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United States Nuclear Regulatory Commission
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NUREG-1937, Vol. 1

Draft Environmental Impact Statement for Combined Licenses (COLs) for South Texas Project Electric Generating Station Units 3 and 4

Draft Report for Comment

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

U.S. Army Corps of Engineers
U.S. Army Engineer District, Galveston
Galveston, TX 77553-1229

US Army Corps

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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 STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the STPNOC application are (1) NRC issuance of COLs for two new nuclear power reactor units at the South Texas Project Electric Generating Station (STP) site in Matagorda County, Texas, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit to perform certain construction activities on the site. The Corps is participating in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the STP site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts.

The EIS includes the evaluation of the proposed action's impacts to waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The Corps will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the Corps' permit decision document, will include an alternatives analysis to determine the Least Environmentally Damaging Practicable Alternative.

After considering the environmental aspects of the proposed action, the NRC staff's preliminary recommendation to the Commission is that the COLs be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by STPNOC; (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. The Corps will issue its Record of Decision based, in part, on this EIS.

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Executive Summary

By letter dated September 20, 2007, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs) for South Texas Project Electric Generating Station (STP) Units 3 and 4, located in Matagorda County, Texas. The review team's evaluation is based on the September 2009 revision to the application, responses to requests for additional information, and supplemental letters.

The proposed actions related to the STP Units 3 and 4 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the STP site, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act to perform certain construction activities on the site. The Corps is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency and participates collaboratively on the review team. The reactor specified in the application is a certified U.S. Advanced Boiling Water Reactor design (U.S. ABWR, hereafter referred to as ABWR in this EIS).

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.) directs that an EIS be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

The purpose of STPNOC's requested NRC action—issuance of the COLs—is to obtain licenses to construct and operate two new nuclear units. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must obtain and maintain the necessary permits from other Federal, State, Tribal, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of the STPNOC application is to determine if two new nuclear units of the proposed design can be constructed and operated at the STP site without unacceptable adverse impacts on the human environment. The purpose of STPNOC's requested Corps action is to obtain a permit to perform regulated activities that would impact waters of the United States.

Upon acceptance of the STPNOC application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (72 FR 72774) to prepare an EIS and conduct scoping. On February 5, 2008, the NRC held two scoping meetings in Bay City, Texas, to obtain public input on the scope of the environmental review. The staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC and its contractor Pacific Northwest National Laboratory (PNNL) visited the STP site in February 2008 and the Allens Creeks alternative site in March 2008. In August 2009, the NRC and PNNL visited the Red 2 and Trinity 2 alternative sites. During the site visits, the NRC staff and its contractors met with STPNOC staff, public officials, and the public.

Included in this EIS are (1) the results of the review team's analyses, which consider and weigh the environmental effects of the proposed actions; (2) potential mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's preliminary recommendation regarding the proposed action.

To guide its assessment of the environmental impacts of a 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). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels – 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.

In preparing this EIS, the review team reviewed the application, including the Environmental Report (ER) submitted by STPNOC; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plan*. In addition, the NRC staff considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

The NRC staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on (1) the application, including the ER submitted by STPNOC; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's 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. The Corps will issue its Record of Decision based, in part, on this EIS.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency (EPA) Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the environmental review. During this period, the NRC and Corps staff will conduct a public meeting near the STP site to describe the results of the environmental review, respond to questions, and accept public comment. All comments received during the comment period will be addressed in the final EIS.

The NRC staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the NRC's Safety Evaluation Report anticipated to be published in 2011.

Abbreviations/Acronyms

AADT	Average Annual Daily Traffic
ABWR	U.S. Advanced Boiling Water Reactor
ac	acre(s)
ACHP	Advisory Council on Historic Preservation
ADAMS	Agencywide Documents Access and Management System
AEP	American Electric Power
AEP	Archaeology and Ethnography Program
APE	area of potential effect
ALARA	as low as reasonably achievable
ASLB	Atomic Safety and Licensing Board
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGCD	Bluebonnet Groundwater Conservation District
BGS	below ground surface
BMP	best management practice
Btu	British thermal unit(s)
Bq	Becquerel(s)
BWR	boiling water reactor
°C	degree(s) Celsius
CAES	compressed air energy storage
CBC	Christmas Bird Count
CCD	Census County Division
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CDR	Capacity, Demand, and Resources Report
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (water flow)
Ci	curie(s)
cm	centimeter(s)
CMP	Coastal Management Program
CMZ	Coastal Management Zone
CNP	CenterPoint Energy
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined license

CORMIX	Cornell Mixing Zone Expert System
Corps	U.S. Army Corps of Engineers
CPGCD	Coastal Plains Groundwater Conservation District
CPS Energy	City Public Service Board of San Antonio, Texas
CPUE	catch per unit effort
CR	County Road (CR 360, CR 392)
CREZ	Competitive Renewable Energy Zones
CWA	Clean Water Act
CWIS	circulating water intake structure
CWS	circulating water system
CZMA	Coastal Zone Management Act
DBA	Design Basis Accident
dBA	decibel(s) (acoustic)
DC	design certification
DCD	Design Control Document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSM	demand side management
D/Q	deposition values
DWS	drinking water standards
EA	Environmental Assessment
EAB	Exclusion Area Boundary
ECP	Essential Cooling Pond
EIS	environmental impact statement
EFH	essential fish habitat
ELF	extremely low frequency
EMF	electromagnetic field
EOF	Emergency Operations Facility
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERCOT	Electric Reliability Council of Texas
ESA	U.S. Endangered Species Act of 1973, as amended
ESRP	Environmental Standard Review Plan
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FDA	final design approval
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement

FM	Farm-to-Market
FMP	Fishery Management Plan
fps	feet per second
FR	Federal Register
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot or feet
ft^2	square feet
ft^3	cubic feet
FWS	U.S. Fish and Wildlife Service
GBq	gigabecquerel
GCC	global climate change
GCRP	U.S. Global Change Research Program
GE	General Electric
GEIS	generic environmental impact statement
GHG	greenhouse gases
GIT	Georgia Institute of Technology
GIWW	Gulf Intracoastal Waterway
gpd	gallon(s) per day
gpm	gallon(s) per minute
GRWMS	gaseous radioactive waste-management system
ha	hectare(s)
HAPC	habitat areas of particular concern
hr	hour(s)
Hg	mercury
Hz	hertz
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch
INEEL	Idaho National Engineering and Environmental Laboratory
IOU	investor owned utility
ISD	Independent School District
ISO	independent system operator
I&S	interest and sinking fund rate
km	kilometer(s)
km^2	square kilometer(s)

kWh	kilowatt-hour(s)
kV	kilovolt(s)

L	liter(s)
lb	pound(s)
LCRA	Lower Colorado River Authority
LCRWPG	Lower Colorado Regional Water Planning Group
LEDPA	least environmentally damaging practicable alternative
LERF	large early release frequency
LLW	low-level waste
LNG	liquefied natural gas
LOS	level of service
LPZ	Low Population Zone
LRF	large release frequency
LST	local standard time
LSWP	LCRA-SAWS Water Project
LTSF	Long-Term Storage Facility
LWA	Limited Work Authorization
LWMS	liquid waste management system
LWR	light water reactor

m	meter(s)
m^3	cubic meter(s)
MACCS2	MELCOR Accident Consequence Code System Version 2
MBq	megabecquerel(s)
MCEDC	Matagorda County Economic Development Corporation
MCEMO	Matagorda County Emergency Management Office
MCR	Main Cooling Reservoir
MDC	Main Drainage Channel
MEI	maximally exposed individual
mg	milligram(s)
MGD	million gallons per day
mg/L	milligram(s) per liter
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MMS	Minerals Management Service
mo	month
MOU	Memorandum of Understanding
M&O	maintenance and operations

mph	mile(s) per hour
mR	milliroentgen
mrad	millirad(s)
mrem	millirem(s)
μS	microsiemens
MSA	Metropolitan Statistical Area
MSL	mean sea level
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s) of uranium
MUD	municipal utilities district
MW	megawatt(s)
MWd	megawatt-day(s)
MW(e)	megawatt(s) electrical
MW(t)	megawatt(s) thermal
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection & Measurements
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
NINA	Nuclear Innovation North America
NMFS	National Marine Fisheries Services
NMM	navigation mile marker
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRG	NRG South Texas LP
NRHP	National Register of Historic Places
NTF	Nuclear Training Facility
ODCM	offsite dose calculation manual
OSF	Onsite Staging Facility
OSGSF	Old Steam Generator Storage Facility
OSHA	Occupational Safety and Health Administration
OW	observation well

PAM	primary amoebic meningoencephalitis
pCi	picocuries
pCi/L	picocuries per liter
PGC	Power Generation Company
PIR	Public Interest Review
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
PM_{10}	particulate matter with a diameter of 10 microns or less
PNNL	Pacific Northwest National Laboratory
ppt	parts per thousand
PSD	prevention of significant deterioration
PUCT	Public Utility Commission of Texas
PWR	pressurized water reactors
RAI	request for additional information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCW	Reactor Building Cooling Water
rem	roentgen equivalent man (a special unit of radiation dose)
REMP	radiological environmental monitoring program
RIMS	Regional Input-Output Model System
RMPF	Reservoir Makeup Pumping Facility
RMR	reliability must run
ROD	Record of Decision
ROI	region of interest
ROW	right of way
RSICC	Radiation Safety Information Computational Center
RSW	Reactor Service Water
Ryr	reactor-year
s	second(s)
SACTI	Seasonal and Annual Cooling Tower Impacts
SAMA	severe accident mitigation alternatives
SAMDA	severe accident mitigation design alternatives
SAWS	San Antonio Water System
SCR	selective catalytic reduction
SECPOP 2000	Sector Population, Land Fraction, and Economic Estimation Program
SER	Safety Evaluation Report
SHPO	State Historic Preservation Officer
SO_2	sulphur dioxide
SO_x	sulphur oxide
STP	South Texas Project Electric Generating Station

STPNOC	STP Nuclear Operating Company
Sv	sievert
SWMS	solid waste management system
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
TAMUG	Texas A&M University at Galveston
TBEG	Texas Bureau of Economic Geology
TBq	terabecquerel(s)
TCC	Texas Central Company
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Plan
TDS	total dissolved solids
TDSHS	Texas Department of State Health Services
TEDE	total effective dose equivalent
THC	Texas Historical Commission
TIS	Texas Interconnected System
TLD	thermoluminescent dosimeter
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TPWP	Texas Prairie Wetlands Project
TRAGIS	Transportation Routing Analysis Geographic Information System
TWC	Texas Water Code
TWDB	Texas Water Development Board
TX	Texas
TXDOT	Texas Department of Transportation
U_3O_8	triuranium octaoxide (“yellowcake”)
UF_6	uranium hexafluoride
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium oxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	U.S. Geological Survey
VOC	volatile organic compound
WCS	Waste Control Specialists, LLC

WHO	World Health Organization
WMA	Wildlife Management Area
WSEC	White Stallion Energy Center
WSWTS	West Sanitary Waste Treatment System
WCID	Water Control and Improvement District
χ/Q	dispersion values
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

1.0 Introduction

By letter dated September 20, 2007, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs) for South Texas Project Electric Generating Station (STP) Units 3 and 4. The review team's evaluation is based on the September 2009 revision to the application, responses to requests for additional information, and supplemental information.

The location of the proposed Units 3 and 4 is approximately 2000 ft northwest of the existing STP Units 1 and 2. The STP site and existing facilities are owned by NRG South Texas LP (NRG); City Public Service Board of San Antonio, Texas (CPS Energy); and the City of Austin, Texas. It is planned that STP Unit 3 would be owned by Nuclear Innovation North America (NINA) South Texas 3 LLC and CPS Energy, and STP Unit 4 would be owned by NINA South Texas 4 LLC and CPS Energy (STPNOC 2009a). STPNOC would be the licensed operator for the proposed Units 3 and 4, as it currently is for the existing Units 1 and 2. In its application, STPNOC specified the certified U.S. Advanced Boiling Water Reactor (ABWR) as the proposed reactor design for Units 3 and 4.

On June 4, 2009, with a subsequent submittal on October 28, 2009, STPNOC submitted a Permit Determination Request to the U.S. Army Corps of Engineers (Corps) Galveston District for activities associated with constructing and operating STP Units 3 and 4. On November 10, 2009, the Corps notified STPNOC that the proposed project would require a U.S. Department of the Army Corps permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The Corps is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency.

The proposed actions related to the STP Units 3 and 4 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the STP site; and (2) the Corps issuance of a permit pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. The permit application requests authorization to expand an existing barge slip on the Colorado River and to culvert and fill waters of the United States for the purpose of constructing a heavy haul road on the site.

1.1 Background

A COL is a Commission approval for the construction and operation of a nuclear power facility. NRC regulations related to COLs are found primarily in Title 10 of the Code of Federal Regulations (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), requires preparation of an environmental impact statement (EIS) for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

According to 10 CFR 52.80(b), a COL application must contain an Environmental Report (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. Part 3 of STPNOC's application contains the ER, which provides a description of the proposed actions related to the application and the applicant's analysis of the potential environmental impacts of construction and operation of proposed Units 3 and 4.

The STPNOC license application references the certified U.S. ABWR design (STPNOC 2009a; 10 CFR Part 52, Appendix A). Subpart B of 10 CFR Part 52 contains NRC regulations related to standard design certifications. The referenced ABWR Design Control Document was approved by the NRC in March 1997 and the final design certification rule was published in the *Federal Register* (FR) on May 12, 1997 (62 FR 25827). Where appropriate, this EIS incorporates the results of the ABWR design review.

1.1.1 Application and Review

The purpose of the STPNOC application is to obtain COLs to construct and operate a baseload nuclear power plant comprised of two new reactors. In addition to the COLs, STPNOC must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of STPNOC's requested Corps action is to obtain a permit to perform regulated activities that would impact waters of the United States.

1.1.1.1 NRC COL Application Review

STPNOC submitted an ER as part of its COL application (STPNOC 2009b). The ER focuses on the environmental effects of construction and operation of two ABWR units. The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81. Detailed procedures for conducting the environmental portion of the review are found in guidance set forth in NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000) and recent updates, hereafter referred to as the ESRP.

In this EIS, the review team evaluates the environmental effects at the STP site of two ABWR reactors each with thermal power ratings of 3853 MW(t). The new units would use a closed-loop cooling water system that would withdraw and discharge water from and to the Main Cooling Reservoir. In addition to considering the environmental effects of the proposed action, the NRC considers alternatives to the proposed action including the no-action alternative and the construction and operation of new reactors at alternative sites. Also, the benefits of the proposed action (e.g., need for power) and measures and controls to limit adverse impacts are evaluated. STPNOC's proposed action to construct and operate two new nuclear units includes requests for exemptions from the ABWR design certification (DC) under 10 CFR 52.93. The environmental impacts of the requested exemptions are addressed in this EIS. The technical analysis for each DC exemption will be included in the NRC's Final Safety Evaluation Report (SER), including a recommendation for approval or denial of each exemption.

Upon acceptance of the STPNOC application, the NRC began the environmental review process by publishing in the *Federal Register* on December 21, 2007, a Notice of Intent to prepare an EIS and conduct scoping (72 FR 72774). On February 5, 2008, the NRC held two public scoping meetings in Bay City, Texas, to obtain public input on the scope of the environmental review and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A listing of the agencies and organizations contacted is provided in Appendix B. The staff reviewed the comments received during scoping and responses were written for each comment. In-scope scoping comments and responses are included in Appendix D. A complete listing of the scoping comments and responses is documented in the South Texas Project Combined License Scoping Summary Report (NRC 2008).

To gather information and to become familiar with the sites and their environs, the NRC and its contractor Pacific Northwest National Laboratory (PNNL) visited the STP site in February 2008 and the Allens Creeks alternative site in March 2008. In August 2009, the NRC and PNNL visited the Red 2 and Trinity 2 alternative sites. During the site visits, the NRC staff met with STPNOC staff, public officials, and the public. Documents related to the STP site and alternatives sites were reviewed and are listed as references where appropriate.

To guide its assessment of the environmental impacts of a 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). Table B-1 of 10 CFR Part 51, 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 STP site, including the environmental impacts associated with constructing and operating reactors at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, 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 COLs for proposed Units 3 and 4 at the STP site.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency (EPA) Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the NRC and Corps staffs' review. A public meeting will be held near the site during the EIS comment period. During this public meeting, the NRC staff will describe the results of the environmental review, provide members of the public with information to assist them in formulating comments on the EIS, respond to questions, and accept comments on the EIS. After the comment period, the review team will consider all comments and address them in the final EIS.

1.1.1.2 Corps Permit Application Review

The Corps is part of the review team that makes a determination based on the three significance levels established by the NRC; however, the Corps' independent Record of Decision (ROD) regarding the aforementioned permit application will reference the analyses in the EIS and present any additional information required by the Corps to support its permit decision. The Corps' role as a cooperating agency in the preparation of this EIS is to ensure that the information presented is adequate to fulfill the requirements of Corps regulations applicable to construction of the preferred alternative identified in the EIS. The Clean Water Act Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230), which contains the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps' Public Interest Review (PIR) (33 CFR 320.4), direct the Corps to consider a number of factors as part of a balanced process. A discussion of those factors is provided below. The Corps' PIR will be part of its permit decision document and thus will not be addressed in the EIS.

This EIS includes the Corps' evaluation of construction and maintenance activities that impact waters of the United States. The Corps' permit decision will reflect the national concern for both protection and use of important resources. The benefit, which reasonably may be expected to increase from the proposal, must be balanced against its reasonably foreseeable detriments. Public interest factors that may be relevant to the proposal will be considered. These factors include conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and cumulative impacts thereof. Evaluation of the impact on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act. The Corps will address these issues in its permit decision document.

As part of the Corps' permit evaluation process, the Corps will issue a public notice to solicit comments from the public about STPNOC's proposal to perform site preparation activities and construct supporting facilities at the STP site.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations (LWAs) for Nuclear Power Plants" (72 FR 57416), the Commission defined "construction" as those activities within its regulatory purview as defined in 10 CFR 51.4. 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 associate 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 the 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 propose to construct structures in and under navigable waters and to discharge dredged, excavated, and/or fill material into waters of the United States, including jurisdictional wetlands that require permits from the Corps, are viewed by the Corps as direct effects related to their Federal permitting action. 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 are referred to as "cooperating agencies." Cooperating agencies have the responsibility to assist 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.

Most proposed nuclear power plants require a permit from the Corps, where impacts are proposed to waters of the United States, in addition to a license from the NRC. Therefore, the NRC and the Corps decided 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 the Corps signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (Corps and NRC 2008). Therefore, the Galveston District of the Corps is participating as a cooperating agency as defined in 10 CFR Part 51.14.

As described in the MOU, the NRC is the lead Federal agency, and the Corps is a cooperating agency in the development of the EIS. 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 Corps permit-decision process. While both agencies must comply with the requirements of NEPA, both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC makes license decisions under the Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.), and the Corps makes permit decisions under the Rivers and Harbors Appropriation Act of 1899 and the Clean Water Act. The Corps is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of Corps regulations, the EPA's Clean Water Act Section 404(b)(1) guidelines, which contain the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps PIR process.

As a cooperating agency, the Corps is part of the NRC review team, involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. For the purposes of assessment of environmental impact under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1 of this EIS; this approach has been vetted by the Council on Environmental Quality when the NRC established its environmental review framework for the renewal of operating licenses. A cooperating agency may adopt the EIS of a lead Federal agency without recirculating it when the cooperating agency concludes, after an independent review of the EIS, that its comments and suggestions have been satisfied and issues a ROD. The goal of the process is that the Corps will have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the Corps may still need some information from the applicant to complete the permit documentation, information that the applicant could not make available by the time of final EIS issuance.

1.1.4 Concurrent NRC Reviews

In reviews that are separate but parallel from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a SER issued by the NRC. The SER presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two ABWR reactors can be constructed and operated at the STP site without undue risk to the health and safety of the public, (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73 and 10 CFR Part 100, and (3) whether site characteristics are such that adequate security plans and measures as referenced in the above CFRs can be developed. The Final SER for the STPNOC COL application is expected to be published in 2011.

In addition to the COL review, STPNOC submitted a request to the NRC for an LWA, in accordance with 10 CFR 50.10(d), for construction of permanent crane foundation retaining walls. In its request dated November 16, 2009, STPNOC explained why it did not believe an LWA was required for this particular activity (STPNOC 2009c). The NRC responded on January 08, 2010 (NRC 2010), that STPNOC would need an LWA for the retaining walls and therefore must either (1) submit a complete LWA request, (2) submit a request for an exemption, or (3) delay construction of the retaining walls until the COLs have been issued for Units 3 and 4 (NRC 2010). STPNOC, in a letter dated February 2, 2010, withdrew their LWA request and formally requested an exemption (STPNOC 2010). The NRC will conduct a separate safety and environmental review for this exemption request. The results of that environmental review will be issued in an environmental assessment.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs for authorizing the construction and operation of two new ABWR units at the STP site. This EIS provides the NRC's analyses of the environmental impacts that could result from building and operating two proposed new units at the STP site or at one of the three alternative sites. These impacts are analyzed to determine if the proposed site is suitable for the addition of the new units and whether any of the alternative sites is considered obviously superior to the proposed site.

The Corps' Federal action is the decision whether to issue a 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 based on an evaluation of the probable impacts, including cumulative impacts, of the proposed construction activities on the public interest. These impacts are analyzed by the Corps to determine whether there is a practicable alternative with less adverse impact on the aquatic ecosystem provided that the alternative does not have other significant adverse consequences.

1.3 The Purpose and Need for the Proposed Actions

The continued growth of residential and commercial development in Texas has created an increased demand for electrical power. The purpose of this proposed action, authorization of the construction and operation of two ABWR units at the STP site, is to provide additional baseload electrical generation capacity for use in the owner's current markets and/or for potential sale on the wholesale market. The need for additional baseload power is discussed in Chapter 8 of this EIS.

Two COLs from the NRC are needed to construct and operate the proposed two new units. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. STPNOC must obtain and maintain permits or authorizations from other Federal, State, and local agencies, and permitting authorities before undertaking certain activities. The ultimate decision whether or not to build the new units and the schedule for building are not within the purview of the NRC or the Corps and would be determined by the license holder if the authorizations are granted.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 9 of this EIS addresses 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 to aquatic resources.

In the no-action alternative, the proposed action would not go forward. The NRC could deny STPNOC's request for the COLs. If the request was denied, the construction and operation of the two new units at the STP site would not occur nor would any benefits intended by the approved COLs be realized. Energy source alternatives include alternative energy sources, focusing on those alternatives that could generate baseload power. The alternative selection process to determine alternate site locations for comparison with the STP site is addressed below. System design alternatives include heat dissipation and circulating water systems, intake and discharge structures, and water-use and treatment systems. Finally, onsite alternatives evaluated by the Corps to reduce potential impacts to waters of the United States including jurisdictional wetlands and shoreline resources, are described.

In its ER, STPNOC defines a region of interest for use in identifying and evaluating potential sites for power generation. Using this process, the applicant reviewed multiple sites and identified nine primary sites for this project from which the alternative sites were selected. The staff evaluated the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of a new power reactor at those sites using reconnaissance-level information. The alternative sites selected from the primary sites include two privately owned greenfield sites and a greenfield site that is partially owned by NRG Energy, Inc. and was previously considered for the location of a nuclear power plant. The objective of the comparison of environmental impacts is to determine if any of the alternative sites are obviously superior to the proposed STP site.

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the Corps is required by regulation to apply the criteria set forth in the 404(b)(1) guidelines (33 USC 1344; 40 CFR Part 230). These guidelines establish criteria that must be met in order for the proposed activities to be permitted pursuant to Section 404. Specifically, these 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)).

1.5 Compliance and Consultations

Before building and operating new units, STPNOC is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. STPNOC (2009b) provided a list of environmental approvals and consultations associated with the proposed Units 3 and 4. Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H. The NRC staff reviewed the list and 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 STP site for building and operating the two proposed ABWR units. A chronology of the correspondence is provided as Appendix C. A list of the key consultation correspondence is provided as Appendix F, which also contains a biological assessment and an essential fish habitat assessment.

1.6 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”

10 CFR Part 73. Code of Federal Regulations, Title 10, *Energy*, Part 73, “Physical Protection of Plants and Materials.”

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, “Reactor Site Criteria.”

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Parts 320-330, “General Regulatory Policies to Nationwide Permit Program.

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, “Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material.”

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, “Terminology and Index.”

62 FR 25827. May 12, 1997. “Standard Design Certification for the U.S. Advanced Boiling Water Reactor Design.” *Federal Register.* U.S. Nuclear Regulatory Commission.

72 FR 57416. October 9, 2007. “Limited Work Authorizations for Nuclear Power Plants.” *Federal Register*. U.S. Nuclear Regulatory Commission.

72 FR 72774. December 21, 2007. “South Texas Project Nuclear Operating Company South Texas Project Site, Units 3 & 4; Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process.” *Federal Register*. U.S. Nuclear Regulatory Commission.

Atomic Energy Act of 1954. 42 USC 2011, et seq.

Federal Water Pollution Control Act (Clean Water Act). 33 USC 1251-1387, et seq.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

Rivers and Harbors Appropriation Act of 1899, as amended. 33 USC 403, et seq.

South Texas Project Nuclear Operating Company (STPNOC). 2009a. *South Texas Project Units 3 and 4 Combined License Application, Part 1, General Financials*. Revision 3, Bay City, Texas. Accession No. ML092931178.

South Texas Project Nuclear Operating Company (STPNOC). 2009b. *South Texas Project Units 3 and 4 Combined License Application, Part 3, Environmental Report*. Revision 3, Bay City, Texas. Accession No. ML092931600.

South Texas Project Nuclear Operating Company (STPNOC). 2009c. Letter from Mark McBurnett, STPNOC, to NRC dated November 16, 2009, "Request for a Limited Work Authorization for Installation of Crane Foundation Retaining Walls." Accession No. ML093230143.

South Texas Project Nuclear Operating Company (STPNOC). 2010. Letter from Mark McBurnett, STPNOC, to NRC, dated February 02, 2010, "Request for Exemption to Authorize Installation of Crane Foundation Retaining Walls." Accession No. ML100350219.

U.S. Army Corps of Engineers and U.S. Nuclear Regulatory Commission (Corps and NRC). 2008. *Memorandum of Understanding: Environmental Reviews Related to the Issuance of Authorizations to Construct and Operate Nuclear Power Plants*. September 12, 2008. Accession No. ML082540354.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan — Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555, Vol. 1, Washington, D.C. Includes 2007 updates.

U.S. Nuclear Regulatory Commission (NRC). 2008. *South Texas Project Combined License Scoping Summary Report.* Washington, D.C. Accession No. ML082260454.

U.S. Nuclear Regulatory Commission (NRC). 2010. Letter from Michael Johnson, NRC, to Mark McBurnett, STPNOC, dated January 8, 2010, "South Texas Project Nuclear Power Plan Units 3 and 4 Request for a Limited Work Authorization for Installation of Crane Foundation Retaining Walls." Accession No. ML093350744.

2.0 Affected Environment

The site proposed by STP Nuclear Operating Company (STPNOC) is located in a rural area of Matagorda County, Texas. STPNOC currently operates two nuclear generating units (existing STP Units 1 and 2) on the South Texas Project (STP) site. The site is located approximately 10 mi north of Matagorda Bay, 70 mi south-southwest of Houston and 12 mi south-southwest of Bay City, Texas, along the west bank of the Colorado River. The proposed Units 3 and 4 location is described in Section 2.1, followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, air, geology, and radiological and nonradiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects, and references are presented in Section 2.13.

2.1 Site Location

STPNOC's proposed location for Units 3 and 4 is wholly within the STP site, approximately 1500 ft north and 2150 ft west of the center of the existing Units 1 and 2 containment buildings on the north side of the Main Cooling Reservoir (MCR), as shown in Figure 2-1 (STPNOC 2009a). Bay City Census County Division (CCD) is the closest population center (more than 25,000 residents) to the proposed new units (STPNOC 2009a) (Figure 2-2). The STP property is approximately 12,220 ac and directly borders the west side of the Colorado River on the site's east boundary.

2.2 Land Use

This section discusses existing conditions related to land-use issues on and in the vicinity (i.e., the area encompassed within a radius of 6 mi) of the STP site. Section 2.2.1 describes the site and the vicinity around the site. Section 2.2.2 discusses the existing transmission line corridors. Section 2.2.3 discusses the region, defined as the area within 50 mi of the site boundary.

2.2.1 The Site and Vicinity

The STP site comprises approximately 12,220 ac in an unincorporated area of Matagorda County, Texas. Land-use classifications of the STP site are shown in Figure 2-3. Landscape features and habitat types are shown in Figure 2-4. Land-use classifications within a 6-mi radius of the STP site are shown in Figure 2-5.

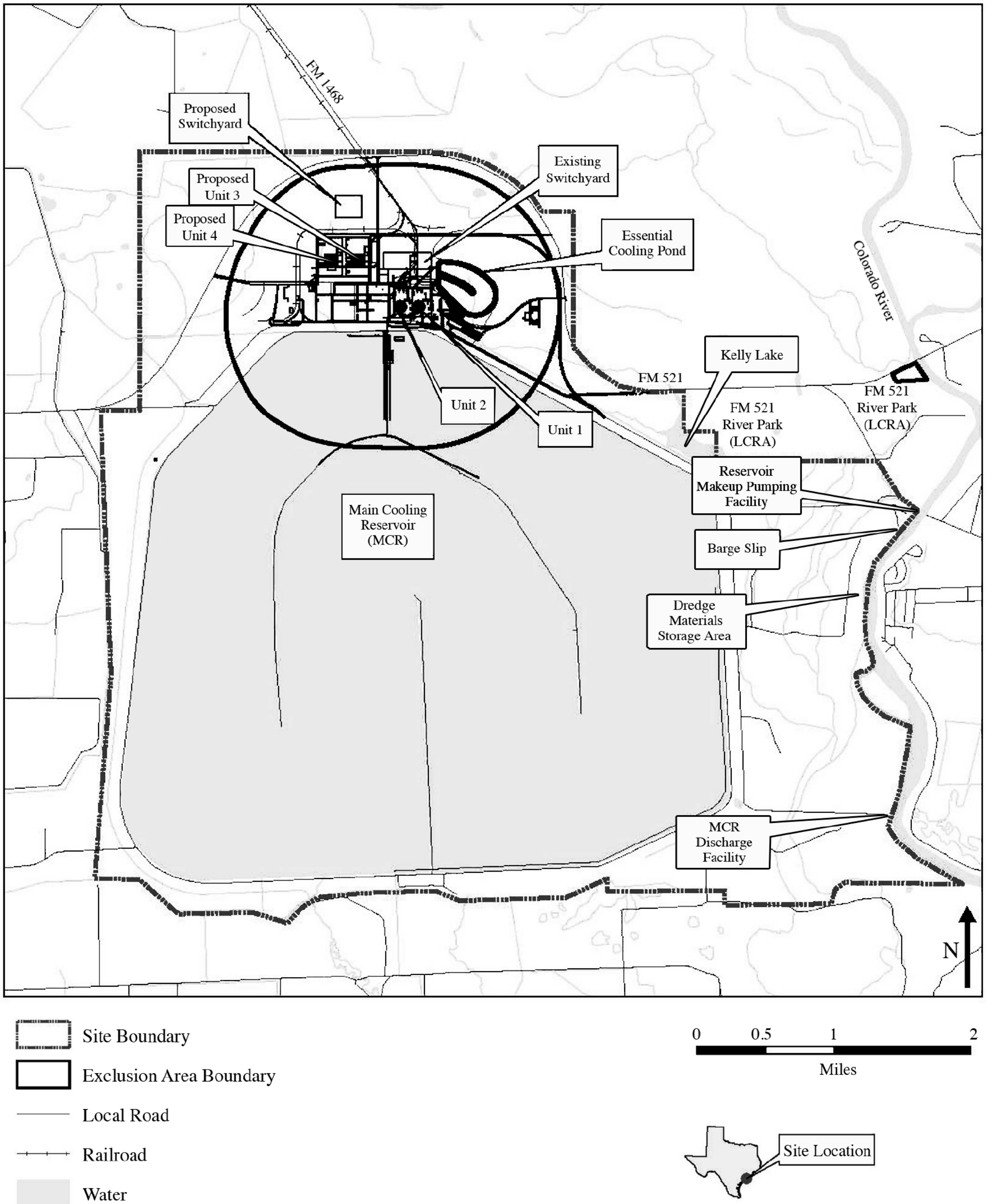

Figure 2-1. STP Site and Proposed Plant Footprint (STPNOC 2009a)

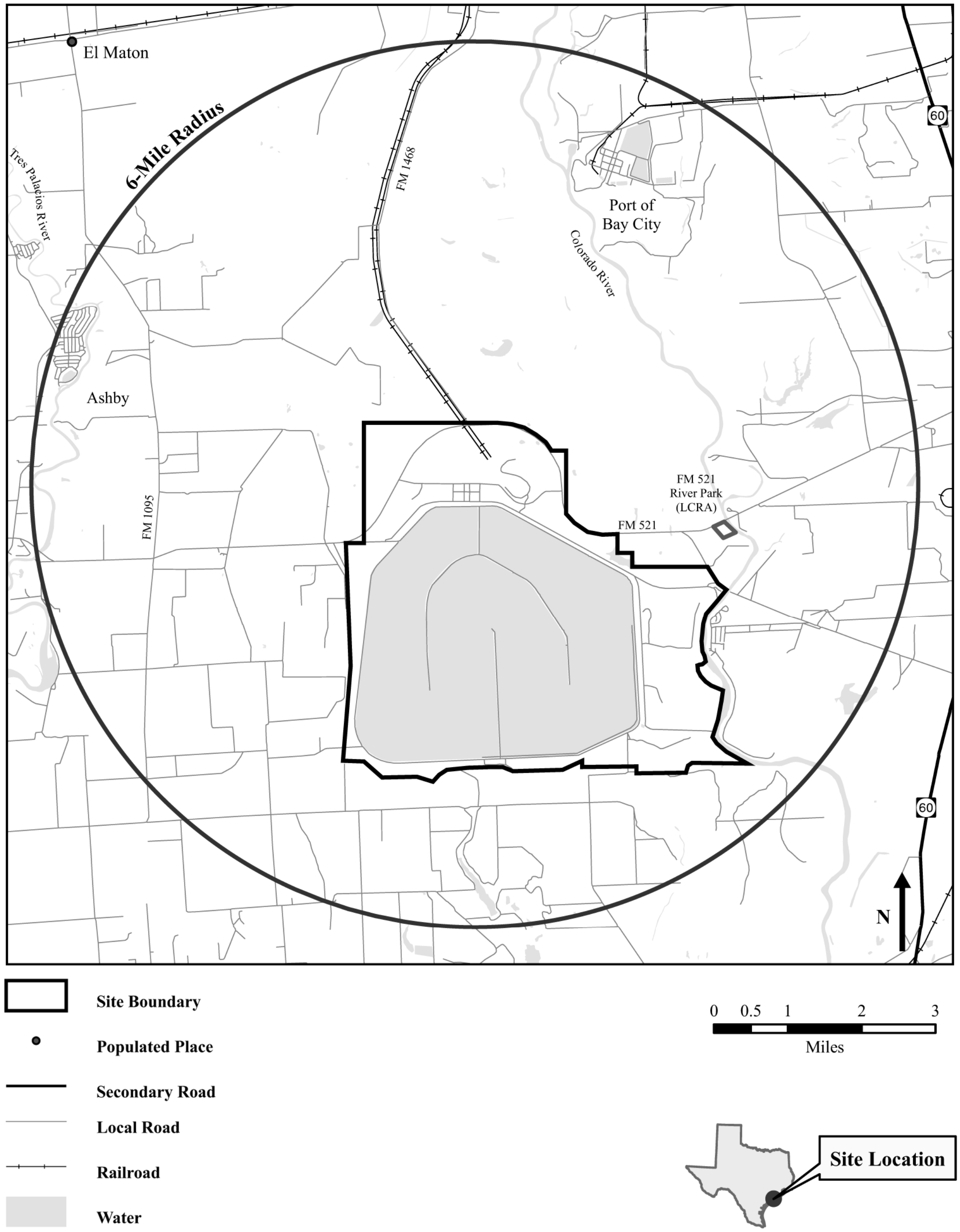

Figure 2-2. STP Site and Vicinity (STPNOC 2009a)

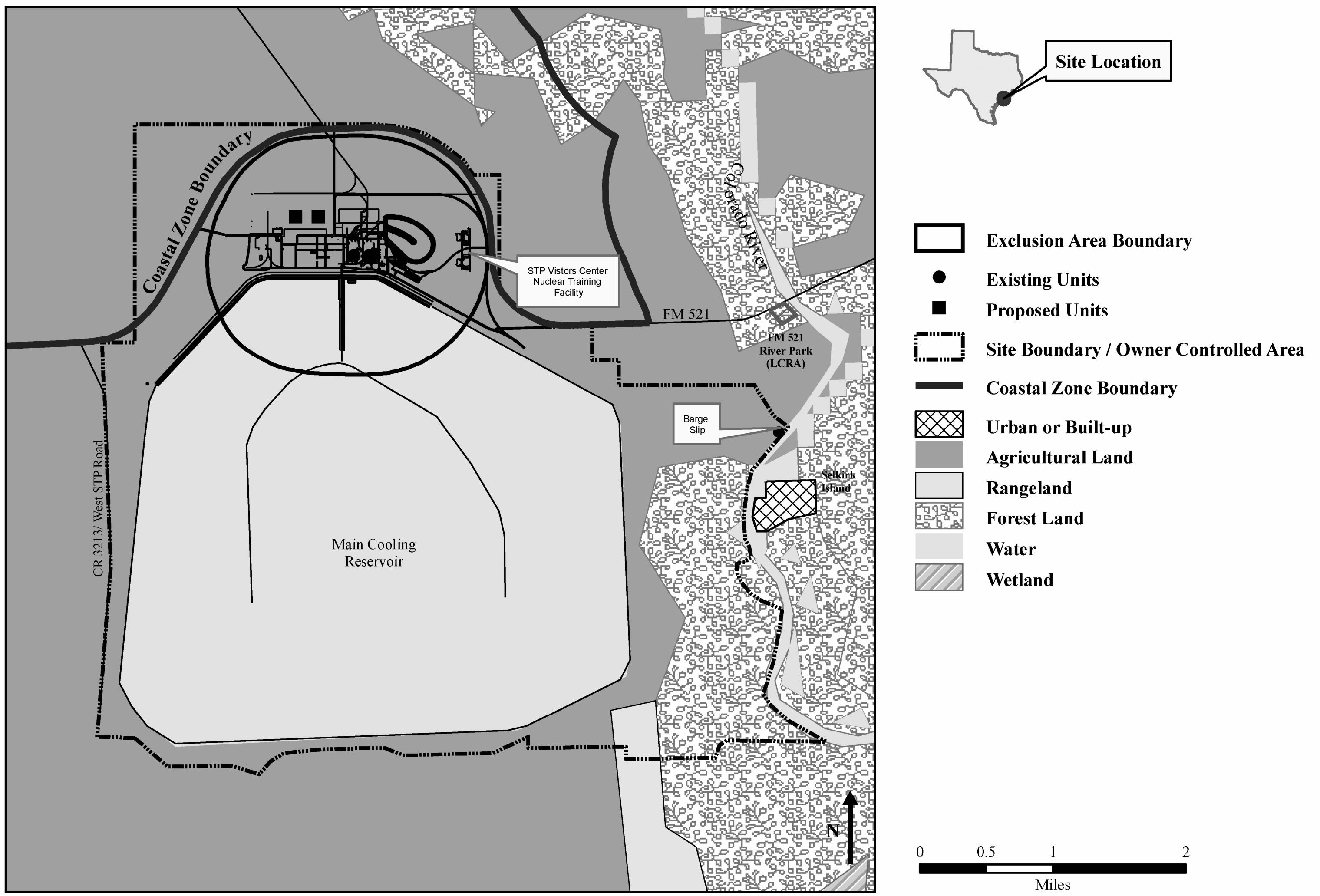

Figure 2-3. Land-Use Classifications at STP Site

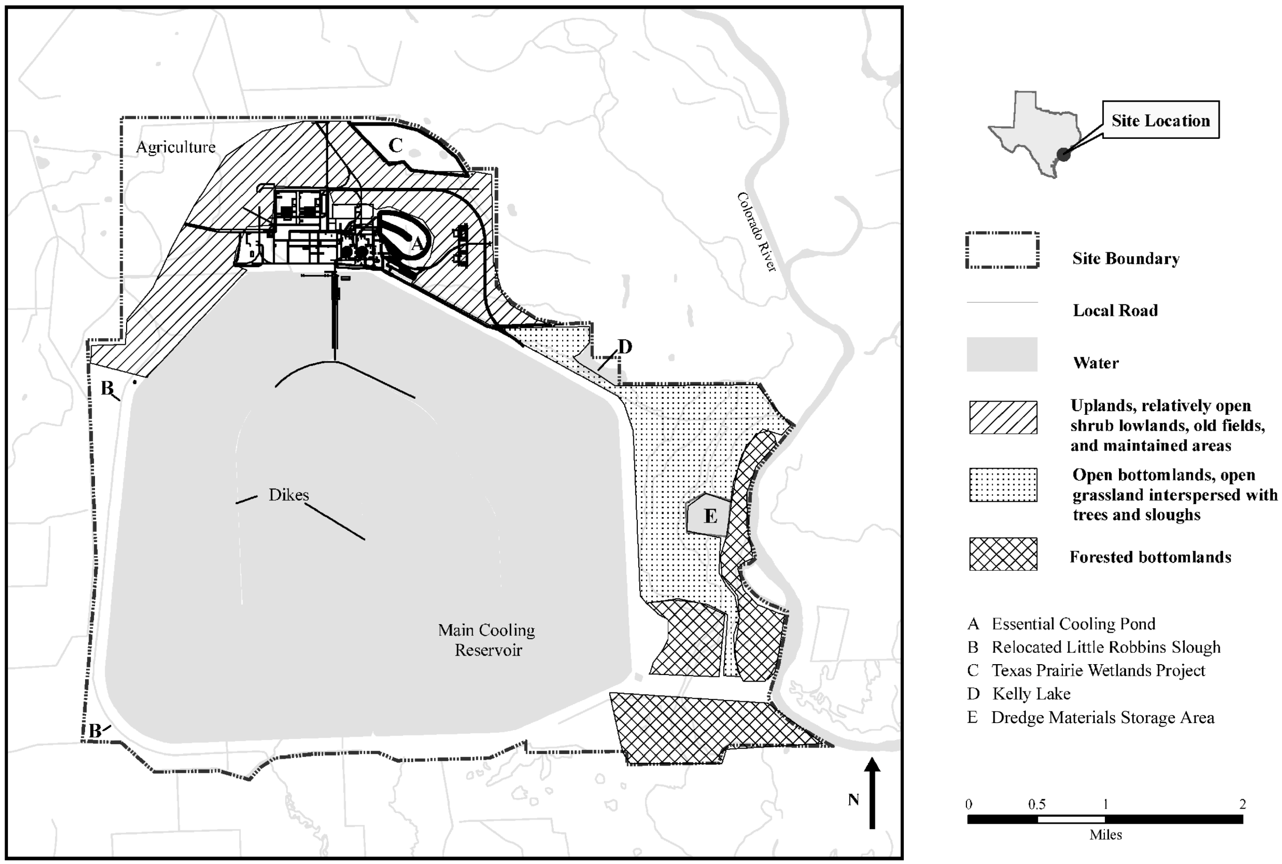

Figure 2-4. Landscape Features and Habitat Types of the STP Site (adapted from STPNOC 2009a)

