summary of Aquatic Ecology Impacts

Based on the information provided by PPL and the review team's independent evaluation, the review team concludes that the cumulative impacts of all of the past, present, and reasonably foreseeable future natural and anthropogenic stressors on the Susquehanna River ecosystem, including the construction, preconstruction, and operation of the proposed BBNPP, are MODERATE to LARGE, primarily from past actions, such as the building of dams in the watershed, abandoned mine drainage, and current and future increases in urbanization. The staff concludes that the incremental contribution of the NRC-authorized activities related to construction and operation of the proposed BBNPP would be SMALL.

7.4 Socioeconomics and Environmental Justice Impacts

The evaluation of cumulative impacts on socioeconomics and environmental justice is described in the following sections.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as a baseline for the cumulative-impact assessment in these resource areas. As described in Section 4.4, any negative socioeconomic impacts of the NRC-authorized construction activities would be SMALL, with three exceptions. The temporary and intermittent (6-yr) traffic impacts in the Berwick area, and at several interchanges along US 11 between Berwick and the BBNPP site, would be MODERATE during shift changes (see Section 4.4.4.1). The review team also expects MODERATE housing impacts in the Borough of Berwick (see Section 4.4.4.3) and MODERATE impacts on the Berwick Area School District (see Section 4.4.4.5). In Columbia County, economic impacts of NRC-authorized construction activities would be MODERATE and beneficial (see Section 4.4.3). The tax impacts of NRC-authorized construction activities would also have a MODERATE and beneficial impact on Salem Township. As described in Section 5.4, the review team determined that all negative socioeconomic impacts of operations would be SMALL. The review team concluded that operations would result in MODERATE and beneficial impacts due to tax revenue to the Berwick Area School District and SMALL beneficial economic and tax revenue impacts elsewhere in the region (see Section 5.4.3.2).

The combined impacts from construction and preconstruction were described in Section 4.4, and were determined to be the same as described above for NRC-authorized activities. In addition to socioeconomic impacts from construction, preconstruction, and operations, the cumulative impacts analysis presented in this section considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative socioeconomic impacts. For this cumulative impacts analysis, the geographic area of interest is considered to be the region within the 50-mi radius around the BBNPP site, and locations near the waterways affected by PPL's consumptive-use mitigation plan (see Section 2.2). The review team focused attention on the two counties—Columbia and Luzerne—that collectively make up the economic impact area most affected by the proposed project.

Historically, Columbia and Luzerne Counties were rural communities with significant employment in agriculture, fishing, and lumbering. However, beginning in the late nineteenth century, the local economy shifted to a mining and manufacturing base. These industries were supported by the development of canals and later extensive rail lines (NRC 2009-TN1725). In recent years, the manufacturing and mining industries have been declining. In 2010, the manufacturing, mining, agriculture, forestry, and fishing industries employed 15.4 percent of the population in the economic impact area, down from 18.8 percent in 2000. In 2010, the educational, health, and social services industries were the largest employers in the economic impact area, employing 24.2 percent of the population (USCB 2011-TN2071). The SSES was built in 1983. With the exception of the SSES presence, the community surrounding the BBNPP site has remained largely agricultural and residential (NRC 2009-TN1725).

Cowanesque Lake is the site most affected by the PPL consumptive-use mitigation plan. Cowanesque Lake is owned and operated by the USACE, and is located in Tioga County, Pennsylvania 2.2 mi upstream from the confluence with the Tioga River. Cowanesque Lake is operated in tandem with the Tioga-Hammond Project to provide flood protection for downstream communities in New York and northeastern Pennsylvania. The Cowanesque Project was completed in 1980 and a normal summer pool elevation of 1,045 ft was reached in April 1981. At the request of the SRBC and operators of two electric generation facilities, the USACE conducted a reformation study to evaluate the feasibility of reallocating flood control water storage at Cowanesque Lake to water supply storage. The reformation study and the accompanying environmental impact study concluded that raising the lake elevation for water supply storage would positively affect recreation water quality and warm water fishery habitat. Several modifications to Cowanesque Lake were completed in the late 1980s, and the target lake elevation was raised from 1,045 to 1,080 ft. The SRBC completed a consumptive-use mitigation plan in 2008 that evaluated modifications to how the water supply at Cowanesque Lake is managed. The new threshold would expand water withdrawals from Cowanesque Lake in order to further protect aquatic habitat and other riparian needs (EA 2012-TN3371).

The socioeconomic impact analyses in Chapters 4 and 5 are cumulative by nature. Economic impacts associated with activities listed in Table 7-1 have already largely been considered as part of the baseline presented in Section 2.5. For example, the economic impacts of existing enterprises (e.g., mining and other electrical utilities) are part of the base used for establishing the Regional Input-Output Modeling System (RIMS II) multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts. Thus, cumulative impacts associated with building and operating the BBNPP beyond those already evaluated in Chapters 4 and 5 have been considered, with the exception of a small number of projects highlighted in Table 7-1. For example, planned improvements to Federal, State, and county roads and bridges will have short-term physical impacts on the road system, and these incremental impacts did not contribute to the rating assigned to the BBNPP.

Based on the above considerations, PPL's ER (PPL Bell Bend 2013-TN3377), and the review team's independent evaluation, the review team concludes that the cumulative impacts from preconstruction, construction, and operation of the proposed BBNPP, and from other past, present, and future projects within the geographic area of interest, could make a temporary adverse contribution to the cumulative effects associated with some socioeconomic issues. Those impacts would include physical impacts (i.e., workers and the local public, buildings, transportation, and visual aesthetics), demography, and the local infrastructure and community services (i.e., traffic, recreation, housing, public services, and education).

The review team concludes that cumulative physical impacts would be SMALL, with the exception of the physical impacts on roads of planned improvements to Federal, State, and county roads and bridges where impacts would be MODERATE. However, the review team further concludes that the incremental physical impacts on local road systems from NRC-authorized activities would be SMALL.

The review team concludes that cumulative economic impacts would be beneficial and SMALL, with the exception of Columbia County where MODERATE and beneficial economic impacts tied to salaries, sales, and expenditures would occur. Cumulative tax impacts would also be SMALL, with the exception of MODERATE impacts on Salem Township during construction and the Berwick Area School District during BBNPP operation. The NRC-authorized activities would be a significant contributor to the MODERATE and beneficial economic impacts on Columbia County and tax impacts on Salem Township and the Berwick Area School District.

With regard to infrastructure and community services, the review team expects MODERATE and adverse cumulative impacts on traffic in the Berwick area and along US 11. Cumulative impacts on housing in the Berwick area are expected to be MODERATE. The cumulative impacts on the Berwick Area School District due to the influx of students during construction would be MODERATE. NRC-authorized activities would be a significant contributor to the MODERATE and adverse impacts on traffic near the site, housing availability in Berwick, and education services in the Berwick Area School District. These cumulative adverse impacts are expected to be temporary and SMALL during BBNPP operation.

The review team concludes that building the proposed BBNPP, in addition to other past, present, and reasonably foreseeable future projects, would have SMALL cumulative impacts on demography, recreation, and public services.

7.4.2 Environmental Justice

The description of the affected environment in Section 2.6 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.5, the review team concludes that NRC-authorized construction would impose no disproportionately high and adverse impacts on minority or low-income populations and, therefore, there would be no environmental justice impacts on minority or low-income populations. As described in Section 5.5, the review team concludes that there would also be no environmental justice impacts from operations.

The combined (preconstruction and NRC-authorized construction) environmental justice impacts from building the proposed BBNPP were described in Section 4.5; the review team determined there would be no combined environmental justice impacts. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future projects that could cause disproportionately high and adverse impacts on minority and low-income populations. For this cumulative analysis, the geographic area of interest is considered to be the 50 mi region described in Section 2.5.1.

From an environmental justice perspective, the potential exists for minority and low-income populations to experience disproportionately high and adverse impacts from large industrial projects. As discussed in Section 2.6.1, the review team found low-income, black, Asian, Hispanic, and aggregated minority populations of interest. The nearest low-income populations of interest are located near Nanticoke (11 mi from the BBNPP site), Hazleton (13 mi from the BBNPP site), Bloomsburg (16 mi from the BBNPP site) and Wilkes-Barre (18 mi from the BBNPP site). There are no aggregate minority populations located in Columbia County. The nearest aggregate minority group is located near Nanticoke (7.48 mi from the BBNPP site) in Luzerne County. Of the 17 census block groups with aggregate minority populations in Luzerne County, 9 are located in Hazleton and 6 are located in Wilkes-Barre. The highest concentrations of aggregate minority populations within the 50 mi region are located in Lehigh County (58 census block groups) (USCB 2011-TN2009). As discussed in Sections 2.6, 4.5, and 5.5, the review team found no unique characteristics or practices through which minority or low-income populations would experience a disproportionately high and adverse impact from building or operating the proposed BBNPP.

The environmental justice impact analyses in Chapters 4 and 5 are cumulative by nature. Environmental justice impacts associated with activities listed in Table 7-1 have already been considered as part of the environmental justice baseline presented in Sections 2.6 and 7.4.1. Based on the above considerations, information provided by PPL, and the review team's independent evaluation, the review team concludes that building and operating the proposed BBNPP would not contribute additional environmental justice cumulative impacts beyond those described in Chapters 4 and 5. As discussed in Section 2.6.1, factors that went into the review team's determination included an assessment of the unique characteristics and practices of minority and low-income populations of interest with regard to the following socioeconomic impact areas: physical impacts (i.e., workers and the local public, noise, air quality, buildings, transportation, and visual aesthetics), and local infrastructure and community services (i.e., transportation, recreation, housing, water and wastewater facilities, schools, and police, fire, and medical services).

The review team concludes there would be no disproportionately high or adverse cumulative impacts to minority or low-income populations from the above socioeconomic impact areas. Therefore, the review team determined there would be no cumulative environmental justice impacts.

7.5 Historic and Cultural Resources

The description of the affected environment in Section 2.7 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.6, for the purpose of National Environmental Policy Act \analysis, the review team concludes that the impacts of construction and preconstruction on historic and cultural resources would likely be SMALL and no further mitigation would be warranted. As described in Section 5.6, the review team concludes that the impacts on cultural resources from operations on historic and cultural resources would be SMALL. Mitigative actions may be warranted only in the event of an unanticipated discovery during any ground-disturbing activities associated with construction or maintenance of the operating facility. These actions would be determined by PPL in consultation with the Pennsylvania Historical and Museum Commission. PPL would follow its cultural resource management procedures if it encountered cultural resources during construction or operation (PPL Bell Bend 2012-TN1757).

The combined impacts from construction and preconstruction are described in Section 4.6 and are concluded to be SMALL. In addition to the combined impacts from construction, preconstruction, and operations, cumulative analyses consider other past, present, and reasonably foreseeable actions that could affect impact historic and cultural resources in the defined geographic area of interest. For this cumulative analysis, the geographic area of interest consists of the areas of direct and indirect effects. Areas of Potential Effect (APEs) that encompass physical and visual impacts reasonably determined to occur during construction, preconstruction, and operation of the proposed BBNPP. These APEs have been defined in coordination with the Pennsylvania Historical and Museum Commission and are described in Section 2.7. The cumulative impacts assessment considers the eligibility of historical properties for listing on the National Register of Historic Places. Coordination with the Pennsylvania Historical and Museum Commission provided information on cultural resources and potential impacts to cultural resources with respect to other past, present, and future actions in the geographic area of interest.