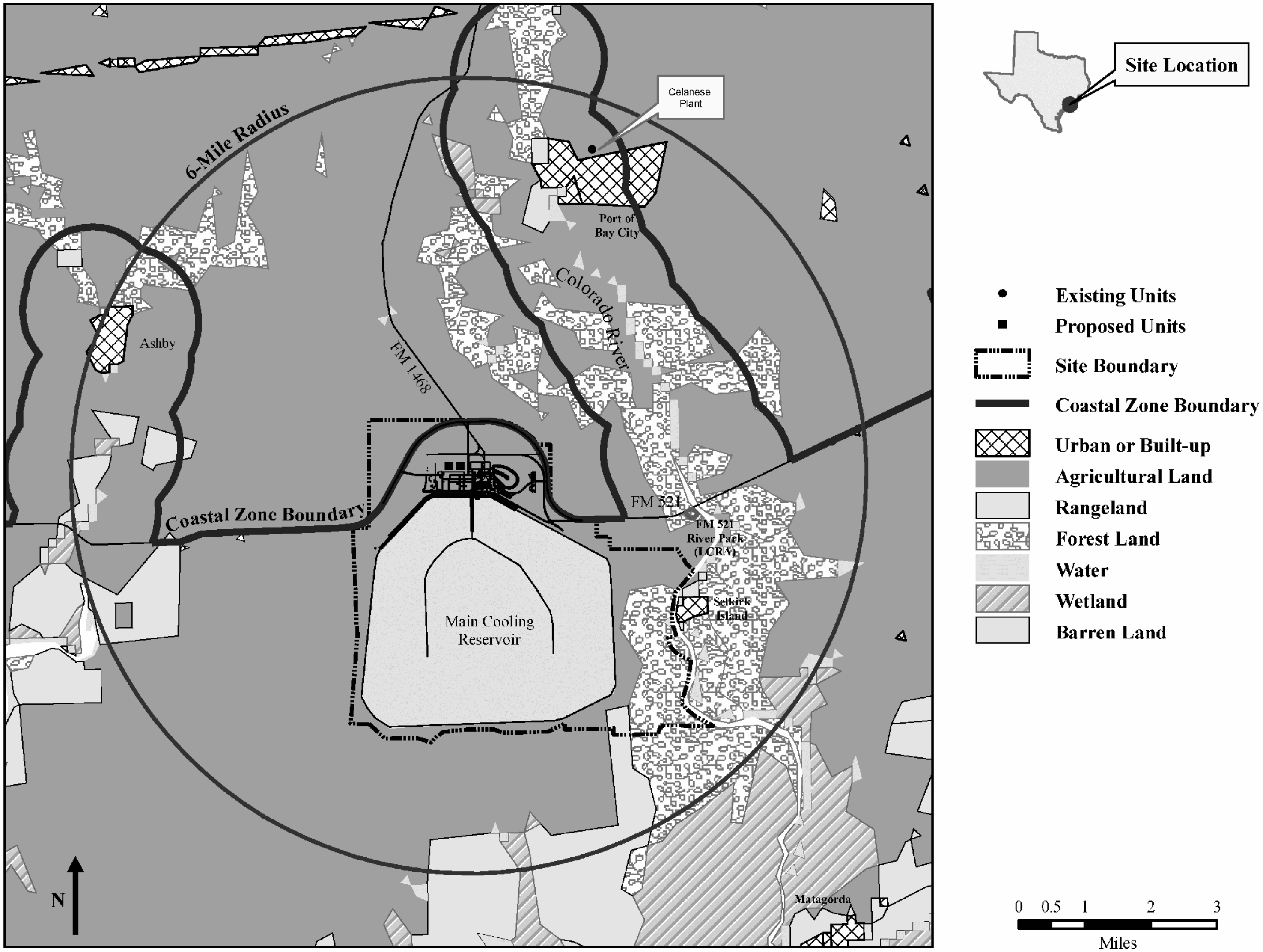

Figure 2-5. Land-Use Classifications in the Vicinity of the STP Site (STPNOC 2009a)

The topography in the vicinity of the STP site is characterized by relatively flat coastal plain with farmland and pasture land predominating. Elevations generally range from 20 to 30 ft above mean sea level (MSL). Approximately 67 percent of the land within the 6-mi vicinity of the STP site is agricultural land; 15 percent is forest land; 11 percent is water; 1 percent is wetlands; 4 percent is rangeland, grassland, or bottomland; 2 percent is urban; and less than 1 percent is barren land (STPNOC 2009a).

The STP site contains two existing nuclear generating units, STP Units 1 and 2, which are licensed by the U.S. Nuclear Regulatory Commission (NRC) and have a combined net electric generating capacity of approximately 2500 MW(e). Unit 1 began commercial operation in March 1988, and Unit 2 began commercial operation in March 1989. Together, the two existing nuclear units, other facilities such as the training facility, and onsite transmission line corridors occupy approximately 300 ac of the STP site (STPNOC 2009a).

The MCR occupies approximately 7000 ac of the STP site, and about 1750 ac are currently occupied by Units 1 and 2 and associated facilities. The remainder of the site is undeveloped land or is used for agriculture and cattle grazing. Some of the undeveloped land located east of the MCR is leased for cattle grazing (STPNOC 2009a). Land use within the STP site is summarized in Table 2-1 (STPNOC 2009a).

No zoning currently applies to the STP site (STPNOC 2009a). STPNOC has maintained its own land management plan for the STP site since 1995. Approximately 90 percent of the STP site, excluding the MCR and existing facilities, constitutes prime farmland (STPNOC 2009a). There are no mineral resources of known commercial value within the STP site boundary or in the 6-mi vicinity of the site (STPNOC 2009a).

The 46-ac Essential Cooling Pond (ECP) serves as the Ultimate Heat Sink (UHS) for existing STP Units 1 and 2 and is east of Units 1 and 2 (STPNOC 2009a). The Texas Prairie Wetlands Project is a managed 110-ac shallow wetland area that was constructed in the northeast portion of the STP site in 1996 to enhance the site for waterbirds (STPNOC 2009a). There are waters of the United States subject to Federal regulatory authority within the proposed building and laydown/spoils sites for proposed Units 3 and 4.

The STP site is located along the west bank of the Colorado River. A barge slip on the Colorado River is located approximately 3.5 mi southeast of existing STP Units 1 and 2. The Colorado River is not a wild and scenic river as that term is defined at in 36 CFR 297.3. Small portions of the STP site near the Colorado River are within the 100-year and 500-year floodplains (STPNOC 2009a).

Table 2-1. Land Use at the STP Site

Land Use Category		Acres	Percentage
bottomland		1176	9.6
Units 1 and 2 construction spoils area		41	0.3
Essential Cooling Pond		46	0.4
existing facilities related to Units 1 and 2		300	2.5
forested communities		53	0.4
forested/mixed pastureland		91	0.7
leased agricultural lands		536	4.4
Main Cooling Reservoir		7000	57.3
maintained and disturbed areas		468	3.8
mixed grass communities		485	4.0
scrub shrub communities		970	7.9
wetlands		162	1.3
reservoir levee systems		759	6.2
dredge materials disposal area		133	1.1
	Total	12,220	

Source: STPNOC 2009a

Several sloughs flow through the STP site. One slough feeds 34-ac Kelly Lake, which is located in the northeast corner of the site (see Figure 2-2) (STPNOC 2009a). Little Robbins Slough is an intermittent stream located in a channel on the west side of the west embankment of the MCR (STPNOC 2009a).

Access to the STP site is from farm-to-market (FM) roads FM 521 and FM 1468. FM 1468 intersects FM 521 approximately 350 ft west of the main plant entrance (STPNOC 2009a). An inactive railroad spur approximately 9 mi long, runs north from the STP site to a commercial railroad line operated by the Union Pacific Railroad. No natural gas pipelines traverse the STP site (STPNOC 2008f).

The Texas Parks and Wildlife Department (TPWD) operates the 7200-ac Mad Island Wildlife Management Area (WMA) located approximately 3 mi south of the STP site. There is a Lower Colorado River Authority (LCRA) park approximately 3 mi east of the STP site (see Figure 2-1). The 7063-ac Clive Runnells Family Mad Island Marsh Preserve is approximately 4 mi southwest of the STP site and contains both upland prairie and a variety of coastal wetlands (STPNOC 2009a). The preserve is owned and operated by The Nature Conservancy of Texas. There are no schools, hospitals, or prisons within the vicinity of the STP site.

Most of the STP site is located within the coastal management zone established by the Texas Coastal Management Program (TCMP) (STPNOC 2009a). As required by section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA) [16 USC 1456(c)(3)(A)], STPNOC consulted with the Texas General Land Office to determine whether or not the proposed project would be consistent with the Texas Coastal Management Program. STPNOC submitted a consistency determination to the Texas Coastal Coordination Council in April 2008 for its review. The Council responded in a June 9, 2008, letter that no unavoidable adverse impacts had been found for proposed Units 3 and 4 and that the proposed project would therefore be consistent with the goals and policies of the TCMP (STPNOC 2009a).

2.2.2 Transmission Lines

Four transmission service providers currently serve the STP site: CenterPoint Energy, American Electric Power Texas Central Company, the City of Austin, and the City Public Service Board of San Antonio (STPNOC 2009a). The existing 345-kV switchyard at the STP site currently has nine 345-kV transmission lines that connect it to the utility grid. These nine lines occupy three corridors, identified as the Eastern, Western, and Northwestern (or Middle) corridors. The corridors originate at the STP site (STPNOC 2009a). The power transmission system for proposed Units 3 and 4 would not require new transmission lines or corridors, but would use five of the nine 345-kV transmission lines that currently connect to existing STP Units 1 and 2 (STPNOC 2009a). A portion of the system would be upgraded as discussed in Chapter 3.

2.2.3 The Region

The 50-mi region surrounding the STP site is shown in Figure 2-6. The STP site is approximately 12 mi south-southwest of Bay City, Texas, and 10 mi north of Matagorda Bay on the Gulf of Mexico. Bay City is the county seat of Matagorda County. Palacios is the other incorporated community in Matagorda County. No Tribal lands of Federally recognized Indian Tribal entities are located within the 50-mi region (STPNOC 2008f).

All or portions of nine counties (Brazoria, Fort Bend, Wharton, Jackson, Victoria, Calhoun, Lavaca, Colorado, and Matagorda) are within 50 mi of the STP site (STPNOC 2009a).

Within the region, approximately 61 percent of the land is agricultural, 18 percent forest, 10 percent rangeland, 5 percent wetland, 2.5 percent urban or built-up, 2 percent fresh water bodies, and less than 1 percent is barren land (STPNOC 2009a).

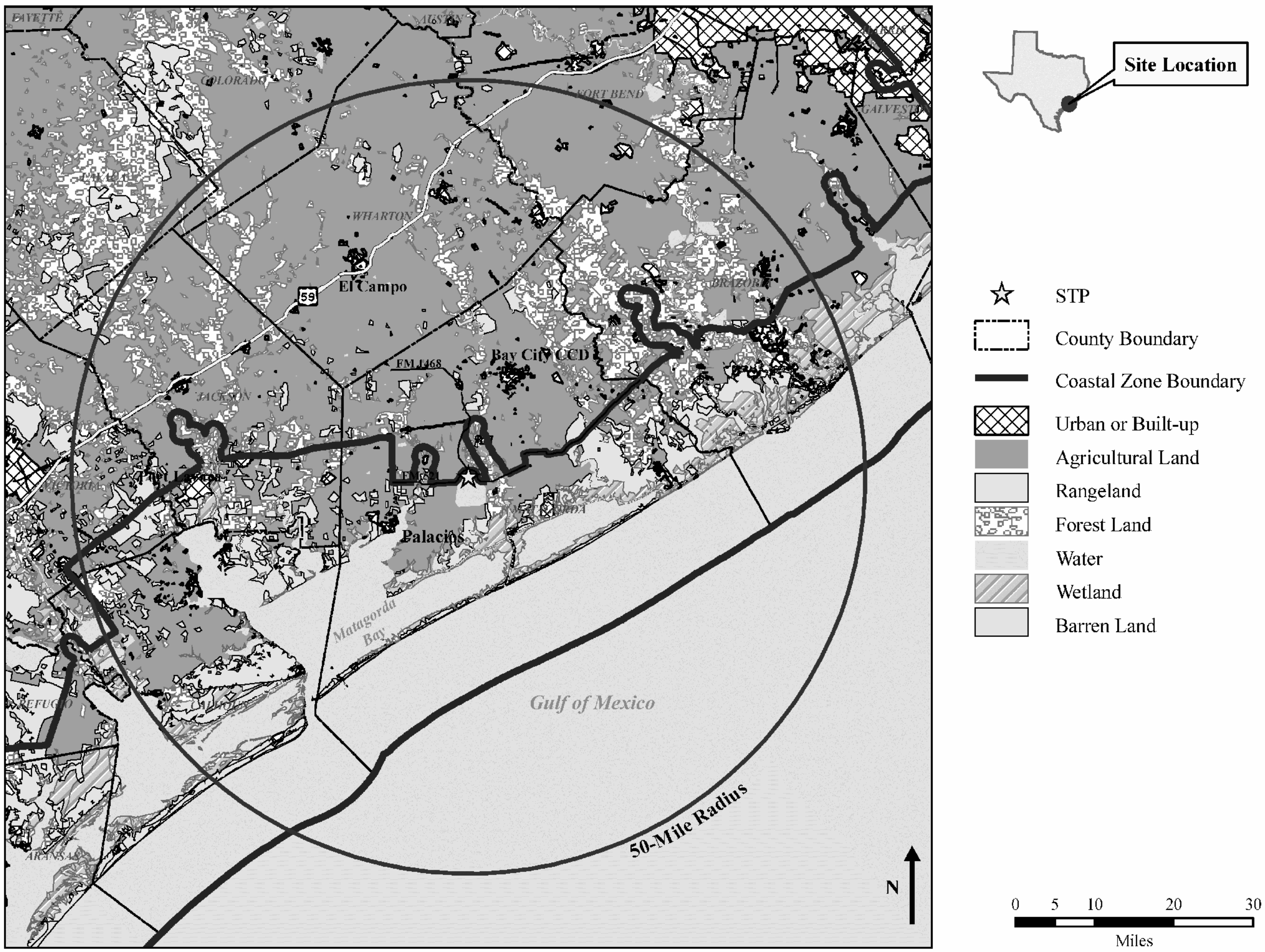

Figure 2-6. Land-Use Classifications in STP 50-mi Region (STPNOC 2009a)

2.3 Water

This section describes the hydrologic processes and water bodies in and around the STP site, the existing water use, and the quality of water in the vicinity of the proposed Units 3 and 4 site. This description is limited to those parts of the hydrosphere that may affect or be affected by building and operation of the proposed Units 3 and 4. Building activities will affect the Shallow Aquifer at the site. Building and operation activities would make use of groundwater from the Deep Aquifer. During operation of the proposed Units 3 and 4, the Colorado River would be the source of makeup water for normal plant operations, and groundwater would be used as the source for makeup water for the UHS of the proposed units, service water for Units 3 and 4, and water for sanitary and potable water systems. The Colorado River would receive water discharged from the MCR. The environment described in this section, therefore, includes (1) the Colorado River system upstream of the site, because (a) it is the source of runoff that sustains the flow in the river and would provide makeup water for normal plant operations and (b) future availability of water in the river may be affected by the amount of water allocated to Units 3 and 4; (2) the Colorado River System downstream of the site because downstream water availability and quality may be affected by water used by Units 3 and 4 and the water discharged from the MCR; (3) local water features at and adjacent to the site, and (4) the local and regional groundwater systems, because they are the source of water during the building and operation of Units 3 and 4.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could affect, or be affected by, building and operation of proposed Units 3 and 4. The hydrologic conditions at the proposed Units 3 and 4 site are described in Section 2.4 of the Final Safety Analysis Report (FSAR) (STPNOC 2009b). A summary of the hydrologic conditions of the proposed site is provided in Section 2.3 of the Environmental Report (ER) (STPNOC 2009a). The following descriptions are based on information from these sources and other publicly available sources of hydrological data (LCRWPG 2006; LCRA 2009a, b; USGS 2009a, b; TCEQ 2007, 2008a; Corps 2009; Texas Department of Transportation 2007).

2.3.1.1 Surface-Water Hydrology

Figure 2-7 shows the location of the STP site with respect to the Lower Colorado River Basin and the Colorado-Lavaca Basin. The Colorado River Basin (Figure 2-8) is approximately 42,318 mi^2 in size (LCRWPG 2006). The Lower Colorado River Basin is the portion downstream of Lake O.H. Ivie (Figure 2-8). Approximately 90 percent of the contributing area of the basin lies upstream of the Mansfield Dam located near Austin, Texas (LCRWPG 2006). The STP site is located on the west bank of the Colorado River at River Mile 14.6. The location of the site with respect to nearby cities, the Matagorda Bay, and the Gulf of Mexico is shown in

Figure 2-9. The Matagorda Bay and the Gulf of Mexico are located approximately 12 and 15 mi to the south, respectively (Figure 2-10). The water surface elevations in the Colorado River near the site are subject to upstream release and tidal fluctuations.

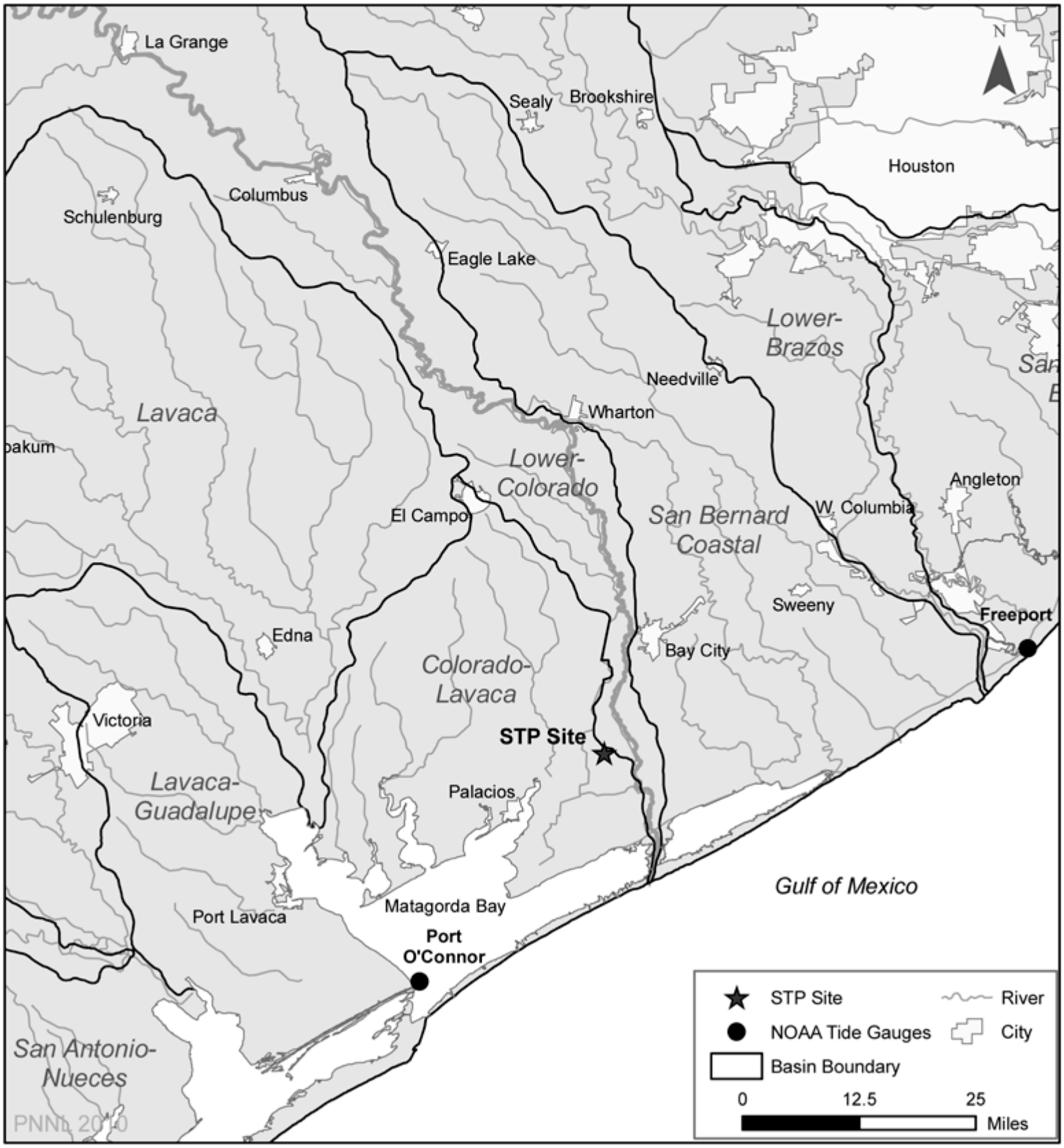

Figure 2-7. Location of the STP Site and the Adjacent Watersheds (STPNOC 2009a)

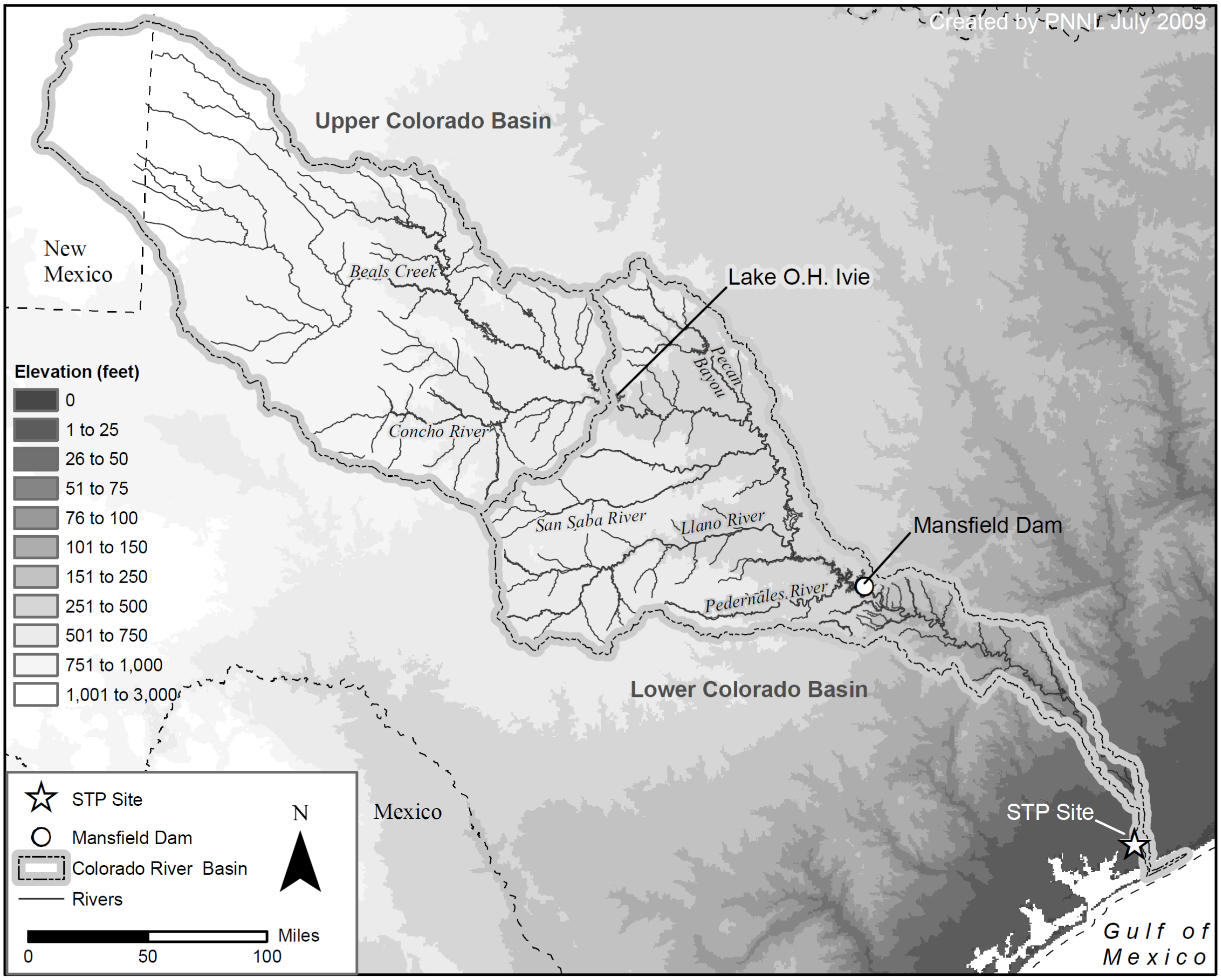

Figure 2-8. The Colorado River Basin (STPNOC 2009a)

The mouth of the Colorado River where it empties into the Gulf of Mexico is located approximately 28 mi east-northeast of Port O'Connor and approximately 48 mi west-southwest of Freeport (Figure 2-7). At both of these gulf coast cities, the National Oceanic and Atmospheric Administration (NOAA) maintains tide gauges. The mean tidal range, the difference between the mean high water and mean low water, at Freeport is 1.4 ft and the diurnal range, the difference between mean higher high water and mean lower low water, is 1.8 ft (NOAA 2009a). The corresponding values at the Port O'Connor tide gauge are 0.7 ft and 0.8 ft (NOAA 2009b). NOAA (2009c) estimated the long term sea-level rise to range from 1.1 to 1.8 ft/century at the Freeport tide gauge using data from 1954 to 2006. NOAA did not perform the corresponding estimate at the Port O'Connor tide gauge.

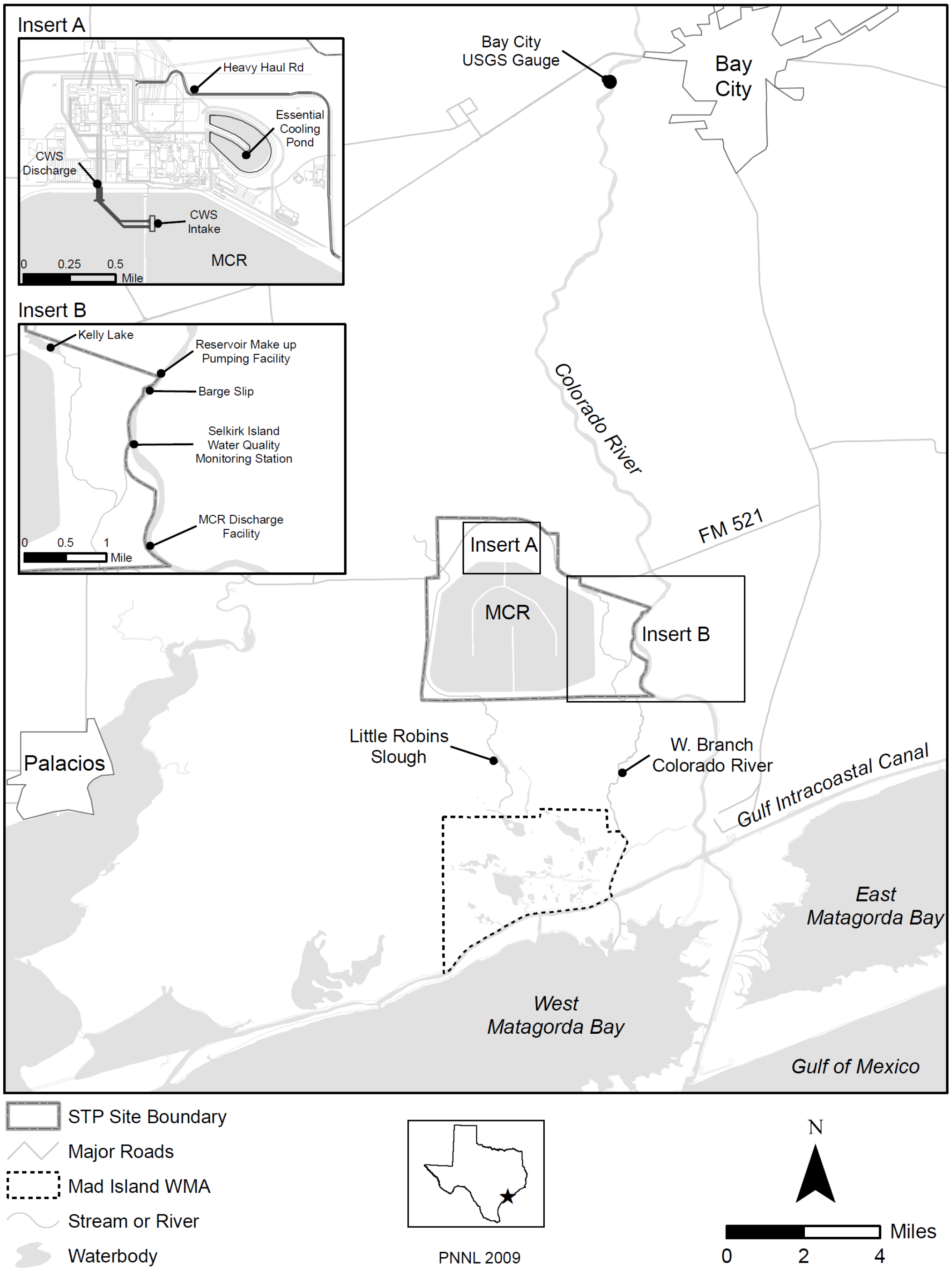

Figure 2-9. Location of the STP Site with Respect to Nearby Cities, the Matagorda Bay, and the Gulf of Mexico (STPNOC 2009a)

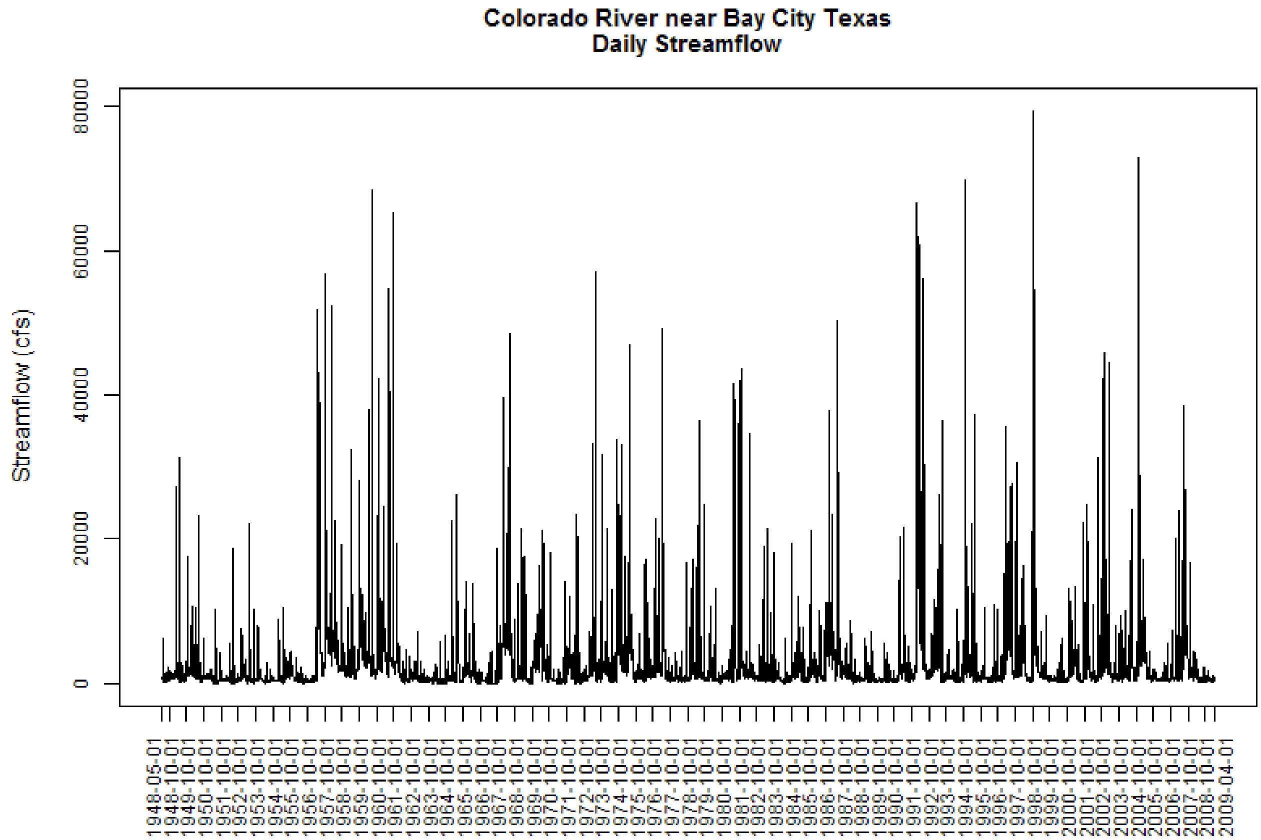

Figure 2-10. Daily Mean Colorado River Discharge near Bay City, Texas (USGS 2009c)

On a longer-term scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge by the U.S. Global Change Research Program (GCRP), a Federal Advisory Committee, has been considered in preparation of this EIS. According to the GCRP, it is reasonably foreseeable that sea level rise may exceed 3 ft by the end of the century (Karl et al. 2009). Actual changes in shorelines would also be influenced by geological changes in shoreline regions (such as sinking due to subsidence). The increase in sea level relative to the Colorado River bed, coupled with reduced streamflow (also due to climate change), would result in the salt water front in the Colorado River moving up towards the Reservoir Makeup Pumping Facility (RMPF).

The discharge and water temperature in the Colorado River near the site are characterized by measurements made at the U.S. Geological Survey (USGS) gauge 08162500, Colorado River near Bay City, Texas. Streamflow discharge data at this gauge has been available since May 1, 1948. The period of record for water quality sampling at this gauge spans October 16, 1974, through June 26, 2001.

The mean annual discharge at the USGS gauge near Bay City, based on data for water years 1949 through 2008, is estimated to be approximately 2629 cfs (USGS 2009a). Mean monthly discharges at the same location reveal that August is the driest month with approximately 932 cfs of mean discharge, and June is the wettest month with approximately 4240 cfs of mean discharge (USGS 2009b). The daily discharge for the period of record for the USGS gauge near Bay City (USGS 2009c) is shown in Figure 2-10. The mean daily discharge for the period of record is 2613 cfs.

Texas experiences frequent droughts (LCRWPG 2006). Droughts in Texas are primarily caused by formation of a stationary, high-pressure system called the Bermuda High that prevents passage of low-pressure fronts (LCRWPG 2006). Based on streamflow data at the USGS gauge near Bay City, the annual discharge during water years 1951 to 1956 ranged from 23 to 48 percent of the mean annual discharge. During 1962 to 1967, the annual discharge ranged from 21 to 79 percent of the mean annual discharge. During 1983 to 1986, the annual discharge ranged from 25 to 72 percent of the mean annual discharge. During 1988 to 1991, the annual discharge ranged from 21 to 78 percent of the mean annual discharge. These episodes are examples of multi-year drought in the Colorado River Basin. Out of 55 years during 1948 through 2008 for which annual discharges were measured by the USGS at the Bay City gauge, the annual discharge was less than 75 percent of mean annual discharge during 26 years.

The streamflow in the Colorado River downstream of Austin, Texas, is influenced by releases from the Mansfield Dam. The LCRA operates six dams: Buchanan, Inks, Wirtz, Starcke, Mansfield, and Tom Miller (LCRA 2009b) that inundate the six highland lakes: Buchanan, Inks, Lyndon B. Johnson, Marble Falls, Travis, and Austin, respectively (Figure 2-11). Lake Buchanan has a storage capacity of 875,566 ac-ft and is used for water supply and hydroelectric power generation. Lake Travis has a storage capacity of 1,131,650 ac-ft and is used for water supply, flood management, and hydroelectric power generation. The combined water storage capacity of the six highland lakes is 2,184,777 ac-ft (LCRA 2009b).

The LCRA manages the Colorado River and Lakes Buchanan and Travis as a single system for water supply in the Lower Colorado River Basin (LCRA 2009c). The two lakes are used to conserve water and inflows into the river below the highland lakes are used to meet downstream demand to the extent possible. Waters stored in the lakes are released only when downstream water rights cannot be met. Generally, LCRA does not release waters from any of the lakes exclusively for hydroelectric power generation. However, during emergency shortage of electricity or during times when such releases would provide other benefits, LCRA may release waters from the lakes (LCRA 2009c).

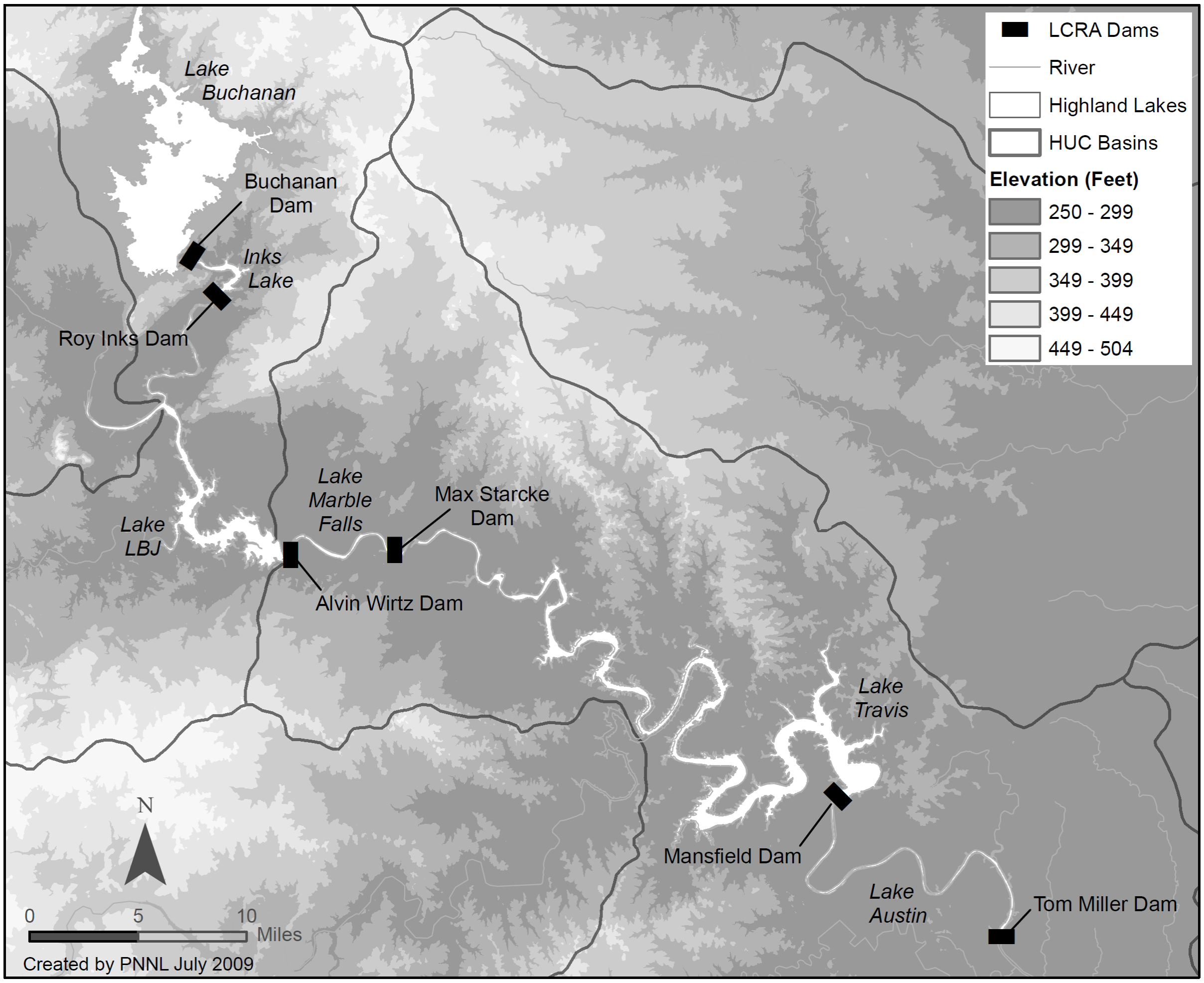

Figure 2-11. The Six LCRA Dams and the Corresponding Highland Lakes They Impound (STPNOC 2009a)

The floodplain in the Lower Colorado Basin has a relatively flat gradient and is characterized by broad floodplains. Streamflow in the Colorado River is controlled by releases from the Mansfield Dam and remains relatively unaffected downstream. A description of existing water diversions downstream of the Mansfield Dam is provided in Section 2.3.2.1.