Historically, several Native American groups, descended from prehistoric Woodland peoples, lived in the general area of the BBNPP when Europeans first arrived in the 1600s. By the mid-eighteenth century, settlers began to occupy and lay claim to the Luzerne and Columbia County areas. In the years that followed, periods of unrest and war were frequent as various European pioneers and Native American groups sought possession of what would become Luzerne and Columbia Counties. By the beginning of the twentieth century, the economic base of Luzerne and Columbia Counties shifted from agriculture, fishing, and lumbering to mining and manufacturing centered in three urban areas: Wilkes-Barre, Hazleton, and Pittston. The North Branch Canal was created in the 1830s to provide a reliable means of transportation to markets outside the county. Later, railroads became the predominant mode of freight transportation, which resulted in the abandonment of the canals. Even with this change in transportation, the coal and lumber industries yielded to competition by the 1930s. Except for the SSES, the APE (physical and visual) has remained largely agricultural and residential into the twenty-first century (NRC 2009-TN1725).

Table 7-1 identifies other past, present and reasonably foreseeable projects and other actions considered in the cumulative analysis of the proposed BBNPP. Present projects within the geographic area of interest that may have a potential cumulative impact on cultural resources include continued operation SSES Units 1 and 2, transmission lines, the proposed BBNPP itself, and future residential and small-scale industrial development within the visual APE. Such projects could affect cultural resources if ground-disturbing activities occur, or if new aboveground structures affect the visual APE. Two historic properties have been identified at the SSES, 36LU15 and 36LU105 (NRC 2009-TN1725), and one National Register of Historic Places-eligible historic property has been identified within the BBNPP site, 36LU288 (see Chapter 2.7 of this EIS); however, protection plans are in place and no additional impacts are expected. If new aboveground structures are constructed within the visual APE, there could be a cumulative effect on the three aboveground properties located within the viewshed of the proposed project that have been determined to be eligible for listing on the National Register of Historic Places. These are the Pennsylvania Canal, North Branch, Key# 141673; the Union Reformed and Lutheran Church, Key# 155049; the A.K. Harter Farm, Woodcrest, Key# 155052 (see Chapter 2.7).

Historic and cultural resources are nonrenewable; therefore, the impact of destruction is cumulative. For the purposes of the review team's National Environmental Policy Act amended analysis, based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative cultural resources impact from preconstruction, construction, and operation of proposed BBNPP and other past, present, and future projects within the geographic area of interest would be SMALL. However, activities related to residential and small-scale industrial development within the visual APE have the potential to affect historic structures. If these activities result in alterations to the cultural environment, the impact could be greater.

7.6 Air Quality

The description of the affected environment in Section 2.9 serves as the baseline for the cumulative-impact assessment for air quality. As described in Section 4.7, the review team concludes that the impacts of NRC-authorized construction activities on air quality, including contribution to greenhouse gas (GHG) emissions, would be SMALL, and no further mitigation beyond those measures identified by PPL in Table 4.6-1 of the ER (PPL Bell Bend 2013-TN3377) would be warranted. As described in Section 5.7, the review team concludes that the impacts of operations on air quality, including contribution to GHG emissions, would be SMALL, and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

As discussed in Section 2.9, the BBNPP site is located in Luzerne County, Pennsylvania, which is part of the Northeast Pennsylvania-Upper Delaware Valley Interstate Air Quality Control Region (40 CFR 81.55 [TN255]). Designations of attainment or nonattainment for criteria air pollutants, including ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead, are made on a county-by-county basis. Luzerne County is designated as unclassifiable or in attainment for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.339 [TN255]). Luzerne County was designated as in attainment of the 8-hour 1997 ozone standard on December 19, 2007 (72 FR 64948-TN2084), and is therefore considered a maintenance area with respect to this standard.

Section 4.7 of this EIS examined air-quality impacts associated with construction and preconstruction activities. Emissions associated with these activities would be predominately fugitive dust from ground-disturbing activities and engine exhaust from heavy equipment and vehicles; these emissions are expected to be temporary and limited in magnitude. Furthermore, as noted in Section 4.7.1, the PADEP Bureau of Air Quality proposed to include emissions of nitrogen oxides associated with building BBNPP in a future revision to the State Implementation Plan; therefore the emissions are not likely to degrade air quality in the Luzerne County maintenance area (PADEP 2012-TN2125). Consequently, potential impacts on ambient air quality from construction and preconstruction would be SMALL. Section 5.7 addresses air-quality impacts from operations. Air emissions from operations would be primarily from worker vehicles and stationary combustion sources such as diesel generators and auxiliary boilers. Stationary sources would be permitted and operated in accordance with State and Federal regulatory requirements, and their operation would be infrequent and mostly for maintenance testing. Therefore, potential impacts on air quality from operations would be SMALL.

In addition to the impacts from building and operations, the cumulative-impact analysis considers past, present, and reasonably foreseeable future actions that could affect air quality (see Table 7-1). For this cumulative analysis of criteria pollutants, the geographic area of interest is Luzerne County, Pennsylvania. Several major emission sources listed in Table 7-1 have existing Title V operating permits in Luzerne County; these sources are among the several energy-related, industrial, and manufacturing projects that are considered major sources of criteria pollutants. Any new projects either would have *de minimis* impacts or would be subject to permitting by the PADEP. State permits are issued under regulations approved by the EPA and deemed sufficient to attain and maintain the National Ambient Air Quality Standards and comply with other Federal requirements under the Clean Air Act. Given these institutional controls, it is unlikely that the air quality in the region would degrade significantly (i.e., degrade to the extent that the region is in nonattainment of the National Ambient Air Quality Standards).

Future development near the BBNPP site also could lead to increases in gaseous emissions related to transportation. Table 7-1 lists low potential for growth within Luzerne County. Given the low potential for growth in Luzerne County, and the minor contribution of criteria pollutant emissions from building and operation, the cumulative impact on air quality would be minimal.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the U.S. Global Change Research Program (GCRP 2014-TN3472), "The majority of the warming at the global scale over the past 50 years can only be explained by the effects of human influences, especially the emissions from burning fossil fuels (coal, oil, and natural gas) and from deforestation…Oil used for transportation and coal used for electricity generation are the largest contributors to the rise in carbon dioxide that is the primary driver of recent climate change." GHG emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7, 6.1.3, and 6.3 of this EIS. The review team has concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single nuclear plant would be minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle would be minimal.

For the following reasons, it is difficult to evaluate cumulative impacts of a single source or combination of GHG emission sources:

- The impact is global rather than local or regional.
- The impact is not particularly sensitive to the location of the release point.
- The magnitude of individual GHG sources related to human activity, no matter how large compared to other sources, is small when compared to the total mass of GHGs that exist in the atmosphere.
- The total number and variety of GHG emission sources are extremely large and are ubiquitous.

These points are illustrated by the comparison of annual carbon dioxide (CO_2) emission rates, one of the principal GHGs, in Table 7-2.

Table 7-2. Comparison of Annual CO_2 Emission Rates

Source	Metric Tons per Year[a]
Global Emissions from Fossil Fuel Combustion (2011)[b]	32,600,000,000
U.S. Emissions from Fossil Fuel Combustion (2012)[b]	5,100,000,000
Pennsylvania Emissions from Power Production (2012)[c]	107,000,000
1,000-MW(eq) Nuclear Power Plant (including fuel cycle, 80 percent capacity factor)[d]	260,000
1,000-MW(e) Nuclear Power Plant (operations only)[d]	4,500
Average U.S. Home[e]	19
Average U.S. Passenger Vehicle[e]	5

Note: 1 metric ton (MT) = 1.1 U.S. tons (at 2,000 lb per U.S. ton)

(a) Emission estimates from U.S. fossil fuel combustion, Pennsylvania power production, and nuclear power are in units of MT CO_2 equivalent (CO_2e) whereas the other energy emissions estimates are in units of MT CO_2. If the emissions in units of MT CO_2e were represented in MT CO_2, the value would be slightly less, as other GHG emissions would not be included.

(b) Source: EPA 2014-TN4008; global emissions expressed in MT CO_2 and U.S emissions expressed in MT CO_2e.

(c) Source: EPA 2013-TN3784; expressed in MT per year of CO_2e.

(d) Source: Appendix I of this EIS; expressed in MT CO_2e.

(e) Source: EPA 2013-TN2505; expressed in MT CO_2.

To track national trends in GHG emissions, the EPA has developed an inventory of emissions and sinks in the United States (EPA 2014-TN4008). The most recently published emission estimates (i.e., for 2012) show that fossil fuel combustion is the major source of energy-related CO_2 emissions, resulting in 5,100,000,000 MT CO_2 per year (see Table 7-2). The EPA estimates that these emissions are approximately 17 percent of global CO_2 emissions from fossil fuel combustion (EPA 2014-TN4008).

Under 40 CFR Part 98 (TN2170), the EPA has established a mandatory GHG reporting requirement—referred to as the Greenhouse Gas Reporting Program—for large, direct sources of GHG emissions in the United States. Data reported by direct emitters provide a "bottom-up" accounting of the major sources of GHG emissions associated with stationary fuel combustion and industrial processes. In general, the threshold for reporting is 25,000 MT or more of CO_2 equivalent (CO_2e) per year. For calendar year 2012, approximately 107,000,000 MT CO_2e (see Table 7-2) were reported released from power plants in Pennsylvania compared to 36,000,000 MT CO_2e from all other reporting sectors (EPA 2013-TN3784).

Appendix I to this EIS provides an estimate of the lifetime GHG emissions associated with the preconstruction, construction, operation, and decommissioning of a reference 1,000-MW(e) reactor. As noted in that appendix, lifetime GHG emission estimates are dominated by the CO_2e estimate for the uranium fuel cycle. Table 7-2 lists the GHG emissions from normal operations, including the uranium fuel cycle, as 260,000 MT CO_2e per year. These emissions are significantly less than the GHG emissions reported released from power plants in Pennsylvania or from fossil fuel combustion in the United States for the year 2010.

Even though GHG emission estimates from normal operations are small compared to other sources, the applicant should consider measures that would reduce GHG emissions. These could include, but would not necessarily be limited to, energy-efficient design features and features to reduce space heating and air-conditioning energy requirements, use of renewable energy sources, use of low-GHG-emitting vehicles, and other policies to reduce GHG emissions from vehicle use, such as anti-idling policies and vanpooling or carpooling.

Evaluation of the cumulative impacts of GHG emissions requires the use of a global climate model. The Global Change Research Program report (GCRP 2014-TN3472) provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of GHG emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based primarily on the scientific assessments of the Global Change Research Program and National Research Council, the EPA Administrator issued a determination in 2009 (74 FR 66496-TN245) that GHGs in the atmosphere may reasonably be anticipated to endanger public health and welfare, based on observed and projected effects of GHGs, their impact on climate change, and the public health and welfare risks and impacts associated with such climate change. Therefore, national and worldwide cumulative impacts of GHG emissions reflect conditions within the MODERATE impact level for air quality related to GHG emissions—noticeable but not destabilizing. Based on the impacts set forth in the Global Change Research Program report (GCRP 2014-TN3472), and the CO_2 emissions criteria in the final EPA CO_2 Tailoring Rule (75 FR 31514-TN1404), the review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing with or without the GHG emissions of the proposed project.