The predominant surface water feature near the STP site is the MCR (Figure 2-9), an engineered cooling pond impounded by earthen embankments constructed on the natural ground surface immediately south of the existing facility. The MCR is part of the closed-cycle cooling system for STP Units 1 and 2 and acts as the normal heat sink for waste heat generated during operations of these units. The MCR is currently operated to dissipate waste heat from the operations of existing Units 1 and 2, primarily via evaporation and radiation to the atmosphere.

Water is lost from the MCR due to evaporation and seepage. A network of relief wells exists along the MCR embankment. These relief wells drain some water away from the Shallow Aquifer that receives seepage from the MCR and discharges it into site drainage ditches. The site drainage ditches discharge to the Little Robbins Slough located towards the west of the STP site and to the Colorado River just upstream of the RMPF located towards the east. Water loss from the MCR due to evaporation results in a build-up of total dissolved solids (TDS) within the reservoir. Make-up water from the Colorado River is withdrawn from the RMPF, which is located on the west bank of the river, to maintain the MCR volume and to control the concentration of TDS in its waters. The MCR has a buried discharge pipe approximately 1.1 mi in length that allows the periodic discharge of water from the reservoir to the Colorado River. The outfall of this discharge line is equipped with seven ports located along the west bank of the Colorado River approximately 2 miles downstream of the RMPF. The U.S. Army Corps of Engineers (Corps) has determined that the MCR is not waters of the United States (Corps 2009). The Texas Commission on Environmental Quality (TCEQ) has also stated that the MCR is not waters of the State (TCEQ 2007). However, the MCR supports an active aquatic and avian habitat (see Sections 2.4.1 and 2.4.2). The MCR also has a spillway near its southeast corner that allows release of excess water from the MCR to the Colorado River during heavy precipitation events. The spillway contains gates that can be manually opened to allow for the release of water.

The Colorado River provides makeup water to replace evaporation loss from the MCR due to the normal operation of existing STP Units 1 and 2. The water evaporated from the MCR includes that due to natural evaporation and due to induced evaporation from the heat load of Units 1 and 2. Water is pumped into the MCR from the Colorado River to maintain the water quality below 3000 µS/cm for specific conductivity (STPNOC 2009a). The Colorado River is not the heat sink for the existing units.

As stated below in Section 2.9.1, the topography near the STP site is flat and therefore the staff concluded that there is no significant difference between local and regional climate. Based on climatological data from Victoria and Corpus Christi, mean precipitation varies from 2 to 3 in. per month with maximum precipitation of approximately 4 to 5 in. per month in May and June and in September and October. Snowfall is not uncommon, occurring over half of the winters; however, snowfall is generally limited to trace amounts. Annual potential evapotranspiration[a] in Texas varies from approximately 53 in. at Port Arthur to over 79 in. at El Paso (Irrigation Technology Center 2009). The annual potential evapotranspiration at Victoria is approximately

(a) Potential evapotranspiration is the evaporation from the soil and transpiration from crops or vegetation under unlimited water supply conditions.

57 in. with monthly variations from 2.3 in. in December to nearly 7 in. in July (Irrigation Technology Center 2009).

The powerblock area of the existing Units 1 and 2 is drained by gravity towards the northwest to a point west of the existing switchyard where the existing Main Drainage Channel (MDC) starts (Figure 2-12). The MDC is an unlined channel that currently runs west through the proposed location of the powerblock for proposed Units 3 and 4 and turns southwest after crossing the existing railroad track. The MDC continues southwest across the west access road and eventually joins the Little Robbins Slough west of the MCR.

Little Robbins Slough is an intermittent stream that originates approximately 2 mi northwest of the STP site and has a drainage area of approximately 4 mi^2. During the building of Units 1 and 2, the original course of the stream was relocated to the west of the MCR. The relocated channel runs along the western edge of the MCR embankment, turns east at the southwest corner of the MCR embankment and rejoins its natural course approximately 1 mi east of the southwest corner of the MCR embankment. The Little Robbins Slough flows into Robbins Slough, which is a brackish marsh that joins the Gulf Intracoastal Waterway (GIWW) approximately 4 mi to the south (Figure 2-9). There is no known streamflow or water quality monitoring of the Little Robbins Slough.

The GIWW is a 1300-mi-long man-made canal that runs along the Gulf of Mexico coast from Brownsville, Texas, to St. Marks, Florida (Texas Department of Transportation 2007). The GIWW is connected to the Colorado River and the Matagorda Bay.

Kelly Lake is a small lake located north of the northeast edge of the MCR embankment (Figure 2-13). It is fed by a small catchment area north of the lake. The USGS topographical map shows at least two drainages that flow into the lake and one that exits the lake. The drainage that exits the lake flows generally south along the east side of the MCR embankment and eventually joins West Branch of the Colorado River near the southeast edge of the MCR embankment.

The RMPF is located on the west bank of the Colorado River approximately 2 mi upstream of the MCR discharge outfall. The RMPF currently houses two pumps of 240 cfs capacity and two pumps of 60 cfs capacity for a total intake capacity of 600 cfs. The intake structure consists of a set of traveling screens, a siltation basin, a sharp-crested weir, and the pumping station. A buried pipeline conveys water from the RMPF to the MCR.

The RMPF contains 18 travelling screens, each 13.5 ft in width (STPNOC 2009a). The bottom of the screens in the embayment is located at elevation of -10 ft MSL. Currently, only half of the installed travelling screens are used to support the operation of the existing STP Units 1 and 2.

2.3.1.2 Groundwater Hydrology

This section describes the aquifer system at the regional, local, and site-specific scales, and summarizes the hydrogeologic properties (including piezometric heads).

Regional Geology and Aquifer System

The groundwater aquifers in the region and in the vicinity of the site are described in Section 2.3.1.2 of the ER (STPNOC 2009a). The STP site lies in Coastal Prairies sub-province of the Gulf Coastal Plains physiographic province. The Coast Prairies sub-province is a broad band paralleling the Texas Gulf Coast (STPNOC 2009a). The sub-province is characterized by relatively flat topography ranging from sea level at the coast to 300 ft MSL along the northern and western inland boundaries of the sub-province. Underlying the STP site is a wedge of southeasterly dipping sedimentary deposits. Numerous local aquifers are found in the thick sequence of alternating and interfingering beds of clay, silt, sand, and gravel. Groundwater ranging in quality from fresh to saline is found in these sediments. Three depositional environments are evident: continental (alluvial plain), transitional (delta, lagoon, beach), and marine (continental shelf). Oscillations of the ancient shoreline have resulted in overlapping mixtures of sediments (STPNOC 2009a, Ryder 1996).

The USGS describes the aquifers underlying the STP site as the Texas coastal lowlands aquifer system, and divides the aquifer system into hydrogeologic units or permeable zones A through E (Ryder and Ardis 2002). Within the State of Texas, both the Texas Water Development Board (TWDB) and the LCRA refer to the aquifer system as both the Gulf Coast Aquifer system and the Coastal Lowlands Aquifer System, and they use hydrogeologic unit names rather than letters to describe the aquifer system (TWDB 2007, TWDB 2006b, Young et al. 2007). Common hydrogeologic unit names, from shallow to deep, are as follows (STPNOC 2009a),

- Chicot Aquifer
- Evangeline Aquifer
- Burkeville Confining Unit
- Jasper Aquifer
- Catahoula Confining Unit
- Vicksburg-Jackson Confining Unit.

The naming convention used in Texas, which is different than that used by the USGS, is employed in the hydrology sections of this EIS (Figure 2-14).

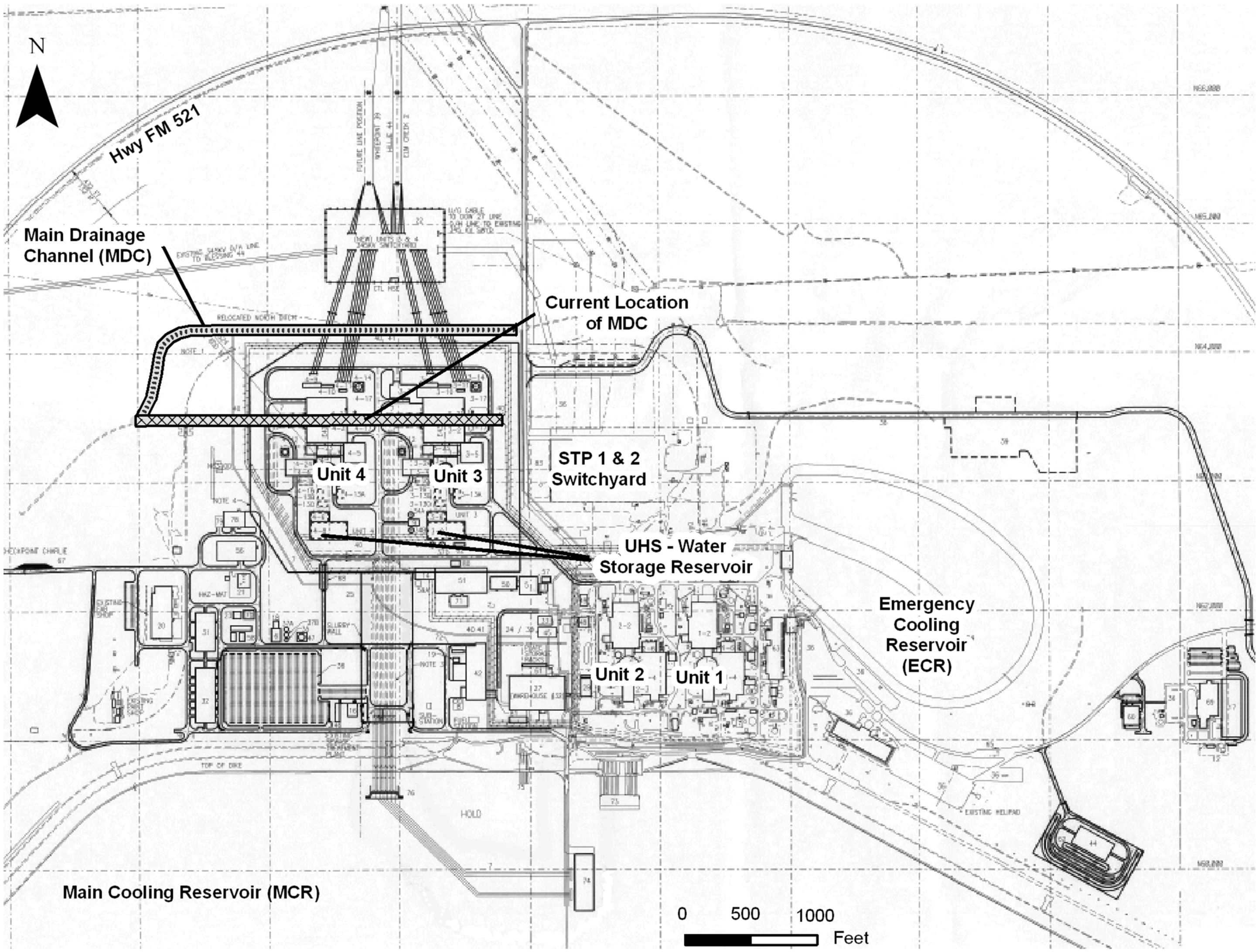

Figure 2-12. Current and Future Locations of the Main Drainage Channel (STPNOC 2009b)

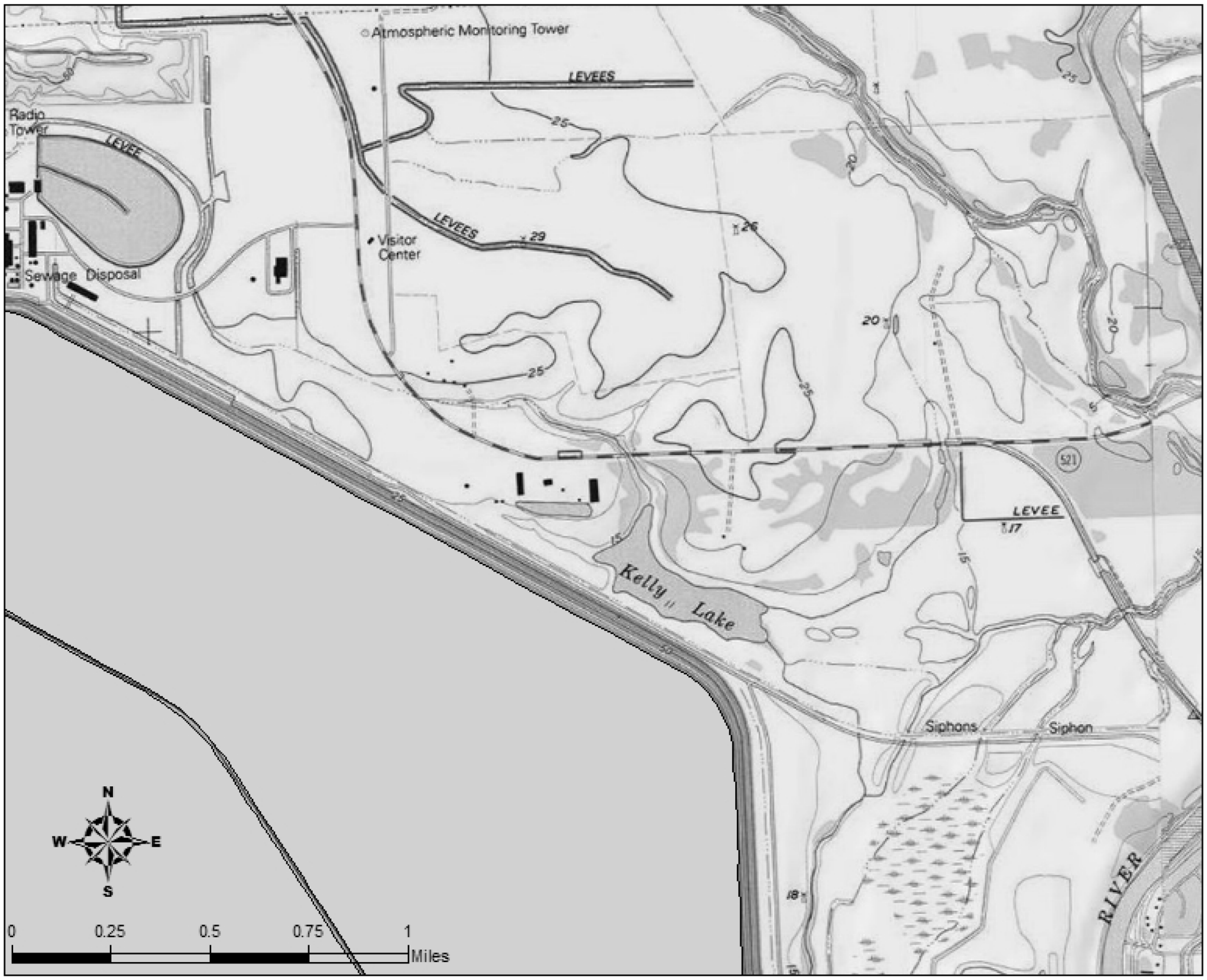

Figure 2-13. Kelly Lake and Local Drainages Flowing Into and Out of the Lake

In the vicinity of the STP site, the Gulf Coast Aquifer system (i.e., the Coastal Lowlands Aquifer system) extends from the coast to approximately 100 mi inland (STPNOC 2009a) (Figure 2-15). The Gulf Coast Aquifer thickens from inland toward the Gulf of Mexico. Inland, its base is the contact of the aquifer with the top of the Vicksburg-Jackson confining unit. Approaching the coast, the base of the aquifer is defined by the approximate depth where groundwater has a TDS concentration of more than 10,000 milligrams per liter (mg/L). The thickness of the aquifer ranges from 0 ft at the up-dip limit of the aquifer system in the northwest to approximately 1000 to 2000 ft in Matagorda County at the down-dip limit of the system in the southeast (STPNOC 2009a, Ryder 1996).

The U.S. Environmental Protection Agency (EPA) has identified the Edwards Aquifer I and Edwards Aquifer II as sole source aquifers in Texas (EPA 2009 a, b, and c). The Edwards Aquifer extends west of Austin, Texas. Based on the location of the Edwards Aquifer, the review team has determined that neither surface water nor groundwater use would impact the Edwards Aquifer.

Local and Site-Specific Aquifer System

Within Matagorda County, the Chicot Aquifer is the aquifer used for groundwater production (Figure 2-15). In the vicinity of the STP site the aquifer thickness is somewhat greater than 1000 ft (STPNOC 2009a). Groundwater flow in Matagorda County is generally to the south and

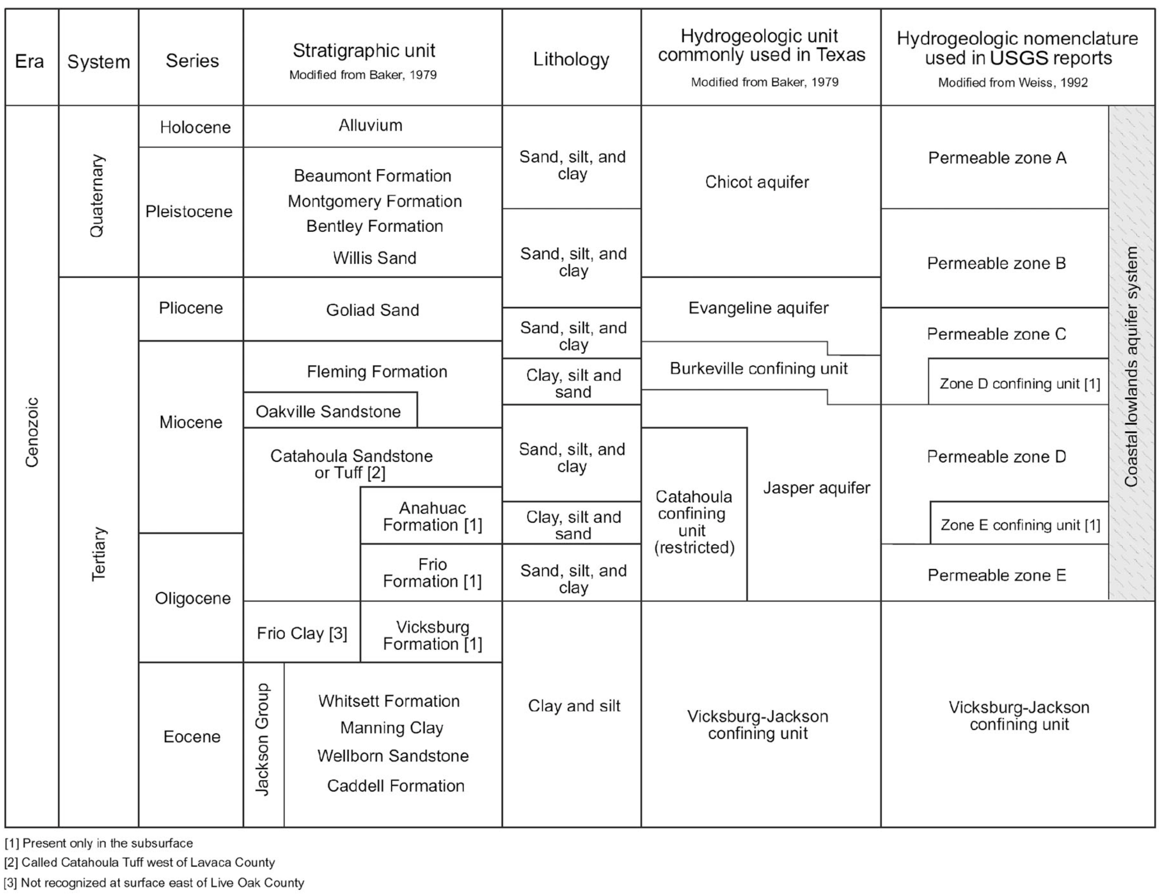

Figure 2-14. Correlation of USGS and Texas Nomenclature (STPNOC 2009a)

southeast toward the Gulf of Mexico; however, rivers and creeks incised into the surface deposits can alter the direction of groundwater flow locally. Pumping of the aquifer system has also resulted in local alterations in groundwater flow direction (STPNOC 2009a; Hammond 1969).

In the vicinity of the STP site, the Chicot Aquifer is composed of a Shallow Aquifer and a Deep Aquifer, and the Shallow Aquifer is further subdivided into Upper and Lower zones (STPNOC 2009a). The Shallow Aquifer's base is between 90 and 150 ft below ground surface (BGS), and the Shallow Aquifer is separated from the Deep Aquifer by a zone of predominantly clay material approximately 150-ft thick. Thus, the upper surface of the Deep Aquifer is between 250 and 300 ft BGS. The top of the Upper Shallow Aquifer is found approximately 15 to 30 ft BGS, and its base is at approximately 50 ft BGS. The Lower Shallow Aquifer is found between the depths of 50 ft and 150 ft BGS.

In order of their depth, the Upper Shallow Aquifer exhibits a potentiometric head of approximately 5 to 10 ft BGS (STPNOC 2009a). The Lower Shallow Aquifer exhibits a potentiometric head of approximately 10 to 15 ft BGS. In 1967, the Deep Aquifer exhibited a potentiometric head of approximately 0 ft MSL (STPNOC 2009a, Hammond 1969). However, in May 2006, the Deep Aquifer exhibited a potentiometric head of approximately 55 ft below MSL beneath the STP site (STPNOC 2009a). This is equivalent to approximately 85 ft BGS where the existing ground surface at the locations for the proposed units is 30 ft above MSL (STPNOC 2009b). The Upper Shallow Aquifer and Lower Shallow Aquifer exhibit semi-confined behavior with some movement of groundwater between them. The existing STP Units 1 and 2 reactor buildings penetrate the confining strata separating these two aquifers and allow vertical groundwater movement. The proposed Units 3 and 4 reactor buildings would also penetrate the confining strata. Other locations on the STP site also exhibit movement of groundwater between the Upper and Lower Shallow Aquifers (e.g., in the vicinity of Kelly Lake and at observation well [OW] locations OW-332 and OW-930). The Shallow and Deep aquifers are separated by a thicker confining zone.

Recharge to the Gulf Coast Aquifer occurs in upland areas where strata associated with specific aquifers outcrop at the surface and are exposed to infiltration resulting from precipitation or irrigation. Aquifers can also be recharged by losing streams and rivers. Outcrop areas are in the northern and western portions of the system. Natural discharge from an aquifer occurs through springs and seeps, gaining streams, cross-formational flow out of an aquifer, and evapotranspiration. In addition, groundwater wells constructed and pumped also result in discharge from the aquifer. The Lower Colorado River is described as a gaining stream that receives groundwater from aquifers (TWDB 2006b).

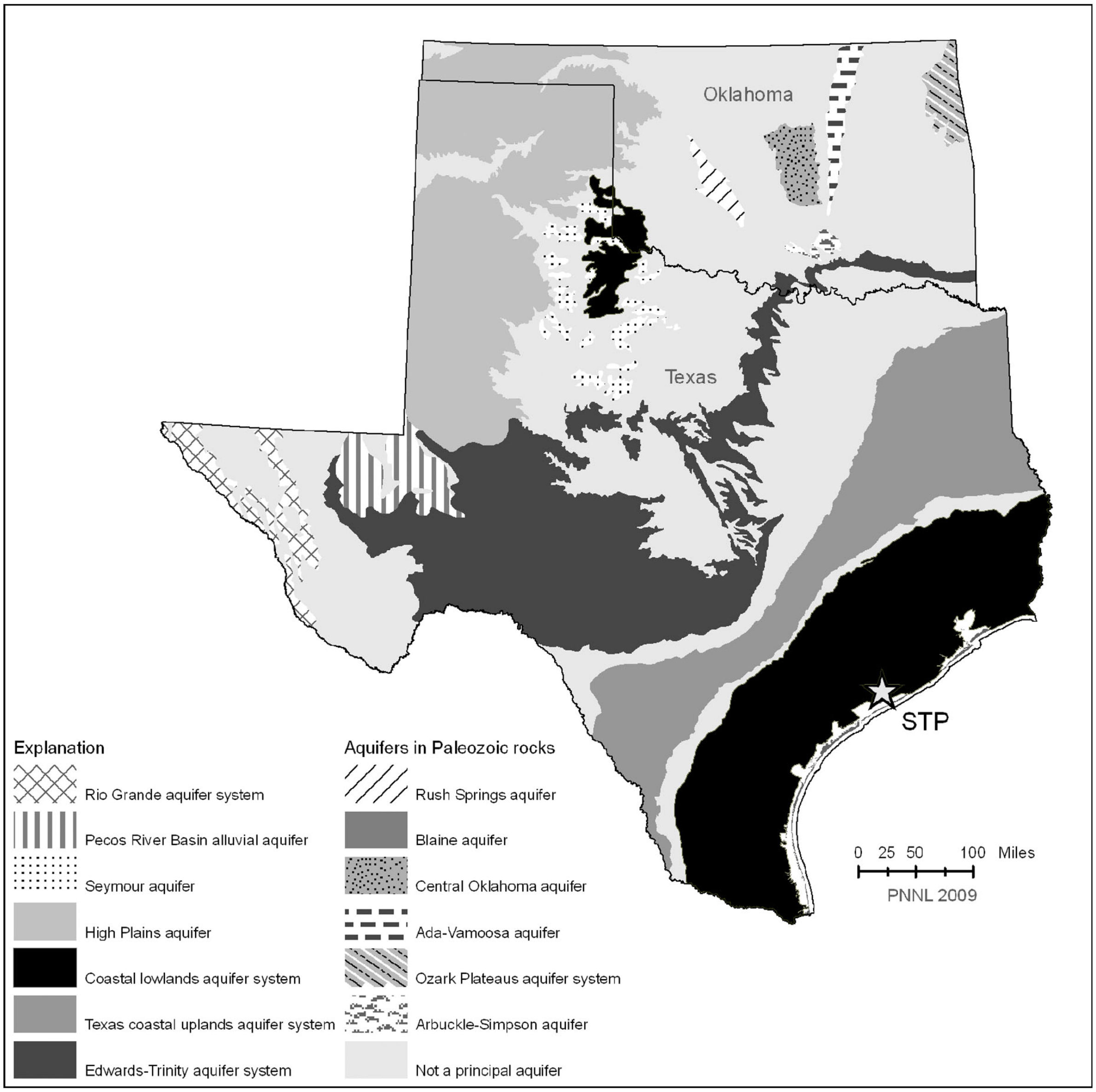

Figure 2-15. Aquifers of Texas (STPNOC 2009a)

Recharge to aquifers within the Chicot Aquifer underlying the STP site occurs to the northwest of the site, and discharge occurs generally to the east, south and southeast of the site (STPNOC 2009a). The Shallow Aquifer outcrops at the land surface and is recharged a few mi northwest of the STP site in Matagorda County, and it discharges to the Colorado River alluvium near the site. The Deep Aquifer outcrops and is recharged farther north and northwest in

Wharton County and discharges into Matagorda Bay and the Colorado River estuary approximately 5 mi southeast of the STP site.

The mean annual precipitation over Matagorda County ranges from 42 to 46 in. (Ryder and Ardis 2002). Based on model simulations, the average recharge in the Texas Gulf Coast Aquifer was 0.52 in./yr in 1982 (Ryder and Ardis 2002). During the period from predevelopment (the early to mid-1930s) until 1982, there are outcrop areas of the aquifer where irrigation water reentered the aquifer by downward percolation. These areas include Matagorda County where the change in recharge since predevelopment ranges from less than 0.5 to 2 in./yr (Ryder and Ardis 2002). In Wharton County, which is upgradient of Matagorda County, the change in recharge since predevelopment is estimated to range from 1 to 6 in./yr. The TWDB in its report on aquifers of the Gulf Coast of Texas (TWDB 2006b) stated that during calibration of its model the recharge rate was estimated as four percent of precipitation which corresponds to nearly 2 in./yr in Matagorda County. In a model produced for the LCRA, Young et al. (2007) described recharge to the Shallow Aquifer system as ranging from 1.5 to 3.0 in./yr, and to the Deep Aquifer system as ranging from 0.25 to 1.0 in./yr.

A feature at the STP site that influences the Shallow Aquifer is the MCR, which is an engineered cooling pond used to dissipate heat from the existing STP units (STPNOC 2009a). The MCR was originally sized for four units similar to existing STP Units 1 and 2, and was created above the original site grade by constructing a 12.4-mi-long earth-fill embankment. The MCR was originally designed to have a normal maximum operating level of 49 ft MSL and exhibit approximately 20 ft of hydraulic head above the original ground surface. The MCR has a surface area of 7000 ac, and it is a major feature of the 12,220-ac STP site. The existing STP Units 1 and 2 are located north of the northern MCR embankment.

The bottom of the MCR is unlined and acts as a local recharge source for the Upper Shallow Aquifer, and it appears to cause some mounding in the Upper Shallow Aquifer and possibly the Lower Shallow Aquifer (STPNOC 2008c, 2009c). A series of 770 relief wells surround the MCR embankment and is designed to collect and discharge some of the seepage from the MCR and relieve hydrostatic pressure on the outer slope and toe of the embankment (STPNOC 2009a). The updated FSAR (UFSAR) (STPNOC 2008j) for STP Units 1 and 2 estimated that 68 percent of the seepage from the MCR would be captured by the relief well system for an MCR maximum pool elevation of 49 ft MSL. Seepage not intercepted by the relief wells remains in the Upper Shallow Aquifer. Potentiometric data on the Upper Shallow Aquifer obtained from observation wells completed in 2006 through 2008 reveal that groundwater flow from north-northwest of the STP site moves south-south-southeast toward the Units 3 and 4 powerblock (STPNOC 2008g). This groundwater flow from the north-northwest converges with the flow outward from the MCR, and the flow within the Upper Shallow Aquifer is then diverted to the southeast and southwest around the MCR.

Initial site characterization efforts completed in 2006 and 2007 were inconclusive with regard to mounding in the Lower Shallow Aquifer caused by the MCR. However, additional wells were installed in 2008, and quarterly monitoring completed in 2008 yielded more comprehensive potentiometric surfaces that show no obvious impact to the Lower Shallow Aquifer from MCR release to the Upper Shallow Aquifer (STPNOC 2009c).

To the east-southeast of the STP site the Upper Shallow Aquifer discharges to either the unnamed tributary flowing into Kelly Lake, groundwater wells, Kelly Lake, or the Colorado River (STPNOC 2008h). It is also plausible that groundwater flow to the southwest in the Upper Shallow Aquifer could discharge to groundwater wells (STPNOC 2008c, h; STPNOC 2009c, e).

In the vicinity of the proposed and existing STP units, where the confining unit has been removed, the hydraulic gradient between Upper and Lower Shallow aquifers is downward, and groundwater movement is known to occur between them (see ER Section 2.3.1.2.5.1). Potentiometric measurements completed in September 2008 in the vicinity of Kelly Lake indicate an upward groundwater gradient between Lower and Upper Shallow aquifers, and a hydraulic equilibrium between the Upper Shallow Aquifer and Kelly Lake (STPNOC 2008g). While these potentiometric measurements indicate discharge is plausible from the Shallow Aquifer to Kelly Lake, measurements completed since September 2008 indicate a downward gradient and suggest seasonal variation (STPNOC 2009e). Other plausible groundwater discharge locations in the Lower Shallow Aquifer to the southeast include groundwater wells and the Colorado River.

As in the case of the Upper Shallow Aquifer, the regional groundwater flow in the Lower Shallow Aquifer approaches the STP site from the north-northwest, and, based on recent site characterization data (STPNOC 2008e), it would be diverted to the southeast. STPNOC (2009e) states that the hydraulic conductivity of the Lower Shallow Aquifer southwest of proposed Unit 4 is an order of magnitude lower than the region to the southeast, and the potentiometric measurement to the southwest indicate a very small and seasonally variable hydraulic gradient. Accordingly, STPNOC does not consider a southwest directed pathway in the Lower Shallow Aquifer to be a preferential pathway from proposed Unit 4. Thus, in addition to exposure locations to the southeast, there is a plausible exposure via groundwater wells to the southwest of proposed Unit 4 from the Upper Shallow Aquifer but not the Lower Shallow Aquifer.

Groundwater flow in the Deep Aquifer is from the northwest (e.g., Wharton County), toward the southeast and the Gulf of Mexico. Groundwater production wells located along the northern perimeter of the MCR withdraw an average 798 gallons per minute (gpm) for STP 1 and 2 operations (STPNOC 2009a).

The Deep Aquifer potentiometric surface in the vicinity of Units 1 and 2 in 1967 was estimated to be near 0 ft MSL (STPNOC 2009a, Hammond 1969). The surface was approximately 60 ft

BGS in 1975 (approximately 37 ft below MSL; local elevation 23 ft above MSL [NRC 1975; The Light Company 1987]). In 1986, prior to operation of existing Units 1 and 2, hydraulic head was approximately 75 ft BGS, or approximately 48 ft below MSL where Units 1 and 2 site grade was 27 ft MSL (The Light Company 1987). The potentiometric surface in 2006 following more than 20 years of Units 1 and 2 operation and associated groundwater withdrawal was approximately 55 ft below MSL (STPNOC 2009a). Thus, there has been a steady decline in the potentiometric surface from 1967 to present. Groundwater reversal is occurring locally to the STP production wells with groundwater being drawn to the wells from the northwest and southeast. Based on the potentiometric surfaces of the Lower Shallow Aquifer (i.e., 10 to 20 ft above MSL (STPNOC 2009a, STPNOC 2008g) and the Deep Aquifer (i.e., 45 to 55 ft below MSL (STPNOC 2009a), there is a downward hydraulic gradient. However, there is between 100 and 150 ft of a low hydraulic conductivity, predominantly clay, confining zone separating these two aquifers (The Light Company 1987; STPNOC 2009a). The UFSAR for existing Units 1 and 2 (The Light Company 1987) reports historic piezometric levels of the Deep Aquifer, and STP water withdrawals have shown a consistent pattern of managed drawdown in the vicinity of production wells with a resulting water table elevation of between 50 to 55 ft below MSL since 1986.

Hydrogeologic Properties

The hydrogeologic properties of the groundwater aquifers in the region and in the vicinity of the site are described in Sections 2.3.1.2.3.6 of the ER (STPNOC 2009a) and Section 2.4S.12 of the FSAR (STPNOC 2009b). Figure 2-16 shows a generalized hydrostratigraphic section at the STP site. Table 2-2 and Table 2-3 summarize the hydrogeologic and physical data of the strata underlying the STP site. Data for the physical properties of bulk density, total porosity and effective porosity shown in Table 2-2 and Table 2-3 were taken from ER Table 2.3.1-17 (STPNOC 2009a) where the number of samples is also reported. Hydraulic properties of the aquifers are from a variety of sources and methods.

Aquifer data from the TWDB for the region (ER Table 2.3.1-14), STP aquifer pumping tests (ER Table 2.3.1-15), STP slug tests (ER Table 2.3.1-16), STP laboratory-derived values, and existing STP Units 1 and 2 FSAR results were all compiled and reviewed by STP in making its site-specific property selections. The property values presented by the applicant have been compared to property values presented in various hydrogeology reports issued by the TWDB (Hammond 1969; TWDB 2006b), the LCRA (Young et al. 2007; LCRA 2007b), and the USGS (Ryder 1996; Ryder and Ardis 2002).

Literature values for hydraulic properties of the Gulf Coast Aquifer, and especially the Chicot Aquifer, are the result of aquifer tests and model calibration at a larger scale than the STP site. Accordingly, a broader range is seen in the literature data, and higher values for transmissivity are evident because of the deeper aquifer profiles being characterized by wells and model cross

Unit	Hydrogeologic Zone	Ground Surface	Thickness	Geologic Materials
Shallow Aquifer	Upper Shallow Aquifer Confining Layer		10 - 30 ft	Clay and Silt
	Upper Shallow Aquifer		20 -30 ft	Silty Sand and Poorly Graded Sand
	Lower Shallow Aquifer Confining Layer		15 - 25 ft	Clay and Silt
	Lower Shallow Aquifer		25 - 50 ft	Silty Sand and Poorly Graded Sand with thin Clay and Silt Layers
Deep Aquifer Confining Layer			100 - 150 ft	Silty Clay and Silt with thin Sand Layers
Deep Aquifer			>500 ft	Sand with thin Clay and Silt Layers

Figure 2-16. Generalized Hydrostratigraphic Section Underlying the STP Site (STPNOC 2009a)

Table 2-2. Representative Hydrogeologic Properties of Confining Layers in the STP Hydrogeologic Strata

Hydrogeologic Unit	Property	Units	Representative Value	Range
Vadose Zone, uppermost confining layer	Thickness	ft	20	10–30
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	101 (am)	96.4–114.9
	Total porosity	%	40 (am)	31.8–42.8
Lower Shallow Aquifer Confining Layer	Thickness	ft	20	15–25
	Vertical hydraulic gradient	-	0.29	0.02–0.294
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	99 (am)	87.3–107.7
	Total porosity	%	42 (am)	36.1–47.2
Deep Aquifer Confining Layer	Thickness	ft	100	100–150
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	101 (am)	82.1–111.4
	Total porosity	%	41.0 (am)	33.4–51.8

Source: STPNOC 2009a, b, e
gpd = gallons per day; gm = geometric mean, am = arithmetic mean; pcf = pounds per cubic foot

sections. Values of total porosity and effective porosity determined from STP site samples are higher than those presented by Ryder (1996), but within the range for sands, silts, and clays.

For the Upper Shallow Aquifer, the representative hydraulic conductivity value is the greater of the geometric means of the values determined by slug tests and by aquifer tests. In this case the aquifer test value of 165 gpd/ft^2 was higher than the slug test value of 107 gpd/ft^2. Use of the higher value is a conservative approach because it results in shorter travel time estimates. For the Lower Shallow Aquifer, the representative hydraulic conductivity value is the higher value of the two data sets (i.e., aquifer test, slug test), which is again based on the aquifer test data set. In this case the aquifer test value of 543 gpd/ft^2 was higher than the slug test value of 152 gpd/ft^2. STP site parameters for the Deep Aquifer are within the range shown by others (Hammond 1969; Ryder 1996; Young et al 2007). Use of the STP site-specific data sets and representative values are preferred over regionally developed parameters since they are likely to better represent site conditions.

The vertical hydraulic gradient shown in Table 2-2 for the Lower Shallow Aquifer confining strata is a downward directed gradient and its value is based on numerous measurements made at well pairs in the Upper Shallow Aquifer and the Lower Shallow Aquifer. The basis and data supporting this estimate of vertical gradient are provided in the ER Table 2.3.1-13 (STPNOC 2009a). Estimates of horizontal hydraulic gradient in the Upper and Lower Shallow aquifers are

Table 2-3. Representative Hydrogeologic Properties of Aquifers in the STP Hydrogeologic Strata

Hydrogeologic Unit	Property	Units	Representative Value	Range
Upper Shallow Aquifer; piezometric surface 5 to 10 ft BGS	Thickness	ft	25	20–30
	Transmissivity	gpd/ft	3708 (gm) 6800 (am)	1100–12,500
	Storage coefficient	-	1.20E-03 (am)	1.7E-03–7E-04
	Horizontal hydraulic conductivity	gpd/ft^2	165 (gm)	65–420
	Horizontal hydraulic gradient	-	0.002 (southeast) 0.0008 (southwest)	0.0007–0.002; 0.0005–0.0008
	Bulk (dry) density	pcf	99 (am)	97.2–100.2
	Total porosity	%	41 (am)	39.5–41.7
	Effective porosity	%	33 (am)	31.6–33.4
Lower Shallow Aquifer; piezometric surface 10 to 15 ft BGS	Thickness	ft	40	25–50
	Transmissivity	gpd/ft	18,209 (gm) 20,050 (am)	13,000–33,150
	Storage coefficient	-	5.8E-4 (am)	4.5E-4–7.1E-4
	Horizontal hydraulic conductivity	gpd/ft^2	543 (gm) 554 (am)	410–651
	Hydraulic gradient	-	0.0007 (southeast)	0.0004–0.0007
	Bulk (dry) density	pcf	102 (am)	94.5–120.0
	Total porosity	%	39 (am)	28.8–43.9
	Effective porosity	%	31 (am)	23.0–35.1
Deep Aquifer	Thickness	ft	800–>1000	
	Transmissivity	gpd/ft	31,379 (gm) 33,245 (am)	24,201–50,000
	Storage coefficient	-	4.9E-4 (am)	2.2E-4–7.6E-4
	Horizontal hydraulic conductivity	gpd/ft^2	420 (gm)	103–3950
	Hydraulic gradient	-	Directed toward STP wells	
	Bulk (dry) density	pcf	103.1	NA
	Total porosity	%	38.8	NA
	Effective porosity	%	31.0	NA

Source: STPNOC 2009a, b; Ryder 1996; LCRA 2007b
gpd = gallons per day; gm = geometric mean, am = arithmetic mean; pcf = pounds per cubic foot.

also based on field observations of the piezometric surface in each aquifer, respectively. To be conservative, hydraulic gradient values from the high end of measured ranges are assigned as representative values.