Consequently, the review team recognizes that GHG emissions, including CO_2, from individual stationary sources and, cumulatively, from multiple sources can contribute to climate change and that the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary of Air-Quality Impacts

Cumulative impacts on air-quality resources are estimated based on the information provided by PPL and on the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local and regional for criteria pollutants and global for GHG emissions) that could affect air-quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the BBNPP site and other projects listed in Table 7-1 would be minimal. The national and worldwide cumulative impacts of GHG emissions would be noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions from the BBNPP site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air-quality resources in the geographic areas of interest would be SMALL for criteria pollutants and MODERATE for GHG emissions. The incremental contribution to the impacts on air-quality resources for both criteria pollutants and GHGs from NRC-authorized activities would be SMALL.

7.7 Nonradiological Health

The affected nonradiological environment described in Section 2.10 serves as a baseline for this nonradiological health cumulative-impact assessment. As concluded previously in this EIS, the nonradiological health impacts from building activities (Section 4.8) and operations (Section 5.8) would be SMALL, and no further mitigation would be warranted. In addition to the impacts from building activities and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative impacts on nonradiological health (see Table 7-1).

As described in Section 4.10, the combined nonradioactive waste impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted beyond that described in PPL's ER. Most of the nonradiological health impacts of building and operation (e.g., noise, etiological agents, and occupational injuries) would be localized and would not have a significant impact at offsite locations. However, impacts such as vehicle emissions arising from the activity of transporting personnel to and from the site would encompass a larger area. Therefore, for nonradiological health impacts, the geographic area of interest for this cumulative impacts analysis includes projects within the 6-mi radius of the BBNPP site, based on the influence of vehicle and other air emissions sources because the BBNPP site is in an air-quality maintenance area (see Section 7.6). This area is expected to encompass areas where public and worker health could be influenced by the proposed project and associated transmission lines, in combination with any past, present, or reasonably foreseeable future actions.

Other than the continued operation of the adjacent SSES, no major current projects in the geographic area of interest would contribute to the cumulative impacts for nonradiological health in a similar manner to the building and operating of the proposed BBNPP. Reasonably foreseeable future projects expected to occur within the geographic area of interest include future urbanization, transmission-line development, and various transportation projects.

There are no known existing or future projects that could contribute to cumulative nonradiological health impacts on workers. Existing and potential development of new transmission lines could increase nonradiological health impacts from exposure to acute electromagnetic fields. However, as stated in Section 5.8.3, adherence to Federal criteria and State utility codes would create minimal cumulative nonradiological health impacts. Further, scientific evidence about human health does not conclusively link extremely low-frequency electromagnetic fields to chronic adverse health impacts. Cumulative impacts from noise and vehicle emissions are associated with current operations of SSES Units 1 and 2 and current urbanization. However, as discussed in Sections 4.8 and 5.8, the proposed BBNPP's contribution to these impacts would be temporary and minimal, and existing facilities would likely comply with Federal, State, and local regulations governing noise and emissions. Sections 7.4.1 and 7.11.2 discuss cumulative impacts related to additional traffic on the regional and local highway networks leading to and from the BBNPP site, and the review team determines that these impacts would be minimal.

The nonradiological health impacts of operating the existing SSES units and proposed new unit at the BBNPP site were evaluated relative to the ambient temperature of the Susquehanna River and the potential propagation of thermophilic or other etiological microorganisms. Both the existing SSES units and the proposed BBNPP would discharge heated water to the Susquehanna River. The review team's independent evaluation indicated that while it is possible that the thermal discharges from the SSES unit and the proposed unit could have an impact on the abundance of etiological agents present in the receiving waters (the

Susquehanna River), the combined thermal plumes only extend 15 m downstream of the BBNPP discharge resulting in an increase in ambient temperature of less than 2°F under low-flow conditions (PPL Bell Bend 2013-TN3377). Section 5.2.3.1 provides a complete description of thermal plume data for the proposed discharge. Furthermore, the low incidence of waterborne diseases in the geographic area of interest indicates that public use of the receiving waters for recreation is carried out in a manner that minimizes the public's potential exposure to these organisms. As stated in Section 2.10.1.3, angling is limited and no public swimming beaches are located along the Susquehanna River near the discharge. Further, signage is present to keep the public away from the intake structure (PPL Bell Bend 2012-TN1171).

The review team is also aware that potential climate changes could affect human health; a recent compilation of the state of the knowledge in this area (GCRP 2009-TN18) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed BBNPP include the following:

- reduced cooling system efficiency (and other power-generation facilities), which would result in increased temperature of the cooling-tower discharge water and possible increased growth of etiological agents
- increased incidence of diseases transmitted by food, water, and insects following heavy downpours and severe storms
- increased severity of water pollution associated with sediments, fertilizers, herbicides, pesticides, and thermal pollution caused by projected heavier rainfall intensity and longer periods of drought; and an increase in average temperature and a decrease in precipitation. This may result in an increase in water temperature and frequency of downpours, which may alter the presence of microorganisms and parasites.

While the changes attributed to climate change in these studies are not inconsequential, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change the incidence of waterborne diseases.

Cumulative impacts on nonradiological health are based on information provided by PPL and the review team's independent evaluation of impacts resulting from proposed BBNPP, along with a review of potential impacts from other past, present, and reasonably foreseeable projects and urbanization located in the geographic areas of interest. The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL, and mitigation beyond what is discussed in Sections 4.8 and 5.8 would not be warranted. However, the review team acknowledges the remaining uncertainty associated with chronic effects of electromagnetic fields.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.11 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts on construction workers engaged in building activities would be SMALL, radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from normal operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from preconstruction and construction are described in Section 4.9 and were determined to be SMALL. In addition to the impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within the 50-mi radius of the BBNPP site. Historically, the NRC has used the 50-mi radius as a standard bounding geographic area to evaluate population doses from routine releases from nuclear power plants. The area within a 50-mi radius of the proposed site includes the two SSES units adjacent to the proposed BBNPP site. In addition, within the 50-mi radius of the site, there are likely to be hospitals and industrial facilities that use radioactive materials.

As described in Section 4.9, the estimate of dose to construction workers during the building of proposed BBNPP is well within the NRC annual exposure limits (i.e., 100 millirem [mrem] per year) designed to protect the public health. This estimate includes doses to workers from the operation of both units on the SSES site. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of the new BBNPP are well below regulatory limits and standards. In addition, based on the estimates of doses to non-human biota given in Section 5.9, the staff concludes that the cumulative radiological impact on non-human biota would not be significant. As stated in Section 5.9.6, PPL plans to conduct a radiological environmental monitoring program (REMP) around the BBNPP site in conjunction with the SSES REMP. The REMP would measure radiation and radioactive materials from all sources, including BBNPP, both SSES units, area hospitals, and industrial facilities. The REMP would monitor the levels in the environment to confirm the estimates of the radiological impact on the public and non-human biota presented in Section 5.9.

Currently, no other nuclear facilities are planned within 50 mi of the proposed BBNPP. The NRC and State of Pennsylvania officials would regulate or control any reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts.

Therefore, the NRC staff concludes that the cumulative radiological impacts of operating a new unit along the existing SSES units and with the influence of other manmade sources of radiation nearby would be SMALL.

7.9 Nonradiological Waste

Cumulative impacts on water and air from nonradiological waste are discussed in Sections 7.2 and 7.6, respectively. The cumulative impacts of nonradioactive solid waste destined for land-based treatment and disposal are primarily related to the available capacity of area treatment and disposal facilities and the amount of waste generated by the proposed project and other reasonably foreseeable projects. As described in Section 4.10, the impacts from NRC-authorized construction on nonradioactive waste would be SMALL, and no further mitigation other than that described in PPL's ER (PPL Bell Bend 2013-TN3377) would be warranted. As described in Section 5.10, the review team concludes that the impacts of operations on nonradioactive waste would also be SMALL, and no further mitigation would be warranted.

As described in Section 4.10, the combined nonradioactive waste impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted beyond that described in PPL's ER. During construction, offsite land-based waste treatment and disposal would be minimized by production and delivery of modular plant units, by segregation of recyclable materials, and by onsite management of vegetative waste. Building activities would generate small quantities of construction debris, and the construction workforce would produce small quantities of municipal solid waste. Most of the projects listed in Table 7-1 would generally either not coincide with the construction of the proposed BBNPP or would produce waste streams of a different nature.

During operation, PPL estimates that the proposed BBNPP would generate an average of approximately 500 T of nonradioactive, nonhazardous, residual solid waste annually, equivalent to less than 0.2 percent of the 267,720 T of municipal solid waste managed in Luzerne County in 2013 (PADEP 2013-TN3911). As of 2013, Pennsylvania had 46 municipal solid waste landfills and 6 waste-to-energy plants, all with adequate capacity (many of them operate at a daily volume of 10,000 T/d) (PADEP 2013-TN3912). Therefore, such impacts would be minimal.

PPL anticipates that the proposed BBNPP would be classified as a small-quantity generator under the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.-TN1281). Small-quantity generators in Pennsylvania are those that generate more than 220 lb but less than 2,200 lb of hazardous waste in a calendar month (PADEP 2014-TN3913). PPL would also develop a hazardous waste-minimization plan to reduce the amount or hazard (e.g., toxicity) of waste generated.

Of the projects listed in Table 7-1, only the operation of SSES Units 1 and 2 uses radioactive material and has the potential to generate mixed waste and is located within the geographic area of interest. Therefore cumulative impacts would be minimal.

Based on the quantity of nonradioactive and mixed waste projected during operation of the proposed BBNPP and the available treatment and disposal capacity, the review team concludes that cumulative impacts of nonradioactive and mixed waste would be SMALL, and additional mitigation would not be warranted.

7.10 Impacts of Postulated Accidents

As described in Section 5.11.4, the NRC staff concludes that the potential environmental impacts (i.e., risks) of a postulated accident from the operation of a new nuclear power plant at the BBNPP site would be SMALL. Section 5.11 considers both design basis accidents (DBAs) and severe accidents. In Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the BBNPP site would be SMALL for a U.S. EPR reactor. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents. As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risks) of a U.S. EPR reactor at the BBNPP site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted.

The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within 50 mi of the proposed BBNPP. The 50-mi radius was selected to cover any potential risk overlaps from two or more nuclear plants. Existing reactors that contribute to risk within this geographic area of interest include SSES Units 1 and 2, located adjacent to the proposed BBNPP site; Limerick Generating Station, Units 1 and 2; Three Mile Island Nuclear Station, Unit 1; and Peach Bottom Atomic Power Station, Units 2 and 3.