Groundwater Pathways

If spills were to occur at the STP site and were to reach saturated groundwater, the most likely aquifers to be affected would be the Upper and Lower Shallow aquifers. Seepage from the MCR would recharge the Upper Shallow Aquifers.

2.3.2 Water Use

This section describes the current water use in the Colorado River Basin including that needed for operation of existing STP Units 1 and 2.

In Texas, water use is regulated by the Texas Water Code. As established by Texas Water Code, surface water belongs to the State of Texas (Texas Water Code, Chapter 11, Section 11.021). The right to use surface waters of the State of Texas can be acquired in accordance with the provisions of the Texas Water Code, Chapter 11. In Texas, surface water is a commodity. Since the Colorado River Basin is currently heavily appropriated, future water users in this basin would likely obtain surface water by purchasing or leasing existing appropriations. Regarding groundwater, Texas law has allowed landowners to pump the water beneath their property without consideration of impacts to adjacent property owners (NRC 2009c). However, Chapter 36 of Texas Water Code authorized groundwater conservation districts to help conserve groundwater supplies. Chapter 36, Section 36.002, Ownership of Groundwater, states that ownership rights are recognized and that nothing in the code shall deprive or divest the landowners of their groundwater ownership rights, except as those rights may be limited or altered by rules promulgated by a district. Thus, groundwater conservation districts with their local constituency offer groundwater management options (NRC 2009c). The existing STP Units 1 and 2 use current STPNOC water rights granted by the TCEQ and the conditions of the existing STPNOC-LCRA water contract to withdrawal surface water from the Colorado River. Groundwater used by STP Units 1 and 2 is withdrawn from the Deep Aquifer under STPNOC's existing Coastal Plains Groundwater Conservation District (CPGCD) permit. STPNOC has stated that the proposed Units 3 and 4 would operate within the limits of these existing surface water and groundwater appropriations (STPNOC 2009a).

Following the drought of record during 1950 to 1957, the TWDB was established to plan and finance water supply projects. In 1997, Texas Senate Bill 1 created a new water planning process that uses sixteen planning regions, called Regional Water Planning Areas (or Regions), within the State. The Bill designated TWDB as the lead agency with the responsibility to coordinate the regional water planning process and to develop the statewide water plan. The most recent Water Plan, the 2007 plan, was adopted on November 14, 2006. The STP site is located in the Lower Colorado Regional Water Planning Group (LCRWPG), or Region K. The area of Region K follows the Colorado River from mid-state to the Gulf of Mexico.

The State is also divided into a number of River Authorities that were created by the Texas State legislature to manage surface water resources in river basins within the state. The STP Site is located in the LCRA, which was created by the Texas legislature in 1934.

As of November 2009, the State of Texas had 96 groundwater or underground water conservation districts that were created either by the Texas legislature or by TCEQ using a local petition process. The conservation districts have the authority to regulate the spacing between water wells, the production of water from wells, or both.

While the River Authorities act as managers and suppliers of surface water and Groundwater Conservation Districts act as managers and permitting authorities for groundwater within their respective areas, water planning at the regional level is performed by the Regions and the TWDB brings the Regional Water Plans together to adopt the State Water Plan. Regional and State-level water planning consider demands, supplies, and future development of both surface and groundwater resources.

2.3.2.1 Surface-Water Use

The existing STP Units 1 and 2 use surface water provided under contract by the LCRA for make-up water requirements of the MCR. Of the six highland lakes that are formed by the six highland dams that LCRA operates, Lakes Travis and Buchanan provide water supply for communities, industries, agriculture, and aquatic life. Water rights are issued by TCEQ for stored water or for run-of-the-river water and senior water rights holders have priority over the diversions if the water supply is limited during dry years. Water can be directly diverted from the Colorado River by run-of-the-river water rights holders (LCRWPG 2006).

The LCRWPG produced the Region K Water Plan in 2006 (LCRWPG 2006). The LCRWPG estimated the surface water supply in Matagorda County to be 184,857 ac-ft per year in 2010 and decreasing to 132,193 ac-ft per year in 2060. The LCRWPG has proposed water management strategies including new water supplies (i.e., surface water and groundwater) and water conservation to meet the level of water demand anticipated between 2010 and 2060. Total water demand for Matagorda County during this period ranges from 302,570 ac-ft per year in the 2040 decade to 286,093 ac-ft per year in the 2060 decade, and averages 292,038 ac-ft per year between 2000 and 2060. The total water demand for Matagorda County includes the STPNOC water rights of 102,000 ac-ft per year (LCRWPG 2006).

In the report “Water for Texas 2007” produced by the TWDB in 2006 (TWDB 2007), the total water demand in Region K is projected to increase from 1,078,041 ac-ft per year in 2010 to

1,302,682 ac-ft per year in 2060. During this same period, existing water supplies are projected to decline from 1,182,078 ac-ft per year to 887,972 ac-ft per year. The decline in water supply is attributed to reservoir sedimentation and expired water contracts (TWDB 2007). However, TWDB (2007) stated that water management strategies are estimated to offset this through a combination of conservation, reuse, new supplies, and desalination measures. Accordingly, the total water demand is expected to be met.

The current surface water resource of the Colorado River near the STP site, represented by the average of mean annual discharges during water years 1949 to 2008 at the Bay City USGS streamflow gauge, is 2629 cfs (1,903,000 ac-ft per year). Some of this flow is reserved for instream flow needs.

The STPNOC currently holds a water right for 102,000 ac-ft of water per year (determined as a 5-year rolling average) from the Colorado River and is authorized to divert water at a maximum rate of 1200 cfs. The diversion is limited to 55 percent of flows in excess of 300 cfs measured at the USGS streamflow gauge at Bay City Dam (USGS gauge 08162500). In addition, STPNOC also has access to a maximum of 20,000 ac-ft of water per year for operation of existing Units 1 and 2 on a rolling five-year average basis, of firm water[(a)] to help maintain the MCR water surface elevation at or above 27 ft MSL. During delivery of firm water, diversion of the river flow is restricted only by the LCRA estuary requirement. According to the Revised Water Management Plan (LCRA 2009c), the LCRA releases water into the Lower Colorado River from Lakes Buchanan and Travis to meet bay and estuary needs. The LCRA releases the critical bay and estuary inflow need of 171,120 ac-ft per year (236 cfs) every year. In years when the lakes are between 55 and 86 percent full on January 1, LCRA releases 250,680 ac-ft per year (346 cfs) and the release increases to 1.03 million ac-ft per year (1423 cfs) if the lakes are more than 86 percent full on January 1.

Using TCEQ's water rights database (TCEQ 2009a), the review team determined that there are 29 active water rights holders in the Colorado River Basin between the Mansfield Dam and the STP site. The combined withdrawal rights for these holders are 327,376 ac-ft per year. The average annual discharge of the Colorado River, based on streamflow measured during 1899 through 2009 at the Colorado River at Austin, Texas gauge (USGS gauge 08158000) approximately 5 mi downstream of Austin, Texas is 2193 cfs (1,587,653 ac-ft per year). Therefore, the review team determined that approximately 21 percent of the surface water resource near Austin, Texas, is currently allocated for use between Mansfield Dam and the STP site.

As reported by TCEQ in April 2009, there are 52 active withdrawals in Matagorda County on the Colorado River, various streams, creeks, and sloughs (TCEQ 2009a). The Colorado River

(a) Firm water is that which is diverted from storage under a contact or resolution issued by the LCRA to high-priority users (Watkins et al 1999).

water rights belonging to the LCRA (4,168,930 ac-ft/yr), the City of Austin (520,403 ac-ft/yr), and the Colorado River Municipal Water District (103,000 ac-ft/yr) are greater in quantity than those of STPNOC (102,000 ac-ft/yr). In Matagorda County, LCRA is the only entity with water rights greater in quantity than STPNOC (TCEQ 2009a). There are several water rights holders with a priority date earlier than that of STPNOC's, however, the combined quantity of these water rights, excluding those belonging to LCRA, is 28,867 ac-ft/yr.

Water lost from the MCR to consumptive use at the STP site is replaced by pumping from the Colorado River. Under normal river flow conditions, STPNOC currently diverts water from the Colorado River for the existing Units 1 and 2 using the rules stated above. From 2001 to 2006, STPNOC diverted an average of 37,084 ac-ft of water per year for operation of Units 1 and 2 (STPNOC 2009a). The applicant also reported that the existing consumptive water use from the Colorado River is approximately 37,100 ac-ft per year (STPNOC 2009a). The existing consumptive use is estimated to be 2 percent (37,100 ac-ft per year of use compared to 1,903,000 ac-ft per year of current surface water resource, i.e., streamflow of the Colorado River as measured at the Bay City USGS gauge). When compared to the TWDB estimates of water supplies in Region K (TWDB 2007), the current STP water use for Units 1 and 2 during normal operations would be 3 percent in 2010 (37,100 ac-ft per year of use compared to 1,182,078 ac-ft per year of estimated supplies).

Water evaporated from the MCR has two components: (1) natural evaporation that occurs at the free water surface without addition of any heat load from the STP units and (2) induced evaporation that occurs because of the additional heat loads discharged with the circulating water into the MCR. The normal and maximum natural evaporation from the MCR are 19,912 gpm (32,118 ac-ft per year) and 23,109 gpm (37,275 ac-ft per year), respectively (STPNOC 2008j). The normal and maximum induced evaporations from STP Units 1 and 2 heat loads were reported by the applicant to be 33,200 and 37,200 ac-ft per year, respectively (STPNOC 2009d). The normal and maximum conditions refer to 93 and 100 percent load factors, respectively (STPNOC 2009d).

2.3.2.2 Groundwater Use

Groundwater use from the Gulf Coast Aquifer system increased between 1940 and the mid-1980s. One cause was the increase in rice irrigation, and Matagorda County was among the counties where this occurred. The largest pumpage from the aquifer was reported in the Houston area where notable subsidence and substantial increases in pumping lift occurred. Issues with overpumping the groundwater resource included land subsidence, saltwater intrusion, stream base-flow depletion, and increased pumping lift. Groundwater use from the Gulf Coast Aquifer system has declined because of these issues and in the mid-1980s the TWDB forecast a decline in groundwater use in the Gulf Coast Aquifer through 2030. Matagorda County was projected to see a net decrease of 48 percent with pumping decreasing from 21,528 gpm (31 MGD) in 1985 to 11,111 gpm (16 MGD) in 2030 (Ryder and Ardis 2002).

Under Texas State law (Water Code, Title 2, Subtitle E, Chapter 36) groundwater conservation districts have the authority and responsibility to define the managed available groundwater in the district (Sec 36.1071 (e)(3)(A)), and the amount of groundwater being used in the district (Sec 36.1071 (e)(3)(B)), and to issue permits based on the managed available groundwater resource. The CPGCD, which is responsible for the groundwater underlying Matagorda County, Texas, has adopted a groundwater availability value of 30,520 gpm (49,221 ac-ft/yr) (Turner Collie & Braden Inc. 2004). This value is consistent with the groundwater availability value appearing in the regional water plans produced in 2002 and 2006 for the TWDB by the Lower Colorado Regional Water Planning Group (Turner Collie & Braden Inc. 2004; LCRWPG 2006). The 49,221 ac-ft/yr value is based on an estimate of maximum usage in 2050 (LCRWPG 2006).

Groundwater management by the CPGCD is an ongoing process. While the current managed available groundwater[(a)] value is 30,520 gpm (49,221 ac-ft/yr), under Texas State law the district is engaged in a process of defining and adopting the desired future condition[(b)] and an updated managed available groundwater value. The district expects to update the “managed available groundwater” value after receipt of information from the TWDB, which is responsible for simulating the groundwater resource using a groundwater availability model (CPGCD 2009).

An estimate of groundwater supplies representative of the ability of water supply systems to provide groundwater is provided in Table 4 of the CPGCD Management Plan (Turner Collie & Braden Inc. 2004). The estimated groundwater supply level is a constant 22,189 gpm (35,785 ac-ft/yr) through 2050. A similar value appears in Table 3.30 of the LCRWPG report (LCRWPG 2006); it ranges from 22,225 to 22,221 gpm (35,844 to 35,838 ac-ft/yr) over the period 2000 through 2060.

The CPGCD provides a summary of the history of groundwater withdrawal from the Gulf Coast Aquifer in the district. Table 2 (Turner Collie & Braden 2004) of the management plan on groundwater use presents available data from 1980 through 2000. Groundwater pumpage peaked in Matagorda County in 1988 at 27,055 gpm (43,634 ac-ft/yr), and has declined since but not continuously. A low pumpage rate of 8783 gpm (14,165 ac-ft/yr) occurred in 1998. The CPGCD reports an average total groundwater usage rate of 18,746 gpm (30,233 ac-ft/yr) through the year 2000.

(a) “Managed available groundwater” means the amount of water that may be permitted by a groundwater conservation district for beneficial use in accordance with the desired future condition of the aquifer as determined under Section 36.108 of Texas water code, i.e., consideration given to the joint planning of multiple districts within a groundwater management area.

(b) “Desired future condition” is one or more metric that specifies the future value of the related aquifer characteristic such as groundwater elevation, groundwater quality, spring flow, land subsidence and other aquifer characteristics that may be deemed suitable by a groundwater conservation district and groundwater management area.

Strategies by the LCRWPG and the CPGCD to provide for the future demand are divided into surface water and groundwater strategies (LCRWPG 2006; Turner Collie & Braden 2004). These strategies provide a decadal estimate of groundwater specific management that would augment the 22,189 gpm (35,785 ac-ft/yr) existing groundwater supply in Matagorda County. These two projections of supplemental groundwater resource availability from the Region K Water Plans issued in 2002 and 2006 were 14,049 gpm (22,658 ac-ft/yr) through the year 2050 and 18,320 gpm (29,546 ac-ft/yr) through the year 2060, respectively. Thus, based on the more recent 2006 Water Plan, the projected use of groundwater through 2060 is approximately 40,509 gpm (65,331 ac-ft/yr). However, the strategies to augment existing groundwater supplies require financial resources to build infrastructure before the total projected groundwater resource would be available in 2060.

In addition to the above groundwater resource estimates, there is the total permitted amount of groundwater within the CPGCD. The three-year permitted total for the period 2005 through 2007 was 259,840 ac-ft. For the period 2008 through 2010 the permitted total is down to 153,854 ac-ft (CPGCD 2009). This reduction in total permitted amount was a result of efforts by the CPGCD to convince owners of groundwater use permits to request groundwater quantities consistent with their realistic needs. The CPGCD estimates that the annual permitted amount for each of these three-year permit periods is 86,600 ac-ft/yr and 51,285 ac-ft/yr (CPGCD 2009).

The quantity of groundwater permitted and the various groundwater resource estimates described above are summarized below in Table 2-4. The annual quantity of groundwater permitted by the CPGCD exceeds the current estimates of managed available groundwater and the estimated groundwater supply. It also exceeds recorded usage within the county. The infrastructure is in place at the STP site to fully utilize its permit limit (described below), and, therefore, while it has not been fully used to date, the full permit limit is included in the estimated groundwater supply value of 22,189 gpm (35,785 ac-ft/yr). The full STP permit limit is also included in the annual permitted value of 31,800 gpm (51,285 ac-ft/yr).

Table 2-4. Groundwater Resource Estimates for Matagorda County

Resource Description	gpm	ac-ft/yr	References
Managed Available Groundwater	30,520	49,221	TC&B 2004, Table 1
Estimated Groundwater Supply	22,189	35,785	TC&B 2004, Table 4
Average GW Use 1980-2000	18,746	30,233	TC&B 2004, Table 2
High Groundwater Use – 1988	27,055	43,634	TC&B 2004, Table 2
Low Groundwater Use – 1998	8783	14,165	TC&B 2004, Table 2
Future Demand – total in – 2060	40,509	65,331	LCRWPG 2006
Annual Permitted (2008 – 2010)	31,800	51,285	CBGCD 2009

Aside from the STP production wells which are located on the STP site, there are three public water supply wells approximately 3.75 mi (6 km) southeast of the site (STPNOC 2009a). They serve the Exotic Isle Subdivision, the Selkirk water system, and the Selkirk Island Utilities, and all are completed in the Deep Aquifer. The closest non-public water supply wells are two wells located approximately 1.25 mi northeast of the site. They are livestock water supply wells.

Current usage by STP for existing Units 1 and 2 was estimated as an average value of 683 gpm (1101 ac-ft/yr) between 1980 and 2000 (Turner Collie & Braden 2004). However, using more recent values from 2001 through 2006, average groundwater use is estimated at 798 gpm (1287 ac-ft/yr) (STPNOC 2009a). The permitted limit of groundwater usage by STP is approximately 1860 gpm (3000 ac-ft/yr) or an absolute usage of 2.93E+09 gallons (9000 ac-ft) during the approximately 3-year permit period[a] (CPGCD 2008). STP has five groundwater production wells completed in the Deep Aquifer that are used to supply groundwater for the operation of STP Units 1 and 2.

A consideration with regard to groundwater use in the region is subsidence caused by substantial declines in groundwater piezometric levels and the consolidation of clays. Recent studies by the USGS (Ryder and Ardis 2002; Kasmarek and Robinson 2004) and the LCRA (2007a) address subsidence in the Gulf Coast Aquifer region. Ryder and Ardis (2002) described the large withdrawal of groundwater in the rice-irrigation region (1900–1975) including most of Jackson and Wharton Counties, and portions of others including Matagorda County, as causing the compaction of clays and a subsidence of less than 1 ft over most of the region with somewhat higher subsidence of 1.5 ft noted in western Matagorda County. However, Ryder and Ardis (2002) concluded that the subsidence was fairly evenly distributed in this mostly rural region, and undesirable impacts were minimized. Hammond (1969) also concluded that subsidence in Matagorda County was not excessive. Hammond noted that excessive subsidence can result in impacts such as cracking highways, breaking pipelines, and sinking of building foundations.

A report completed by the Lower Colorado River Authority and San Antonio Water System (LCRA-SAWS) Water Project also estimated land-surface subsidence since 1900 over most of Matagorda County to be less than 1 ft (LCRA 2007a). Where land-surface subsidence exceeds 1 ft in northwest Matagorda County, it is attributed to groundwater withdrawals associated with gas/petroleum exploration and sulfur mining.

The USGS completed a model of groundwater flow and land-surface subsidence applicable to the northern part of the Gulf Coast Aquifer system (Kasmarek and Robinson 2004). This modeling effort focused on the Harris-Galveston-Fort Bend County area where as much as 10 ft

(a) For the current groundwater operating permit, the issue date is February 7, 2008, and the expiration date is February 28, 2011. For future groundwater permits, the permit term may vary slightly, but would be approximately 3 years.

of subsidence has occurred; however, the model extended to include Wharton and Matagorda counties to the southwest. The model match was close to measured values in the focus area, and predicted no subsidence in the coastal irrigation area including Wharton and Matagorda counties.

During construction and through operation in 1993 of STP Units 1 and 2, a subsidence rate of less than 0.1 in. to about 0.2 in. per year was observed (STPNOC 2007).

2.3.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the STP site. Monitoring programs for thermal and chemical water quality are also described.

2.3.3.1 Surface-Water Quality

This section describes the water quality of surface water bodies near the STP site that may be affected by the construction and operation of proposed Units 3 and 4. STPNOC presented a discussion of the water quality conditions in Section 2.3.3.1 of the ER (STPNOC 2009a).

The State of Texas divides river reaches into segments for water quality determination. The segment of the Colorado River adjacent to the STP site, Segment 1401, is classified as a Tidal Stream (TCEQ 2008a). The TCEQ lists aquatic life, contact recreation, and fish consumption as some of the uses of this segment. The TCEQ, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b), prepares a statewide Water Quality Inventory. The TCEQ also identifies impaired water bodies during this process and lists them on the 303(d) List. Segment 1401 is listed on the 2008 Texas 303(d) List as impaired by presence of bacteria (TCEQ 2008a).

The MCR is part of the closed-cycle cooling system for the existing units. The MCR is permitted to occasionally discharge to the Colorado River through a buried pipeline under a Texas Pollutant Discharge Elimination System (TPDES) permit (TCEQ 2005). During the operation of the existing units, no discharge from the MCR to the Colorado River was performed, with the exception of one test of the MCR discharge system (STPNOC 2009a). The current TPDES permit allows an average daily MCR discharge of 144 MGD with a daily maximum of 200 MGD. The average daily MCR discharge temperature is limited to 95ºF with a daily maximum of 97ºF. Total residual chlorine in the MCR discharge is limited to a daily maximum of 0.05 mg/L. The pH of the MCR discharge is limited between 6.0 and 9.0 standard units. The TPDES permit specifies that MCR discharge must not exceed 12.5 percent of the flow of the Colorado River at the discharge point. The permit also restricts the MCR discharges to periods when the flow of the Colorado River adjacent to the site is 800 cfs or greater. The MCR discharge facility consists of seven submerged ports located on the west bank of the Colorado River approximately 2 mi downstream of the RMPF. Each port can discharge at a maximum rate of 44 cfs, for a total maximum MCR discharge of 308 cfs.

The segment of the Colorado River adjacent to the STP site, Segment 1401, is classified by the TCEQ as tidal (TCEQ 2009b). The water body uses for the segment include aquatic life use, contact recreation use, general use, and fish consumption use. Title 30 of Texas Administrative Code (30 TAC), Part 1, Chapter 307, §307.10, Appendix A lists site specific uses and criteria for classified segments. The criteria specified for Segment 1401 are a minimum 24-hour mean dissolved oxygen at any point within the segment of 4.0 mg/L, a pH range of 6.5 and 9.0 standard units, an indicator bacteria count of 126 colonies per 100 mL or alternatively, fecal coliform criteria of 200 colonies per 100 mL, and a maximum temperature of 95°F at any point within the segment. The 2008 Texas 303(d) list (TCEQ 2009c) lists Segment 1401 impaired by bacteria since 2006. A total maximum daily load (TMDL) is currently being developed by TCEQ for this segment. The other surface water bodies near the STP site, Little Robbins Slough, West Branch of the Colorado River, and Kelly Lake are not listed in the 303(d) list. East Matagorda Bay and Matagorda Bay are listed since 1996 in the Texas 303(d) list as impaired by bacteria. TMDL are also currently being developed by TCEQ for these waters.

At the USGS gauge 08162500, Colorado River near Bay City, Texas, monthly water quality sampling data exist only for the months October 1974, through October 1976, February and June of 2000, and March and June of 2001. The LCRA monitors water-quality data in the Colorado River Basin to evaluate overall water quality, ecological conditions, and compliance with State water quality standards (LCRA 2009a).

The LCRA monitors Colorado River water quality at a station named Colorado River Tidal at Selkirk Island, located approximately 2 mi downstream from the FM 521 and approximately 0.7 mi downstream from the RMPF. The water quality data is available for this station from LCRA (2009c).

Water quality data at the Selkirk Island station show a dissolved oxygen range from 0 to 13.5 mg/L with an average of 6.5 mg/L for the period October 1982 through November 2008. For the same period, pH measurements ranged from 6.6 and 9.8 standard units with an average of 7.9 standard units and water temperature measurements ranged from 43.5 to 92.1°F (6.4 to 33.4°C) with an average of 72.5°F (22.5°C). During the period June 1994 through September 2001, *Escherichia coli* bacteria ranged from 1 to 1280 colonies per 100 mL with an average of 129 colonies per 100 mL. During the period October 1982 through July 2001, fecal coliform ranged from 0 to 13,000 colonies per 100 mL with an average of 391 colonies per 100 mL. The Texas Surface Water Quality Standards (30 TAC, Part 1, Chapter 307, Section 307.10, Appendix A) list the following criteria for Segment 1401: (1) dissolved oxygen of 4.0 mg/L, (2) pH range of 6.5 to 9.0 standard units, (3) indicator bacteria count of 35 E. coli for freshwater and *Enterococci* spp. for saltwater per 100 mL or 200 fecal coliform per 100 mL, and (4) water temperature of 95 degrees Fahrenheit. Based on this data, the Colorado River near the STP site occasionally does not meet the criteria set for dissolved oxygen (12 percent of the times measurements were made) and bacteria (24 percent of the times measurements were made). These measurements are consistent with the listing of Segment 1401 on the Texas 303(d) List.

In addition to the water quality monitoring station in the Colorado River, LCRA also maintains three stations in the Matagorda Bay. Two of these stations are located in West Matagorda Bay and one in East Matagorda Bay.

2.3.3.2 Groundwater Quality

This section describes the water quality of groundwater near the STP site that may be affected by the building and operation of proposed Units 3 and 4. STPNOC presented a discussion of the water quality of groundwater in Section 2.3.3.2 of the ER (STPNOC 2009a). Discussions of the present day setting of the underlying groundwater, and of regional salt water intrusion rely on the STPNOC ER, STPNOC annual environmental operating reports, and studies performed by the USGS and the LCRA.

Regional water quality data from the mid-1960s show all wells above or just below the EPA secondary drinking water standard for TDS (STPNOC 2009a; Hammond 1969). More current data for STP production and observation wells indicate that all but a single well are above the TDS standard of 500 mg/L (STPNOC 2009a). Locally, groundwater from the Shallow Aquifer is described as slightly saline because of TDS concentrations above 1000 mg/L (i.e., slightly saline waters have TDS between 1000 and 3000 mg/L). Onsite wells completed in the Shallow Aquifer have an average TDS concentration of approximately 1200 mg/L (STPNOC 2009a). Several regional wells and a majority of the shallow wells in the more current STP data set also exhibited chloride concentrations higher than its EPA secondary drinking water standard value of 250 mg/L. Fluoride was higher than the EPA secondary drinking water standard of 2 mg/L in a single well in each data set; the regional data set and the STP data set. The site-specific data are consistent with the regional water quality information that identify the Deep Aquifer as the preferred drinking water source, and identify the Shallow Aquifer as a lower quality water source. The water quality signatures of the Upper and Lower Shallow aquifers (i.e., sodium chloride and sodium bicarbonate respectively) suggest natural communication is occurring between these aquifers in the vicinity of two observation wells; OW-332 (near the northeast corner of proposed Unit 3) and OW-930 (approximately 4000 ft east of existing Units 1 and 2).

The MCR is connected hydraulically to the underlying Upper Shallow Aquifer and seepage from the MCR recharges the aquifer. A relief well system, (i.e., 770 wells that surround the MCR) is designed in part to intercept the majority of the seepage from the MCR into the Upper Shallow Aquifer. STPNOC (2009a) has estimated that for the MCR at a maximum pool elevation of 49 ft MSL total seepage from the MCR is 3530 gpm (5700 ac-ft/yr), and that approximately 68 percent of this or 2390 gpm (3850 ac-ft/yr) is intercepted by the relief wells. Regarding radioactive contaminants in the MCR and in seepage from the MCR that recharges the Upper Shallow Aquifer, see Section 5.9.6.

A potential impact on the quality of the Deep Aquifer groundwater resource in the vicinity of the STP site is saltwater intrusion or encroachment resulting from pumping of groundwater in the region. Ryder and Ardis (2002) described saltwater intrusion or encroachment as a potential threat to the rice-irrigation region that includes Matagorda County because of saltwater-bearing deposits downdip, above and below the freshwater deposits. Because of the reduction of hydraulic head from long-term pumping of the aquifer system for rice irrigation, saltwater encroachment could occur by either lateral migration in coastal areas or vertical migration where freshwater sands overlie saline groundwater. However, because the groundwater system exhibits a balance between net recharge and total pumping, Ryder and Ardis (2002) conclude that "(s)altwater encroachment is not currently a serious threat to the quality of groundwater used in the coastal rice-irrigation area" that includes portions of Wharton and Matagorda Counties.

In their study of variable density groundwater flow and groundwater well design, the LCRA (2007b) provided a cross sectional analysis of Colorado, Wharton and Matagorda Counties with added pumping equivalent to 24,800 gpm (40,000 ac-ft/yr, the historical maximum) in Matagorda County over an 80-year period. Wells were placed in the model beginning about 1 mi from the coast, and screened over 400 to 500 ft to a depth of about 1000 ft BGS. Maximum drawdown was about 80 ft over the 80-year period, and the overall water quality did not change. The study also evaluated well design parameters. For wells with 400 to 500 ft screens completed to approximately 700 ft BGS, the LCRA (2007b) study assumed the fresh/saline interface occurred at 1200 ft BGS and found for a hydraulic conductivity of 18 ft/day and anisotropy ratio of 1000 (Kr/Kv) that the critical pumping rate was 527 gpm. For a more realistic anisotropy ratio of 10,000, the LCRA study found that the critical pumping rate was 14,165 gpm. The LCRA (2007b) study provides guidance to others in the region so that groundwater withdrawals should not result in significant degradation of the groundwater quality in the regional groundwater system because of saltwater intrusion.

In the Regional Geology and Aquifer System section, the base of the aquifer is defined as the depth where the groundwater has a TDS concentration of more than 10,000 milligrams per liter (mg/L). Using this metric, Ryder (1996) noted that the thickness of the aquifer system in Matagorda County ranged from 1000 to 2000 ft. A measure of impact on the quality of the groundwater resource in the Deep Aquifer is the change in depth where the TDS concentration is 10,000 mg/L, or the change in depth to thresholds of TDS level associated with higher quality water. LCRA (2007b) described the groundwater of the Deep Aquifer according to TDS level as either fresh (less than 1000 mg/L), slightly saline (1000 to 3000 mg/L), or moderately saline (greater than 3000 mg/L). In the vicinity of the STP site, the LCRA (2007b) study mapped the 3000 mg/L TDS surface at a depth of between 1000 and 1200 ft BGS.

2.3.4 Water Monitoring

2.3.4.1 Surface-Water Monitoring

The closest USGS streamflow gauge upstream of the STP site is the USGS gauge 08162500, Colorado River near Bay City, Texas. Daily discharge in the Colorado River at this gauge is available since May 1, 1948. NOAA maintains tide gauges at Freeport and at Port O'Connor. Water diverted from the Colorado River to make up the loss of water from the MCR and water consumed are monitored monthly and reported to TCEQ annually according to the TCEQ water rights permit. The volume of water diverted from the Colorado River is also reported to the Texas Water Development Board annually.

Monthly water quality data is available for a limited period (see Section 2.3.1.1). Lower Colorado River Authority monitors Colorado River water quality at Selkirk Island approximately 1 mi downstream from the STP intake structure (see Section 2.3.3.1). Data monitored at this location includes various flow parameters (such as dissolved oxygen, pH, water temperature, and turbidity), bacteria (*Escherichia coli*, *Enterococci* spp., and Fecal Coliform), chemistry (biological and chemical oxygen demand, alkalinity, hardness, dissolved calcium and magnesium, nitrate, nitrite, phosphorus, sulfate, and total organic carbon), metals in water and sediment (including Aluminum, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, and Zinc), and organic material in sediment.

STPNOC monitors discharges and effluents as required by the TPDES permit for existing STP Units 1 and 2 at six locations (Figure 2-17). The effluent flows are compiled as daily totals and are reported to TCEQ monthly. When discharge from the MCR to the Colorado River occurs at Outfall 001, the rate of discharge is continuously monitored. The other five outfalls are all internal to the MCR and are monitored on a daily basis.

As part of the Radiological Environmental Monitoring Program, STPNOC analyzed water samples for radionuclides (including Tritium, Iodine, Cesium, Manganese, Iron, Cobalt, Zinc, Zirconium, Niobium, Lanthanum, and Barium) from several locations at the STP site (STPNOC 2009a). Only the levels of Tritium were found to be detectable in four of 12 samples. The maximum concentration of Tritium was reported in south-southeast part the MCR near the discharge facility.

Since 1995, STPNOC has also sampled the west branch of the Colorado River, Little Robbins Slough, east branch of the Little Robbins Slough, an onsite drainage ditch located northeast of the MCR, and the MCR (STPNOC 2009a). Tritium was detected at all six sampled locations within these waterbodies. The maximum concentrations found in these waterbodies are reported in Table 2-5. The EPA primary drinking water standard for Tritium is 20,000 pCi/L. The waters of the MCR are not used for drinking.

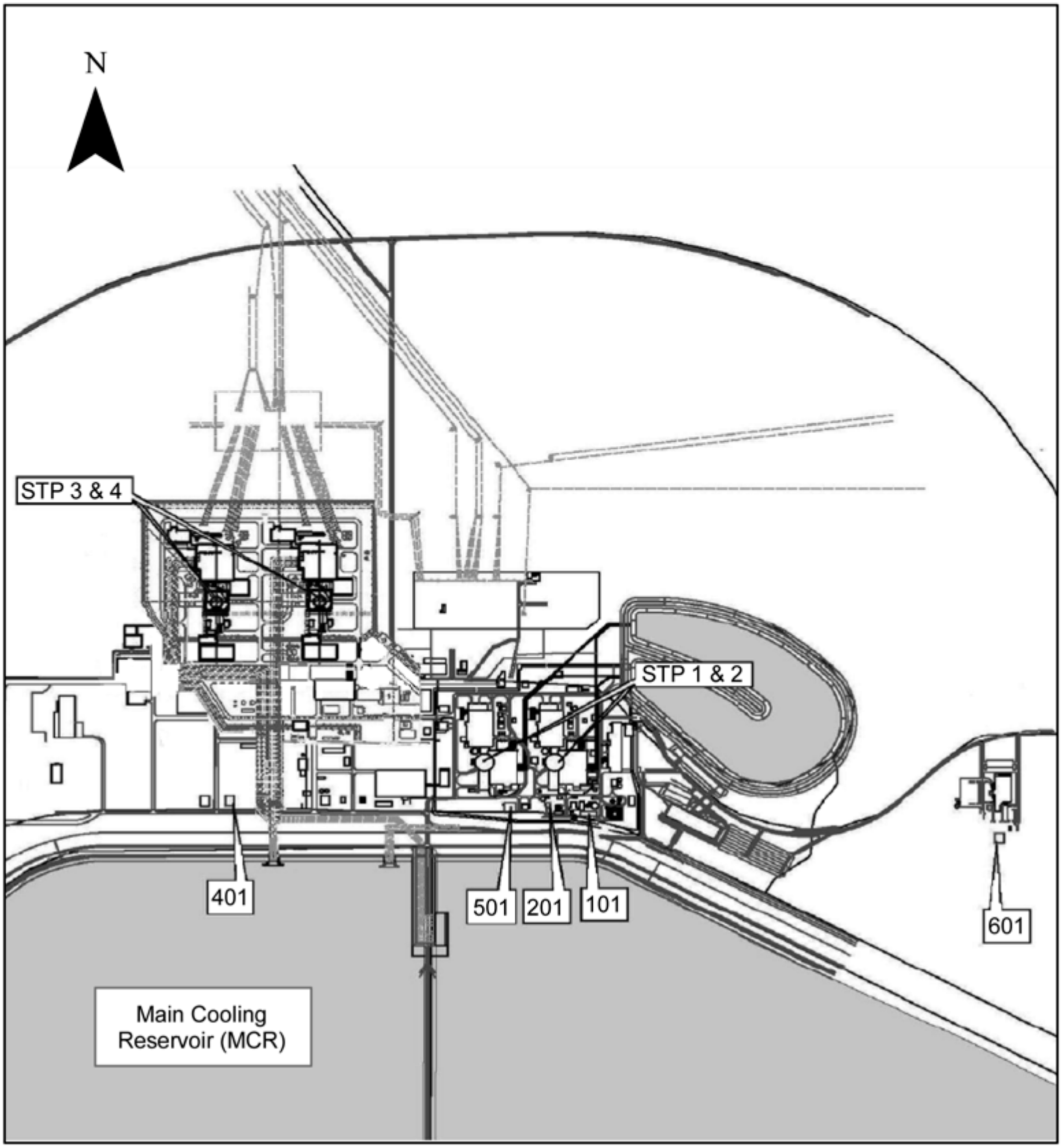

Figure 2-17. Hydrological Monitoring Locations for Existing STP Units 1 and 2 (STPNOC 2009a)

Table 2-5. Maximum Tritium Concentration in Water Bodies Near the STP Site (1995-2005)

Location	Maximum Measured Tritium Concentration (pCi/L)	Year the Measurement was Made
West branch of Colorado River	6093	1999
Little Robbins Slough	7725	1995
East branch of Little Robbins Slough	6352	1999
Onsite Drainage Ditch northeast of the MCR	6944	1999
MCR	17,410	1996
Source: STPNOC 2009a		

Stormwater runoff discharge from the STP site is monitored at eight outfalls (Figure 2-18) during precipitation events. Two of these outfalls are located on the Colorado River, one on the West Branch of the Colorado River, two on the Little Robbins Slough, and the other three on other surface water drainages.

2.3.4.2 Groundwater Monitoring

Prior to the application for proposed Units 3 and 4, the applicant has conducted annual environment surveys including groundwater and published annual reports (STPNOC 2007, 2008i). The 2006 report presents information generated from sampling 16 Shallow Aquifer wells within the Protected Area and a comparable number of Shallow Aquifer STP controlled wells outside the Protected Area (STPNOC 2007, 2009c). Data from wells within the Protected Area are used to monitor past leaks and track contaminant migration while data from outside the Protected Area are used to track the migration of water leaving the MCR and entering the Shallow Aquifer. During site characterization for STPNOC's application, 28 groundwater observation wells were installed in 2006 (STPNOC 2009a), and an additional 26 observation wells were installed in 2008 (STPNOC 2008g). As discussed in Section 2.3.1.2 above, hydraulic head in the Upper and Lower Shallow aquifers was reported in the application (STPNOC 2009a) and in subsequent RAI responses (STPNOC 2008a, g; 2009c).

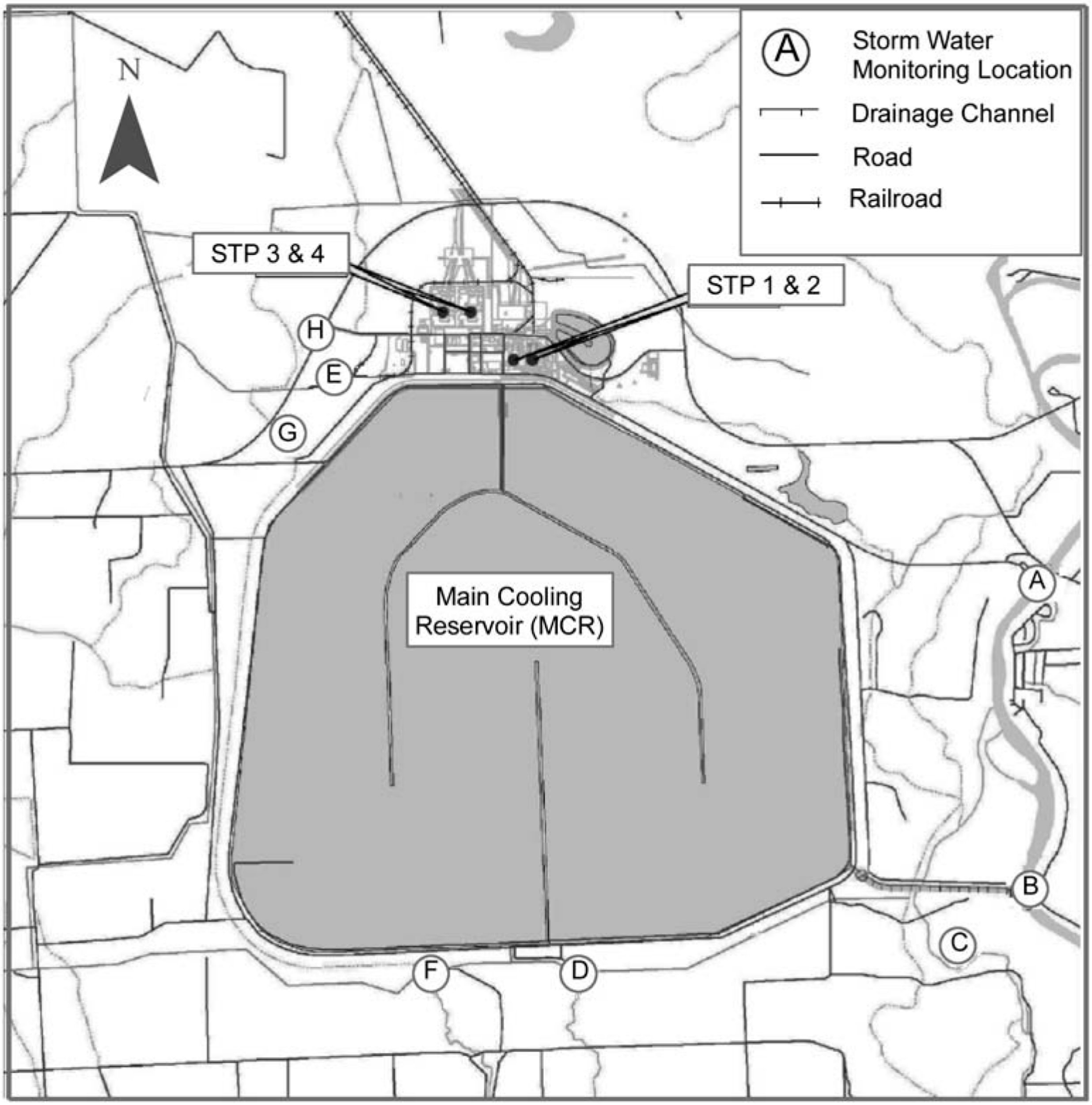

Figure 2-18. Stormwater Monitoring Locations for Existing STP Units 1 and 2 (STPNOC 2009a)

2.4 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by the building, operation, and maintenance of proposed Units 3 and 4 at STP. Sections 2.4.1 and 2.4.2 provide general descriptions of terrestrial and aquatic environments on and in the vicinity of the STP site and in areas that would be subject to activities required for the proposed power transmission system upgrades. These areas include the 20 mi of existing transmission line corridor where upgrades would be required, the addition of a new 345-kV switchyard on the STP site, and the changes necessary to redirect five existing transmission lines into the new switchyard on the STP site (STPNOC 2009a). The 345-kV transmission lines to be upgraded originate at the STP site in Matagorda County and travel a 400-ft wide corridor for approximately 20 mi, terminating at the Hillje Substation. The Hillje Substation is located in the southwestern corner of Wharton County, just across the border from Matagorda County.

Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from building, operating, and maintaining new nuclear power generating facilities and along transmission corridors where upgrades and tower replacement would be conducted to support the power transmission requirements for Units 3 and 4. These descriptions also support the evaluation of mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

2.4.1 Terrestrial Ecology

The STP site occupies approximately 12,220 ac immediately west of the Colorado River, approximately 10 mi from the river's confluence with Matagorda Bay, within the Coastal Prairies sub-province of the Gulf Coastal Plains physiographic province of Texas (STPNOC 2009a; TBEG 1996). This section identifies terrestrial ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by the building, operation, and maintenance of Units 3 and 4 and associated transmission lines.

2.4.1.1 Terrestrial Communities of the Site and Vicinity

The terrestrial communities found in this region are typical of the Coastal Prairies that begin near the Gulf of Mexico shoreline (adjoining the Gulf Coast Marshes) and occupy young deltaic sands, silts, and clays that form nearly flat grasslands (TBEG 1996). This area is typified by low elevation, generally less than 60 ft MSL, with open prairie habitat interspersed with creek and river drainages flowing toward the Gulf Coast marshes. Trees are usually not found except locally along streams and in oak groves. Remnants of Coastal Prairies in Texas are dominated by little bluestem (*Schizachyrium scoparium*), brown-seed paspalum (*Paspalum plicatulum*), and Indiangrass (*Sorghastrum nutans*) (Diamond and Smeins 1984). Bottomland hardwood forests occur along the major river systems that drain the Coastal Prairies. The Gulf Coast Prairies are well suited to agriculture and farming, cattle ranching, and urban and industrial development (FWS and USGS 1999). These land uses have transformed the region and much of Matagorda County has been converted to croplands or pasture (STPNOC 2009a). Little of the original coastal prairie vegetation remains in the region.

The dominant land cover in the vicinity of the STP site consists primarily of habitats associated with agriculture and grazing, and grazing continues on portions of the STP site. Past agricultural land uses at the site have influenced the current vegetation at STP. The existing plant associations on the STP site consist primarily of successional vegetation occurring on old abandoned agricultural fields and pastures. Although the topography of the region is relatively flat and low, the landscape at the site can be characterized as either forested and bottomland habitats in low lying areas that consist of pastures or patchy forested lands near the Colorado River, low-lying wetland habitats, and upland areas where scrub-shrublands and grasslands have established on previously cultivated, grazed, or disturbed lands (STPNOC 2009a). Recent ecological surveys of the site provided information identifying and describing different habitats and mapped the vegetation cover and land use on the STP site (Figure 2-19) (ENSR 2008a; STPNOC 2008b). Two open water areas—the approximately 7000-ac MCR and the 46-ac ECP—represent the majority of the mapped habitat found onsite (Table 2-6, Figure 2-19). Areas immediately adjacent to existing facilities consist of parking areas, gravel lots, and landscaped areas. Two other types of land use are identified on the vegetation cover/land-use map: a dredge materials disposal area and the spoils area used for the building of existing STP Units 1 and 2. The vegetation cover types are briefly described in the following text.

Table 2-6. Approximate Acreages of Habitats and Land Use Found on the STP Site

Habitat	Acreage	Habitat	Acreage
Bottomland Forest	1176	Dredge Materials Disposal Area	133
Upland Forest	53	Construction Spoil Area for Units 1 and 2	41
Mixed Forest/Grassland	91	Maintained Areas (Mowed Grasses and Forbs)	468
Pasture/Agriculture	536	Existing Facilities	300
Scrub Shrub	970	Existing roadways and levees	759
Mixed Grassland	485	Wetlands including Kelly Lake	162
Main Cooling Reservoir	7000	Essential Cooling Pond	46

Sources: ENSR 2008a and STPNOC 2008g

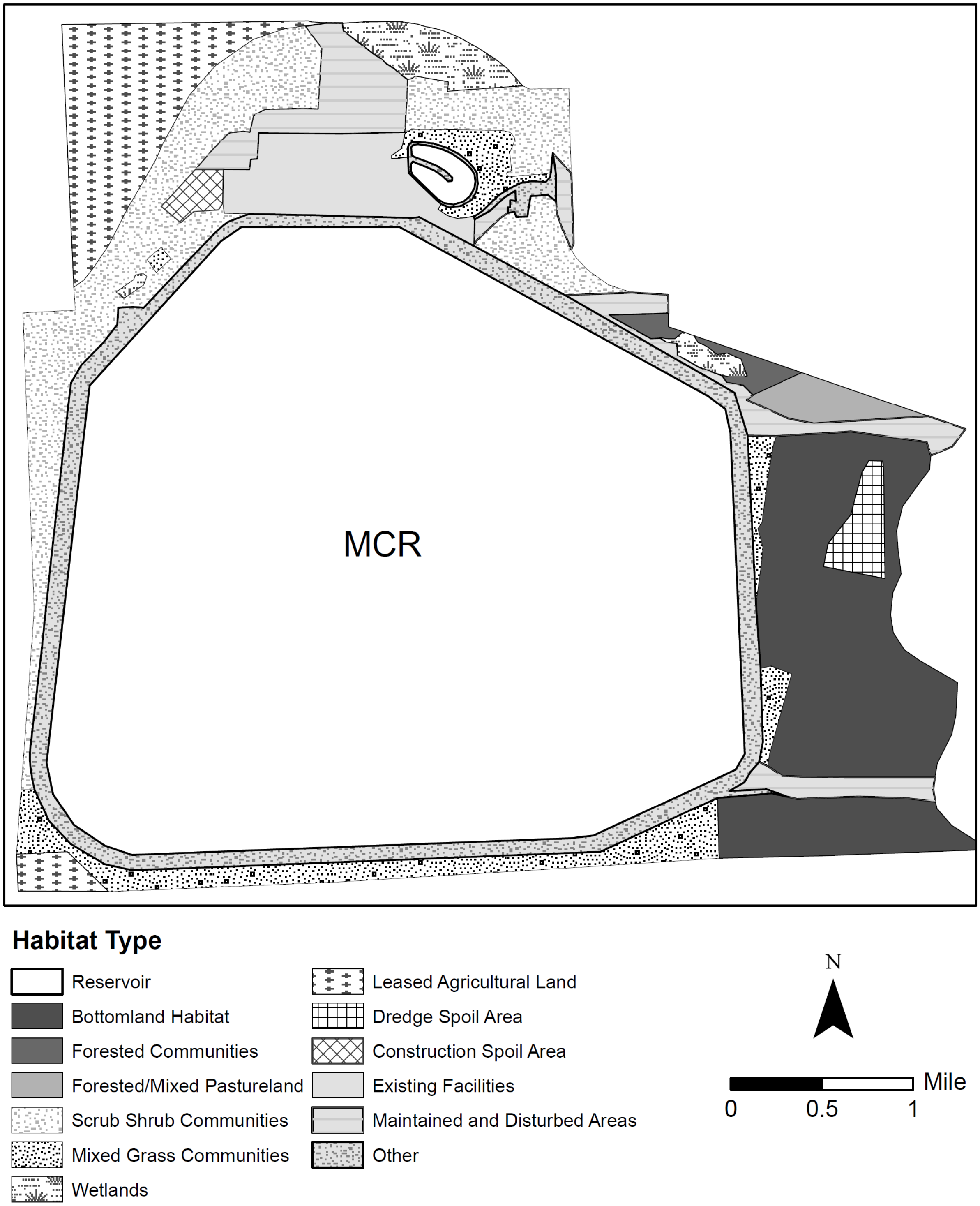

Figure 2-19. Vegetation Cover and Land-Use Cover Types at the STP Site

Forested Communities

The bottomland forests occur along the site boundary with the Colorado River and represent the most diverse habitat found on the STP site. Much of the bottomland area was historically modified through land-use practices (clearing and herbicide applications) to promote livestock forage production. These bottomlands now consist of a mosaic of forested and pasture lands. Dominant tree species include pecan (*Carya illinoinensis*), sugarberry (*Celtis laevigata*), live oak (*Quercus virginiana*) and American elm (*Ulmus americana*). Shrubs and herbaceous plants include yaupon (*Ilex vomitoria*), American beautyberry (*Callicarpa americana*), dewberry (*Rubus* spp.), sedges (*Carex* spp.), and poison ivy (*Toxicodendron radicans*) (STPNOC 2009a). Depressions and sloughs within these bottomlands receive drainage from the upland portions of the site and provide shallow wetland habitats. Several STP facilities occur within the bottomland forest areas, including the RMPF, the dredge materials disposal area, and the MCR spillway/blowdown area (ENSR 2008a).

Upland forested habitat (53 ac) is found adjacent to Kelly Lake (ENSR 2008a). Reference ENSR 2008 consisting of live oak, sugarberry and yaupon. Immediately east of this community, a 91-ac mixed forest/ grassland habitat is leased for cattle. It contains sugarberry and a few live oaks with an herbaceous layer consisting of broadleaf carpetgrass (*Axonopus compressus*), Bermuda grass (*Cynodon dactylon*), and *Paspalum* species. Additional forested communities are located on the east side of the property north of the existing heavy haul road and on the southeast section of the property between the MCR spillway and the Colorado River.

Wetland Communities

Three types of wetlands are found on the STP site. The largest is a managed 110-ac shallow wetland area (part of the Texas Prairie Wetlands Project) that was developed in 1996 in the northern portion of the site adjacent to road FM 521 (STPNOC 2009a). To enhance the property for waterbirds (STPNOC 2009a), impoundments were built to create foraging habitat for wintering waterfowl, wading birds, and shorebirds. This managed wetland area is included as part of the Great Texas Coastal Birding Trail that spans the entire Texas Gulf (STPNOC 2009a; TPWD 2009g).

The second significant wetland habitat is associated with the 34-ac Kelly Lake in the eastern portion of the site (STPNOC 2009a; ENSR 2008a). It consists of open water areas surrounded by emergent vegetation including a band of cattail (*Typha* spp.) and arrowhead (*Sagittaria* spp.).

The third wetland component observed on the STP site includes 29 smaller wetlands totaling about 18 ac (STPNOC 2009f). Nineteen of these are less than 0.50 ac in size while the remaining eight range from 0.5 to 5.2 ac in size. The dominant vegetation within these sites includes cattail, spikerush (*Eleocharis* spp.), disk water hyssop (*Bacopa rotundifolia*), bluestem (*Andropogon* spp.), sea myrtle (*Baccharis halimifolia*), and rattlebox (*Sesbania drummondii*).

Wetland vegetation is also associated with streams modified for surface and stormwater drainage common throughout the site (ENSR 2007a), including Little Robbins Slough, a stream that was relocated when building the MCR for existing Units 1 and 2.

Upland Communities

Upland areas on the STP site consist of a patchy mosaic of shrub-dominated and herbaceous vegetation typical of successional areas recovering from prior disturbance. Scrub-shrub habitat dominates the northern and western portions of the site (ENSR 2008a). This land was agricultural land before Units 1 and 2 were built (NRC 1975). The habitat is dominated by sea myrtle, dewberry, and patchy grasses—all plants common to disturbed or abandoned agricultural land in this region (STPNOC 2008f). Sea myrtle appears to be the most common shrub in the plant associations near the proposed plant site (STPNOC 2009a).

Mixed grasslands occur along the southern site boundary, north and east of the ECP, and between the MCR and bottomland habitats. The dominant grass species include angleton bluestem (*Dicanthium aristatum*), King Ranch bluestem (*Bothriochloa ischaemum*), bristle grass (*Setaria* spp.), brownseed paspalum, and Bermuda grass. Maintained and disturbed habitats on the STP site consist of areas that are routinely mowed, such as the outside slopes of levees (ENSR 2008a) and mowed fields adjacent to existing reactor facilities. Common plants in these areas include dallisgrass (*P. dilatatum*), brownseed paspalum, angleton bluestem, sedge (*Carex* spp.), Bermuda grass, clover (*Trifolium* spp.), and carpetgrass (STPNOC 2008f).

Wildlife Species on the STP site

Wildlife species found within the STP site are typical of those found in the east Texas coastal prairie lands. Common mammals may include white-tailed deer *(Odocoileus virginianus),* bobcat *(Lynx rufus),* gray fox (*Urocyon cinereoargenteus*), eastern cottontail rabbit *(Sylvilagus floridanus),* raccoon *(Procyon lotor),* nine-banded armadillo *(Dasypus novemcinctus mexicanus),* Virginia opossum *(Didelphis virginiana)*, hispid cotton rat *(Sigmodon hispidus),* and feral pig *(Sus scrofa).* Mammals that were observed on the STP site during recent ecological surveys include white-tailed deer, feral pigs, eastern cottontail, swamp rabbit (*Sylvilagus aquaticus*), fox squirrels (*Sciurus niger*), gray squirrels (*S. carolinensis*), and hispid cotton rat. Of these, white-tailed deer were most often observed (ENSR 2008a).

Seven bat species occur in Matagorda County, and could potentially be associated with STP. These are the eastern pipistrelle or tri-colored bat (*Perimyotis subflavus*), the eastern red bat (*Lasiurus borealis*), the hoary bat (*L. cinereus*), the northern yellow bat (*L. intermedius*), the Seminole bat (*L. seminlous*), the evening bat (*Nycticeius humeralis*), and the Brazilian or Mexican free-tailed bat (*Tadarida brasiliensis*).

Common reptile species may include the alligator (*Alligator mississippiensis*), the copperhead snake (*Agkistrodon contortrix contortrix*), the cottonmouth snake (*A. piscivorus*), the eastern hog-nosed snake (*Heterodon platirhinos*), eastern racer (*Coluber constrictor*), corn snake (*Elaphe guttata*), eastern rat snake (*E. obsoleta*), the diamondback watersnake (*Nerodia rhombifer rhombifer*), eastern box turtle (*Terrapene carolina*), ornate box turtle (*T. ornata*), *snapping turtle* (*Chelydra serpentina*), *red-eared pond slider* (*Trachemys scripta elegans*), green anole (*Anolis carolinensis*), and five-lined skink (*Eumeces fasciatus*). Other reptiles potentially associated with STP include the western diamondback rattlesnake (*Crotalus atrox*), diamondback terrapin (*Malaclemys terrapin*), and the fence lizard (*Sceloporus undulatus*) (ENSR 2007b; STPNOC 2008b).

Amphibians likely to occur in wetland areas of the STP site include the southern leopard frog (*Rana sphenocephala*), the green tree frog (*R. clamitans*), and the bullfrog (*R. catesveiana*) (ENSR 2007b). Table 2-7 is a list of amphibians known to occur in Matagorda County.

Table 2-7. Amphibians Found in Matagorda County, Texas

Common Name	Scientific Name
Smallmouth Salamander	*Ambystoma texanum*
Eastern Newt	*Notophthalmus viridescens*
Eastern Lesser Siren	*Siren intermedia*
Gulf Coast Toad	*Incilius valliceps*
Woodhouse’s Toad	*Bufo woodhousii*
Northern Cricket Frog	*Acris crepitans*
Cope’s Gray Treefrog	*Hyla chrysoscelis*
Green Treefrog	*Hyla cinerea*
Squirrel Treefrog	*Hyla squirella*
Gray Treefrog	*Hyla versicolor*
Spotted Chorus Frog	*Pseudacris clarkii*
Bullfrog	*Rana catesbeiana*
Southern Leopard Frog	*Rana sphenocephala*

Source: AmphibiaWeb 2009

The site and the surrounding region host a large number of resident and migratory birds throughout the year. The STP site lies near the terminus of the Central Flyway migration route and the managed prairie wetlands are a stop along the Great Texas Coastal Birding Trail (TPWD 2009g). The STP site lies within a major migratory corridor for neotropical migrants, and radar studies indicate that floodplain forests and other forested wetlands are important stopover habitats (STPNOC 2008b).

Resident birds commonly seen and observed during recent surveys at the STP site include turkey vultures (*Cathartes aura*), black vultures (*Coragyps atratus*), crows (*Corvus* spp.), grackles (*Quiscalus* spp.), northern cardinal (*Cardinalis cardinalis*), red-winged blackbirds (*Agelaius phoeniceus*), bobwhite quail (*Colinus virginiana*), and mourning doves (*Zenaida macroura*). Many different species of wading birds were observed at the STP site when building Units 1 and 2 including wood storks (*Mycteria americana*), roseate spoonbills (*Platalea ajaja*), great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), white-faced ibis (*Plegadis chihi*), white ibis (*Eudocimus albus*), and little blue herons (*Egretta caerulea*) (NRC 1975). All of these birds except wood storks have been observed on the site more recently during the Mad Island Christmas Bird Count (CBC) surveys conducted each year (ENSR 2008a; STPNOC 2008b). Other waterbirds noted onsite included white pelicans (*Pelecanus erythrorhynchos*), laughing gulls (*Larus atricilla*), cormorants (*Phalacrocorax* spp.), anhingas (*Anhinga anhinga*), and belted kingfishers (*Ceryle alcyon*). Waterfowl species that use STP wetlands include American coots (*Fulica americana*), teal (*Anas* spp.), and northern shovellers (*Anas clypeata*) (NRC 1975). Waterfowl observed on the MCR in 1987 included 16 duck species and 3 species of geese (STPNOC 2009a, 2008b). Winter CBC surveys found 23 species of ducks and 5 species of geese (ENSR 2008a).

Avian species observed during more recent biological surveys on the site (2006 and 2007) are indicated in Table 2-8. Within the STP site, 215 total avian species have been documented during annual CBCs from 1993 through 2007 (ENSR 2008a). During this 15-year period, an average of 122 bird species was observed onsite per year, with a range of 60 to 142 species per year. Bird/habitat associations for STP included woodland (101 bird species observed), shoreline (48 species), open-water (40 species), grassland (24 species), and scrub-shrub (2 species). These species were classified by their habitat of occurrence (where they were observed); however, these birds may frequent multiple habitats found on the STP site (ENSR 2008a; STPNOC 2009a, 2008b).

Waterbirds nest on terminal ends of the “Y” dike used to direct water flow in the MCR. Nesting on the MCR dikes was first observed in 1986 and has been monitored annually since 2000 as part of the Texas Colonial Waterbird Surveys (FWS 2009b). The STP colony has been dominated by nesting laughing gulls (53 percent) and gull-billed terns (*Sterna nilotica*) (31 percent) of the approximately 1200 to 1600 nests per year counted from 2000 to 2005 (STPNOC 2009a, 2008b). Seven additional bird species nest on the dikes with typically fewer than 100 nests each.

1 **Table 2-8**. Birds Observed On or Around the STP Project Area for Units 3 and 4

Common Name	Scientific Name	Habitat Observed	Trans-Gulf Migrant[(a)]
Red-winged blackbird	*Agaelaius phoeniceus*	Grassland/Scrub-shrub	
Anhinga	*Anhinga anhinga*	MCR	
Great blue heron	*Ardea herodias*	Wetland/MCR	
Cattle egret	*Bubulcus ibis*	Grassland/Wetlands	
Red-tailed hawk	*Buteo jamaicensis*	Grassland/Scrub-shrub	
Red-shouldered hawk	*Buteo lineatus*	Grassland/Scrub-shrub	
Crested caracara	*Caracara cheriway*	Grassland	
Turkey vulture	*Cathartes aura*	Grassland/Scrub-shrub/Developed	
Belted kingfisher	*Ceryle alcyon*	Wetlands	X
Killdeer	*Charadrius vociferus*	Grassland/Developed	
Northern harrier	*Circus cyaneus*	Grassland/Scrub-shrub	
Northern bobwhite	*Colinus virginianus*	Grassland/Scrub-shrub	
Black vulture	*Coragyps atratus*	Grassland/Scrub-shrub/Developed	
American crow	*Corvus brachyrhyncos*	Grassland/Scrub-shrub	
Bluejay	*Cyanocitta cristata*	Scrub-shrub	
Fulvous whistling-duck	*Dendrocygna bicolor*	Wetland	
Little blue heron	*Egretta caerulea*	Wetlands	
Snowy egret	*Egretta thula*	Wetland/MCR	
Tri-colored heron	*Egretta tricolor*	Wetland/MCR	
White ibis	*Eudocimus albus*	Grassland/Wetlands	
American coot	*Fulica americana*	Wetlands	
Common yellowthroat	*Geothlypis trichas*	Scrub-shrub	X
Bald eagle	*Haliaeetus leucocephalus*	River shoreline	
Barn swallow	*Hirundo rustica*	Grassland/Developed	X
Laughing gull	*Larus atricilla*	MCR/Developed	
Northern mockingbird	*Mimus polyglottos*	Grassland/Scrub-shrub/Developed	
Brown-headed cowbird	*Molothrus ater*	Grassland/Scrub-shrub	
Black-crowned night-heron	*Nycticorax nycticorax*	Wetland	
Osprey	*Pandion haliaetus*	MCR	
American white pelican	*Pelecanus erythrorhynchos*	MCR	

Table 2-8. (contd)

Common Name	Scientific Name	Habitat Observed	Trans-Gulf Migrant[(a)]
Brown pelican	*Pelecanus occidentalis*	MCR	
Cliff swallow	*Petrochelidon pyrrhonota*	MCR	X
Roseate spoonbill	*Platalea ajaja*	MCR	
Purple martin	*Progne subis*	Grassland/Scrub-shrub/Developed	X
Boat-tailed grackle	*Quiscalus major*	Grassland/Scrub-shrub/Developed	
Gull-billed tern	*Sterna nilotica*	MCR	
Eastern meadowlark	*Sturnella magna*	Grassland/Scrub-shrub	
American robin	*Turdus migratorius*	Grassland	
Scissor-tailed flycatcher	*Tyrannus forficatus*	Grassland/Scrub-shrub	X
Mourning dove	*Zenaida macroura*	Grassland/Developed	

Sources: STPNOC 2009a, 2008b; ENSR 2008a.
(a) Birds that cross the Gulf of Mexico from the Yucatan Peninsula to the Gulf Coast (TPWD 2009f).

2.4.1.2 Terrestrial Resources – Transmission Lines

Transmission corridors that originate at the STP site pass through forested, agricultural, and grass lands typical of Texas coastal prairie. The transmission lines and associated corridors are managed by four transmission service providers as described in Section 2.2. Only a 20-mi section of the Hillje transmission line would be disturbed by activities related to building the proposed Units 3 and 4. These activities would require replacing towers and upgrading the existing transmission lines along this section. Current transmission line corridor management involves mechanical, manual, and chemical methods to limit vegetation encroachment on transmission corridors.

The existing transmission lines generally pass through typical habitats associated with the coastal prairie region of east Texas—agricultural fields, pasture/rangeland, and some forests. However, the westward transmission lines reach into the Edwards Plateau with different habitats such as Edwards Aquifer springs and karst areas (STPNOC 2009a). The 20-mi STP-to-Hillje corridor passes primarily through agricultural lands—the majority of the land in the corridor (>95 percent) is currently used for agriculture and rangelands (STPNOC 2009a). Wildlife using agricultural and rangeland habitats in the STP-to-Hillje corridor areas are expected to be similar to those using the disturbed and maintained habitats found on the STP site, such as white-tailed deer, eastern cottontail, and raccoon. Depending on the condition of the fields (flooded or dry) and the types of crops grown, a wide variety of the birds common to the interior of the coastal plain of Texas could use the corridor habitats.

2.4.1.3 Important Terrestrial Species and Habitats

This section describes Federally and State-listed proposed, threatened, and endangered terrestrial species, any designated and proposed critical habitat, and ecologically important species or habitats, and commercially and recreationally valuable species that may occur in the vicinity of the STP site or within the vicinity of the 345-kV powerline that would be upgraded between the STP site and Hillje Substation. A list of Federally and State-listed species occurring in counties (Matagorda and Wharton) that contain the site and the 345-kV transmission line to be upgraded was obtained from the U.S. Fish and Wildlife Service (FWS) county listings for the State of Texas, and the TPWD (2008a). Location information was obtained from the TPWD, Wildlife Division, Diversity and Habitat Assessment Programs (Texas Natural Diversity Database 2009).

Important Terrestrial Species Site and Vicinity

Matagorda County has 24 terrestrial species that are either Federally or State-listed as endangered or threatened (TPWD 2008a; FWS 2009a). Areas on the STP site that would be affected by building Units 3 and 4 were investigated by the applicant's contractor biologists to determine the presence or absence of state or Federally listed fauna and flora, evaluate whether suitable habitat exists for these species and assess potential nesting areas and flyways.

Federally Listed Species

The Federally listed wildlife species with recorded occurrences in Matagorda and Wharton Counties are shown in Table 2-9. Only the American alligator (*Alligator mississippiensis*), listed as threatened under the Federal Endangered Species Act (ESA), has been observed on the STP site. There are no Federally listed plant species known to occur in Matagorda County.

Table 2-9. Federally Listed Terrestrial Species Occurring in the Vicinity of the STP Site and the STP-to-Hillje Transmission Corridor

	Scientific Name	Federal Status	State Status	Matagorda County	Wharton County
Birds					
Piping plover	*Charadrius melodus*	LT	T	Y	
Whooping crane	*Grus americana*	LE	E	Y	Y
Northern Aplomado falcon	*Falco femoralis septentrionalis*	LE	E	Y	
Reptiles					
American alligator	*Alligator mississippiensis*	DM, SAT	-	Y	

Source: FWS 2009a
LT = Federally listed as threatened; LE = Federally listed as endangered; DM = Delisted, monitor; SAT = Federally listed as threatened due to similarity of appearance; T = State-listed as threatened; E = State-listed as endangered; Y = occurs in the county.

The recently Federally delisted bald eagle (*Haliaeetus leucocephalus*) is also known to occur on site and active nesting sites have been located within and relatively close to the STP site boundaries. The bald eagle will remain Federally protected under the Bald and Golden Eagle Protection Act (16 USC 668-668d) and the Migratory Bird Treaty Act (16 USC 703, et seq.). It is also currently listed as a threatened species by the State of Texas and its occurrence and habitat use on the STP site is discussed with other State-listed species. The recently Federally delisted brown pelican (*Pelecanus occidentalis*) was also observed near the MCR. On November 17, 2009, (74 FR 59443) the FWS removed the brown pelican from the Federal List of Endangered and Threatened Wildlife due to recovery. Brown pelicans are listed as an endangered species by the State of Texas, and their occurrence and habitat use on the STP site is discussed with other State-listed species.

American Alligator — In 1967, the American alligator was classified by FWS as Federally endangered throughout its range, including Texas. By 1987, following several reclassification actions in other states, the American alligator was pronounced fully recovered, and was reclassified to "threatened based on similarity of appearance" to the American crocodile (*Crocodylus acutus*) in the remainder of its range (52 FR 21059). American alligators can be found throughout the Southeast from the Carolinas to the Texas and north to Arkansas (FWS 2008). Alligators generally live in wetlands and alligators commonly occur in the wetlands and near open ditches and waterways on the STP site. Operation of STP Units 1 and 2 has not been shown to adversely affect the American alligators found on the site.

Piping Plover — The Northern Great Plains population of piping plover (*Charadrius melodus*) was listed as threatened (50 FR 50726) due to excessive hunting during the 19th century and remains threatened as a result of flood control and water regulation that destroys or degrades the vegetated sandbars and river islands used for nesting. This population of plovers winters primarily along the Gulf Coast in Texas, Louisiana, Alabama, and Florida and critical habitat has been designated in these states for wintering habitat. In winter, these birds inhabit beaches, mudflats, and sandflats along the Gulf of Mexico as well as barrier island beaches and spoil islands on the Gulf Intercoastal Waterway. Piping plovers overwinter along Matagorda Bay and Matagorda Peninsula, approximately 7-8 mi south of the STP site (66 FR 36038).

Whooping Crane — The whooping crane (*Grus americana*) was listed as threatened with extinction in 1967 and listed as endangered in 1970. The Aransas-Wood Buffalo National Park Population (AWBP) of cranes nests in Wood Buffalo National Park in Canada and winters in coastal marshes at the Aransas National Wildlife Refuge in Texas approximately 35 mi south of the STP site (Figure 2-20). These birds arrive on the Texas coast between late October and mid-December and spend approximately 6 months on the wintering grounds at Aransas National Wildlife Refuge. Whooping cranes forage primarily in brackish bays, marshes, and salt flats, feeding on blue crabs (*Callinectes sapidus*), clams, and fruits of wolfberry (*Lycium* spp.). Although birds move to uplands in the refuge to feed on acorns, snails, crayfish and insects, they return to the salt marshes in the evening to roost. Use of uplands or croplands adjacent to the refuge is rare. The whooping crane has not been observed on the STP site and is not likely to use the inland habitats found onsite. These birds may migrate through the Central Flyway (as described below) and fly over the STP site, but are unlikely to reside at the STP site or to use agricultural lands found in the STP-Hillje transmission corridor.

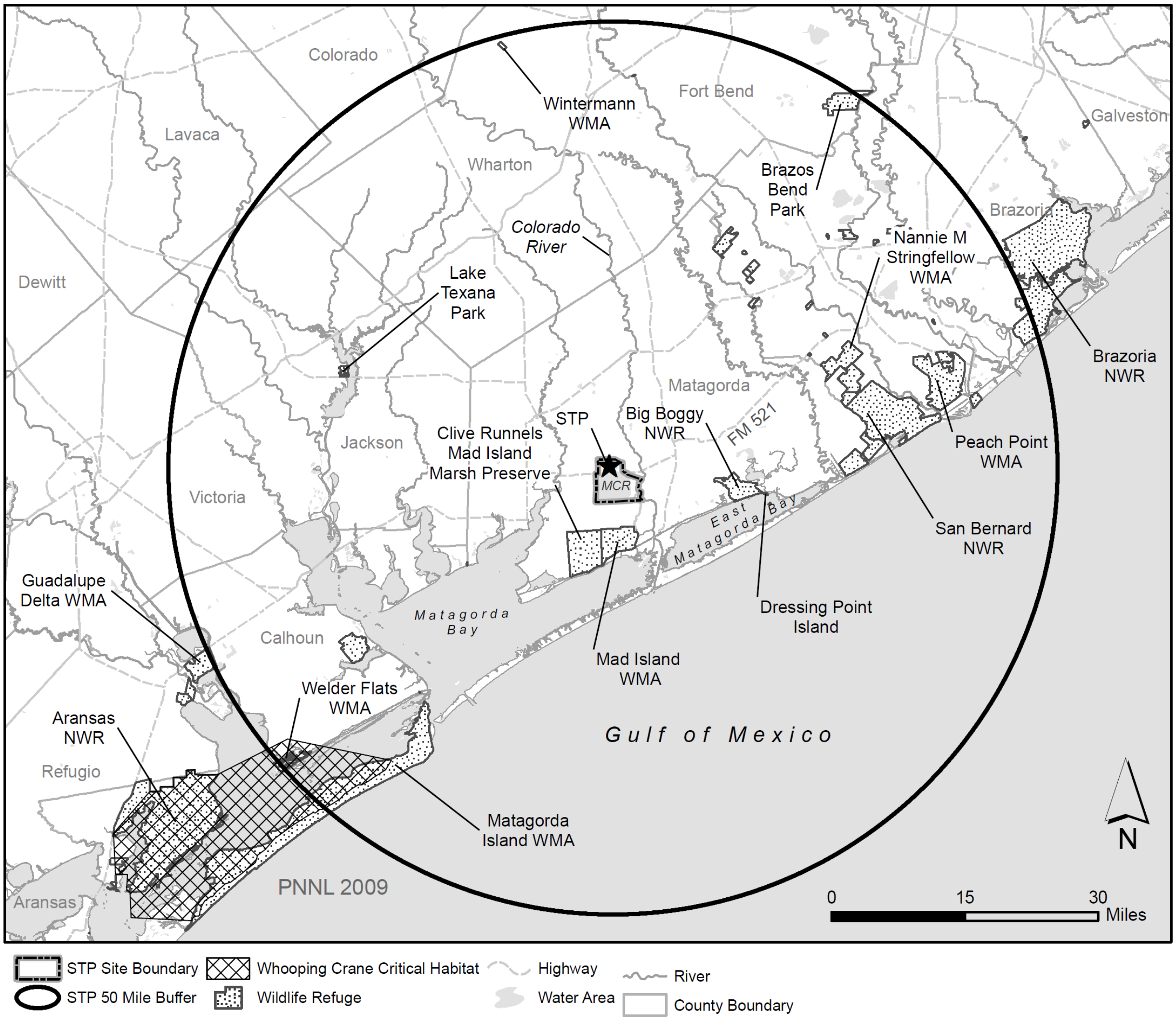

Figure 2-20. Locations of Wildlife Refuges and Critical Habitat within 50 mi of the STP Site

Northern Aplomodo Falcon — The northern Aplomado falcon has been observed within 10 mi of the STP site, but has not been found on the STP site. A recovering population of the Federally endangered northern Aplomado falcon is located on Matagorda Island, which is part of the Aransas National Wildlife Refuge Complex, but no known nest sites are located within the vicinity of STP. Several Aplomado falcons have been observed during CBC bird surveys on the Mad Island Marsh during the past several years (NAS 2009).

State-Listed Species

The TPWD is responsible for maintaining lists of rare species in Texas. Species listed as threatened and endangered by TPWD with the potential to occur in Matagorda and Wharton County are documented in Table 2-10.

TPWD identified protected species potentially occuring in Matagorda County and Wharton County, and several have been subject to loss of their specific habitats as humans settled the area and altered the natural landscape. The decline of the red wolf (*Canis rufus*) has been linked to changes in land use and the predominance of agricultural use in east Texas, which has reduced forested habitats and enhanced habitats for the coyote (*C. latrans*). Habitat loss and degradation resulted in a population overlap for these two species, and interbreeding between the two canine species has effectively resulted in the extirpation of the red wolf from Texas (Davis and Schmidly 2009). Likewise, habitat has declined for the ocelot (*Leopardus pardalis*), and ocelots are now limited to a few isolated areas in southern Texas (TPWD 2003), with none occurring near the STP site. The Louisiana black bear (*Ursus americanus luteolus*), one of 16 subspecies of American black bear, was once common in the forests of eastern Texas. However, this subspecies was presumed to be extirpated from this area by the 1940s, and a resident breeding population does not currently exist in eastern Texas (TPWD 2003). The Eskimo curlew (*Numenius borealis*), which used to commonly migrate through the Texas coastal plains in March and April, has also been a victim of overhunting and the conversion of open and coastal prairie habitats to agriculture. This species was once an abundant spring migrant across the Texas coastal prairie but may now be extinct (TPWD 2003). As a result of population declines and possible extirpation and extinction, the red wolf, ocelot, Louisiana black bear, and Eskimo curlew would not be expected to occur in the vicinity of the STP site or associated transmission lines.

The bald eagle, brown pelican, wood stork, white-faced ibis, reddish egret (*Egretta rufescens*), sooty tern (*Sterna fuscata*), peregrine falcon (*Falco peregrinus*), and white-tailed hawk (*Buteo albicaudatus)* are listed by the State of Texas and are known to occur in the region. With the exception of the sooty tern and the wood stork, these species have all been observed on the STP site during recent winter CBC efforts or during site surveys. Bald eagles are present year-round throughout Texas as spring and fall migrants, breeders, or winter residents. Breeding populations occur primarily in the eastern half of the State and along coastal counties from Rockport to Houston (TPWD 2003). The bald eagle occurs on the STP site, and an active bald eagle nest is located near its eastern boundary in remote woodlands near the Colorado River. This nest site was first reported in 2004 (STPNOC 2009a, d). A second bald eagle nest is located within 6 mi of the STP site (Texas Natural Diversity Database 2009).

Table 2-10. State-Listed Species Occurring or Potentially Occurring in the Region of the STP Site and the STP-to-Hillje Transmission Corridor

Common Name	Scientific Name	State Status	Matagorda County	Wharton County
Birds				
Bald eagle	*Haliaeetus leucocephalus*	T	Y	Y
Brown pelican	*Pelecanus occidentalis*	E	Y	
Eskimo curlew	*Numenius borealis*	E	Y	Y
Peregrine Falcon	*Falco peregrinus*	T	Y	Y
Reddish egret	*Egretta rufescens*	T	Y	
Sooty tern	*Sterna fuscata*	T	Y	
White-faced ibis	*Plegadis chihi*	T	Y	Y
White-tailed Hawk	*Buteo albicaudatus*	T	Y	Y
Wood stork	*Mycteria americana*	T	Y	Y
Mammals				
Louisiana black bear	*Ursus americanus luteolus*	T	Y	
Ocelot	*Leopardus pardalis*	E	Y	
Red wolf	*Canis rufus*	E	Y	
Reptiles				
Smooth green snake	*Liochlorophis vernalis*	T	Y	
Texas horned lizard	*Phrynosoma cornutum*	T	Y	Y
Texas scarlet snake	*Cemophora coccinea lineri*	T	Y	
Texas tortoise	*Gopherus berlandieri*	T	Y	
Timber/canebrake rattlesnake	*Crotalus horridus*	T	Y	Y
Plants[(a)]				
Coastal gay-feather	*Liatris bracteata*			
Threeflower broomweed	*Thurovia triflora*			

Source: TPWD 2008a

(a) The plant species included in this table are species of concern in the state of Texas that were identified as being of interest by the TPWD (STPNOC 2008f).

DL= delisted, E= endangered, T = threatened, Y= yes or present.

Brown pelicans, also called American brown pelican or common pelican, are listed as an endangered species by the State of Texas. This species inhabits the Atlantic, Pacific, and Gulf Coasts of North and South America and is found on the Gulf Coast of Florida, Alabama, Louisiana, Texas, Mississippi, and Mexico. Since the 1960s, the brown pelican has made a gradual comeback in Texas from fewer than 10 breeding pairs to an estimated 4097 breeding pairs in 2005 in 12 colonies (73 FR 9408). Most of the breeding pairs in Texas occur on Pelican

Island in Corpus Christi Bay, Nueces County, and Sundown Island near Port O'Connor in Matagorda County. Smaller colonies occasionally nest on Bird Island in Matagorda Bay, on Dressing Point Island in East Matagorda Bay, and on islands in Aransas Bay (TPWD 2003). A breeding colony also exists on Little Pelican Island in Galveston Bay (Glass and Roach 1997).

Brown pelicans inhabit warm coastal marine and estuarine environments of the Gulf of Mexico (Cornell 2009b) and are rarely found residing in inland habitats. Brown pelicans typically forage in shallow waters within 12 mi of nesting sites during breeding, and rarely venture more than 45 mi offshore. Brown pelicans nest on small, isolated coastal islands in Texas where they are safe from predators. Their diet consists almost entirely of fish and is primarily menhaden (*Brevoortia tyrannus*) and mullets (TPWD 2003). The brown pelican has been observed at the MCR and the Lower Colorado River, and may use water bodies on the site for resting, foraging, and drinking. Brown pelicans nest within Matagorda Bay and the GIWW, which is relatively close to the site (within 10 mi).

Wood storks historically were observed in the emergent wetlands and bottomland forest wetlands on STP (NRC 1975) but would not be likely to use the scrub-shrub and grassland habitats that exist within the disturbance footprint. Nesting of wood storks has been restricted to Florida, Georgia, and South Carolina; however, they may have formerly bred in most of the southeastern United States and Texas. A second distinct, non-endangered population of wood storks breeds from Mexico to northern Argentina. Storks from both populations move northward after breeding, with birds from the Mexico region moving up into Texas and Louisiana and as far north as Arkansas and Tennessee along the Mississippi River Valley (FWS 2009c).

The white-faced ibis and the reddish egret are both wading birds that frequent marshes and ponds and are likely to use the managed prairie wetland habitat found on the STP site. The white-faced ibis seems to prefer freshwater marshes, where it can find insects, newts, leeches, earthworms, snails, and especially crayfish, frogs, and fish (TPWD 2009d). Reddish egrets use their long, spear-like bills to stab their prey, which most often consists of small fish, frogs, tadpoles, and crustaceans in salt and brackish water wetlands (TPWD 2009e). The white-tailed hawk could potentially use a variety of the habitats found on the STP site for hunting and resting. No known nesting sites were found during recent ecological surveys of the proposed plant site and facilities.

Peregrine falcons have a wide and diverse distribution and the Texas Gulf coast is the spring staging area for peregrine falcon migration in the Western hemisphere. The peregrine falcon may also use a variety of habitats found on the STP site for hunting and perching. Fifteen peregrine falcons were noted in the total Mad Island Marsh CBC, but no known nesting sites were found during recent ecological surveys of the STP site (STPNOC 2009a, 2008b) or recorded in TPWD databases (Texas Natural Diversity Database 2009). The coastline plays an important role in the survival of migrating peregrines. Birds take advantage of abundant prey along the open coastline and tidal flats to accumulate stores of fat (TPWD 2003). In Texas, the

American peregrine is found primarily in the Trans-Pecos Region; the Arctic peregrine nests in Alaska, Canada, and Greenland, and migrates through Texas to South America for winter (TPWD 2003).