Tables 5-18 and 5-19 in Section 5.11 provide comparisons of estimated risk for the proposed U.S. EPR reactor at the BBNPP site and other current-generation reactors. The estimated population dose risk for the proposed U.S. EPR reactor at the BBNPP site is well below the mean and median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028-TN594). For existing nuclear generating stations within the geographic area of interest (i.e., SSES Units 1 and 2; Limerick Generating Station, Units 1 and 2; Three Mile Island Nuclear Station, Unit 1; and Peach Bottom Atomic Power Station, Units 2 and 3), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1 [TN250]).

The severe-accident risk due to any particular nuclear power plant gets smaller as the distance from that plant increases. However, the combined risk at any location within 50 mi of the BBNPP site would be bounded by the sum of risks for all these operating and proposed nuclear power plants. Even though several plants could potentially be included in the combination, this combined risk would still be low. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the BBNPP site likely would be SMALL, and no further mitigation is warranted.

7.11 Fuel Cycle, Transportation, and Decommissioning Impacts

The cumulative impacts related to the fuel cycle, transportation of radioactive materials (fuel and waste), and facility decommissioning for the proposed BBNPP site are described below.

7.11.1 Fuel Cycle (Including Radioactive Waste)

As described in Section 6.1, the NRC staff concludes that the environmental impacts of the fuel cycle due to operation of the proposed BBNPP would be SMALL. Fuel-cycle impacts would occur not only at the BBNPP site but also at other locations in the United States or, in the case of foreign-purchased uranium, in other countries as described in Section 6.1.

In addition to fuel-cycle impacts from BBNPP, this cumulative analysis considers fuel-cycle impacts from the existing two units at the SSES site. There are no other nuclear power plants within 50 mi of the BBNPP site. Table S–3 in 10 CFR 51.51 (TN250) provides the environmental impacts from uranium fuel-cycle operations for a model 1,000-MW(e) light water reactor operating at 80 percent capacity with a 12-month fuel-loading cycle and an average fuel burnup of 33,000 megawatt-days per metric ton of uranium (MWd/MTU). In accordance with 10 CFR 51.51(a) (TN250), the NRC staff concludes that those impacts would be acceptable for the 1,000-MW(e) reference reactor. The impacts of producing and disposing of nuclear fuel include mining the uranium ore, milling the ore, converting the uranium oxide to uranium hexafluoride, enriching the uranium hexafluoride, fabricating the fuel (i.e., conversion of uranium hexafluoride to uranium oxide fuel pellets), and disposing of the spent fuel in a proposed Federal waste repository. As discussed in Section 6.1 of this EIS, advances in reactors since the development of Table S–3 in 10 CFR 51.51 (TN250) would have the effect of reducing environmental impacts relative to the operating reference reactor. For example, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. As discussed in Section 6.1, the environmental impacts of fuel-cycle activities for the proposed unit would be about two times those presented in Table S–3 in 10 CFR 51.51 (TN250). Adding the fuel-cycle impacts from the currently operating SSES units would increase the environmental impacts by another two times from those presented in Table S–3 so the cumulative impacts would be approximately four times those of the reference reactor in Table S–3. Therefore, the NRC staff concludes that the cumulative fuel-cycle impacts of operating the BBNPP site would be minor, and additional mitigation would not be warranted.

The *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NUREG-2157) (NRC 2014-TN4117) examines the incremental impacts of continued storage on each resource area analyzed in NUREG-2157 in combination with other past, present, and reasonably foreseeable future actions. Section 6.5 of NUREG-2157 indicates ranges of potential cumulative impacts for multiple resource areas. These ranges are primarily driven by impacts from activities other than the continued storage of spent fuel at the reactor site; the impacts from these other activities would occur regardless of whether spent fuel is stored during the continued storage period. In the short-term timeframe, which is the most likely timeframe for the disposal of the fuel, the potential impacts of continued storage for at-reactor storage are SMALL and would, therefore, not be a significant contributor to the cumulative impacts. Because the impacts during the short-term timeframe are SMALL, continued storage would not be a significant contributor to the cumulative impacts. In the longer timeframes for at-reactor storage, or in the less likely case of away-from-reactor storage, some of the impacts from the storage of spent fuel could be greater than SMALL. However, other Federal and non-Federal activities occurring during the longer timeframes, as noted in NUREG-2157, include uncertainties as well, contributing to the cumulative impacts. All of these uncertainties lead to the ranges in cumulative impacts as discussed throughout Chapter 6 of NUREG-2157. The overall cumulative impact conclusions would not be changed if the impacts of continued storage were removed. Based on the analysis and impact determination in NUREG-2157, and taking into account the impacts that the NRC can predict with certainty, which are SMALL; the uncertainty reflected by the ranges in some impacts; and the relative likelihood of the timeframes, the staff finds that the impacts in NUREG-2157 support an overall finding that the cumulative impacts from radiological wastes from the fuel cycle (which includes the impacts associated with spent fuel storage during operation and any continued storage period) would be minor (NRC 2014-TN4117).

7.11.2 Transportation

The description of the affected environment in Section 2.5.2.3 of this EIS serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6 of this EIS, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the proposed BBNPP site would be SMALL. In addition to impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the proposed BBNPP site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the proposed BBNPP site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the site. The additional traffic increases the risk of traffic accidents, injuries, and fatalities. A review of the projects listed in Table 7-1 indicates no other major projects in the region that could potentially increase nonradiological impacts.

SSES is the only operating facility with potential for cumulative nonradiological impacts. Impacts for joint outages in the same year are included in the analysis in Section 5.8.6 and are not significant.

There are numerous State parks, forests, and game lands and other recreational areas within the proposed BBNPP project region. Development is likely limited in these areas and potential park improvements, in general, are of smaller scope and have lower resource and personnel requirements than construction at a new nuclear power plant. Therefore, park improvements are not likely to result in a measurable cumulative impact.

In Sections 4.8.3 and 5.8.6, the review team concluded that the impacts of transporting construction material and construction and operations personnel to and from the proposed BBNPP site would be a small fraction of the existing nonradiological impacts in Luzerne County. Based on the magnitude of construction of a nuclear power plant relative to the other construction activities, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed BBNPP would be SMALL, and no further mitigation would be warranted.

As described in Section 6.2, the NRC staff concludes that the impacts of transporting unirradiated fuel to the proposed BBNPP site and irradiated fuel and radioactive waste from the proposed BBNPP site would be SMALL. In addition to impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the proposed BBNPP site.

Historically, the radiological impacts on the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the proposed BBNPP site have been associated with shipments of fuel and waste to and from the existing, adjacent SSES. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the proposed BBNPP and the SSES sites, fuel fabrication facilities, and waste disposal sites located in other parts of the United States. No other major activities with the potential for cumulative radiological impacts were identified in the geographic area of interest. Based on Table S–4 in 10 CFR 51.52 (TN250), the impacts of transporting unirradiated fuel to the SSES and irradiated fuel and radioactive waste from the SSES would be minimal. When combined with the impacts of transporting unirradiated fuel to the proposed BBNPP site and irradiated fuel and radioactive waste from the proposed BBNPP site, the cumulative impacts of transporting unirradiated fuel to the proposed BBNPP and SSES sites and irradiated fuel and radioactive waste from the proposed BBNPP and SSES sites would also be minimal. In addition, the past, present, and reasonably foreseeable impacts in the region surrounding the proposed BBNPP site are a small fraction of the impacts from natural background radiation.

Advances in reactor technology and operations since the development of Table S–4 in 10 CFR 51.52 (TN250) would reduce environmental impacts relative to the values in that table; therefore, the values in Table S-4 remain bounding. For example, nuclear power plants have improved fuel management to achieve higher performance and reduce fuel requirements. This would lead to fewer unirradiated and spent fuel shipments than for the 1,000-MW(e) reference reactor discussed in 10 CFR 51.52 (TN250). In addition, advances in shipping cask designs would result in fewer shipments of spent fuel to offsite storage or disposal facilities. This would reduce the cumulative impacts of transporting unirradiated fuel to the proposed BBNPP and SSES sites and irradiated fuel and radioactive waste from the proposed BBNPP and SSES sites.

Therefore, the NRC staff considers the cumulative impacts of transporting unirradiated fuel to, along with irradiated fuel and radioactive waste from, a new nuclear power plant at the proposed BBNPP site would be SMALL, and no further mitigation would be warranted.

7.11.3 Decommissioning

As discussed in Section 6.3, environmental impacts from decommissioning are expected to be SMALL because the licensee would have to comply with decommissioning regulatory requirements.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the BBNPP site. The only other nuclear facilities within 50 mi of the BBNPP are the two units at the SSES site. In Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be SMALL (NRC 2002-TN665). In addition, in Section 6.3 the NRC staff concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be minimal. Therefore, the cumulative impacts from decommissioning the proposed BBNPP would be SMALL, and additional mitigation would not be warranted.

7.11.4 Summary of Cumulative Fuel Cycle, Transportation, and Decommissioning Impacts

Based on the analysis above, the cumulative impacts from fuel cycle activities, transportation of radioactive material, and decommissioning would be SMALL, and additional mitigation would not be warranted.

7.12 Staff Conclusions and Recommendations

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of one nuclear unit at the BBNPP site together with other past, present, and reasonably foreseeable future actions. The review team assessed the specific resources that could be affected by the incremental effects of the proposed action when considered with other actions listed in Table 7-1 in the same geographic area. This assessment included the impacts of construction and operation for the proposed new unit as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed action.

Table 7-3 summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although MODERATE or LARGE impacts for some resources are possible, as discussed below.

MODERATE cumulative impacts to surface-water resources in the geographic area of interest are the result of extensive past and present use of surface water in the Susquehanna River Basin. However, the incremental impact on surface-water use and quality from building and operating the proposed new unit at the BBNPP site would be SMALL.

Cumulative impacts to terrestrial resources in the Susquehanna River ecosystem from all natural and anthropogenic stressors in the past, present, and reasonably foreseeable future are MODERATE. The MODERATE impact level to terrestrial resources is driven not only by cumulative impacts to habitats and species from other past projects in the area of interest, but by impacts to wetlands, forests, and other terrestrial habitats on the BBNPP site and associated impacts to wildlife, particularly Federally listed, State-listed, and State-ranked species. Although incremental impacts on terrestrial resources could be noticeable near the BBNPP site, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

The cumulative impacts to aquatic resources of all of the past, present, and reasonably foreseeable future natural and anthropogenic stressors on the Susquehanna River ecosystem, including the construction, preconstruction, and operation of the proposed BBNPP, are MODERATE to LARGE, primarily from past actions, such as the building of dams in the watershed, abandoned mine drainage, and current and future increases in urbanization. The incremental contribution of the construction and operation of the proposed new unit at the BBNPP site to cumulative impacts on aquatic resources in the area of interest would be SMALL.

For socioeconomics, NRC-authorized construction would result in MODERATE short-term adverse effects on transportation, housing, and education services in specific local communities during peak construction and preconstruction employment years. These effects would be temporary and are expected to become SMALL during BBNPP operation. Cumulative economic impacts would be SMALL (beneficial) to MODERATE (beneficial) in Columbia County. Cumulative tax impacts would be SMALL (beneficial) to MODERATE (beneficial) in Salem Township during construction and the Berwick Area School District during the operations phase. Cumulative impacts of planned improvements to Federal, State, and county roads and bridges would be MODERATE. However, the incremental physical impacts on local road systems from NRC-authorized activities would be SMALL. MODERATE national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing, with or without the GHG emissions of the proposed BBNPP. The incremental contribution of impacts on air-quality resources for both criteria pollutants and GHGs from building and operating the proposed BBNPP would be SMALL.