The sooty tern is a pelagic species that is found across tropical oceans. In eastern North America, this species nests on islands on islands in the Gulf of Mexico from Texas to Louisiana (NatureServe Explorer 2009a). This species is not likely to use or occur in the habitats found on the STP site. The sooty tern has not been observed during CBC surveys or any ecological surveys of the STP site and vicinity.

Of the State-listed reptiles that could occur on the STP site, the most likely to be found in the available habitats would be the smooth green snake (*Liochlorophis vernalis*), the Texas scarlet snake (*Cemophora coccinea lineri*), and the Texas tortoise (*Gopherus berlandieri*). The smooth green snake prefers coastal short-grass prairie habitats. The Texas scarlet snake prefers sandy soils and occurs in scrub-shrub and mixed hardwoods (ENSR 2007b). The Texas tortoise prefers scrub and grassland habitats. None of these species were encountered in surveys of the proposed project areas, and the TPWD database has no known locations for these species within the vicinity of the site (Texas Natural Diversity Database 2009).

The Texas horned lizard (*Phrynosoma cornutum*) prefers open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees. The timber rattlesnake (*Crotalus horridus*) could potentially use a variety of habitats on the site including flood plains, deciduous woodlands, and swamps where dense ground cover occurs. Neither of these species was encountered in any biological surveys of the proposed project areas, and the TPWD database has no known locations for these species within the vicinity of the site (Texas Natural Diversity Database 2009).

Two plant species of concern were identified by the TPWD with the potential to occur on or near the STP site: coastal gay-feather (*Liatris bracteata*) and threeflower snakeweed (*Thurovia triflora*), which are both endemic species to the coastal prairies in south Texas. These two species occur on the nearby Clive Runnells Family Mad Island Marsh Preserve (TPWD 2007). These plant species occur within coast prairie grasslands, in sparsely vegetated spots with clayey to silty soils (NatureServe Explorer 2009b). Neither of these plant species was found during biological surveys of the proposed project area. Coastal gay-feather does occur within 6 mi of the STP site (Texas Natural Diversity Database 2009).

Ecologically Important Species and Habitats

Ecologically important species and habitats in the vicinity of the STP site include several important refuges and preserves listed below and those wetlands on the STP site that provide significant habitat for flora and fauna. Wetlands that would be expected to provide important habitat onsite include the Texas Prairie Wetland Project, the emergent wetlands associated with

Kelly Lake, and the wetlands found adjacent to the dredge spoils disposal area. Other smaller wetland areas on the site also provide limited habitat for a variety of wildlife.

The Texas Prairie Wetland Project in the northeast portion of the STP site is approximately 200 yards from the new switchyard site. Here, water impoundments are managed to create foraging habitat for wintering waterfowl, wading birds, and shorebirds. These impoundments are included as a viewing stop on the Great Texas Coastal Birding Trail that spans the entire Texas Gulf (TPWD 2009b).

The STP site lies within the Central Flyway migration route—a major migratory corridor for neotropical migrants and other birds. Thousands of migrating birds, especially waterfowl, fly south from cooler regions of the North American continent and visit or winter in this coastal area (STPNOC 2009a). This region of Texas is also an important stopover point for other migratory species traveling to or from Central and South America as part of the trans-Gulf migration. Crossing the Gulf of Mexico is a dangerous and energetically expensive phase of the migration process, requiring a long, non-stop flight (Simons et al. 2004) and making it a limiting factor for some bird populations. Resting and foraging areas near the Gulf Coast are critical to ensure that trans-Gulf migratory birds can continue their migration after recovering.

In addition to lying within the Central Flyway migration route, the region around STP contains three important wildlife areas. The Mad Island WMA (managed by TPWD) is approximately 3 mi due south of the STP site and was established to preserve coastal wetland habitat for wintering waterfowl. This 7200-ac management area consists of fresh to brackish marshes with sparse brush and flat coastal prairie (STPNOC 2009a). The area provides beneficial habitat for many wildlife species including sandhill cranes (*Grus canadensis*), bobcats, gray fox, raccoon, river otter (*Lontra canadensis*), mink (*Neovison vison*), armadillo, rabbits, and numerous other species. Hunting is allowed for feral hogs, alligators, and waterfowl through special permits (TPWD 2008b).

The 7063-ac Clive Runnells Family Mad Island Marsh Preserve is approximately 4 mi southwest of the STP site and contains both upland prairie and a variety of coastal wetlands (STPNOC 2009a). The preserve, owned and operated by The Nature Conservancy, is actively managed to enhance rice fields and wetlands for resident and migratory waterbirds. Nearly 250 species of birds—including migrating and resident songbirds, shorebirds, colonial nesting birds, and wading birds—use the area for feeding, resting and roosting.

The Big Boggy National Wildlife Refuge borders Matagorda Bay approximately 9 mi southeast of the STP site. It consists of more than 4500 ac of rice fields, managed impoundments, and salt marsh habitat, and was established to preserve habitat for neotropical migrating birds in the fall and spring, wintering waterfowl, and other bird life (STPNOC 2009a; FWS 2009d). Within the refuge, Dressing Point Island is an important bird rookery for many species of waterbirds, including the State-listed brown pelican.

Commercially and Recreationally Valuable Species

Commercially and recreationally valuable terrestrial species found at STP include game species, such as white-tailed deer, feral pigs, rabbits, gray squirrel, northern bobwhite quail, mourning dove, and numerous species of waterfowl (ENSR 2008a). Of these, deer, waterfowl, and mourning doves are considered common on the STP site (ENSR 2008a). Mourning doves likely use a variety of habitats at STP including croplands and pastures, grasslands, and open hardwood forests. The birds feed on cereal grains, and grass and forb seeds on the ground (Cornell 2009a). White-tailed deer are also likely to use a variety of habitats at the STP site including grasslands, shrublands, and open forest, but require shrubs and woody vegetation for browse (TPWD 2008c). No hunting or trapping is allowed on the STP site, and no travel corridors for game species cross the STP site, with the exception that migratory waterfowl use the MCR and other site impoundments and wetlands during migration. The Texas Gulf Coast is one of the most important wintering and migration habitats in North America for continental populations of waterfowl, shorebirds, and other wetland-dependent migratory birds. Although no hunting is allowed on the STP site, contractors are sometimes hired by the applicant to remove feral pigs from the STP site and reduce the population to avoid damage to the soils on the reservoir embankment and destruction of habitats by the pigs (STPNOC 2009a).

Invasive Species and Pests

Although the STP site hosts such potential disease vectors as ticks and mosquitoes, no vector-borne diseases have been reported to STP (STPNOC 2009a). Invasive plant species are found on the STP property—for example yaupon and McCartney rose (*Rosa multiflora*) commonly occur. Feral pigs can become a pest species on the STP site when their foraging and rooting activities damage soils and plants.

Important Terrestrial Species and Habitats— Transmission Lines

The proposed upgrade of the transmission system includes replacing some of the towers and replacing conductors along the 20-mi corridor that runs between the STP site and the Hillje Substation, located in the southwestern corner of Wharton County, just across the border from Matagorda County. The corridor is 400 ft wide and 20 mi long and terminates at the Hillje Substation. The majority of the land in the corridor (more than 95 percent) is currently used for agriculture and rangelands.

Federally and State-listed Species

No Federally listed species (Table 2-9) except the American alligator are known to occur within the 2 mi of the 20-mi transmission corridor. Two important species, the coastal gay-feather (State species of concern) and the bald eagle (State threatened species) are known to occur within 2 mi of the corridor (Texas Natural Diversity Database 2009).

The interior least tern (*Sterna antillarum athalassos*) is listed by TPWD as occurring or potentially occurring in Wharton County, although the FWS does not include the interior least tern in their county listing for Wharton. The subspecies is Federally listed only when inland (more than 50 mi from a coastline) where it may nest along sand and gravel bars within braided streams (TPWD 2008a). This species has not been observed on the STP site or during CBC surveys of the surrounding areas. Its occurrence is unknown in the vicinity of the transmission corridor.

The Attwater's prairie chicken (*Tympanuchus cupido attwateri*) is also listed by TPWD as occurring or potentially occurring in Wharton County, although the FWS does not include this species in their county listing for Wharton. Habitat loss and alteration are the primary reasons for population decline of the Attwater's prairie chicken in eastern Texas—in 2003, fewer than 60 birds remained in two fragments of habitat located in Galveston and Colorado Counties. This species has not been observed on the STP site or during CBC surveys of the surrounding areas. Disturbed habitats and agricultural or managed rangeland habitats found with the 20-mi corridor are not suitable habitat for this species, which requires tall prairie grasslands (TPWD 2003).

Ecologically Important Species and Habitats—Transmission Lines

The STP-to-Hillje transmission corridor lies within the Central Flyway migration route-- a major migratory corridor for neotropical migrants and other birds. Because the transmission corridor leaves the site and travels to the north, the southern end is less than 10 mi from the Mad Island WMA and the Clive Runnels Mad Island Marsh Preserve. The corridor does contain a small amount of wetland habitat (~9 ac) as identified by the National Wetland Inventory data for the corridor (FWS 2010). No areas designated by the FWS as a critical habitat for endangered or threatened species are crossed by any of the corridors leaving STP nor do they cross any State or Federal parks, wildlife refuges or preserves, or WMAs (STPNOC 2008a).

Commercially and Recreationally Important Species

Game species common to the region that are likely to use the lands traversed by the transmission line corridor include those species commonly found in agricultural lands like deer, rabbits, squirrels, mourning dove, and possibly bobwhite quail. Vegetation management activities employed to maintain the corridor are unlikely to disturb these animals for periods much longer than the duration of the activity and vegetation management could actually benefit game species by providing more open habitats (STPNOC 2009a).

2.4.1.4 Terrestrial Ecology Monitoring

STPNOC does not conduct any routine monitoring of the terrestrial resources on the site. Regulatory agencies have not required ecological monitoring of the STP site or its associated transmission corridors since the period of reservoir filling (mid 1980s) and there is no ongoing monitoring of terrestrial resources on the site. The proposed location of Units 3 and 4 consists primarily of previously developed lands (warehouses, parking lots, laydown yards, etc.), a mowed field, and a relatively open shrubland area dominated by sea myrtle and bluestem grasses (STPNOC 2009a). Several biological surveys were recently conducted by the applicant's contractor on the proposed plant area to identify the habitats and species present. Additional work has been done to map and delineate important wetlands and associated habitat on the site (ENSR 2008a; STPNOC 2008c). Pedestrian surveys of the proposed project areas found no threatened and endangered species or other important species occupying the area (STPNOC 2009a).

Transmission line corridors that originate at the STP site pass through forests, agricultural areas, and grasslands typical of the Texas coastal prairie. The transmission lines and associated corridors are managed by four transmission service providers (STPNOC 2009a). Only a 20-mi section of the Hillje transmission line corridor would be disturbed by building activities related to replacing towers and upgrading the existing transmission lines. The transmission system associated with existing Units 1 and 2 is maintained by the American Electric Power (AEP) Texas Central Company (TCC), which maintains the corridor from STP to the Hillje Substation. Current transmission line corridor management involves mechanical, manual, and chemical methods to limit vegetation encroachment on transmission corridors. These vegetation management activities are intended to reduce safety hazards from tall vegetation and minimize any potential disruptions to power transmission. AEP has procedures in place to document transmission line mortalities of large birds, should they occur, and to deal with bird nests found in hazardous locations along the corridors (STPNOC 2009a, g).

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the STP site and other areas likely to be affected by building, operating, or maintaining the proposed Units 3 and 4. The section describes the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action could have an impact and also identifies "important" or irreplaceable aquatic natural resources and the locations that might be affected by the proposed action.

2.4.2.1 Aquatic Resources of the Site and Vicinity

Approximately 57.5 percent of the 12,220 ac STP site is covered in water (STPNOC 2009a). The onsite aquatic communities occur in several sloughs, drainage areas, wetlands, Kelly Lake, the ECP for existing Units 1 and 2, and the MCR. Within the vicinity, the major aquatic communities occur in the Colorado River and Matagorda Bay.

Sloughs, Drainage Areas, Wetlands, and Kelly Lake

Little Robbins Slough is a stream that flows across the site, from the northwest corner, along the western edge of the MCR embankment, and then out the southwest corner. This water flow is critical to the function and structure of the marshes below the site (Mad Island WMA and Clive Runnells Family Mad Island Marsh Preserve) flowing into GIWW. The slough is the major source of freshwater to the marshes, and the marshes are a nursery for juvenile fish and shellfish. During the building of the MCR, the slough was altered extensively (up to 65 percent of the drainage area for the slough in the southern boundary of the site was removed) and channelized into its current configuration (NRC 1975). The aquatic community in Little Robbins Slough from below the southern boundary of the site to Matagorda Bay was evaluated from 1973-74, to establish a baseline for the evaluation of the system after it was built. The results of this study and the evaluation of potential impacts from building the MCR indicated that there would be as much as 24 percent reduction of the annual freshwater runoff into the marshes, leading to potentially significant displacement of freshwater species and reduction of the nursery for estuarine-dependent organisms (NRC 1975). However, as a result of seepage flow from the MCR into the slough, subsequent studies after the MCR was built and prior to operation estimated the total long-term average annual reduction of freshwater input into the marshes to be 6 percent. The reduction in flow of freshwater from the slough into the marshes and any subsequent changes in salinity or nutrient input were not expected to alter the structure and function of the upper marsh aquatic community (NRC 1986).

The site has numerous drainage areas, including constructed drainage ditches, which vary in water flow and volume that are tied to rain events. The Final Environmental Statements (FESs) for the construction and operation phases of Units 1 and 2 (NRC 1975, 1986) included a description of the aquatic community at a number of these areas around the site. The most common species listed include: grass shrimp (*Palaemonetes kadiakensis*; also known as Mississippi grass shrimp), crayfish (possibly of several genera), blue crab, red shiner (*Cyprinella lutrensis*), mosquitofish (*Gambusia affinis*), silverband shiner (*Notropis shumardi*), sailfin molly (*Poecilia latipinna*), green sunfish (*Lepomis cyanellus*), warmouth (*L. gulosus*), bluegill (*L. macrochirus*), white crappie (*Pomoxis annularis*), tidewater silverside (*Menidia peninsulae*), striped mullet (*Mugil cephalus*), and several species of killifish (Family Cyprinodontidae, likely *Lucania* spp. and *Fundulus* spp.). Aquatic invertebrates reported were primarily the early life stages of midges, beetles, mayflies, biting midges, dragonflies, and damselflies. The fish and invertebrates are common species along the Texas coastline, and most of them tend to be tolerant of salinity and water temperature fluctuations (NRC 1975, 1986; Thomas et al. 2007; Hassan-Williams and Bonner 2009; STPNOC 2009a).

In May 2007, ENSR conducted a rapid bioassessment of the MDC. The channel currently runs from the North Accession Road west across the proposed powerblock area for proposed Units 3 and 4, and then turns southwest eventually joining Little Robbins Slough. The MDC flows through mostly mowed and some undisturbed fields. Its banks are uniformly sloped, lined with riparian vegetation, but the vegetation does not form a canopy cover across the ditch. The water surface width, water depth, top bank width, and substrate type (silt/clay and silt/clay/gravel) varies along the length of the MDC. Water temperature was 29.7°C and dissolved oxygen was 8.0 to 8.4 mg/L (aerobic conditions). There is no continual flow of water in the MDC; however, water depth increases during rain events, and water drains into Little Robbins Slough during high flows. Eleven fish taxa and three non-fish taxa were identified during the rapid bioassessment. The dominant fish species changed down the length of the MDC, with various sunfish species (largemouth bass [*Micropterus salmoides*], redear sunfish [*Lepomis microlophus*], pumpkinseed [*L. gibbosus*], and bluegill) being dominant closest to the North Accession Road, followed by sailfin mollies and sheepshead minnows (*Cyprinodon variegatus*). The mid section of the MDC was dominated by mosquitofish. Red eared slider (*Trachemys scripta elegans*), crayfish (several genera occur in the area, e.g., *Procambarus* spp.), and grass shrimp (also known as Mississippi grass shrimp) were also collected. All collections were conducted with seines, and no aquatic insect larvae were reported (ENSR 2007c; STPNOC 2009a).

The rapid bioassessment showed that the types of aquatic organisms found in the MDC are good indicators of long-term effects, broad habitat characteristics, and integrated ecosystem conditions. The types of aquatic organisms are ubiquitous in Texas coastal wetlands along the Gulf in Texas. Largemouth bass are top predators, which are known to inhabit a wide range of habitats and pioneer areas that have recently been desiccated (Barbour et al. 1999; ENSR 2007c). The other sunfish species are all insectivores and intermediately tolerant species (Barbour et al. 1999; ENSR 2007c). Mosquitofish feed on insects, zooplankton, and detritus, are often found in shallow coastal waters, and can tolerate a range of temperatures, salinities, and oxygen conditions (Ross 2001; ENSR 2007c). Sheepshead minnows are hardy species and capable of living in harsh environments (Barbour et al. 1999; ENSR 2007c). Sailfin mollies are omnivores and can survive in a range of salinities and low oxygen conditions (Barbour et al. 1999; ENSR 2007c). These fish likely move throughout the drainage systems onsite when flow conditions accommodate their movement.

Kelly Lake is located in the northeast edge of the MCR embankment, approximately 7300 yds from the location for Unit 3 (Figure 2-14) (STPNOC 2009a). The lake covers approximately 34 ac and is primarily fed by drainage areas but may also receive groundwater discharge (STPNOC 2009a). There have been no aquatic ecology surveys in this lake during the licensing of existing STP Units 1 and 2 or during the recent efforts to characterize the site (NRC 1975, 1986; STPNOC 2009a).

Essential Cooling Pond

The ECP is a small cooling pond (46 ac) and serves as the ultimate heat sink for existing Units 1 and 2. In 2002, a survey of the ECP found only two fish species in the waters: sailfin molly and sheepshead minnow. Both of these species have been found in Little Robbins

Slough, the MDC, and Colorado River, but only the sheepshead minnow has been found in the MCR (ENSR 2007c, 2008b, c; STPNOC 2009a).

Main Cooling Reservoir

The MCR is a 7000-ac, man-made impoundment that is the normal heat sink for waste heat generated during operations of existing STP Units 1 and 2 (Figure 2-21). The reservoir is unlined, and the normal maximum operating level elevation is 49 ft above MSL (currently, the operating level for Units 1 and 2 is 47 ft) (STPNOC 2009a). The water level and quality (e.g., total dissolved solids) in the MCR is maintained by pumping water from the Colorado River through the RMPF. The RMPF is located on the west bank of the Lower Colorado River, and consists of a traveling screen intake structure, siltation basin, sharp-crested weir, and a 1200 cfs capacity pump station. Water from the river is pulled through a coarse trash rack and log guides and into traveling water screens (STPNOC 2009a). A handling and bypass system on the traveling screens can collect fish caught on the screens and return them via a sluice downstream to the river (STPNOC 2009a). Water that passes through the traveling screens goes into a siltation basin, across a sharp-crested weir and into the pumping station. The water is then pumped into the northeast corner of the MCR through two buried 108-in diameter pipelines (STPNOC 2009a). From the southeast corner of the MCR, water can be discharged through a pipeline and a seven-port diffuser back into the Colorado River downstream of the RMPF (STPNOC 2009a). A diverse aquatic community does exist in the MCR, but the organisms are not available for harvest. There is no public access or use of the MCR. The Corps has determined that the MCR is not waters of the United States (Corps 2009), and the Corps and TCEQ have stated that the MCR is not waters of the State (TCEQ 2007; STPNOC 2009a).

In the FES for construction of STP Units 1 and 2 (NRC 1975), the NRC staff predicted that the MCR would become populated with an aquatic community as fish and other aquatic organisms were entrained by pumping water from the Colorado River. The NRC staff stated that initially, the community would resemble that in a river and then evolve into a community more typical of other freshwater impoundments in Texas (NRC 1975). The first survey of the aquatic community in the MCR was a catch-and-release fishing tournament for employees only in 1994. The most commonly caught species were red drum (*Sciaenops ocellatus*) and catfish (undetermined species, most likely blue catfish [*Ictalurus furcatus*]). Other species that were landed included black drum (*Pogonias cromis*), common carp (*Cyprinus carpio carpio*), largemouth bass, longnose gar (*Lepisosteus osseus*), Atlantic croaker (*Micropogonias undulatus*), and southern flounder (*Paralichthys lethostigma*) (STPNOC 2009a).

From May 2007 to April 2008, ENSR collected biological samples throughout the MCR and at the circulating water intake structure (CWIS) for existing Units 1 and 2 located within the MCR. The objective of the study was “to characterize the aquatic species within the MCR, and to evaluate

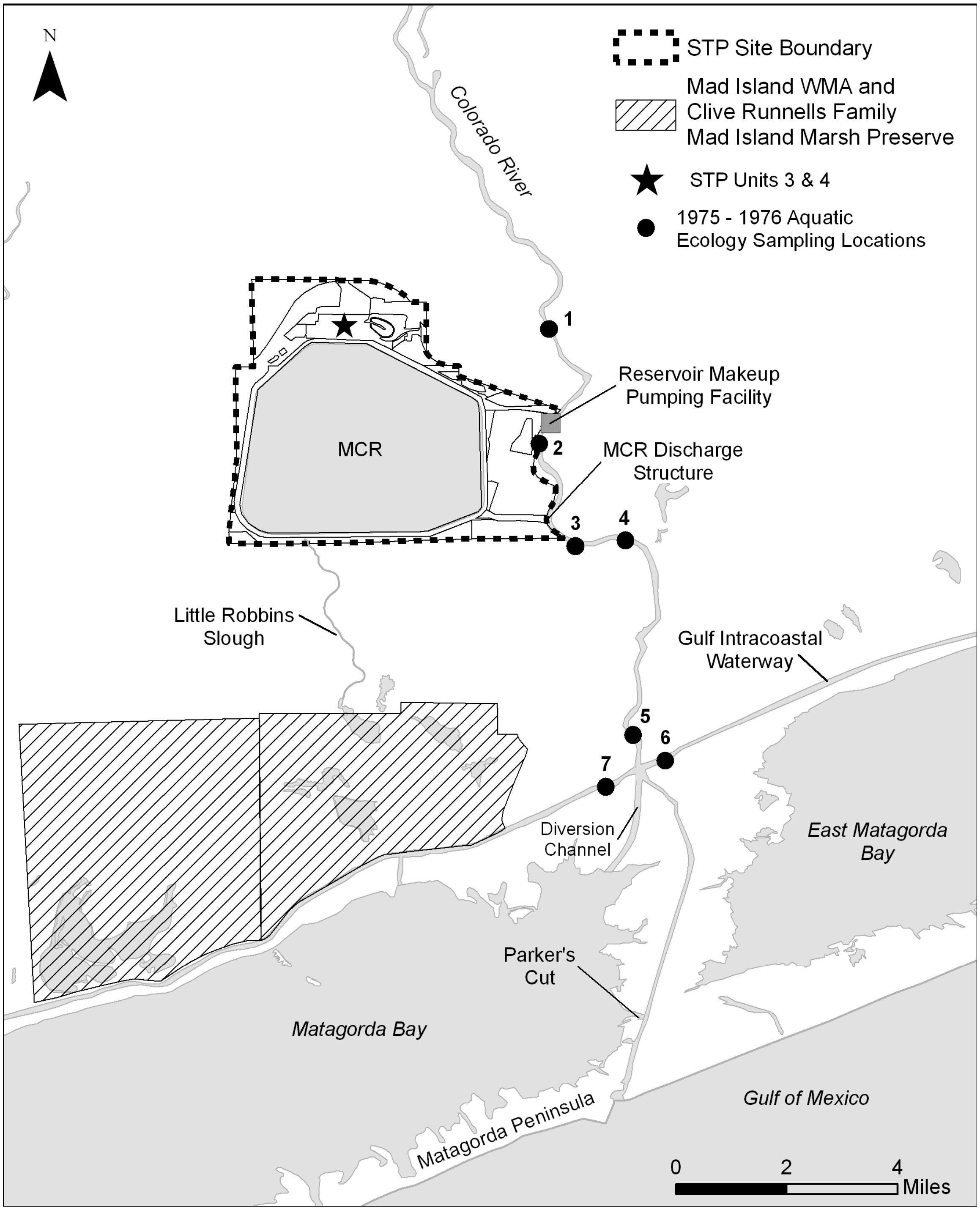

Figure 2-21. Location of STP with Respect to Important Aquatic Resources and the 1975-1976 Aquatic Ecology Sampling Locations

impingement and entrainment impacts to establish, to the extent possible, relationships between the presence of aquatic organisms and the current (STP Units 1 and 2) intake design and operating parameters" (ENSR 2008b). To characterize the different aquatic zones and life stages of organisms found in the MCR, multiple types of sampling gear were used, including gill nets, trawls, beach seines, and plankton nets. Four sampling events took place over the year at five fixed locations within the MCR (ENSR 2008b) (Figure 2-21). Water temperature, salinity, and dissolved oxygen were recorded when samples were taken. At the CWIS, small mesh nets were used to sample impingement, and plankton nets were used to sample entrainment. Samples were collected over a 24-hour period, twice per month from May through September during the peak hot months of the summer, and once per month from October through April. The same water quality measurements were recorded during the CWIS sampling events (ENSR 2008b).

The results of the MCR sampling in 2007-2008 demonstrate that the prediction in the FES for construction (NRC 1986) for a diverse community of fish developing with time in the reservoir was mostly correct. A total of 11,605 finfish and invertebrates were collected over the duration of the sampling program for the MCR (Table 2-11). The most common fish species collected were with seines, and included threadfin shad (*Dorosoma petenense*, 62 percent), inland silverside (*Menidia beryllina*, 18 percent), rough silverside (*Membras martinica*, 12 percent), and blue catfish (3 percent). The macroinvertebrates were characterized using plankton tows, and a total of 5362 organisms was collected in the MCR. The most common species (84 percent of all samples) collected were Harris mud crab larvae (*Rhithropanopeus harrisii*), and more than 99 percent of all sampled organisms were crustaceans (ENSR 2008b). Thus, the robust aquatic community that has developed in the MCR resembles more the estuarine portion of the Colorado River rather than a freshwater impoundment.

During the sampling at the CWIS, very few fish species were impinged (<50 percent) or entrained (<1 percent). A total of 3982 organisms representing 25 fish species, 7 invertebrate species, and 1 reptile were collected during impingement sampling (Table 2-12). Impingement rates were highest during the winter and early spring months. The dominant species collected in the impingement samples were threadfin shad (42 percent), Harris mud crab (24 percent), blue crab (24 percent), Atlantic croaker (5 percent), and white shrimp (*Litopenaeus setiferus*, formerly known as *Penaeus setiferus*, 3 percent). A total of 207,696 organisms representing 9 different fish families and 12 different invertebrate classes were collected during entrainment sampling (Table 2-13). Entrainment rates were highest during the spring months. The dominant taxa collected in the entrainment samples were Harris mud crab (68 percent), unidentified decapods (15 percent), and harpacticoid copepods (6 percent). Less than 1 percent of the total composition of entrained organisms was fish eggs (ichthyoplankton) (ENSR 2008b).

Water quality sampling in the MCR showed that there were seasonal and spatial changes within the reservoir. Water temperature was the highest at the cooling water discharge area and gradually decreased by approximately 10°F as the water traveled through the internal levee system to the CWIS. The temperature through the water column did not vary much: 65.3°F to 96.1°F for surface measurements, and 65.1°F to 95°F for bottom measurements. Through the year, the temperature did vary, as temperature data from trawl samples increased from an

Table 2-11. Fish and Shellfish Collected in the MCR by Gear Type, 2007-2008

Common Name	Scientific Name	Gill Net	Bag Seine	Trawl	Total
Finfish					
Atlantic croaker	*Micropogonias undulatus*	17		86	103
black drum	*Pogonias cromis*	26			26
blue catfish	*Ictalurus furcatus*	308	35	50	393
bluegill	*Lepomis macrochirus*		31		31
channel catfish	*Ictalurus punctatus*	3	21	6	30
common carp	*Cyprinus carpio carpio*	97		9	106
freshwater drum	*Aplodinotus grunniens*	7	3	39	49
gizzard shad	*Dorosoma cepedianum*		45	28	73
Gulf menhaden	*Brevoortia patronus*	4		1	5
inland silverside	*Menidia beryllina*		2068		2068
ladyfish	*Elops saurus*	36	1		37
gray (mangrove) snapper	*Lutjanus griseus*	2			2
naked goby	*Gobiosoma bosc*		3		3
needlefish	*Strongylura exilis*		1		1
pinfish	*Lagodon rhomboides*		3	1	4
red drum	*Sciaenops ocellatus*	1			1
rough silverside	*Membras martinica*		1362		1362
sheepshead minnow	*Cyprinodon variegatus*		4		4
smallmouth buffalo	*Ictiobus bubalus*	2			2
spotted gar	*Lepisosteus oculatus*		1	2	3
striped mullet	*Mugil cephalus*	1	41		42
threadfin shad	*Dorosoma petenense*		6463	768	7231
white mullet	*Mugil curema*		7		7
Invertebrates					
blue crab	*Callinectes sapidus*	11	2	6	19
rangia clam	*Rangia cuneata*			3	3
	Total	**515**	**10091**	**999**	**11605**

Source: ENSR 2008b

Table 2-12. Aquatic Species Collected during Impingement Sampling in the MCR's CWIS for Units 1 and 2, 2007-2008

Common Name	Scientific Name	Total Number
Finfish		
American eel	*Anguilla rostrata*	1
Atlantic croaker	*Micropogonias undulatus*	182
bay anchovy	*Anchoa mitchilli*	3
bay whiff	*Citharichthys spilopterus*	2
black drum	*Pogonias cromis*	2
blue catfish	*Ictalurus furcatus*	6
bluegill	*Lepomis macrochirus*	9
channel catfish	*Ictalurus punctatus*	4
common carp	*Cyprinus carpio carpio*	2
freshwater drum	*Aplodinotus grunniens*	5
freshwater goby	*Ctenogobius shufeldti*	2
gizzard shad	*Dorosoma cepedianum*	2
goby	*Gobiidae* spp.	8
Gulf menhaden	*Brevoortia patronus*	2
inland silverside	*Menidia beryllina*	5
ladyfish	*Elops saurus*	1
naked goby	*Gobiosoma bosc*	13
needlefish	*Strongylura exilis*	2
rough silverside	*Membras martinica*	2
sand seatrout	*Cynoscion arenarius*	3
sharptail goby	*Oligolepis acutipennis*	2
sheepshead	*Archosargus probatocephalus*	1
speckled worm eel	*Myrophis punctatus*	1
spot croaker	*Leiostomus xanthurus*	1
threadfin shad	*Dorosoma petenense*	1668
Invertebrates		
blue crab	*Callinectes sapidus*	944
brown shrimp	*Farfantepenaeus aztecus*	10
grass shrimp	*Paleemonetes pugio*	33
lesser blue crab	*Callinectes similis*	3
Harris mud crab	*Rhithropanopeus harrisii*	953
river shrimp	*Macrobrachium ohione*	3
white shrimp	*Litopenaeus setiferus*	106
Other		
flat-headed snake	*Tantilla gracilis*	1
	Total	**3982**

Source: ENSR 2008b

Table 2-13 Aquatic Species Collected During Entrainment Sampling in the MCR's CWIS for Units 1 and 2, 2007-2008

Common Name	Taxon	Total Number
Finfish		
anchovy	*Anchoa* spp.	30
clupeid	Clupeidae	544
fish egg		418
goby	Gobiidae	61
perch-like fish	Perciformes	6
naked goby	*Gobiosoma bosc*	5
needlefish	Belonidae	3
silversides	Atherinidae	201
wrasse	Labridae	3
Invertebrates		
amphipod	Amphipoda	145
bivalve	Mollusca	1
brachyuran decapod (zoea)	Brachyura	353
copepod	Copepoda	6588
decapod (mud crabs)	Panopeidae	10798
decapod (zoea)	Decapoda	31919
fish lice	Copepoda	399
harpacticoid copepod	Copepoda	12212
Harris mud crab	*Rhithropanopeus harrisii*	140192
insect	Insecta	24
midge	Diptera	110
mite or ticks	Acari	12
mysid shrimp	Mysida	2660
polychaete	Annelida	4
seed shrimp	Ostracoda	78
shrimp	Caridea	1
tongue biters	Isopoda	16
water flea	Cladocera	800
unidentified		113
	Total	**207,696**

Source: ENSR 2008b

average 86.4°F in May to 93.4°F in August and then decreased in October to 76.8°F and then to 70.5°F in February. Salinity remained constant throughout the reservoir and the water column, ranging from 1.6 to 1.7 ppt. Dissolved oxygen concentrations indicated that the MCR remained rather well oxygenated throughout the reservoir, in the water column, and throughout the year. Measurements for dissolved oxygen ranged from 4.6 mg/L to 13.9 mg/L and averaged 8.3 mg/L over the study period. The highest dissolved oxygen concentrations were during the month of May, and the lowest were during the month of August (ENSR 2008b).

Colorado River

The Colorado River is one of the largest river systems in Texas. The river is approximately 862 mi, extending from the high plains to the coastal marshes in Matagorda County (Figure 2-8). The segment of the river around STP, between Bay City and GIWW is a diverse, fluvial system that meanders through the coastal plain providing freshwater, sediments, and nutrients to Matagorda Bay (ENSR 2008c). Today, there is no direct connection between the Gulf of Mexico and the Colorado River. Aquatic resources associated with the Gulf of Mexico can move into and out of the Colorado River through the navigation channel (that connects the Gulf to the GIWW), the GIWW and a diversion channel to Matagorda Bay. The major shipping channels connect to the GIWW in the northeast through the Freeport Harbor Channel (Corps 2008) and in the southwest through the Matagorda Ship Channel (Corps 2007).

The flow of the Colorado River and the Gulf of Mexico has changed with development of the area since the 1920s. The course of the river prior to the 1920s flowed directly into Matagorda Bay. In the 1930s, a delta began to form in the mouth of the river and a channel was constructed through Matagorda Peninsula, shunting the river flows away from the bay directly into the Gulf of Mexico. Then in the 1950s, the Tiger Island Channel was constructed through the west side of the delta, re-establishing flow between the river and the bay. The Corps constructed a deeper river diversion channel northwest of the Tiger Island Channel in 1990. In 1991, two dams were constructed to divert the river flow, including one across the Tiger Island Channel (called the Tiger Island Cut dam, recently renamed to Parker's Cut) and a diversion dam across the river channel on Matagorda Peninsula. By July 1992, all of the Colorado River flow was diverted into Matagorda Bay, through the GIWW and the newly constructed diversion channel. The changes in freshwater inflow to Matagorda Bay over time, and the changes to flow from the Gulf of Mexico into the Colorado River have likely influenced the aquatic communities historically in the river and bay (Wilber and Bass 1998).

The Lower Colorado River has been evaluated on a limited basis with specific studies conducted in 1973-1974, 1975-1976, 1983-1984 associated with the licensing of existing STP Units 1 and 2 (NRC 1975, 1986). Baseline sampling in 1973-1974 for the construction FES was conducted during unusually heavy rainfall that changed the freshwater/saltwater makeup in the river around the proposed RMPF. Additional studies were performed in 1975-1976, prior to makeup water pumping, and in 1983-1984, during filling of the MCR. Below is a discussion of the findings of the surveys performed as part of the construction FES for phytoplankton (e.g., algae), zooplankton (e.g., copepods), macrozooplankton (e.g., larval stages of crustaceans), ichthyoplankton (e.g., fish eggs) and nekton (e.g., fish or other organisms living in the open water column) (STPNOC 2009a). Most of the sampling locations for the 1975-1976 are shown in Figure 2-21. The sampling locations in 1983-1984 were limited to the vicinity of the RMPF (NRC 1986).

Phytoplankton: In the summer of 1973, the Lower Colorado River and an adjacent stretch of GIWW were surveyed for phytoplankton. The phytoplankton community was dominated by diatoms and cyanobacteria (blue-green algae). A total of 216 taxa representing 94 genera and five major divisions were collected. Diatoms were more numerous at the bottom-water samples, and cyanobacteria and dinoflagellates were predominant in the water column. The reviewers of the study noted that the phytoplankton results indicated a “relatively stable environment which allows development of a moderately diverse plankton flora” (STPNOC 2009a). However, they also noted that the high numbers of cyanobacteria and crytomonads were probably due to the water quality changes associated with the heavy rainfall that year (STPNOC 2009a).

Zooplankton: Zooplankton was also surveyed during the 1973-1974 studies of the Lower Colorado River and GIWW. A total of 144 zooplankton species were collected, comprising of protozoans (65 species), rotifers (52 species), copepods (11 species), and cladocerans (6 species). The survey showed that the zooplankton community structure changed based on salinity, such that during periods of low river flow and strong incoming tides, species diversity increased at upstream stations. The study noted that estuarine species were likely carried further upstream than normal with the tidal pulse and were able to survive because of higher salinities (STPNOC 2009a).

Macrozooplankton: The area of the Lower Colorado River and GIWW was surveyed in 1975-1976 and 1983-1984 at stations 1 through 5 (Figure 2-21). Overall the results indicated that the abundance and occurrence of species in the macrozooplankton community were influenced by seasonal changes in the environment and with the movement of the saltwater up and down the river (salt wedge). Station 5, in the river near the GIWW, had the highest macroplankton densities, and the number of organisms decreased as samples were taken further up the river. In the 1975-1976 samples, both freshwater and estuarine-marine decapod larvae predominated the macrozooplankton community from May to September, and estuarine-marine decapods larvae dominated the community from October to December. The abundance and diversity of decapod larvae were lowest from January-April, where the copepod *Acartia tonsa* was most prevalent. In 1983, the most abundant zooplankton invertebrates were cladocerans, Malacostraca species, and copepods. But in 1984, the most abundant macrozooplankton invertebrates were immature stages of the Harris mud crab, ghost shrimp (*Callianassa* spp.), and jellyfish (Cnidaria) (NRC 1986).

The macrozooplankton community also included several species of commercial importance to the area, including early life stages of blue crab, white shrimp, and brown shrimp (*Farfantepenaeus aztecus*, formerly known as *Penaeus aztecus*) Early life stages of pink shrimp (*Farfantepenaeus duorarum*, formerly known as *Penaeus duorarum*) were not reported and may have been included in the count of brown shrimp. The megalops stage of the blue crab was found at all stations but the density of the species decreased with the samples from further up the river. Postlarval white shrimp were found in all the samples but rarely occurred at station 1-3, within the vicinity of STP intake and discharge structures. Postlarval brown shrimp were always found at Station 5, near the GIWW, but the frequency of occurrence decreased in the samples from stations 1 and 2. The highest density of the early life stages of blue crab, white and brown shrimp was in the salt wedge at any sampling location. There was also a trend of higher density of early life stages of these crustaceans along the river banks as compared to the deeper river channel. In 1985-1986 survey study, the postlarval brown shrimp, all life stages of white shrimp, and megalops and juvenile stages of the blue crab were collected only sporadically and never in very high densities (NRC 1986).

In 1983-1984, the sediment basin in the RMPF was sampled. The predominant species in the sedimentation basin were postlarval stage of white shrimp, river shrimp, and Harris mud crab (NRC 1986).

<u>Ichthyoplankton</u>: Plankton tows were used to collect fish eggs at the five sampling stations on the Lower Colorado River from the GIWW to upstream of the RMPF. In 1975-1976, estuarine-marine species dominated throughout the sampling area, indicating that the results were influenced by an extended period of saltwater in the stations closest to the GIWW and a predominant salt wedge up the river. Densities of ichthyoplankton were highest from May-October 1975 and March-April 1976, and there was a positive trend between higher densities and increasing salinity. The sampling region in the river is considered an estuarine nursery ground for a number of commercially important species that were found during the survey: Gulf menhaden (*Brevoortia patronus*), Atlantic croaker, sand seatrout (*Cynoscion arenarius*), spotted seatrout (*C. nebulosus*), spot croaker (*Leiostomus xanthurus*, also called spot), sheepshead (*Archosargus probatocephalus*), pigfish (*Orthopristis chrysopterus*), black drum, red drum, and southern flounder. The most abundant ichthyoplankton species were Gulf menhaden, bay anchovy (*Anchoa mitchelli*), Atlantic croaker, and naked goby (*Gobiosoma bosc*). In early May and August, freshwater conditions were dominant, and the abundance of ichthyoplankton shifted to freshwater drum (*Aplodinotus grunniens*) and cyprinid species (NRC 1986).

The 1983-1984 survey found that the most abundant ichthyoplankton species were bay anchovy, darter goby (*Ctenogobius boleosoma*), and naked goby. These were the only species collected from station 2, next to the RMPF. The temporal and spatial tends of the dominant ichthyoplankton species of the post-pumping sampling were similar to the trends found during the 1975-1976 (NRC 1986).

Nekton: Seines and trawls were used for nekton sampling at all locations along the Lower Colorado River in 1975-1976, and only at station 2 in 1983-1984. The most abundant species in the earlier study were white shrimp, Gulf menhaden, bay anchovy, croaker, and mullet. All of these species except for menhaden decreased in abundance as the sampling progressed up the river. Many of the commercially important estuarine species (e.g., red drum and southern flounder) were only collected at station 5. The density of menhaden changed based on location and sampling gear, with highest densities at station 1 from trawl samples and at station 1 seine samples. Bay anchovy, an estuarine resident, was the second most abundant species at station 5. The invertebrate species were found at all locations during 1975-1976 sampling. At station 1, the most abundant invertebrate species changed based on gear type: brown shrimp were the most abundant in trawl samples, and blue crabs were the most abundant in seine samples. In 1983-1984, the number of invertebrates at station 2 decreased: five shrimp (river and white shrimp), two blue crabs, and a crayfish (NRC 1986). Brown, pink, and white shrimp are of commercial importance in the vicinity of the STP site (TPWD 2002; Corps 2007), and while various life stages of brown and white shrimp were collected in the 1975-1976 and 1983-1984 studies, pink shrimp were only reported once during those studies in the 1984 impingement samples in the Colorado River (NRC 1986).

A comprehensive aquatic survey of the Colorado River in the vicinity of the STP site was conducted by ENSR from June 2007 through May 2008 as part of the application process for the proposed Units 3 and 4 at STP (STPNOC 2009a). The goals of this study were to:

- Determine current species richness and relative abundances for fish and macroinvertebrates in the Lower Colorado River study area;
- Determine the current distribution of species associated with RMPF and the discharge facility;
- Compare current data to historical data to determine if the composition of aquatic organisms has changed considerably since the initial existing STP Units 1 and 2 licensing; and
- Document current salinity patterns in the Lower Colorado River (ENSR 2008c).

Figure 2-22 and Figure 2-23 show the study area associated with the 2007-2008 aquatic assessment consisted of an approximately 9-mi stretch of the Lower Colorado River extending from the GIWW north to the FM 521 bridge, which is approximately 1.5 mi east of the MCR (ENSR 2008c). The river stretch was divided into three reaches, each 3 mi in length, using the navigation mile markers (NMM) currently in place along the river. The reaches were identified as Segment A (from the GIWW to NMM 3), Segment B (from NMM 3 to NMM 6), and Segment C (from NMM 6 to NMM 9). Segment C included both the RMPF, located just upstream of NMM 8, and the MCR's discharge structure located just upstream of NMM 6. Sampling was conducted using gill nets, hoop nets, trawls, and bag seines to collect fish and invertebrate species within the different reaches of the river (ENSR 2008c).

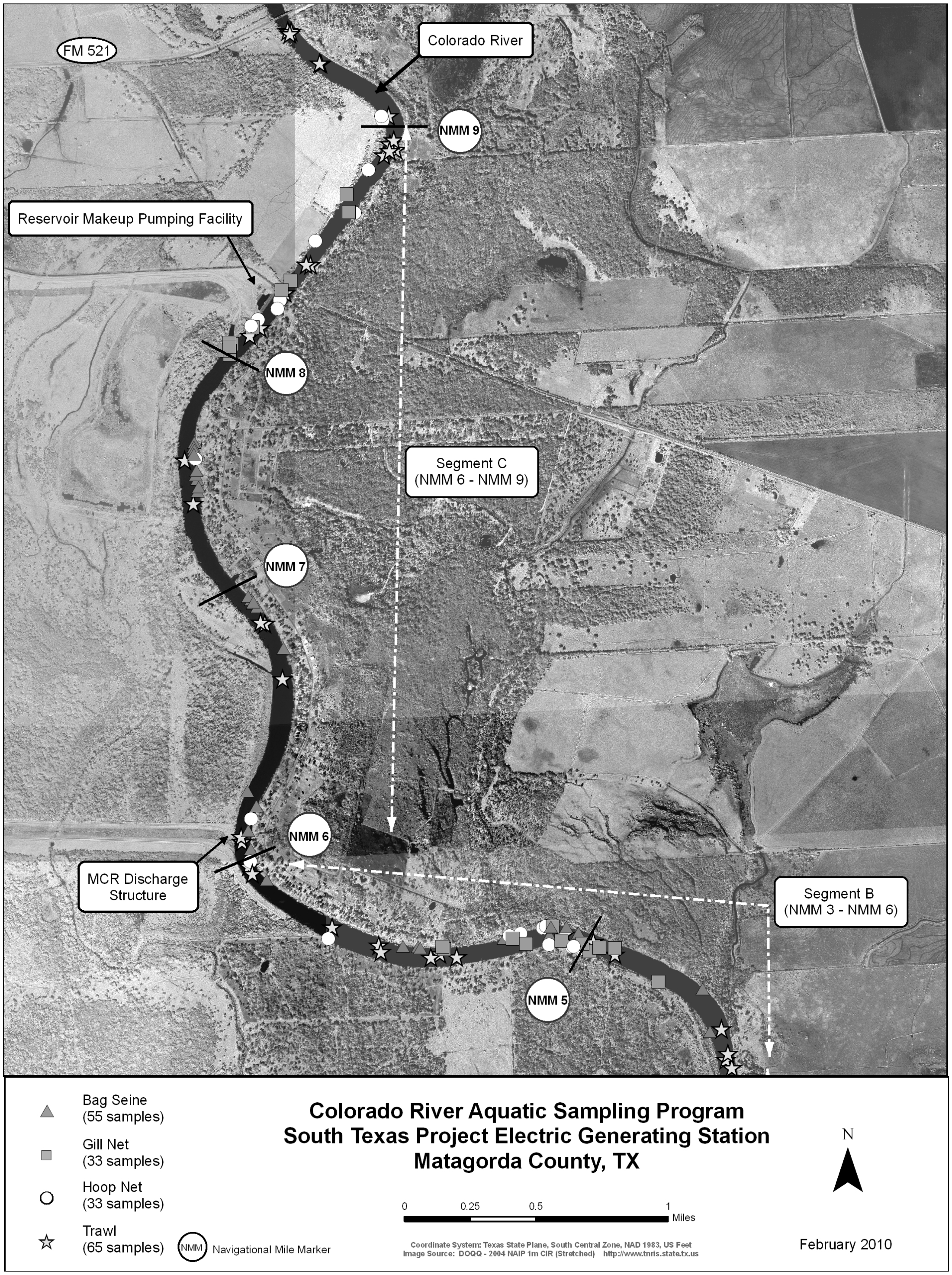

Figure 2-22. Aquatic Ecology Sampling Locations for 2007-2008, from NMM 5 to 9

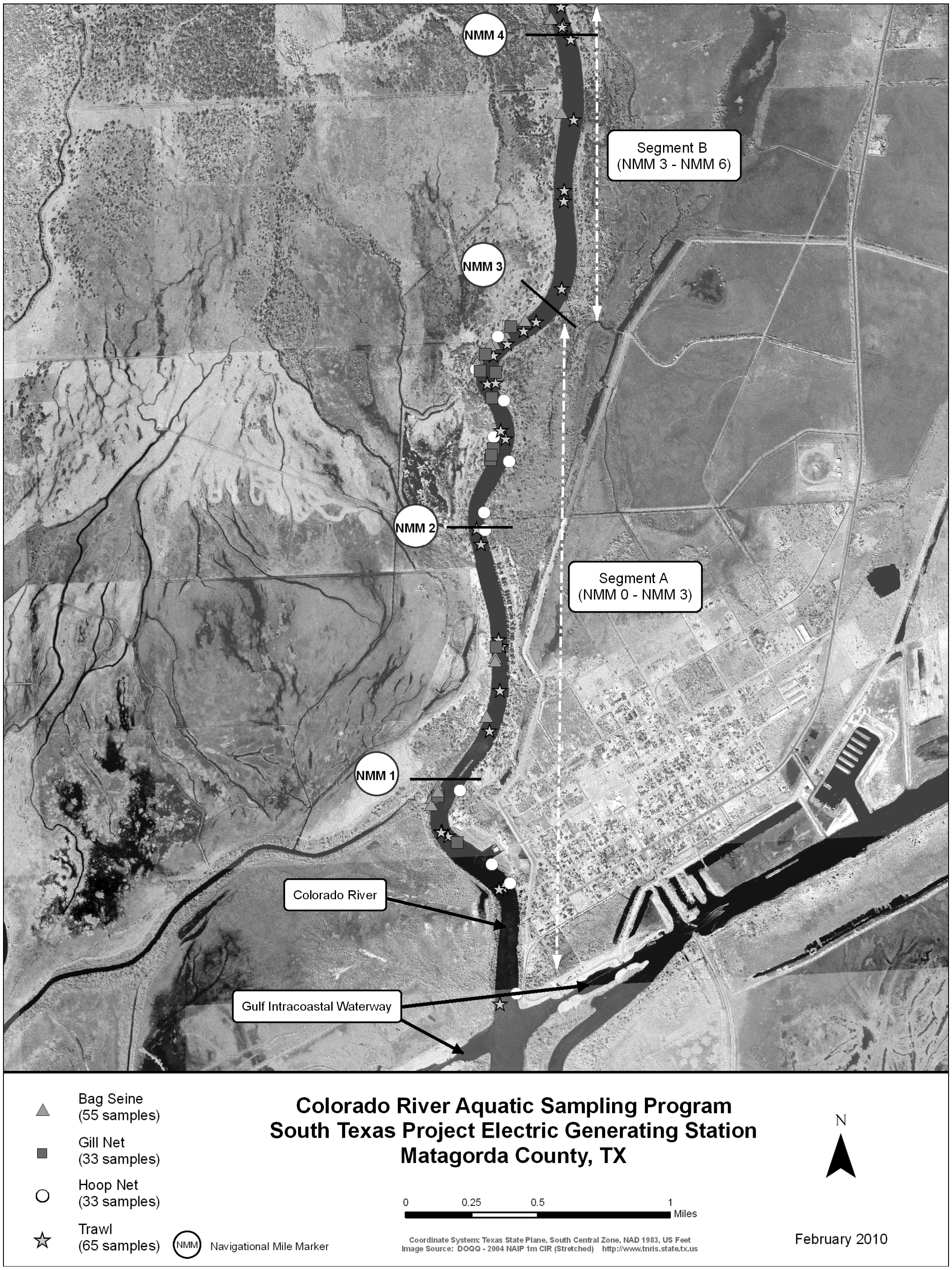

Figure 2-23. Aquatic Ecology Sampling Locations for 2007-2008, from GIWW to NMM 4

Hydrological data including salinity, dissolved oxygen, and temperature were collected during each sampling event in 2007-2008. In addition, hydrological data were collected at NMMs located at one-mi intervals on the river to help define where and how these attributes affect the species community within the river (ENSR 2008c).

Biological and environmental data were used to characterize spatial and temporal patterns of species richness and diversity, relative abundance, and fish and macroinvertebrate size relationships. Species richness, diversity, and relative abundance were estimated by gear type for the entire study area as well as within each river reach. Simpson's Index, Shannon-Wiener diversity indices, evenness, and the Jaccard coefficient of community similarity were analyses used to evaluate and characterize the aquatic community (ENSR 2008c).

A total of 186 samples were collected over the year-long assessment using four sampling gears (65 trawls, 55 seines, 33 gill nets, and 33 hoop nets) within the approximate 9-mi study area of the Lower Colorado River (Table 2-14). Catch rates for each of the gears were variable from month to month and some trends were evident based on the season. Percent composition of organisms collected by each gear during the study indicated that all gears were represented by more than 8 species (each comprising greater than 1 percent of the total catch), and species composition captured by each of the gears varied considerably among seasons. Species richness, diversity, and evenness by river segment and gear indicated that species collected with trawls and seines had greater species richness (44 total species versus 18-20 species collected in gill nets and hoop nets); however other diversity metrics were not considerably different among the sampling gears. Segment A (closest to the GIWW) had the highest value of species richness for all gears except hoop nets. Species diversity in trawl catches varied moderately among the three river segments, with both the Simpson's and Shannon-Wiener Index values indicate that Segment B had slightly higher diversity than Segments A and C (ENSR 2008c).

Hydrological data showed seasonal trends. Surface water temperatures ranged from 11.6°C in January to 31.0°C in August, and bottom water temperatures ranged from 11.1°C in January to 30.8°C in August. The difference in temperature from the surface to the bottom of the river was an average of 0.4°C throughout the study period, reflecting the general shallow depths in the system. Salinity changed by season, with lower salinities during winter and higher salinities during spring. Salinity readings at the surface were fairly stable ranging from 0.0 ppt to about 7 ppt, with the highest salinities occurring downstream, in Segment A, below NMM 2, and the lowest in Segment C, above NMM 8 (Figure 2-22 and Figure 2-23). Salinities at mid-water depths were the most variable of all three depths recorded. Throughout the year, the bottom salinities were generally highest, ranging from 0.0 ppt to a high of 25 ppt, with the lowest salinities reaching further upstream. Comparison of flow rates and catch rates for all four gears indicates an inverse relationship between flow rate and catch rate. Dissolved oxygen ranged from 5–12 mg/L, with the highest measurements at the surface compared to the bottom of the river. There were no strong relationships between catch rate and dissolved oxygen or salinity; however, bag seine catch rates had a slight positive trend with increasing salinity (ENSR 2008c).

Table 2-14. Fish and Shellfish Collected in the Colorado River by Gear Type, 2007-2008

Common Name	Scientific Name	Bag Seine	Gill Net	Hoop Net	Trawl	Total
alligator gar	*Atractosteus spatula*	2	2	13		17
Atlantic brief squid	*Lolliguncula brevis*	1			30	31
Atlantic croaker	*Micropogonias undulatus*	562	1		482	1045
Atlantic cutlassfish	*Trichiurus lepturus*				6	6
Atlantic seabob	*Xiphopenaeus kroyeri*				127	127
Atlantic spadefish	*Chaetodipterus faber*			3		3
Atlantic threadfin	*Polydactylus octonemus*				6	6
bay anchovy	*Anchoa mitchilli*	24			264	288
bay whiff	*Citharichthys spilopterus*	15			2	17
bayou killifish	*Fundulus pulvereus*	3				3
black drum	*Pogonias cromis*	1	1	1	1360	1363
blackcheek tonguefish	*Symphurus plagiusa*				3	3
blue catfish	*Ictalurus furcatus*	51	22	3	677	753
blue crab	*Callinectes sapidus*	190	2	3	77	272
bluegill	*Lepomis macrochirus*	3				3
brown shrimp	*Farfantepenaeus aztecus*	264			192	456
bull shark	*Carcharhinus leucas*		6			6
channel catfish	*Ictalurus punctatus*	22		2	6	30
cichlid	*Cichlasoma* spp.				16	16
crayfish	*Procambarus* sp.				1	1
crevalle jack	*Caranx hippos*	2				2
cyprinids	Cyprinidae	1				1
diamond killifish	*Adinia xenica*	11				11
flathead catfish	*Pylodictis olivaris*			2		2
freshwater goby	*Ctenogobius shufeldti*	9				9
gafftopsail catfish	*Bagre marinus*		9		183	192
gizzard shad	*Dorosoma cepedianum*	8		2	52	62
grass carp	*Ctenopharyngodon idella*		2	1		3
grass shrimp	*Palaemonetes pugio*	1762				1762
gray (mangrove) snapper	*Lutjanus griseus*				1	1

Table 2-14. (contd)

Common Name	Scientific Name	Bag Seine	Gill Net	Hoop Net	Trawl	Total
Gulf killifish	*Fundulus grandis*	15				15
Gulf menhaden	*Brevoortia patronus*	2960	5	2	1076	4043
hardhead catfish	*Ariopsis felis*		1	1	252	254
Harris mud crab	*Rhithropanopeus harrisii*				1	1
inland silverside	*Menidia beryllina*	6				6
killifish sp.	*Fundulus* sp.	5				5
ladyfish	*Elops saurus*		2		1	3
lesser blue crab	*Callinectes similis*	1			5	6
lined sole	*Achirus lineatus*				3	3
longnose gar	*Lepisosteus osseus*			1		1
mosquitofish	*Gambusia affinis*	1				1
naked goby	*Gobiosoma bosc*	3				3
pigfish	*Orthopristis chrysoptera*				1	1
pinfish	*Lagodon rhomboides*				11	11
rainwater killifish	*Lucania parva*	2				2
red drum	*Sciaenops ocellatus*	8	8	38	25	79
red eared slider	*Trachemys scripta elegans*			1		1
river shrimp	*Macrobrachium ohione*	10			5	15
rough silverside	*Membras martinica*	17				17
sailfin molly	*Poecilia latipinna*	150				150
sand seatrout	*Cynoscion arenarius*	22	5		294	321
sharptail goby	*Oligolepis acutipennis*	39				39
sheepshead	*Archosargus probatocephalus*	14	1	6	48	69
sheepshead minnow	*Cyprinodon variegatus*	79			7	86
shiner	*Notropsis* spp.	2				2
silver jenny	*Eucinostomus gula*				2	2
silver perch	*Bairdiella chrysoura*				350	350
smallmouth buffalo	*Ictiobus bubalus*		32	5		37
southern flounder	*Paralichthys lethostigma*	2	2	3	12	19
southern stingray	*Dasyatis americana*				1	1
spot croaker	*Leiostomus xanthurus*	88		1	156	245
spotfin mojarra	*Eucinostomus argenteus*	3			5	8
spotted gar	*Lepisosteus oculatus*	1	1	10	1	13

Table 2-14. (contd)

Common Name	Scientific Name	Bag Seine	Gill Net	Hoop Net	Trawl	Total
spotted seatrout	*Cynoscion nebulosus*		4		53	57
star drum	*Stellifer lanceolatus*				86	86
striped mullet	*Mugil cephalus*	1676		1	1	1678
threadfin shad	*Dorosoma petenense*	4			7	11
violet goby	*Gobioides broussonnetii*	2				2
white mullet	*Mugil curema*	181			2	183
white shrimp	*Litopenaeus setiferus*	584			2870	3454
	Total	**8806**	**106**	**99**	**8760**	**17771**

Source: ENSR 2008c

Changes in the aquatic community over time in the Colorado River were evaluated using the results of the 1974, 1983, 1984, and 2007-2008 studies. The sampling locations and gear types did vary with each study, making some comparisons more difficult. Trawl samples collected from the GIWW to the STP site in 1974 showed that there was a moderately diverse species community for the lower river based on measures for species richness, diversity, and evenness. All three measures were slightly lower than those in similar segments of the river compared to the 2007-2008 study, suggesting that the diversity of aquatic species is greater now than in the past. Data collected during 1974 examining specific segments also indicated a diverse community for all three segments. The 1983-1984 trawl and seine data indicated overall lower species richness, diversity, and evenness relative to the present data (ENSR 2008c). Rerouting of the Lower Colorado River (completed in 1992) has likely contributed to these changes in diversity of aquatic species.

The Jaccard coefficients of community similarity was used to determine similarities between the samples collected in similar reaches of the Lower Colorado River based on the presence or absence of taxa. For this measure, as the coefficient approaches 1.0, the more taxa in the two samples are the same; and for the converse, as the coefficient approaches 0, the samples have fewer taxa in common. In comparing applicable months and gears from the 2007-2008 data with samples collected during 1974, the Jaccard coefficient value was 0.44, indicating that the less than half of the aquatic species sampled in 1974 were the same as those found in 2007-2008. Comparison of applicable months from the 2007-2008 data to the 1983-1984 samples resulted in a coefficient value of 0.19, indicating that there was low similarity for these aquatic communities (ENSR 2008c). Comparison of data from river segment C in 2008 with 1974 and 1983-1984 trawl data for a similar river segment resulted in values of 0.36 and 0.37, respectively, suggesting a moderate level of similarity between historical and present communities. Comparison of data for bag seine samples from applicable months during 2007-

2008 with 1983-1984 seine data resulted in coefficient values of only 0.07 and 0.11, suggesting low similarity between historic and present day communities in shallow waters accessible to seines. When 2007-2008 bag seine data for segment C was compared to 1983 to 1984 data from the same segment, Jaccard coefficient values increased to 0.31 and 0.33, suggesting moderate community similarity. Overall, present data indicate a more diverse faunal community than that represented by historic data in the Lower Colorado River (ENSR 2008c).

The number and assortment of organisms collected during this study indicate that this portion of the Lower Colorado River supports a diverse assemblage of fauna. The regular occurrence of both freshwater and saltwater species, the range of macroinvertebrate and finfish fauna, and the sheer number of species captured among various sampling gears and river reaches provide evidence of a dynamic ecosystem. There was low to moderate level of similarity between the current 2007-2008 faunal communities and the historic communities (1974 and 1983-84) (ENSR 2008c).

Matagorda Bay

Matagorda Bay is 300 mi^2 formed by a 45-mi-long barrier island-peninsula complex that is parallel to the Gulf of Mexico coast southeast of the STP site. The bay is connected to the waters on the site through the discharges of Little Robbins Slough into the marshes next to the GIWW, which then flows into the bay. As mentioned above, the Colorado River flows by STP then across the GIWW into a diversion channel into the bay. The bay is described as the Matagorda Bay system, and it is the third largest estuary on the Texas coast. The bay system includes Lavaca, East Matagorda, Keller, Carancahua, and Tres Palacios bays (Corps 2007).

The aquatic community of Matagorda Bay system includes organisms in the open water areas as well as organisms over hard substrates (including oyster reefs and offshore sands). In the open water areas of the bay, phytoplankton (e.g., algae) are the major primary producers that are the main food source for zooplankton (e.g., small crustaceans), fish and benthic organisms (e.g., mollusks). As discussed in a recent Corps EIS (2007), a study of Lavaca Bay by the FWS found that phytoplankton species composition changes based on the season, with maximum abundance occurring in the winter and minimum in the summer, and the most dominant organisms were diatoms. Zooplankton composition also changed seasonally, with the greatest abundance during the spring and smallest in the fall. The dominant species are the copepod, *Acartia tonsa* and the barnacle nauplii (swimming juvenile life-stage of barnacles). The same composition of phytoplankton and zooplankton are thought to be found throughout the Matagorda Bay estuary (Corps 2007).

The Matagorda Bay system supports a diverse population of aquatic organisms that are found in the open water column (nekton), including fish, shrimp, and crabs. The nekton assemblages consist mainly of secondary consumers feeding on zooplankton or juvenile and smaller organisms in the water column. Some of these species are resident species, spending their entire life in the bay, whereas other species may spend only a portion of their life cycle in the bay. According to a summary of studies on the nekton species in the Matagorda Bay estuary, the dominant nekton species inhabiting the Matagorda Bay estuary include the bay anchovy, Atlantic croaker, brown shrimp, pink shrimp, white shrimp, hardhead catfish (*Ariopsis felis*), sand seatrout, blue crab, and Gulf menhaden. All of these species are ubiquitous along the Texas coast and they are unaffected by seasonal or other short-term changes (e.g., salinity). The abundance of these species naturally changes with the season, with biomass and number usually being the smallest in the fall after Gulf-ward migrations. In the winter and early spring, newly spawned fish and shellfish begin migrating into the bay, with the maximum biomass observed during the summer months (Corps 2007). Many of these species have been collected in the Colorado River and some in the MCR at the STP site (NRC 1975, 1986; ENSR 2008b, c; STPNOC 2009a).

Areas of the Matagorda Bay estuary that are not considered open water include oyster reefs and offshore sands. The oyster reefs of Matagorda Bay are formed in areas where the substrate is hard and the current is strong enough to provide phytoplankton and nutrients to the oysters and carry sediment away from the organisms. The reefs are subtidal or intertidal and found near passes and cuts, and along the edges of marshes. The oyster reefs provide an ecological important function to the bay system by providing habitat to other benthic organisms and influencing water clarity and quality (oysters can filter water 1500 times the volume of their body per hour). While oysters can survive in salinities ranging from 5 to 40+ ppt, they thrive within a range of 10 to 25 ppt. The current distributions of oyster reefs in Matagorda Bay are not mapped, but the prominent locations (including commercial harvests) are in the vicinity of Lavaca Bay (Corps 2007). One of the goals of the diversion of the Colorado River into the bay is to increase mixture of freshwater in the estuary, and enhance locations of the bay for further reef development (Wilbur and Bass 1998).

The offshore sands of the Matagorda Bay system include areas of open sandy substrate as well as regions where seagrass or attached algae grow. Much of the diverse fauna in these areas is buried in the sand and the organisms rely on the phytoplankton for food. Sand dollars (*Mellita quinquiesperforata*) and several species of brittle stars (*Hemipholis elongata*, *Ophiolepis elegans*, and *Ophiothrix angulata*) are some of the most common species found in the shallow offshore sands. The bivalves in offshore sands include the blood ark (*Anadara ovalis*), incongruous ark (*A. brasiliana*), southern quahog (*Mercenaria campechiensis*), giant cockle (*Dinocardium robustum*), disk dosinia (*Dosinia discus*), pen shells (*Atrina serrata*), common egg cockle (*Laevicardium laevigatum*), crossbarred venus (*Chione cancellata*), tellins (*Tellina* spp.), and the tusk shell (*Dentalium texasianum*). The most common gastropods are moon snail (*Polinices duplicatus*), ear snail (*Sinum perspectivum*), Texas olive (*Oliva sayana*), Atlantic auger (*Terebra dislocata*), Sallé’s auger (*Terebra salleana*, now known as *Hastula salleana*), scotch bonnet (*Phalium granulatum*), distorted triton (*Distorsio clathrata*), wentletraps (*Epitonium* sp.), and whelks (*Busycon* spp.). Crustaceans also inhabit the open sand areas, including white and brown shrimp, rock shrimp (*Sicyonia brevirostris*), blue crabs, mole crabs (*Albunea* spp.), speckled crab (*Arenaeus cribrarius*), box crab (*Calappa sulcata*), calico crab (*Hepatus epheliticus*), and pea crab (*Pinnotheres maculatus*). With respect to the number of individuals found in the open sands, the most abundant infaunal organisms are the polychaetes (Capitellidae, Orbiniidae, Magelonidae, and Paraonidae) (Corps 2007).

2.4.2.2 Aquatic Resources – Transmission Lines

Power generated from proposed Units 3 and 4 would be transmitted using existing transmission line corridors. Only a 20-mi section of the Hillje transmission line would be disturbed by building activities related to replacing towers and upgrading the existing transmission lines. The transmission corridors pass through forested, agricultural, and grass-lands typical of the Texas coastal prairie (STPNOC 2009a). The water bodies crossed by the transmission corridors include small rivers, small streams, agricultural ponds, drainage areas, and wetlands (NRC 1975). No aquatic surveys are known to have been conducted along these corridors. The staff's review of the terrain along the Hillje transmission line during a pre-application site visit did not indicate any notable aquatic features within that region of the corridor (NRC 2008a). Observed water bodies included wetlands and small ponds. Aquatic species in the water bodies along the transmission corridors are likely similar to those communities typically found along the coastal plain and are likely tolerant to temporary changes in water quality (STPNOC 2009a).

2.4.2.3 Important Aquatic Species and Habitats

This section discusses important aquatic species and habitats that could be affected by building, operating, and maintaining the proposed Units 3 and 4 and associated transmission lines. Although there are no designated critical habitats for aquatic species in the vicinity of the STP site and associated transmission lines, this section will discuss other important habitats for aquatic species.

Important Species

This section describes important species in the vicinity of the STP site and associated transmission lines that could be affected by the proposed actions (Table 2-15). Such species include commercially and recreationally important species, species with designated essential fish habitat (EFH), Federally and State-listed species, and ecologically important species that are essential to the maintenance or survival of the other species or critical to the structure and function of the riverine, estuarine, and marine ecosystems.

Commercial and Recreational Species

The important commercial fisheries in Matagorda Bay target shrimp (grass, brown, and white), Eastern oysters (*Crassostrea virginica*), blue crabs, and finfish. All of these species have been found in the Colorado River in the vicinity of the site and in the MCR, except for oysters. The marine and estuarine finfish include Gulf menhaden, striped mullet, bay anchovy, spotted seatrout, southern flounder, and Atlantic croaker, sheepshead, and red and black drum. Important freshwater species included blue catfish, channel catfish (Ictalurus punctatus), smallmouth buffalo (Ictiobus bubalus), and bluegill (NRC 1975; LCRA 2006; Corps 2007; ENSR 2008b, c; STPNOC 2009a).

The contribution of commercial catch from Matagorda Bay compared to all the harvest in the Texas bay systems varies based on the fishery. Matagorda Bay has one of the lowest percentages of the total finfish harvest of all Texas bay systems, which was less than 5 percent of the coast-wide landings from 1997 to 2001. Over the same time period, Matagorda Bay contributed more of the commercial catch of shellfish from the Texas bay systems: 24 percent of brown shrimp; 29 percent of white shrimp; and 13 percent of blue crabs. The contribution of eastern oysters commercially harvested in Texas is only about 5 percent from Matagorda Bay (Corps 2007).

Table 2-15. Important Aquatic Species that May Occur in the Vicinity of STP Site

Common Name	Scientific Name	Type	Category
American eel	*Anguilla rostrata*	Fish	State-Rare
Atlantic croaker	*Micropogonias undulatus*	Fish	Commercial; Ecological
bay anchovy	*Anchoa mitchilli*	Fish	Commercial; Ecological
black drum	*Pogonias cromis*	Fish	Commercial; Recreational
blue catfish	*Ictalurus furcatus*	Fish	Commercial; Recreational
blue sucker	*Cycleptus elongates*	Fish	State-Threatened
bluegill	*Lepomis macrochirus*	Fish	Recreational; Ecological
channel catfish	*Ictaluruspunctatus*	Fish	Commercial; Recreational
flathead catfish	*Pylodictis olivaris*	Fish	Recreational
gafftopsail catfish	*Bagre marinus*	Fish	Recreational
gray (mangrove) snapper	*Lutjanus griseus*	Fish	EFH
Gulf menhaden	*Brevoortia patronus*	Fish	Commercial; Ecological
hardhead catfish	*Ariopsis felis*	Fish	Recreational
inland silverside	*Menidia beryllina*	Fish	Ecological
king mackerel	*Scomberomorus cavalla*	Fish	Recreational; EFH
largemouth bass	*Micropterus salmoides*	Fish	Ecological
mosquitofish	*Gambusia affinis*	Fish	Ecological
red drum	*Sciaenops ocellatus*	Fish	Commercial; Recreational; EFH
rough silverside	*Membras martinica*	Fish	Ecological

Table 2-15. (contd)

Common Name	Scientific Name	Type	Category
sheepshead	*Archosargus probatocephalus*	Fish	Commercial; Recreational
smallmouth buffalo	*Ictiobus bubalus*	Fish	Recreational
smalltooth sawfish	*Pristis pectinata*	Fish	Federally & State-Endangered
Southern flounder	*Paralichthys lethostigma*	Fish	Commercial; Recreational
Spanish mackerel	*Scomberomorus maculates*	Fish	Recreational; EFH
spotted seatrout	*Cynoscion nebulosus*	Fish	Commercial; Recreational
striped mullet	*Mugil cephalus*	Fish	Commercial; Ecological
threadfin shad	*Dorosoma petenense*	Fish	Ecological
blue crab	*Callinectes sapidus*	Invertebrate	Commercial; Ecological
brown shrimp	*Farfantepenaeus aztecus*	Invertebrate	Commercial; Ecological; EFH
Eastern oyster	*Crassostrea virginica*	Invertebrate	Commercial; Ecological
grass shrimp	*Paleamonetes pugio*	Invertebrate	Ecological
Gulf Coast clubtail	*Gomphus modestus*	Invertebrate	State-Rare
pink shrimp	*Farfantepenaeus duorarum*	Invertebrate	Commercial; EFH; Ecological
smooth pimpleback	*Quadrula houstonensis*	Invertebrate	State-Proposed Threatened
Texas fawnsfoot	*Truncilla macrodon*	Invertebrate	State-Proposed Threatened
Western Gulf stone crab	*Menippe adina*	Invertebrate	EFH
white shrimp	*Litopenaeus setiferus*	Invertebrate	Commercial; EFH
blue whale	*Balaenoptera musculus*	Mammal	Federally Endangered
finback whale	*Balaenoptera physalus*	Mammal	Federally Endangered
humpback whale	*Megaptera novaeangliae*	Mammal	Federally Endangered
sei whale	*Balaenoptera borealis*	Mammal	Federally Endangered
sperm whale	*Physeter macrocephalus*	Mammal	Federally Endangered
West Indian manatee	*Trichechus manatus*	Mammal	State-Endangered
hawksbill sea turtle	*Eretmochelys imbricata*	Reptile	Federally & State-Endangered
green sea turtle	*Chelonia mydas*	Reptile	Federal & State-Endangered
Kemp’s ridley sea turtle	*Lepidochelys kempii*	Reptile	Federally & State-Endangered
leatherback sea turtle	*Dermochelys coriacea*	Reptile	Federally & State-Endangered
loggerhead sea turtle	*Caretta caretta*	Reptile	Federally & State-Endangered

Sources: NRC 1975; GMFMC 2004; LCRA 2006; Corps 2007; TPWD 2009a, b, h; NMFS 2009a; FWS 2009a

TPWD’s guide to fishing indicates that the following species are of recreational interest in the vicinity of STP site: catfish (blue, channel, flathead [*Pylodictis olivaris*], gafftopsail [*Bagre marinus*], hardhead), black and red drum, southern flounder, king mackerel (*Scomberomorus cavalla*), and Spanish mackerel (S. maculates), spotted seatrout, and sheepshead (TPWD 2008a). All of these species have been found in the Colorado River in the vicinity of the site, except for the mackerel (NRC 1975; STPNOC 2009a; ENSR 2008b, c).

The following is a description of the life cycles of important recreational and commercial aquatic species (Table 2-15), included to facilitate understanding of how and when these species utilize estuarine habitat in the project area. The species that have designated EFH in the area are discussed further below, as well as in the EFH assessment in Appendix F.

Commercially and Recreationally Important Fish

Atlantic croaker. The Atlantic croaker is an inshore demersal fish found from the Gulf of Maine to Florida and throughout the Gulf of Mexico. During their life they move throughout the area: eggs are laid in the water column in the marine environment; as larvae, the croakers move into estuarine areas and become demersal; juveniles are demersal and move into tidal rivers and creeks, where they spend 6 to 8 months; adult croakers are demersal and move between estuarine and oceanic waters, and then they spawn in the nearshore of the Gulf in September to May. In the vicinity of Matagorda Bay, Atlantic croakers are considered highly abundant as juveniles, and abundant as adults, but other life stages are not found. The youngest croakers feed on zooplankton, but juveniles and adults are bottom feeders, consuming benthic worms, mollusks, and crustaceans. Adults may occasionally eat other fish. Striped bass (*Morone saxatillis*), southern flounder, blue catfish, red drum, sheepshead and spotted seatrout prey on Atlantic croakers (Patillo et al. 1997; Corps 2007; TPWD 2009m).

Texas has a valuable commercial fishery for Atlantic croakers, but not in the Matagorda Bay area (Corps 2007). They are commonly caught recreationally in the area, although croakers are not considered a popular game fish (Patillo et al. 1997). There are no limits for harvesting croakers in Texas (TPWD 2009o). Since these fish use marine, estuarine, and tidal rivers, they have often been collected during surveys of waters in and around the STP site. Atlantic croakers have been collected in Matagorda Bay (Corps 2007) and in the Colorado River during the 1975-1976 (NRC 1986) and 2007-2008 surveys (ENSR 2008c). This species was also collected in the MCR during the 1994 employee tournament (STPNOC 2009a) and in the 2007-2008 survey (ENSR 2008c).

Bay anchovy. Bay anchoy are rather small (4 in. maximum in length) schooling fish that may represent the greatest biomass of any fish in the estuarine waters along the Gulf Coast. They are a common foraging fish for other aquatic and terrestrial predators. Bay anchovy are pelagic, and occur throughout the water column over their life stages in estuarine and tidal river habitats. They are tolerant of poor water quality, and can be found in relatively anoxic conditions in pollution-stressed areas. Thus, shifts in population, where bay anchovy become the dominant species, can be an indicator of detoriating water quality. Eggs are most abundant at the surface of the water, while larvae, juveniles and adults are nektonic, freely swimming in the water. In Matagorda Bay, the adults and spawning adults are highly abundant, juveniles and larvae are abundant, and eggs are common. Spawning occurs in bays, estuaries, and tidal rivers in waters less than 20 ft deep during the spring and early summer along the Texas coast. Juveniles and adults feed primarily on zooplankton, small crustaceans, mollusks and other fish as well as detritus (Patillo et al. 1997; Hassan-Williams and Bonner 2009).

Bay anchovy are indirectly important to commercial and recreational fishing as a major food source for the game fish in the region (Corps 2007). This species was collected in the Columbia River during the 1975-1976 nekton samples (NRC 1986), the 1983-1984 ichthyplankton samples (NRC 1986), and in the 2007-2008 bag seine and trawl samples (ENSR 2008c). In addition, bay anchovy have been found in the MCR and were collected during impingement studies of the MCR's CWIS (ENSR 2008b). They have also been collected in nekton samples in Matagorda Bay (Corps 2007).

Black drum. Black drum are common demersal fish species found from the Chesapeake Bay to Florida, and throughout the Gulf of Mexico. The species is estuarine-dependent and found throughout Matagorda Bay and in the tidal rivers. Eggs are pelagic and buoyant, and the larvae stay in the water column and are pushed by the tides into estuaries and tidal rivers. Juveniles prefer shallow, nutrient rich, turbid waters such as in the tidal rivers of the region. Adults often move in large schools, searching for food in estuaries and bays. Spawning occurs primarily in nearshore water and estuaries. All life stages are common in Matagorda Bay. Black drum feed on benthic organisms, and adults particularly feed on oysters (Patillo et al. 1997).

Black drum are harvested commercially in Matagorda Bay, and are also an important seasonal recreational species in the region (Patillo et al. 1997). There are no bag or possession limits for harvesting black drum; however they must be from 14 to 30 in. in length (TPWD 2009o). Black drum have been collected in the Colorado River during the 1975-1976 ichthyoplankton samples (NRC 1986) and mostly in the 2007-2008 trawl samples (ENSR 2008c). This species was also collected in the MCR during the 1994 employee tournament (STPNOC 2009a), during 2007-2008 gill sampling around the MCR as well as in impingement samples of the MCR's CWIS (ENSR 2008b).

Bluegill. The bluegill is a native fish throughout Texas and across the eastern United States, and it is commonly introduced to areas for recreational purposes. In Texas, they are found in lakes and ponds, and while they prefer slow moving water, e.g., streams and rivers. Younger fish generally utilize areas where there is cover (e.g., woody debris) while adults seek more open waters. Bluegill are nest builders, and spawning occurs from April through September. Bluegill feed primarily on insects, crustaceans, and fish but may also consume some plant material (Hassan-Williams and Bonner 2009; TPWD 2009m).

Bluegills are a recreationally important species, but there are no limits for their collection (TPWD 2009l). The species has been collected onsite in the MDC (ENSR 2007c; STPNOC 2009), as well as in the MCR survey and during impingement studies of the MCR's CWIS (ENSR 2008b). Bluegill were also collected in the Colorado River during the 2007-2008 sampling (ENSR 2008c).

Catfish species. There are five catfish species that have been collected on and around the STP site: blue, channel, flathead, gafftopsail and hardhead catfish. Blue and channel catfish are commercially and recreationally important fish in the Colorado River, flathead and hardhead catfish are recreationally important, and gafftopsail catfish are commercially important species in Texas. There are commercial bag and possession limits for blue and channel catfish, and while there are no such limits for gafftopsail catfish, the three catfish species must be greater than 14 in. for commercial harvest. There are recreational bag and minimum length limits for blue, channel and flathead catfish, but there are no posted limits for hardhead catfish (TPWD 2009l, o). All of these species are top predators in the food chain; however, they differ in their tolerance of salinity. Blue, flathead, and hardhead catfish are found in freshwater, estuarine and marine waters; channel catfish prefer freshwater; and gafftopsail catfish prefer estuarine and marine waters. Hardhead catfish are the smallest of the five species with a maximum length of 19 in.; gafftopsail, blue, channel, and flathead catfish can grow to 34, 47, 50, and 55 in., respectively. The males of these species build nests, and spawning occurs in spring and summer as the water warms. All of the species are bottom dwellers, feeding on benthic crustaceans, mollusks, and other invertebrates, as well as small fish. As adults, the gafftopsail catfish differ in that they only consume other fish (Corps 2007; Hassan-Williams and Bonner 2009; TPWD 2009m).

Blue catfish were collected in the Colorado River in during the 2007-2008 sampling, predominantly in the trawl samples (ENSR 2008c), and they were also collected in the MCR during the 1994 employee tournament (STPNOC 2009), in the 2007-2008 samples throughout the MCR as well as in impingement samples at the MCR's CWIS (ENSR 2008b). Channel catfish were less common than blue catfish, but they were collected in the Colorado River in during the 2007-2008 survey (ENSR 2008c) and in the MCR during the 2007-2008 samples throughout the MCR as well as in impingement samples at the MCR's CWIS (ENSR 2008b). Only two flathead catfish were collected in the Colorado River during 2007-2008 (ENSR 2008c). Gafftopsail were collected in the Colorado River during 2007-2008 (ENSR 2008c) and in open water sampling of Matagorda Bay (Corps 2007). Hardhead catfish were collected in the Colorado River during 2007-2008 (ENSR 2008c) and in nekton samples in Matagorda Bay (Corps 2007).

Gulf menhaden. Gulf menhaden are only found in the Gulf of Mexico, typically in the estuarine and nearshore marine waters but the juveniles will often move up tidal rivers. They are an important link in the food chain between primary producers, phytoplankton and detritus, and top predators. Like bay anchovy, they are an important foraging fish for other aquatic and terrestrial predators. The species is migratory, moving in and out of estuaries over their lifetime. In Matagorda Bay, Gulf menhaden are highly abundant as adults and juveniles, but their other life stages are not present. Spawning has not been observed, but the species is thought to spawn offshore in marine waters from October through April. Larvae feed primarily on zooplankton. The fish lose their teeth as they metamorphose into juveniles, and they become omnivorous filter feeders consuming phytoplankton, zooplankton and detritus (Patillo et al. 1997; Hassan-Williams and Bonner 2009).