Table 7-3. Cumulative Impacts on Environmental Resources, Including the Impacts of the Proposed BBNPP

Resource Area	Cumulative-Impact Level
Land Use	SMALL
Water-Related	
Water Use – Surface Water	MODERATE
Water Use – Groundwater	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	SMALL
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems	MODERATE to LARGE
Socioeconomic	
Physical impacts	SMALL except for MODERATE cumulative impacts from other planned road improvements
Demography	SMALL
Economic impacts on the community	SMALL and beneficial except for MODERATE and beneficial economic impacts on Columbia County and MODERATE and beneficial tax impacts on Salem Township and the Berwick Area School District
Infrastructure and community services	SMALL except for MODERATE traffic impacts on area highways, MODERATE housing impacts in the Borough of Berwick, and MODERATE student impacts on the Berwick Area School District
Environmental Justice	None
Historic and Cultural Resources	SMALL
Air Quality	SMALL for criteria pollutants MODERATE for GHG emissions
Nonradiological Health	SMALL
Radiological Health	SMALL
Nonradiological Waste	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

8.0 Need for Power

8.1 Introduction

Chapter 8 of the U.S. Nuclear Regulatory Commission's (NRC's) *Environmental Standard Review Plan* (ESRP) (NRC 2000-TN614), with additional clarification provided in NRC Interim Staff Guidance (NRC 2013-TN2600), guides the NRC staff's review and analysis of the need for power for a proposed nuclear power plant. In addition to the ESRP guidance, the NRC addressed need for power in a 2003 response to a petition for rulemaking (68 FR 55905-TN733). In the 2003 response, the NRC reviewed whether or not need for power should be considered in NRC environmental impact statements prepared in conjunction with applications that could result in the construction of a new nuclear power plant. The NRC (68 FR 55905-TN733) concluded that:

> The need for power must be addressed in connection with new power plant construction so that the NRC may weigh the likely benefits (e.g., electrical power) against the environmental impacts of constructing and operating a nuclear power reactor. The Commission emphasizes, however, that such an assessment should not involve burdensome attempts to precisely identify future conditions. Rather, it should be sufficient to reasonably characterize the costs and benefits associated with proposed licensing actions.

While the NRC will perform a need for power analysis for a new nuclear power plant in its environmental impact statement, the NRC also stated in its response to the petition that (1) the NRC does not supplant the states, which have traditionally been responsible for assessing the need for power-generating facilities, for their economic feasibility, and for regulating rates and services, and (2) the NRC has acknowledged the primacy of state regulatory decisions regarding future energy options (68 FR 55905-TN733).

In cases where the applicant would be a merchant generator, not subject to serving a specific service territory and not receiving a regulated rate of return for their generation, the market provides two principal checks and balances to ensure the power would be needed and dispatched. First, the current bid/auction market process for selecting which generating units will participate in the market and provide power almost guarantees nuclear generating units will always be a part of the market's capacity; the presence of an active least-to-most cost selection process provides the staff with sufficient assurance that the power generated by the applicant will be needed. Second, this market bidding practice provides strong incentive for plant construction and operations to be as economically efficient as possible, to ensure a satisfactory rate of return on the investment.

The review team recognizes these market realities, and acknowledges that private investors and utility commissions (representing rate payers), in the case of regulatory approval, ultimately judge whether there is a need for the power from a nuclear power plant. Using the guidance cited above, the NRC staff characterizes this process in this section to aid the public in understanding the basis for determining the need for the power to be produced from the proposed action.

PPL Bell Bend, LLC (PPL) stated in its combined construction permit and operating license application that the proposed Bell Bend Nuclear Power Plant (BBNPP) would be a merchant plant (i.e., a plant connected to the electrical grid for the purpose of selling energy to customers in a wholesale electric power market, illustrated in Figure 8-1). The applicant expects this plant to come online in 2025 (PPL Bell Bend 2014-TN3625). The applicant states that the purpose is to generate baseload power (1,600 MW(e)) for the BBNPP market area.

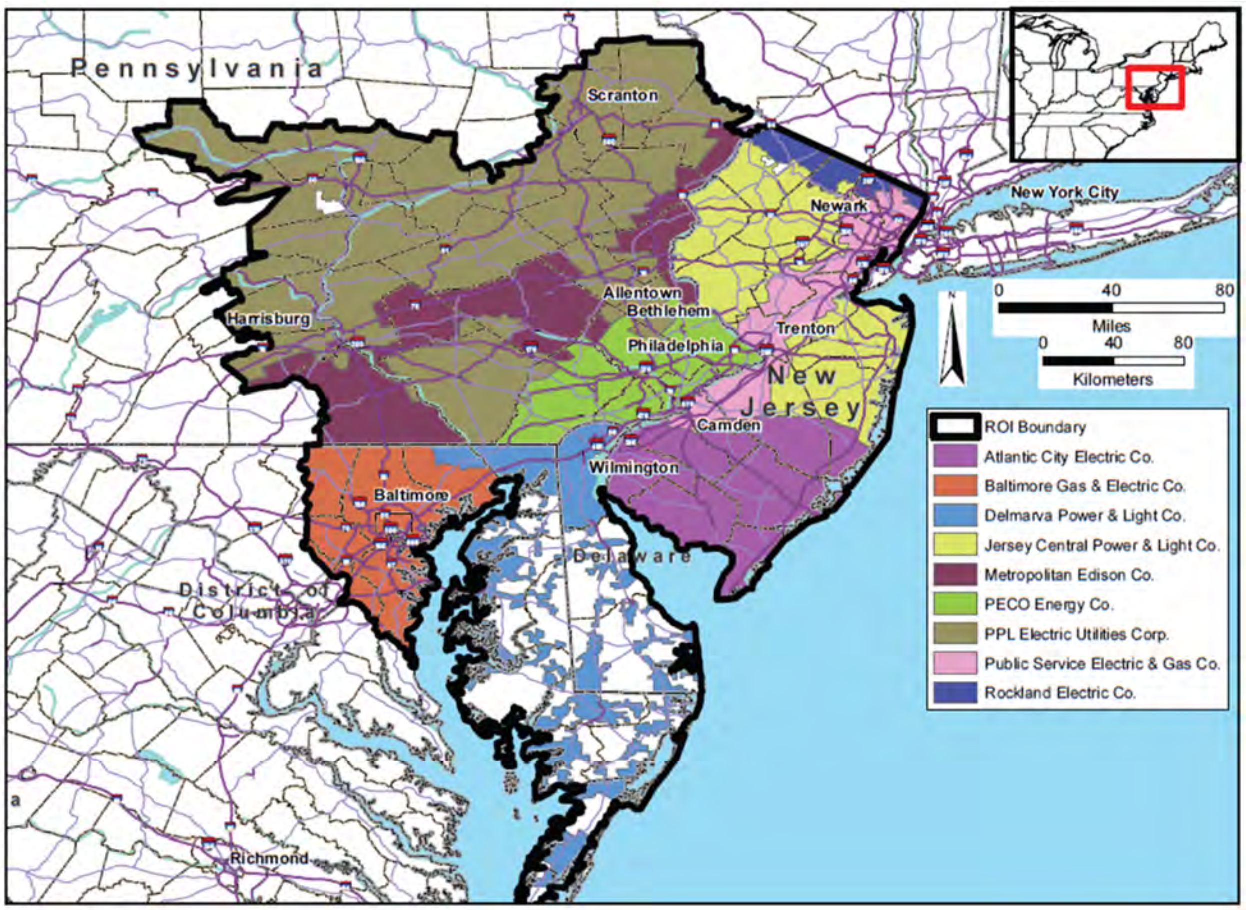

Figure 8-1. Expected Market Area of the BBNPP (PPL Bell Bend 2013-TN3377)

This review recognizes that PPL is a merchant power vendor that must compete in electricity markets with other suppliers. As a merchant power vendor, PPL must bear market-related risks that differ from those of regulated power vendors. In particular, PPL receives no negotiated rate of return that may characterize regulated utilities operating in similar power markets.

For this reason, the acceptance criteria in this need for power analysis consider whether relevant service region supply and demand conditions are consistent with market entry by a vendor with additional capacity as is proposed. The NRC staff's determination, based on the assessment that follows, is that expected 2025–2028 market conditions justify PPL's proposed action.

8.2 Description of Power System

8.2.1 Description of PJM, North American Electric Reliability Corporation, and ReliabilityFirst Corporation

The purpose of the proposed BBNPP is to provide baseload generation for use by the owners and/or for eventual sale on the wholesale market. Pennsylvania and the other states in PPL's projected market area are in a regional electric grid operated by the PJM Interconnection, LLC (PJM). PJM is a regional transmission organization that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia (PJM 2012-TN1541). Figure 8-2 displays the PJM area. PJM is one region within the ReliabilityFirst Corporation (RFC), whose footprint appears in Figure 8-3, which is one of eight approved regional entities of the North American Electric Reliability Corporation (NERC). RFC compiles key forecast information for inclusion in the annual NERC long-term resource assessments.

NERC's mission is to ensure the reliability of the bulk power system in North America. NERC develops and enforces reliability standards, monitors the bulk power system, assesses and reports on future transmission and generation adequacy, and offers education and certification programs to industry personnel (NERC 2008-TN1542). RFC's primary responsibilities include developing reliability standards and monitoring compliance to those reliability standards for all owners, operators, and users of the bulk electric system and providing seasonal and long-term assessments of bulk electric system reliability within the RFC geographic area (RFC 2012-TN1543). RFC members serve the electrical requirements of more than 72 million people in a 240,000 mi^2 area (Figure 8-3).

PJM balances the supply and demand for electricity using an open market structure (deregulated) similar to a stock exchange. This is done subject to reliability constraints that help keep the electricity grid stable and responsive by maintaining sufficient generating capacity reserves. PJM also is the responsible power planning entity for its market area, and produces forecasts and other analyses of future electricity demand that are relied upon across its market area (PJM 2012-TN1541).

The eastern portion of the PJM market area is a subset of the entire PJM area and is considered the primary market area for the BBNPP. This area is summer peaking, and summer peak reliability criteria are used throughout the assessment. The primary market area includes parts of Pennsylvania, Maryland, and Virginia, and all of New Jersey and Delaware. This area corresponds to the utility service areas shown in Figure 8-1, and is nearly analogous to the PJM Mid-Atlantic zone.

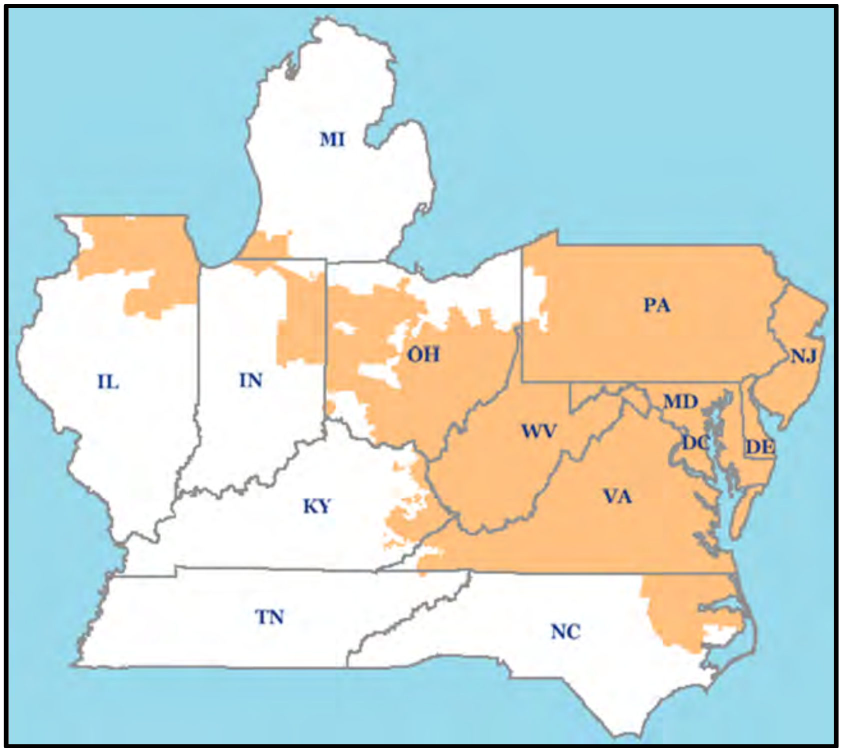

Figure 8-2. Map of the Combined PJM Region (FERC 2011-TN1546)

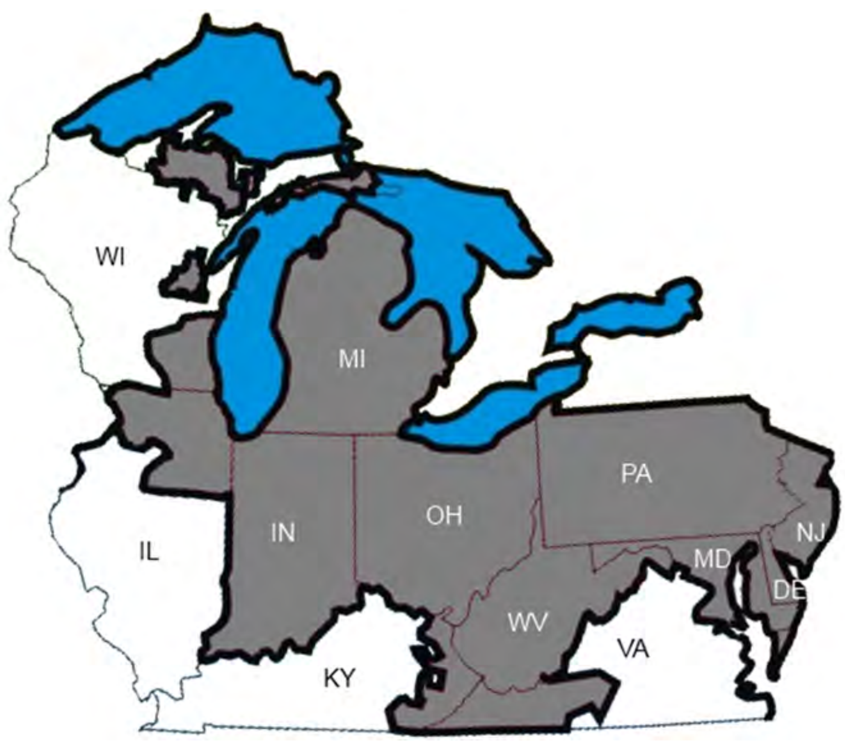

Figure 8-3. Map of the RFC Region (NERC 2012-TN1547)

8.2.2 Independent Assessment Process

The staff relied upon analyses for the same market area and the same temporal scope performed by PJM in its *2007–2014 Load Forecast Reports* (most recently, PJM 2014-TN3105). These PJM projections are incorporated by RFC in their long-term forecasts (RFC 2013-TN3108). NRC guidance provides that additional independent analysis by the NRC may not be needed when power analyses prepared by an independent third party, such as an affected state, NERC reliability council, or regional transmission organization, is sufficiently (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty (NRC 2000-TN614). Taken in aggregate, the review team determined that the studies and reports summarized here and in Section 0 satisfy the four tests.

8.2.2.1 Systematic Test

The review team determined that RFC and PJM have a systematic and iterative process for load forecasting and reliability assessment that is updated annually. PJM is required by the Pennsylvania Public Utility Commission (PPUC) to provide extensive studies, issue reports, make recommendations for transmission system needs and resource adequacy, and make legislative recommendations to further those objectives (PPL Bell Bend 2013-TN3377). The development of these reports is subject to a robust stakeholder input process. Because of the high level of peer review oversight and accountability within the Federal Energy Regulatory Commission system, PJM serves as a neutral and independent source of information on electricity issues for policymakers and investors.

Membership in RFC is open to any entity that either operates in the RFC region or represents consumers within the RFC region. The members are organized by the following market segments: consumers, cooperatives, independent generators, independent power marketers, independent retail electric providers, investor owned utilities, and municipal utilities (RFC 2012-TN1543). RFC's forecasting methods also are subject to peer review (Brattle Group 2006-TN1557; Itron 2010-TN1558). Moreover, the analyses and actions of PJM based on these analyses are overseen by the PPUC and similar regulators in other states in the PJM territory.

8.2.2.2 Comprehensive Test

The review team finds that, in aggregate, the RFC/PJM studies and reports relied upon for conclusions in Section 0 are comprehensive. RFC and PJM (RFC 2013-TN3108; PJM 2014-TN3105) consider trends in customer demand (including the underlying factors of population, macroeconomic activity, income, and employment growth) and impacts of both normal and extreme weather conditions. The electricity supply analysis takes into account changes in generation profile and potential generation additions and retirements; trends in electric power generation by fuel source; trends in consumption by class of consumer; forecasts of future electricity sales; transmission congestion in PJM; demand-side management, demand response, and distributed generation; and electric reliability assessments. The demand forecasts are fed into the generation and transmission planning process. The forecasts also are subject to a public review and comment.

8.2.2.3 Subject to Confirmation Test

The review team finds that, in aggregate, the studies and reports relied upon for conclusions in Section 0 are subject to confirmation. Forecasts covering the RFC region, including PJM and the BBNPP market area, are independently prepared, reviewed, confirmed, and consolidated by PPUC (PPUC 2013-TN3107) and NERC (NERC 2013-TN3106), among many stakeholder entities.

In its 2006 independent peer review of the PJM load forecasting models, the Brattle Group concluded the following:

- The PJM model has been specified and estimated independently from any of its member electricity distribution companies.
- PJM forecasts are generally consistent with those of its members.
- At the full regional level, the mean absolute percent error, a commonly used statistic for appraising forecast accuracy, was 3.87 percent for peak demand, and the reviewers could not significantly improve that value independently.
- When re-estimated for actual weather, the model came within 0.73 percent of actual peak demand.
- The PJM model adequately accounts for changes in weather sensitivity over time.

8.2.2.4 Responsive to Forecasting Uncertainty Test

The review team finds that, in aggregate, the studies and reports relied upon for conclusions in Section 0 are responsive to forecasting uncertainty. In preparing its load forecasts and reliability assessments, PJM takes into account forecasting uncertainty. For example, PJM's process carefully considers the effects of weather (especially temperature) uncertainty on the demand for electricity and on the reserve margin, as well as alternative economic growth scenarios (Brattle Group 2006-TN1557). In addition, PJM takes into account the fact that not all proposed or conceptual new generating units will be built and some existing generating units may be taken offline for various reasons. PJM also considers the effects of alternative macroeconomic models and alternative econometric specifications of its forecasts (Itron 2010-TN1558).

8.2.2.5 Summary of RFC / PJM Analytical Process

Based on its review of PJM, RFC, NERC, and PPUC documents, the review team determined that, in aggregate, the forecasts and documents of these entities are sufficiently (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty to serve the needs of the review team in complying with Section 102 of the National Environmental Policy Act (42 USC 4321 et seq.-TN661). In keeping with the ESRP (NRC 2000-TN614), NRC Interim Staff Guidance (NRC 2013-TN2600), and the Commission statements in 68 FR 55905 (TN733), the review team gave particular credence to the following:

- RFC's 2014 long-term resource assessment (RFC 2013-TN3108),
- PJM's 2014–2029 load forecast report (PJM 2014-TN3105),

- NERC's evaluation of long-term system adequacy (NERC 2013-TN3106), and
- PPUC's electric power outlook for 2012–2017 (PPUC 2013-TN3107).

Following ESRP guidance (NRC 2000-TN614) to extend the need for power analysis "through the 3rd year of commercial operation of all proposed units", the review team need assessment extends through 2029 for power demand. The power supply analysis extends through 2023, limited by the extent of the RFC reliability forecasts for retirements and new capacity additions, which become speculative beyond that point. The review team extended the supply analysis to 2029 for consistency with the demand forecast.

8.3 Power Demand

The review team relied upon the PJM 2014 Load Forecast (PJM 2014-TN3105) to compile a demand forecast covering just those PJM components identified by the applicant as part of the BBNPP region of interest shown in Figure 8-1. Based on those projections, between 2014 and 2029, coincident peak loads for this area are expected to grow by an average of 0.78 percent per year. This growth rate is slightly less aggressive than the annual growth rate of 0.90 percent for PJM as a whole for the same period. By 2029, internal load for the BBNPP market area is expected to increase to over 57 GW of load and over 274 TWh of consumption. See Figure 8-4 to examine this trend.

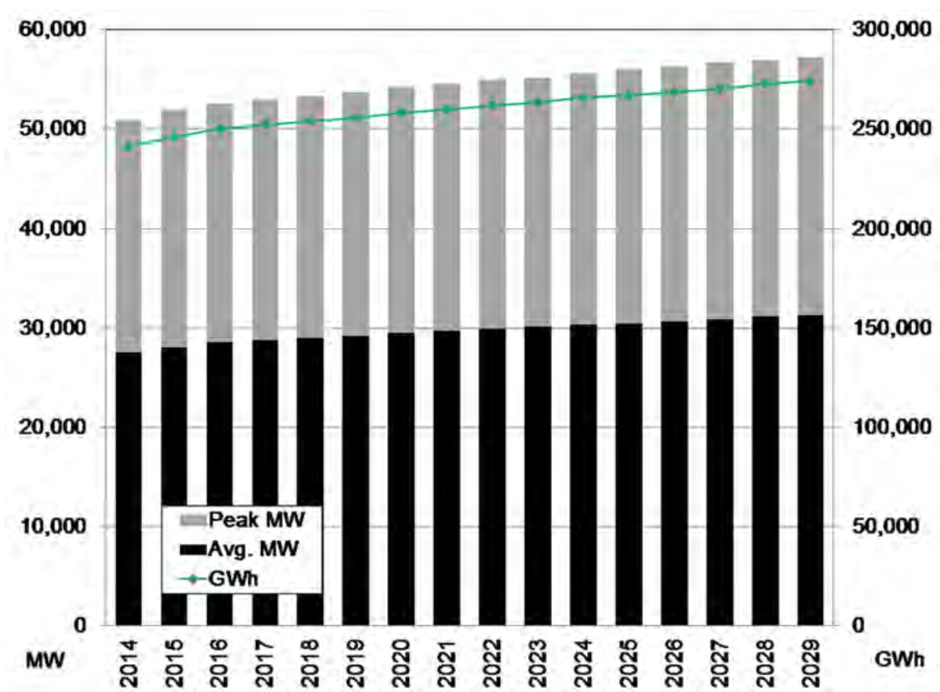

Figure 8-4. Projected Internal Summer Peak Demand, Average Demand, and Consumption in the BBNPP Market Area 2014–2029 (PJM 2014-TN3105). (Net of planning reserves)

This demand forecast accounts for demand-side management actions such as energy efficiency and conservation programs, demand response programs, updated building codes, and appliance standards. Together, these resources are projected to diminish PJM system-wide annual peak demand by an average of more than14.4 GW through 2029 (PJM 2014-TN3105), or about 7.1 percent of PJM peak demand in 2029 (see Table 8-1). PJM demand projections also consider market projections of the industrial, residential, and commercial electricity customer sectors as well as projected industrial activity levels and major factors that resulted in forecasting uncertainties (e.g., weather and business cycles of large customers).

Demand forecasts of the last decade were disrupted somewhat by the national economic recession that began in 2008, the effects of which are still being felt in many parts of the country. As illustrated in Figure 8-5, the recession has had a marked effect on the load forecasts of most utilities, including those in the PJM region and the BBNPP market area. The difference between the 2007 (pre-recession) forecast and the current forecast for the BBNPP market area translates to a reduction of more than 10 GW of summer peak demand by 2029. Thus, the diverging forecast trends suggest the recession will have a long-term effect in this area, such that current forecast levels of peak load are not expected to return to 2007 forecast out-year levels for at least 10 years.

The BBNPP market area is a subset of the greater PJM territory into which capacity resources can be dispatched. Thus, capacity resources are not typically summarized for PJM zones or the BBNPP market area, specifically. This prevents a direct comparison of demand in the BBNPP market area to the associated supply of generation resources. Therefore, the review team compared the demand trend for the BBNPP market area to PJM system-wide demand growth trend (see Table 8-1). The review team also examined the PJM generation interconnection planning queue and the PJM generation deactivation queue, both of which are summarized at the individual service area level. The active queues provide important, but incomplete, information about the prospective 5-year planning horizon. The review team determined that demand forecasts developed for the PJM Mid-Atlantic zone closely approximate the BBNPP market area described in the environmental report, which is based on the specific utility service areas included by the applicant. The table indicates that the BBNPP market area share of PJM system-wide and PJM Mid-Atlantic peak demand and annual consumption remains nearly constant over the projection period. This implies that PJM system-wide resource adequacy would not be expected to affect the BBNPP market area differently. The need for power demonstrated at the PJM level would apply relatively equally in the BBNPP market area.

Table 8-1. BBNPP Market Area and PJM Region Projected Summer Demand and Consumption (including planning reserves)

Area	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Total Internal Demand (MW) (Internal Load + Reserves)										
BBNPP Market Area	63,234	63,834	64,485	64,840	64,667	65,168	65,711	66,134	66,482	66,878
PJM Mid-Atlantic	74,962	75,716	76,470	77,009	76,768	77,293	77,877	78,426	78,907	79,364
PJM Region Total	196,701	198,938	200,947	202,797	202,272	204,005	205,742	207,378	208,824	210,271
Market Area Share of PJM Mid-Atlantic	0.844	0.843	0.843	0.842	0.842	0.843	0.844	0.843	0.843	0.843
Market Area Share of PJM	0.321	0.321	0.321	0.320	0.320	0.319	0.319	0.319	0.318	0.318
Consumption (GWh)										
BBNPP Market Area	301,184	303,946	307,200	309,630	309,348	310,784	313,156	315,439	318,628	319,990
PJM Mid-Atlantic	368,071	371,524	375,607	378,689	378,475	380,307	383,287	386,150	390,096	391,811
PJM Region Total	1,043,935	1,054,058	1,066,414	1,075,955	1,075,584	1,081,213	1,090,207	1,098,924	1,110,467	1,116,012
Market Area Share of PJM Mid-Atlantic	0.818	0.818	0.818	0.818	0.817	0.817	0.817	0.817	0.817	0.817
Market Area Share of PJM	0.289	0.288	0.288	0.288	0.288	0.287	0.287	0.287	0.287	0.287
Demand-Side Management (MW)										
BBNPP Market Area	5,446	5,462	5,479	5,487	5,436	5,440	5,446	5,449	5,452	5,454
PJM Mid-Atlantic	6,269	6,287	6,307	6,316	6,257	6,262	6,269	6,273	6,276	6,278
PJM Region Total	14,457	14,498	14,544	14,565	14,429	14,441	14,457	14,465	14,472	14,477
Market Area Share on PJM Mid-Atlantic	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869
Market Area Share of PJM	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377

Source: Compiled by review team from PJM (2014-TN3105) https://earrth.pnnl.gov/spaces/referencespace/References/PJM 2012-pjm-load-report.pdf

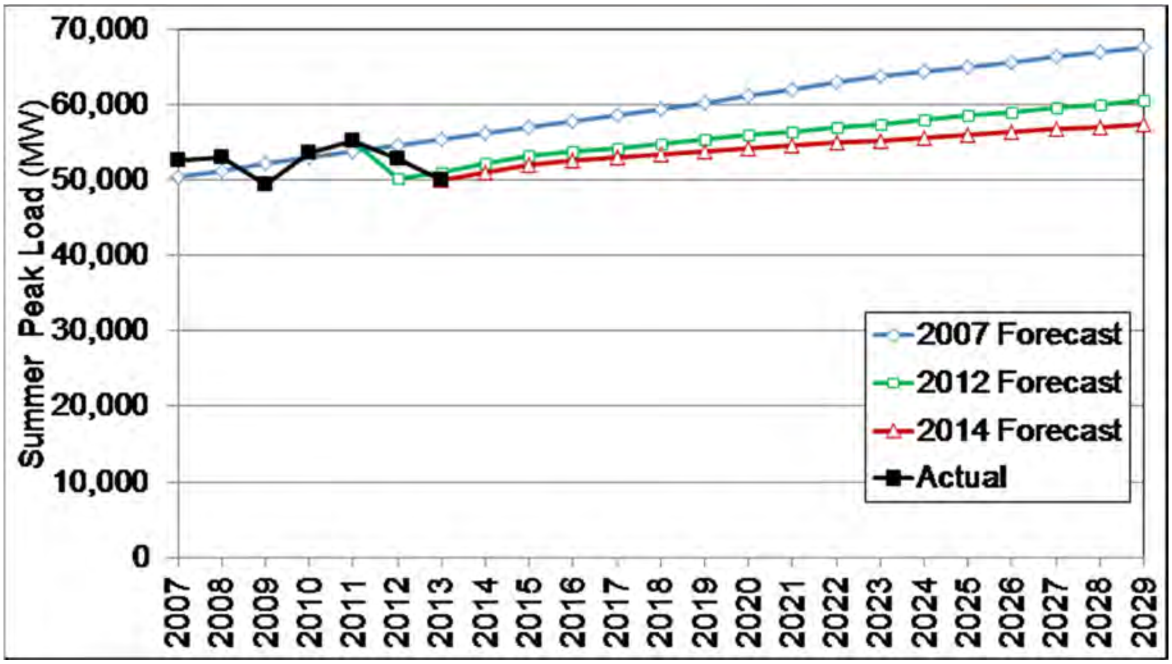

Figure 8-5. BBNPP Market Area 2007, 2012, and 2014 Internal Peak Load Forecasts. (Compiled by review team from PJM [PJM 2007-TN1554; PJM 2012-TN1549; PJM 2014-TN3105])

8.4 Power Supply

This section discusses generating capacity forecasts that affect the BBNPP market area. The review team compiled available information covering capacity forecasts in the PJM region of the RFC entity. This information appears in Table 8-2. The forecast begins with 2014 installed capacity covering the entire PJM region. Net transactions are purchased power resources that add to the installed capacity, resulting in existing capacity resources of 187.5 GW through 2022.

Net planned capacity additions include the addition of new resources from planned new plant construction and power uprates at existing plants. These additions are offset by planned retirements of old or uneconomic existing plants, which are subtracted from the starting net capacity. Planned retirements are discussed in more detail below.

In power planning, there are various categories of generation resources. Planned generation additions are those resources that have initiated an interconnection agreement with PJM and are expected to come online during the projection period. Conceptual capacity includes those resources that may be proposed or prospective, but which have yet to initiate an interconnection agreement with PJM. BBNPP is part of the pool of conceptual resources, among many other generation options. These resources are more speculative, and thus, PJM has assigned a confidence level to govern the proportion of those conceptual resources actually expected to come to fruition. The confidence level ranges from 35 percent in the near term to 20.9 percent in the out years of the forecast. Therefore, the net supply of generation resources is the sum of existing capacity, planned additions, and conceptual capacity, less expected retirements.

Table 8-2. 2020–2029 PJM Region Summer Peak Supply Forecast Summary

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Existing Capacity (MW)	185,331	185,331	185,331	185,331	185,331	185,331	185,331	185,331	185,331	185,331
Net Transactions (MW)	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
Net Capacity (MW)	187,531	187,531	187,531	187,531	187,531	187,531	187,531	187,531	187,531	187,531
Planned Additions (MW)	14,693	14,693	14,693	14,693	14,693	14,693	14,693	14,693	14,693	14,693
Planned Retirements (MW)	-11,417	-11,417	-11,417	-11,417	-11,417	-11,417	-11,417	-11,417	-11,417	-11,417
Net Planned Capacity (MW)	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276	3,276
Conceptual Capacity (MW)	41,788	41,788	41,788	41,788	41,788	41,788	41,788	41,788	41,788	41,788
Cumulative Confidence Level (%)	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
Expected Conceptual Capacity (MW)	8,718	8,718	8,718	8,718	8,718	8,718	8,718	8,718	8,718	8,718
Net Supply (MW)	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525
Reserve Margin w/o Additional Resources (%)	16.8	15.8	14.9	14.0	14.2	13.4	12.6	11.8	11.1	10.5

Source: (RFC 2013-TN3108) and review team analysis.

The review team notes that at least three evolving market influences keep the future picture of power supply uncertain. First, as described above, the estimated existing fossil-fired generation affected by pending U.S. Environmental Protection Agency rules continues to be revised. As of this draft environmental impact statement, the estimate of potentially idled generation in the RFC region has been revised significantly upward to 18 to 26 GW by 2016, depending on whether lenient or strict-case assumptions apply (Celebi et al. 2012-TN1556). For the PJM region, this amounts to 14 to 21 GW, or 8 to 11 percent of existing capacity. Under the most recent NERC long-term assessment (NERC 2013-TN3106), the 2012 analysis results for retirements (NERC 2012-TN2039) were incorporated by reference. These results suggest PJM idled generation could rise to 16.5 GW by 2015, and to nearly 22 GW after that. Each of these cases reports analyses of the issue separated by just months of time, which reflects the uncertainty of the situation. In the RFC 2014 forecast (RFC 2013-TN3108), 14.4 GW of retirements are projected by 2016. Current deactivation queues indicate that PJM expects 10.8 GW of generation retirements PJM system-wide in 2015, and 3.3 GW for the BBNPP market area (PJM 2014-TN3961). These most recent estimates are below the earlier projections of retirements, and lead the review team to favor the PJM projections reflected in the RFC 2014 forecast. Thus, Table 8-2 reflects that forecast.

Next, long-term lower natural gas prices, spurred by shale gas exploration success and resulting new discoveries, also could lead to substantial additional coal plant retirements. In the Brattle Group analysis (Celebi et al. 2012-TN1556), the authors estimate that an additional drop in gas price of $1 per MMBTU would almost double the retirements forecast under either the lenient or the strict regulatory case and gas-fired generation would increase in response. Similarly, they estimate that a $1 per MMBTU increase in forward gas prices would essentially halt the coal-fired generator retirements at currently announced levels. To the degree that trending lower natural gas prices are perceived to be a long-term trend, more natural-gas-fired generation resources would be expected in response. Like BBNPP, these resources would be considered part of the pool of conceptual resources in the RFC forecast.

Finally, the prospect of potential future carbon legislation, in addition to the pending U.S. Environmental Protection Agency regulations discussed, would contribute added pressure to retire existing fossil plants. The recent analysis also found that imposition of a $30/ton carbon tax in the 2020 time frame could be as disruptive as continued lower gas prices and would result in more than doubling the number of coal plant retirements compared to current estimates, depending on implementation (Celebi et al. 2012-TN1556). Though speculative and not factored into the review team's analysis, and even with mitigative implementation actions that would dampen the impacts of such a tax, it would have an additional substantial impact on the existing fossil fleet.

These assessments lead the review team to conclude that substantial fossil (coal- and oil-fired) plant retirements should be expected leading up to and during the period the BBNPP unit would be coming online.

The review team will present summary information covering planned supply based on the RFC forecast (RFC 2013-TN3108). After examining the effects of alternative assumptions about future generation retirements from NERC (2012-TN2039) and the Brattle Group (Celebi et al. 2012-TN1556), the RFC analysis appears to most closely align with current conditions in the BBNPP market area. Based on the RFC forecast and the expected 15.6 percent reserve margin required by PJM reliability standards, with no other factors affecting the analysis and no additional resources coming online beyond those forecast, the PJM reserve margin would drop below 15.8 percent by 2021 (see Table 8-2). To maintain the required reserve margins, new generation or demand response resources, in addition to those already in the planning queue, will be needed throughout the forecast period.

8.5 Assessment of Need for Power and Findings

The review team reviewed reports prepared by the PJM regional Independent System Operator, the RFC, and other independent assessments, in conjunction with its assessment of the need for power from the proposed BBNPP unit. The review team's key findings from the reports and their impact on the need for baseload power are summarized as follows:

- In the PJM territory, merchant generators can ensure baseload operation by self-scheduling the operation of their plants (Monitoring Analytics 2014-TN3336). This means that the operator commits to generate and takes the market-clearing wholesale electricity price. Under this model, the operator is confident that over the long run, the price it receives will be high enough to cover fixed and variable costs, with some remaining margin accruing to operating profit. PPL indicated that BBNPP would be a self-scheduled resource (PPL Bell Bend 2014-TN3625).

- BBNPP would be a baseload merchant generation resource. Thus, the need for the project should be assessed in terms of expected baseload supply. As of 2011, the PJM generation fleet composed 70.3 percent of baseload resources (Monitoring Analytics 2012-TN1560).

The review team used 70.3 percent throughout the assessment to represent the baseload portion of PJM capacity. The baseload proportion was applied to the estimated surplus, or deficit capacity, shown in Table 8-3. Table 8-3 illustrates the assessment results based on the PJM projections reported in the RFC forecast (RFC 2013-TN3108).

Table 8-3. Review Team Assessment of Forecast BBNPP Market Area Power Needs (2020–2029)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
PJM Total Internal Demand (MW)	196,701	198,938	200,947	202,797	202,272	204,005	205,742	207,378	208,824	210,271
PJM Net Supply (MW)	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525	199,525
Reserve Margin Surplus/ (-) Deficit (%)	1.2	0.2	-0.7	-1.6	-1.4	-2.2	-3.0	-3.8	-4.5	-5.1
PJM Surplus/ (-) Deficit (MW)	2,431	388	-1,422	-3,272	-2,747	-4,480	-6,217	-7,853	-9,299	-10,746
BBNPP Market Area Share of PJM Demand	0.321	0.321	0.321	0.320	0.320	0.319	0.319	0.319	0.318	0.318
BBNPP Market Area Surplus/ (-) Deficit (MW)	780	125	-456	-1,047	-879	-1,429	-1,983	-2,505	-2,957	-3,417
Baseload Surplus/ (-) Deficit (MW)	548	88	-321	-736	-618	-1,005	-1,394	-1,761	-2,079	-2,402

Source: Table 8-1, Table 8-2, and review team analysis. Totals affected by rounding.

- The demand for power at the summer peak, and the monthly average demand for energy in the BBNPP market area, are both projected to rise over the period between 2014 and 2029 at approximately 0.78 percent per year (PJM 2014-TN3105). This rate of growth is slightly slower than the PJM system-wide growth rate. The recent recession has significantly reduced the summer peak load projections throughout the length of the projection period. Because average demand also is expected to rise at the same rate as peak demand, the need for baseload resources is growing at an equal rate to intermediate and peaking resources.

- Forthcoming regulations governing emissions from fossil-fired generation will cause an increase in capacity retirements above what has been considered in earlier forecasts. Depending on economic decisions to be faced regarding the cost of compliance and the operating cost of these plants, either moderate-case assumptions or strict-case assumptions may apply, and will affect the projection of planned retirements. RFC (2013-TN3108) projects that about 14.4 GW of retirements will occur in the PJM region by 2015. Alternative analysis suggests that this number could be as high as 22 GW by 2016. The NERC (2012-TN2039) assessment estimates that 16.5 GW of retirements will occur by 2015, when summing announced and unannounced retirements. Regardless of the forecast, these supply impacts exceed the impact of the reduced demand forecast induced by the recent recession.

- In addition to the effects of the recent recession, the demand forecast accounts for over 14.4 GW of demand reduction achieved through energy efficiency and demand response programs across PJM, including the adoption of stricter Federal building energy codes and appliance standards.
- When increased demand and planned supply factors both are considered, the extended 2014 PJM forecast in Table 8-3 shows a net need for new generation of 4,480 MW by 2025 in PJM. This implies a need for new baseload generation to serve the BBNPP market area portion of PJM, with at least 1,005 MW needed by 2025 and rising to 2,079 MW by 2028, based on 70 percent of generation being baseload. To the degree that the affected retirements amount to a greater proportion than 70 percent baseload, proportionally more baseload resource will be needed. For example, most coal-fired generation operates as baseload, thus the need is likely to exceed these estimates.
- The RFC (2013-TN3108) forecast indicates that some currently conceptual resources would need to come online beginning in 2021, in order to maintain reliability reserve margins, and all such resources would be required by 2022. In addition, by 2023, 22.4 percent of the available demand response resource would be required, without additional new capacity above that already considered. The forecasters point out that reliance on demand response resources as a hedge against reserve margins is tenuous, because there is relatively little experience in the region to assess what levels of demand response might remain available later in the period after being dispatched early in the 2014–2023 period. The curtailment experience of individual demand response customers is likely to govern future program participation and affect out-year projections of available demand response resources.

While the review team expects that generation resources would continue to be brought online through the 2029 planning horizon covered by the load forecast, the supply forecast extends only through 2023. In order to extend the assessment of future capacity to 2029 to match the load forecast, and in the absence of any projection beyond 2023, the review team assumed that PJM would continue to meet its reserve margin target of 15.6 percent over the 2024 to 2029 time period. Thus, the review team estimated the amount of capacity needed by multiplying each year's net internal demand by the corresponding gap between 15.6 percent and the estimated margin implied by holding constant net supply at the 2023 forecast level. Those values appear as the "PJM Surplus/Deficit" row in Table 8-3.

The review team confirms the applicant's assessment and concludes that there is an expected future shortage of baseload power in the BBNPP market area that at least partially could be addressed by construction of the proposed BBNPP. Although a recent recession has noticeably reduced the PJM forecast of future demand for electricity, pending regulations affecting fossil-fired generation more than offset the expected decline in demand with increased plant retirements. Based on this analysis, the review team concludes that there is a justified need for the planned 1,600 MW(e) baseload capacity output of BBNPP in the market area in the 2025 to 2028 period, and this need may occur as soon as 2022, depending on which projection of future fossil-plant retirements proves most reliable.

NRC FORM 335 (12-2010) NRCMD 3.7 **BIBLIOGRAPHIC DATA SHEET** *(See instructions on the reverse)*	U.S. NUCLEAR REGULATORY COMMISSION	1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.) NUREG-2179, Volume 1 Draft	
2. TITLE AND SUBTITLE Environmental Impact Statement for Combined License (COL) for Bell Bend Nuclear Power Plant, Draft Report for Comment		3. DATE REPORT PUBLISHED MONTH April	YEAR 2015
		4. FIN OR GRANT NUMBER	
5. AUTHOR(S) See Appendix A		6. TYPE OF REPORT Technical	
		7. PERIOD COVERED (Inclusive Dates)	

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

Division of New Reactors Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)

Same as above

10. SUPPLEMENTARY NOTES

Docket No. 52-039

11. ABSTRACT (200 words or less)

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by PPL Bell Bend, LLC (PPL) for combined construction permit and operating license (combined license or COL). The proposed actions related to the PPL application are (1) NRC issuance of COL for one new power reactor unit at the Bell Bend Nuclear Power Plant (BBNPP) site in Luzerne County, Pennsylvania, and (2) U.S. Army Corps of Engineers (USACE) decision to issue, deny, or issue with modifications a Department of the Army (DA) permit to perform certain dredge and fill activities in waters of the United States and to construct structures in navigable waters of the United States related to the project. This EIS documents the review team's analysis, which considers and weighs the environmental impacts of constructing and operating one new nuclear unit at the BBNPP site and at alternative sites, including measures potentially available for reducing or avoiding adverse impacts.

After considering the environmental aspects of the proposed action before the NRC, the NRC staff's preliminary recommendation to the Commission is that the COL be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by PPL; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	13 AVAILABILITY STATEMENT
Bell Bend Nuclear Power Plant Combined License Application	unlimited
Bell Bend Nuclear Power Plant COL	14. SECURITY CLASSIFICATION
Bell Bend Nuclear Power Plant Environmental Review	(This Page) unclassified
Draft Environmental Impact Statement	(This Report) unclassified
NEPA	15. NUMBER OF PAGES
NUREG-2179	16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

NUREG-2179, Vol. 1
Draft

Environmental Impact Statement for the Combined License (COL)
for the Bell Bend Nuclear Power Plant

April 2015