Gulf menhaden are commercially important fish in the Gulf of Mexico (Patillo et al. 1997), but they are not harvested in Matagorda Bay (Corps 2007). The species was collected in the Colorado River during the 1975-1976 ichthyoplankton and nekton samples (NRC 1986) and during the 2007-2008 survey, particularly in the bag seines (ENSR 2008c). Gulf menhaden were also collected during the 2007-2008 MCR survey as well as during impingement studies of the MCR's CWIS (ENSR 2008b). They were also one of the dominant species in nekton samples from Matagorda Bay (Corps 2007).

Sheepshead. Sheepshead spawn offshore during March and April. The species is a broadcast spawner, releasing eggs and sperm into the water column for fertilization in the coastal waters. Larvae are pelagic as they move into the seagrass beds of the estuary, where they remain as plankton for 30 to 40 days, then metamorphose into juveniles. As they mature into juveniles they become substrate-oriented, remaining in the seagrass beds. Adults are demersal in the nearshore waters. In Matagorda Bay, sheepshead are abundant as adults and juveniles, but their other life stages are not present. Larvae are carnivorous, and juveniles and adults are omnivorous (Patillo et al. 1997; Corps 2007).

Sheepshead are commercially harvested in Matagorda Bay (Corps 2007), and but there are no bag or possession limits for harvesting, only that the fish must exceed 15 in. in length. Recreational catches are limited to five fish per day, and they must exceed 15 in. in length (TPWD 2009l, o). Sheepshead were collected in the Colorado River during the 1975-1976 ichthyoplankton samples (NRC 1986) and 2007-2008 survey (ENSR 2008c). They were also collected during impingement studies of the MCR's CWIS (ENSR 2008b). Sheepshead was also one of the dominant species in nekton samples from Matagorda Bay (Corps 2007).

Smallmouth buffalo. Smallmouth buffalo are primarily freshwater fish (Hassan-Williams and Bonner 2009), but they were collected in all segments of the Colorado River to the GIWW during the 2007-2008 survey (ENSR 2008c). They are found in streams along the U.S. east coast up to Pennsylvania and west to Montana and south to Mexico. In Texas, they are found throughout the state with the exception of the Panhandle region. They are common in reservoirs and large streams with modest currents. Smallmouth buffalo are broad cast spawners over submerged aquatic vegetation (SAV), and they spawn from March through September. The species feeds primarily on the bottom, consuming insects, mollusks, zooplankton, periphyton and detritus (Hassan-Williams and Bonner 2009). Smallmouth buffalo are primarily recreationally important fish, although they are harvested for pet and livestock feed (Hassan-Williams and Bonner 2009). The species was collected during the 2007-2008 surveys of the MCR and the Colorado River (ENSR 2008b, c).

Southern flounder. Southern flounder are in coastal habitats from North Carolina, through Florida and along the Gulf coast to northern Mexico. Spawning occurs offshore during the late fall and early winter. Eggs and sperm are randomly released into the water column for fertilization. After spawning, adults return to the estuaries and rivers. Larval flounder remain offshore in the plankton for 4 to 8 weeks. As they metamorphose into juveniles, currents carry the larvae into estuaries. Juvenile southern flounders begin migrating to up tidal rivers, where, according to some researchers, juvenile and young adults remain for the first 2 years (Patillo et al. 1997; Corps 2007; Hassan-Williams and Bonner 2009).

Southern flounder are commercially harvested in Matagorda Bay (Corps 2007) and are also recreationally important in the region. There are commercial bag and possession limits, recreational bag limits, and harvested fish must exceed 14 in. in length (TPWD 2009f, i). Southern flounder were collected in the Colorado River during the 1975-1976 ichthyoplankton and nekton samples (NRC 1986) as well as during the 2007-2008 survey (ENSR 2008c). The species was also collected in the MCR during the 1994 employee tournament (STPNOC 2009a) but was not collected in the 2007-2008 survey (ENSR 2008b).

Spotted seatrout. The spotted seatrout is an inshore demersal fish found from Massachusetts down to Florida and throughout the Gulf of Mexico to the Bay of Campeche, Mexico. They are most abundant from Florida to Texas. Eggs are either pelagic or demersal, depending on salinity. Larvae start out pelagic and become demersal after 4 to 7 days. Juveniles and adults remain demersal as they complete their life cycle, forming small schools, foraging in inshore waters. In Matagorda Bay, all of the life stages of spotted seatrout are common. The species is an opportunistic, visual carnivore that feeds in the upper portion of the water column and near the surface (Patillo et al. 1997).

Spotted seatrout have been a commercially important species in Texas, but declining populations resulted in a closure of the fishery. Currently there is no commercial harvesting of them in Matagorda Bay (Patillo et al. 1997; Corps 2007). The species is part of the recreational fishery within the vicinity of STP, and the regulations state that only 10 fish are allowed per day, each between 15 and 25 in. in length (TPWD 2009l). Spotted seatrout were collected in the Colorado River during the 1975-1976 ichthyoplankton samples (NRC 1986) and 2007-2008 survey of the river (ENSR 2008c). Spotted seatrout have also been collected in Matagorda Bay (Corps 2007).

Striped mullet. Striped mullet are found worldwide in warm, tropical, sub-tropical, and temperate waters. They are an important forage fish for other aquatic and terrestrial predators. The species is a broadcast spawner, releasing eggs and sperm into the water column for fertilization in the coastal waters. The eggs and larvae remain offshore where they develop into prejuveniles, and then enter the bays and estuaries to mature. In Matagorda Bay, all life stages of the striped mullet are abundant. Larvae are carnivorous, consuming planktonic material.

Their diet changes from omnivores to herbivores as they develop as juveniles, and adults remain predominantly herbivores (Patillo et al. 1997; Corps 2007).

Striped mullet are harvested commercially in Matagorda Bay, and are also recreationally important in the vicinity of STP (Corps 2007). There are no commercial or recreational limits for catching striped mullet however, from October through January fish may only be collected if they are less than 12 in. in length (TPWD 2009l, o). Stripped mullet have been collected in onsite drainages (NRC 1975; STPNOC 2009a) as well as in the MCR (ENSR 2008b). The species was also collected in the Colorado River during the 1975-1976 nekton samples (NRC 1986) and in the 2007-2008 survey (ENSR 2008c).

<u>Commercially and Recreationally Important Shellfish</u>

Blue crab. Blue crabs are crustaceans (decapods) and are abundant throughout the Gulf of Mexico. During their life stages, they are found in various regions of the coastal waters. After female blue crabs mate, they migrate to higher salinity areas of the estuary (near tidal inlets or just offshore) where they lay their eggs. Eggs are attached to the underside of the female's abdomen, where they remain for about 2 weeks. Just prior to the eggs hatching, females move seaward and the eggs hatch offshore. Blue crab larvae pass through several larval stages in the marine plankton before moving back into the estuary with the surface plankton. Female blue crabs occur in the bays year round, but their population peaks in June and July. Male blue crabs remain in the lower salinity portions of the bays throughout their life. In Matagorda Bay, adult and juvenile crabs are abundant, and the larvae are highly abundant. However, mating females and those brooding eggs are only common outside of the bay. Larval crabs likely feed on plankton and zooplankton, whereas juveniles and adults are omnivores, scavengers, detritivores, predators, and cannibals that feed on a variety of plant and animal matter (Patillo et al. 1997; Corps 2007).

Blue crabs are commercially important shellfish in Matagorda Bay, and while there are no bag or possession limits there are regulations on the size, number of traps that can be placed, and time of year for harvesting the crabs. The species is also important recreationally, and the regulations are similar to commercial harvesting (TPWD 2009f, i). Blue crabs were collected onsite in drainages (NRC 1975; STPNOC 2009a) and were one of the most common species collected and in 2007-2008 survey of the MCR (ENSR 2008b) and during the impingement sampling at the MCR's CWIS (ENSR 2008b). They were collected in the Colorado River during the 1975-1976 nekton samples (NRC 1986) and during the 2007-2008 survey (ENSR 2008c). Blue crabs have also been collected in nekton samples in Matagorda Bay (Corps 2007).

Eastern oyster. Eastern oysters are mollusk (bivalves) that are found throughout the estuarine coastal areas of the Gulf of Mexico. As adults, the oysters are sessile and can form reefs over time. In the spring, rising temperatures and chemical cues stimulate the release of sperm into the water column by male oysters. Females then release their eggs into the water. The eggs are planktonic. Larval oysters remain as plankton in the water column for 2 or 3 weeks before settling onto a hard substrate and eventually transforming into an adults. In Matagorda Bay, all life stages are common. While larvae consume plankton, juvenile (spat) and adults are suspension filter feeders, consuming plankton and zooplankton as they filter large quantities of brackish water (Patillo et al. 1997; Corps 2007).

Eastern oysters are harvested commercially in Matagorda Bay. Open season for oysters is from sunrise to sunset during November through April, but there are no season limits for private leases with permits from TPWD. Commercial regulations are associated with the size, culling, collection method, and quantity. The species may also be collected recreationally in Texas from November through April, and there are limits associated with the size, collection tools, and quantity (TPWD 2009l, o). There are no reports of oysters in the Colorado River above the GIWW, but there are efforts to improve oyster reefs in Matagorda Bay (LCRA 2006; Corps 2007).

Species with Designated Essential Fish Habitat

EFH has been designated by the Gulf of Mexico Fishery Management Council in the Lower Colorado River, GIWW, and Matagorda Bay. Below is a discussion of the four fish and three shellfish species that are protected as part of this designation. Further information can be found in the EFH Assessment included in Appendix F in support of a NRC/Corps joint consultation with the National Marine Fisheries Service (NMFS) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

EFH is designated by life stage for each species as follows. Coastal migratory pelagic fish include juvenile king mackerel (*Scomberomorus cavalla*) and all life stages (eggs, larvae, juveniles, adults) of the Spanish mackerel (*S. maculatus*). The grey (mangrove) snapper (*Lutjanus griseus*) is the only species of reef fish in the vicinity, and the listing is for all life stages of the gray snapper. All life stages of red drum are listed in the vicinity. The shrimp species include all life stages for the brown shrimp, pink shrimp, and white shrimp. Finally, EFH for the vicinity includes the all life stages of the Western Gulf stone crab (*Menippe adina*). *Menippe adina* has been recognized as a new species, distinct from *M. mercenaria*, and is the species most common in the Gulf along the Texas coastline (Guillory et al. 1995).

King mackerel are highly migratory and are aggressive predators that specialize in feeding on other fishes. Common prey includes herrings, including menhaden and sardines. King mackerel can live to at least 14 years, although most die earlier. Females grow larger than males and spawn in their third or fourth year of life, with spawning occurring in the summer months (TSFGW 2005). Adults are primarily found offshore, but juveniles occasionally frequent estuarine waters for foraging (GMFMC 2004). Although no king mackerel have been observed during sampling studies, juvenile king mackerel are likely to occur in Matagorda Bay, GIWW, and the Colorado River.

Adult Spanish mackerel forage in estuarine and marine nearshore pelagic waters, and eggs and juveniles also occur nearshore marine surface (eggs) and pelagic (juveniles) waters (GMFMC 2004). Spawning takes place from late spring to late summer at depths of less than 50 m along the Texas inner continental shelf (De Vries et al. 1989). Although no Spanish mackerel have been observed during sampling studies, adults may occur in the Colorado River, the GIWW, and Matagorda Bay whereas eggs, larvae, and juveniles are most likely to occur in the GIWW and Matagorda Bay.

For estuarine habitats associated with the Colorado River, GIWW, and Matagorda Bay, larval, juvenile, and adult life stages of gray snapper, or mangrove snapper, are likely present because this species occupies primarily inshore habitats (GMFMC 2004). Eggs are found primarily in marine waters as part of the plankton community. Juveniles and adults are found in inshore marine and estuarine habitats with SAV or near mangroves, where they forage on small fish and crustaceans (Croker 1962). Gray snapper were collected within the first 3 mi of the Colorado River and the GIWW during the 2007-2008 sampling events (ENSR 2008c). Adults and juveniles occur in potential foraging habitat within the Colorado River, GIWW, and Matagorda Bay.

Red drum larvae and juveniles spend most of their time in estuarine soft bottom, sand/shell, and SAV habitats actively feeding on mysids, crustaceans, and fish. Adults spend some time near inshore SAV, sandy or hard-bottom foraging habitats, but are predominantly found offshore where spawning activities occur (GMFMC 2004). Red drum move to deep offshore waters to spawn in the fall and then return to nearshore coastal and estuarine habitats where they spend most of their life cycle (FFWCC 2007). Tidal currents move larvae to nearshore habitats, where they grow rapidly as juveniles during the first 2 years, and associate with seagrass habitats with little wave action (Buckley 1984). Red drum were collected in the Colorado River in 2007-2008 (ENSR 2008b, c) and is known to be in Matagorda Bay and the GIWW. Red drum was collected with all types of sampling gear, indicating that the species was well distributed in the river. With the exception of spawning adults, all life stages of red drum may occur in the Colorado River, GIWW, and Matagorda Bay.

In the vicinity of STP, EFH is designated for three shrimp species: pink, white, and brown shrimp. All of these species migrate from offshore pelagic environment as larvae to inhabit grassy, estuarine habitats as juveniles (GMFMC 2004). Adult shrimp spawn in offshore waters between spring and early summer for brown shrimp, and from spring to fall for white shrimp (FWS 1983), and throughout the year for pink shrimp (TPWD 2002). White shrimp larvae may also be found in the nearshore marine water column, but prefer estuarine habitats, and migrate further upstream in estuarine waters than brown shrimp (GMFMC 2004). White and brown shrimp prefer soft bottom, shallow estuarine areas (FWS 1983). Post-larval and juvenile pink shrimp are closely associated with seagrass beds in estuarine waters (TPWD 2002). Juvenile and adult shrimp of all three species are omnivorous with diets that vary depending on available food sources within the occupied habitat which is preferably soft bottom, shallow estuarine areas (FWS 1983). Both white and brown shrimp were collected in sampling studies all along the Colorado River in 1975-1976, 1983-1984 and 2007-2008 (ENSR 2008b, c). Larval and juvenile white and brown shrimp are likely to occur in the Colorado River, GIWW, and Matagorda Bay. Pink shrimp are often difficult to distinguish from brown shrimp, and pink and brown shrimp are usually reported together in information about the shrimping fishery in Texas coastal waters (Patillo et al. 1997); this is likely the reason pink shrimp are not reported in the Colorado River studies. The three shrimp species combined represent the greatest commercial harvest for Matagorda Bay, exceeding the catches for finfish and other shellfish (TPWD 2002; Corps 2007).

The Gulf stone crab occupies estuarine and marine SAV, sand/shell, and hard-bottom habitats as eggs, larvae, and juveniles (GMFMC 2004). Adults prefer a diet of oysters, are typically found near oyster reefs or other hard-bottom substrate, and are both intertidal and subtidal (Wilber 1989). The stone crab fishery is managed by a Gulf of Mexico Fishery Management Plan to regulate this renewable fishery with harvest only of claws greater than 2.75 in. long. Florida stone crabs require high salinities for juvenile growth, but the Western Gulf stone crab tolerates estuarine waters (GMFMC 2004). All life stages of Western Gulf stone crab may occur in the GIWW and Matagorda Bay, but none of the surveys conducted in the vicinity of STP since the 1970s has identified this species.

Ecologically Important Species

Several ecologically important species or taxa occur in the on-site water bodies and the Colorado River near the STP site. Ecologically important species are those that are important to the structure or function of the aquatic system, e.g., forage fish for many other species, or they provide critical links in the food web for Gulf of Mexico estuarine and marine ecosystems. These species may also be indicators of habitat quality in the system. As discussed in Section 2.4.2.1, there have been few surveys of on-site water bodies and the Colorado River that have included characterization of the primary producers and species representative of the lower parts of the food chain, e.g., surveys of algae and macroinvertebrates. However, the surveys of aquatic communities indicate that there is an abundant and diverse aquatic community in on-site water bodies and the river that could only exist if the primary producers and species representative of the lower parts of the food chain were also abundant and diverse.

In addition to primary producers, forage fish and invertebrates play ecologically important roles in the food web. Some of these include commercially important species and species with designated EFH. Bay anchovy is a commercially important species (discussed above) that is also an important forage fish. Anchovies are consumed by other fish found in the Colorado River such as Atlantic croaker, blue catfish, ladyfish, red drum, sand seatrout, spotted seatrout, and southern flounder (Patillo et al. 1997). Other examples of fish (particularly early life stages) and invertebrates that are important prey for other fish and are also commercially important include Altantic croaker, striped mullet, and blue crab (Patillo et al. 1997). Brown, pink, and white shrimp are species with designated EFH (discussed above) that are also important food sources for a number of other fish, including ladyfish, hardhead catfish, red drum, black drum, sand seatrout, spotted seatrout, and southern flounder (Patillo et al. 1997).

Other commercially important species are used as indicators of habitat quality. Because bay anchovy can adapt quickly to pollution stress, shifts in their population may be an indicator of poor deteriorating water quality. Atlantic croaker, Gulf menhaden, and Eastern oyster are indicator species for environmental stress, often used in toxicity studies with heavy metals and organic compounds, and are target species for NOAA's National Status and Trends Program (Patillo et al. 1997). Gulf menhaden are frequently involved in fish kills and have been monitored as an indicator of hypoxia (low dissolved oxygen) in the Gulf. Because the distribution and abundance of oysters is particularly influenced by salinity, this species is one of the key organisms being monitored as part of the recovery of Matagorda Bay and in understanding freshwater inflow into the bay since the completion of the Colorado River diversion project (Patillo et al. 1997; LCRA 2006).

Grass shrimp are ecologically important as prey for a number of aquatic and terrestrial species as well as for their role in breaking down detritus in estuarine and tidal rivers (Patillo et al. 1997). The species was one of the most frequently collected invertebrates in the 2007-2008 Colorado River survey and in the MCR (ENSR 2008b, c), and all life stages are considered highly abundant in Matagorda Bay (Patillo et al. 1997). These shrimp are not commercially important but are likely collected as bait for recreational fishing. Grass shrimp are most often found in shallow waters, often in vegetated areas. Juveniles and adults can tolerate salinities from 0 to 55 ppt, but it is unclear how salinity affects early life stages and growth. The spawning season is from February to October. Grass shrimp are opportunistic, omnivorous feeders, including consumption of large detrital particles, and provide food sources for organisms in a variety of trophic levels (Patillo et al. 1997).

Ecologically important species for the on-site water bodies, e.g., the MDC and MCR, include foraging fish and invertebrates. Largemouth bass, bluegill, and mosquitofish were the most common species collected in the MDC (ENSR 2007c). These fish are tolerant of environmental changes, and common in inshore waters in Texas. All of these species are carnivores, feeding primarily on macroinvertebrates, and as adults may also feed on other smaller fish (Hassan-Williams and Bonner 2009). The most common fish in the MCR were the threadfin shad, inland silverside, and rough silverside (ENSR 2008b). These fish are probably the main prey for such top carnivore species found in the MCR as the blue and channel catfish (Patillo et al. 1997). Threadfin shad are planktivore filter feeders while inland silverside are carnivores, feeding primarily on macroinvertebrates (Patillo et al. 1997; Hassan-Williams and Bonner 2009).

Federally and State-Listed Species

All the Federally listed aquatic species in Matagorda County are those listed by NMFS and include the endangered smalltooth sawfish (*Pristis pectinata*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and Kemp's ridley sea turtle (*Lepidochelys kempii*). The threatened species include the loggerhead sea turtle (*Caretta caretta*) and green sea turtle (*Chelonia mydas*). In addition, NMFS lists several endangered whale species that could be found off the Texas coastline in deeper offshore waters, including blue whale (*Balaenoptera musculus*), finback whale (*B. physalus*), sei whale (*B. borealis*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter macrocephalus*). Because the whale species are not found in Matagorda Bay, the GIWW, or the Colorado River, they are not included in the Biological Assessment (BA) (in Appendix F).

The only State-listed endangered species in Matagorda County is the West Indian manatee (*Trichechus manatus*). While the West Indian manatee is Federally listed as endangered and occurring in Texas, it is not listed as occurring in Matagorda County. The State-listed threatened species in Matagorda County include a fish, the blue sucker (*Cycleptus elongates*), and two freshwater mussels, the smooth pimpleback (*Quadrula houstonensis*) and the Texas fawnsfoot (*Truncilla macrodon*). TPWD has identified rare and protected species in the county, including American eel (*Anguilla rostrata*), Gulf Coast clubtail (*Gomphus modestus*), creeper (squawfoot) (*Strophitus undulatus*) and pistolgrip (*Tritogonia verrucosa*) (TPWD 2009i).

In correspondence with the TPWD, none of these aquatic species were found within 6 mi of the STP site (STPNOC 2009a; TPWD 2009a, j). The Federally listed sea turtle species may be found in Matagorda Bay and the navigational shipping channels at Port Freeport. The other Federally listed species are not likely to be found within the bay or shipping channels. No identified threatened and endangered aquatic species are located along the Hillje transmission line corridor (STPNOC 2009a; TPWD 2009j).

<u>Federally Listed Species</u>

Smalltooth sawfish was listed by NMFS as endangered on April 1, 2003 (68 FR 15674), and they were once prevalent throughout Florida and were commonly encountered from Texas to North Carolina. The current range of this species is now restricted to peninsular Florida, therefore, the smalltooth sawfish is not included in the BA (in Appendix F). NMFS states that the primary reason for the decline of the species is bycatch (especially in gill nets) in various commercial and recreational fisheries. Loss of habitat is cited as another reason for the decline of the species, especially the mangrove forests that are important nursery areas for juvenile sawfish. Sawfish inhabit shallow waters close to shore with muddy or sandy bottoms, often in mangroves. They also occur in sheltered bays, on shallow banks, and in estuaries or river mouths, occasionally traveling inland in large river systems (NMFS 2009b; Corps 2008). There have only been three records of sawfish reported in the Matagorda Bay region in the last 20 years: Carancahua Bay (Matagorda Bay) in 1979; in the Gulf of Mexico off Aransas Bay in 1984; and an unverified report in Lower Laguna Madre (Baffin Bay) in 2003. There are no current or short-term recovery efforts identified for the species in the region or within Texas (TPWD 2009n).

Loggerhead sea turtle are distributed widely in tropical and subtropical seas, in the Atlantic Ocean from Nova Scotia to Argentina, Gulf of Mexico, Mediterranean Sea, and Indian and Pacific oceans (although they are rare in the eastern and central Pacific). They nest all along the Atlantic coast from Florida to as far north as New Jersey, but they nest sporadically along the Gulf coast, including Texas. The population of loggerheads in Texas has been declining as has the world-wide population. Loggerheads are the most abundant sea turtle in Texas marine waters, preferring shallow inner continental shelf waters and occurring very infrequently in the bays. They are often seen around offshore oil rig platforms, reefs, and jetties. Loggerheads are probably present year-round but they are most often noticed in the spring when the Portuguese man-of-war (*Physalia physalis*) (one of their preferred food choices) is abundant. Loggerheads constitute a major portion of the dead or moribund turtles that are washed ashore (stranded) each year on the Texas coast. A large proportion of these deaths are the result of drowning from accidental capture by shrimp trawlers. Nests have been confirmed in along the Texas coastline, mostly to the south in the vicinity of Padre Island (NMFS and FWS 2007a, 2008; TPWD 2009k; Corps 2007, 2008). This species does occur in the study area. To the northwest, eight loggerheads were caught in Freeport Harbor from 1995 to 2000, one loggerhead was captured by a relocation trawler in 2002, and one was killed during dredging operations of the entrance/jetty channel to Freeport Harbor in 2006 (Corps 2008). To the southeast, a loggerhead turtle was killed in 1996 during dredging operations in the entrance channel of the Matagorda Ship Channel, and two loggerheads were taken in the entrance channel of the ship channel during dredging operations in 2006 (Corps 2007). The loggerhead sea turtle is further discussed in the Biological Assessment in Appendix F.

The green sea turtle is a circumglobal species found throughout tropical and subtropical waters. Their distribution in U.S. Atlantic waters is around the U.S. Virgin Islands, Puerto Rico, and continental United States from Massachusetts to Texas. The green turtle in Texas inhabits shallow bays and estuaries where it can graze on various marine grasses, but juveniles are often found in bays without seagrasses. The greatest cause for the decline of the species worldwide is commercial harvest for eggs and food, but the turtles are also threatened by incidental catch during commercial shrimp trawling (TPWD 2009i). Major nesting activity for these turtles occurs outside of U.S. waters, on Ascension Island, Aves Island (Venezuela), Costa Rica, and in Surinam. Nesting within the U.S. is primarily in Florida, with some nesting areas in Georgia, North Carolina, and Texas (NMFS and FWS 1991b; Hirth 1997). Green turtle nests are rare in Texas and have primarily been located south at Padre Island National Seashore. No green turtle nests have been recorded around Matagorda Bay. Juvenile and adult green turtles are in the study area (NMFS and FWS 1991, 2007b; TPWD 2009i; Corps

2007, 2008). A study by Texas A&M University at Galveston (TAMUG) in 1996-1997 (Williams and Renaud 1998) found that four of the green turtles fitted with radio transmitters spent time in Lavaca Bay, western Matagorda Bay, and Powderhorn Bayou. A green turtle was recorded swimming in the Matagorda Ship Channel and one was taken during dredging operations at the same location in 2004 (Williams and Renaud 1998; Corps 2007). In 2006, two green turtles were killed during maintenance dredging of the entrance and jetty channels of the Freeport Harbor Project (Corps 2008). The Atlantic green sea turtle is further discussed in the Biological Assessment in Appendix F.

The leatherback sea turtle is found in the Atlantic, Pacific and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain and Norway; as far south as Australia, Cape of Good Hope, and Argentina. This species is mainly pelagic, occupying the open ocean, and seldom approaches land except for nesting. Foraging turtles have been observed in bays and estuaries following large concentrations of jellyfish (TPWD 2009i). Leatherbacks nest primarily in tropical regions. The largest nesting assemblages in the Atlantic and Caribbean occur in the U.S. Virgin Islands, Puerto Rico, and Florida. There have been no recorded nests in Texas since the 1930s on Padre Island. There have been occasional reports of leatherbacks feeding on jellyfish off Port Aransas and in the Brownsville. No leatherback sea turtles have been taken by dredging activities in Texas. One leatherback was caught in 2003 by a relocation trawler in a shipping channel approximately 1.5 mi north of Aransas Pass (NMFS and FWS 1992a, 2007c; TPWD 2009k; Corps 2007, 2008). This species is unlikely to occur in the vicinity of the STP site. The leatherback sea turtle is further discussed in the Biological Assessment in Appendix F.

The hawksbill sea turtle is probably the most tropical of all the sea turtles, found throughout the tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans and rarely in temperate regions. Hawksbill sea turtles are widely distributed in the Caribbean and western Atlantic, and all life stages have been found regularly off southern Florida and in the northern Gulf (especially Texas). The first and only hawksbill nest recorded in Texas was in 1998 at Padre Island National Seashore. Outside of Florida, Texas is the only state where hawksbills are encountered with any regularity. Most of these sightings are around stone jetties and have been post-hatchling and juvenile turtles. These small turtles have probably traveled north from nesting beaches in Mexico (NMFS and FWS 1993, 2007d; TPWD 2009k; Corps 2007, 2008). This species potentially occurs in the study area. The hawksbill sea turtle is further discussed in the Biological Assessment in Appendix F.

The Kemp's ridley sea turtles distribution is primarily in the Gulf of Mexico and the Atlantic seaboard. It is the smallest marine sea turtle in the world. The turtles inhabit shallow coastal and estuarine waters, usually over sand or mud bottoms. Kemp's ridleys are found in small numbers in Texas and are probably in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. The nesting area for Kemp's ridleys is almost entirely on an 11-mi stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 mi south of the Rio Grande. The species has nested sporadically in Texas in the last 50 years, with reports increasing over the last 12 years from 4 nests in 1995 to 102 nests in 2006, with a majority of the nests at Padre Island National Seashore. There was one nest recorded on Matagorda Peninsula in 2002, and four on Matagorda Island in 2004. The increase in nests is related to the success of breeding programs in the Texas. A study by TAMUG in 1996 found that seven of the Kemp's ridley turtles fitted with radio transmitters spent most of their time within 4 mi of the western shoreline of Matagorda Bay, but also swam to Lavaca Bay, Carancahua Bay, Tres Palacios Bay, and Powderhorn Bayou (Williams and Renaud 1998). Two Kemp's ridleys were taken at the entrance of the Matagorda Ship Channel in 2006 during dredging operations (NMFS and FWS 1992b, 2007e; TPWD 2009k; Corps 2007, 2008; Williams and Renaud 1998). Of all the turtles, Kemp's ridleys are likely to be the most common in the study area. The Kemp's ridley sea turtle is further discussed in the Biological Assessment in Appendix F.

The blue whale is listed as endangered by NMFS under the ESA. This species inhabits and feeds in both coastal and pelagic environments, and its distribution is thought to be associated with its food requirements. Populations of blue whales move toward the North and South Poles in the spring to feed in waters with high zooplankton production during summer months. In the fall, the whales move toward the subtropics, presumably to reduce energy expenditure while fasting and reproducing. The blue whale is considered only an occasional visitor in the U.S. Atlantic waters. While the actual southern limit of the range of the blue whale is unknown, the western North Atlantic is thought to be still within its feeding range. Some records have suggested an occurrence of this species in waters near Florida and in the Gulf of Mexico. However, the blue whale is not expected to occur in the study area and, therefore, is not included in the BA (Corps 2007, 2008).

The finback or fin whale is listed as endangered by NMFS under the ESA. This species is found offshore and the whales tend to be nomadic. Finback whales follow the same migration for feeding and reproduction as the blue whales. The finback whale is not expected to occur in the study area and, therefore, isnot included in the BA (Corps 2007, 2008).

The sei whale is listed as endangered by NMFS under the ESA. This species inhabits, breeds, and feeds in open oceans, and is usually restricted to more temperate waters. Sei whales migrate several thousand miles to the equator in the fall. Their feeding ranges and reproduction are similar to those of the blue whales. They are also known to occur near Cuba, the Virgin Islands and infrequently in U.S. waters. In the vicinity of U.S. waters, Sei whales are grouped into four stocks: East North Pacific, Hawaii, Nova Scotia, and Western North Atlantic stocks. There are not enough data to determine trends in the recovery of the species. However, sei whales continue to be taken through unauthorized hunting and incidental ship strikes and gillnetting bycatch. Sei whales are not expected to occur in the study area and, therefore, are not included in the BA (Corps 2007, 2008).

The humpback whale is listed as endangered throughout its range and is considered “depleted” under the Marine Mammal Protection Act. The humpback whale is found worldwide in all ocean basins, but this species is less common in Arctic waters. Humpback whales are generally considered to inhabit waters over continental shelves, along their edges and around some oceanic islands. These whales are seasonal migrants and are found in temperate and tropical waters of both hemispheres during the winter breeding season. During the summer feeding season, most humpbacks occur in higher latitude waters with high biological productivity. In the vicinity of U.S. waters, there are currently four recognized stocks (based on geographically distinct winter ranges) of humpback whales: Gulf of Maine, the eastern North Pacific, the central North Pacific, and the western North Pacific stocks. The worldwide population of humpback whales is thought to have been greater than 125,000 individuals prior to commercial whaling activities. The U.S. population of humpbacks is currently estimated to be less than 7000 whales. Recovery plans for the species are focused on maintaining and enchancing habitats, identifying and reducing direct human impact, monitoring and updating of data on the species, and enhancing coordination and cooperation between recovery program units across the globe. The only known occurrence of humpbacks in Texas waters was in 1992 along the Bolivar Jetty near Galveston. The humpback whale is not expected to occur in the study area and, therefore, is not included in the BA (Corps 2007, 2008).

The sperm whale is listed as endangered by NMFS under the ESA. Overexploitation from commercial whaling during the past two centuries is thought to be the reason for the decline of the species. Sperm whales are found throughout the world’s oceans in deep waters. They tend to inhabit areas with water depths exceed 1900 ft, and are uncommon in waters less than 985 ft deep. Sperm whale migrations are not as predictable or well understood as the humpback whales. Their distribution appears to be dependent on their food source and suitable conditions for breeding and varies with the sex and age composition of the group. Those whales in the oceans in mid-latitudes tend to migrate north and south depending on the seasons (whales move poleward in the summer), while the whales in tropical and temperate areas do not have an obvious seasonal migration. The sperm whale is not expected to occur in the study area and, therefore, is not included in the BA (Corps 2007, 2008).

<u>State-listed Species</u>

The West Indian manatee is listed by TPWD as an endangered species in Matagorda County. FWS lists the species in all the counties up the coast of Texas to Calhoun County, just south of Matagorda County. This aquatic mammal inhabits brackish bays, large rivers, and saltwater systems. Its diet consists of available submergent, emergent, and floating vegetation. The manatee is more commonly found in the warmer waters off of coastal Mexico, the West Indies, and Caribbean to northern South America. In the U.S., manatees are primarily found in Florida. Sitings of manatees in Texas are extremely rare and are likely to be individuals that are migrating or wandering up from Mexican waters. Historically, manatees were found in Cow

Bayou, Sabine Lake, Capano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande. In May 2005, a live manatee was photographed in the Laguna Madre near Port Mansfield, south of Corpus Christi. The Corps determined that manatees were unlikely to be found in the vicinity of the Matagorda Ship Channel and Port Freeport (Corps 2007, 2008), and therefore, they are unlikely to be found within the vicinity of STP.

The blue sucker, State listed as threatened, is described as a sucker that is dark olive or blue-black on its back and sides and white on the underside. The species is thought to reach up to a length of 40 in., with a small head, small mouth and overhung snout typical of sucker species (Thomas et al. 2007). The species is reported to be in the major rivers of Texas, usually in the channels and free-flowing pools with moderate currents and exposed bedrock, hard clay, sand or gravel substrates. Its spawning areas are typically upstream in riffles (TPWD 2009h). There are no reports of the blue sucker in the Colorado River in the vicinity of STP, although the habitat for the fish exists in the region.

TWPD categorized the American eel as rare and protected in Matagorda County. American eel is found in rivers and streams along in all the states in the Gulf Coast and along the Atlantic. It is a catadromous species, meaning that eels spend most of their lives in freshwater and travel to the western Atlantic Ocean (Sargasso Sea) to spawn. The larvae are ribbon-shaped and are carried by currents back to rivers. Larvae then metamorphose into “glass eels” and move back upstream into rivers to mature into adults. The adults can grow up to 4.3 ft. in length, and have a slightly compressed, snake-like body (Thomas et al. 2007). The number of eels reported in Texas has been diminishing since the 1970s. LCRA has reported finding an American eel as far up the Colorado River as Altair, Texas, where the eel had to traverse over dams. However, in studies over the last 30 years, TPWD has only collected seven eels in the bays sampled from Matagorda down to Corpus Christi (STPNOC 2009a). ENSR (2008b) reported collecting one adult eel (2.6 ft in length) during the impingement sampling in the MCR’s CWIS for Units 1 and 2.

Gulf Coast clubtail is a dragonfly that is reported in Matagorda County and categorized as rare and protected by TPWD. The early life stages of the clubtail are aquatic and are spent in medium-sized rivers with moderate gradients and streams with silty sand or rocky substrate. The adult clubtails are found to forage in trees along stream riparian areas (TPWD 2009h). There are no reports of clubtails in the surveys of water bodies around STP, although the habitat for these dragonflies exists in the region.

Four freshwater mussels have been identified by TPWD as being found in Matagorda County (TPWD 2009h). While not much is known specifically about the life histories and distribution of these species, they are all known as uniod mussels and have a larval stage called a glochidium. For glochidia to mature to juvenile mussels, they must live as a parasite in the gill tissues of a host fish. An important component to the distribution of freshwater mussels in various water bodies is associated with the relationship between the mussels and the host fish (Howells et al.

1996). While the habitat exists around STP and in the drainages along the Hillje transmission corridor to support these freshwater mussel species, none of these organisms have been reported during surveys of the on-site water bodies at STP or in the reach of the Colorado River in the vicinity of the site (ENSR 2008a, b, c; STPNOC 2009a). Below is a discussion on what is known about the four species reported by TPWD in Matagorda County.

Texas Parks and Wildlife Commission acted on November 5, 2009, to place 15 of the 50 freshwater mussel species that have been identified in the state on the State threatened species list (TPWD 2009h; 35 Texas Register 249). The list includes the smooth pimpleback and Texas fawnsfoot that are reported for Matagorda County. Smooth pimpleback is reported in the Colorado and Brazos River drainage basin. It prefers substrates that are mud, sand and fine gravel in very slow to moderate flow rates. It is unclear if the mussels have glochidia and the host species for the glochidia is unknown (Howells et al. 1996; TPWD 2009i). Surveys from 1980 to 2006 for the smooth pimpleback have noted steep declines in the number of extant populations in both river drainages (TPWD 2009h). Texas fawnsfoot is reported in the Colorado, Trinity and Brazos River drainages. However, there is no information about its preferred habitat, glochidia production or fish host species (Howells et al. 1996; TPWD 2009i).

Additionally, TPWD categorized two other freshwater mussels, creeper and pistolgrip, as rare and protected in Matagorda County. Creeper or squawfoot occurs in drainages from the Guadalupe River to the north and east, including the Colorado River drainage. The creeper has been found in a variety of habitats, including substrates varying from silt to gravel, shallow to fairly deep water, and flow rates from still to rather rapid. The species does appear to be sensitive to drought conditions. While the creeper is known to produce glochidia and several fish hosts have been identified (e.g., largemouth bass, creek chub (*Semotilus astromaculatus*), plains killifish (*Fundulus zebrinus*) and green sunfish), there is evidence that the species might be able to complete its life cycle without a host species (Howells et al. 1996). Pistolgrip occurs in drainages from the San Antonio River to the north and east, including the Colorado River drainage. Like the creeper, the pistolgrip has been reported in a variety of habitats. The species is known to produce glochidia but the fish host species is unknown. Historically, the pistolgrip has been important economically for the shell-button industry as well as a producer of high quality, freshwater peal industry (Howells et al. 1996).

Important Habitats

As discussed in Section 2.4.1.3, the Mad Island WMA and Clive Runnells Family Mad Island Marsh Preserve are to the southwest of the STP site and are important habitats for aquatic organisms associated with Matagorda Bay and the Gulf of Mexico (Figure 2-21). The area consists of freshwater wetlands, estuarine intertidal marshes and intertidal flats, and supports early life stages of red drum, blue crab, shrimp, oysters, southern flounder and speckled seatrout (*Cynoscion nebulosus*)(TPWD 2007; TNC 2009). The flow of water from Little Robbins Slough in the vicinity of STP provides freshwater into these wetlands, and the mixture of freshwater and estuarine waters is essential to the productivity of the aquatic community (NRC 1975, 1986; TPWD 2007; TNC 2009). Additionally, there is designated EFH in the vicinity of STP. The Colorado River extending up to the bridge at FM 521, GIWW and Matagorda Bay are within Ecoregion 5 of the designated EFH by the Gulf of Mexico Fishery Management Council's FMP (GMFMC 2004). Ecoregion 5 extends from Freeport, Texas to the Mexican border. FMPs applying to waters identified for the Colorado River, GIWW and Matagorda Bay within the vicinity of STP include coastal migratory pelagic, reef fish, red drum, shrimp, and stone crab (GMFMC 2004). There are no habitat areas of particular concern for the Colorado River (GMFMC 2004). Further discussion can be found in the EFH Assessment in Appendix F.

2.4.2.4 Aquatic Monitoring

STPNOC does not conduct any routine monitoring of the aquatic resources on the site. Regulatory agencies have not required ecological monitoring of the STP site, the operation of the RMPF on the Colorado River, or the associated transmission corridors since the period of reservoir filling (mid-1980s), and there is no ongoing monitoring of aquatic resources on the site. There have been studies in the past associated with licensing of the existing STP Units 1 and 2, and impingement and entrainment impacts at the RMPF at both high- and low-river flow conditions were estimated (NRC 1975, 1986). Several studies were conducted in preparation for the COL application for proposed Units 3 and 4.

The recent studies have included a rapid bioassessment of onsite drainages ditch system (ENSR 2007c) and aquatic assessments of the MCR and the CWIS for existing Units 1 and 2 (ENSR 2008b) and the Colorado River (ENSR 2008c). The onsite drainage ditch system was characterized using a modified version of EPA's standardized Rapid Bioassessment Protocols, including fish surveys and water quality sampling (physiochemical analyses). Results were used to evaluate potential aquatic ecology impacts of building activities that would eliminate some existing ditches, change the flow of water, especially during rain events, into the remaining and expanded drainage ditch system (ENSR 2007c).

From May 2007 through April 2008, the aquatic ecology of the MCR was characterized, and an evaluation of impingement and entrainment at the CWIS for existing Units 1 and 2 on the MCR was conducted. This was the first effort to characterize the fish and shellfish community in the MCR since it was constructed (other than a catch-and release fishing tournament for employees in 1994) (STPNOC 2009a). Four sampling events were conducted across four sampling regions in the MCR to collect fish and shellfish using a variety of sampling gears. The impingement and entrainment studies at the CWIS were conducted over a 24-hr period, twice per month from May through September and once per month from October through April. Results of these studies were used to characterize the aquatic resources in the MCR and to "establish relationships between the presence of aquatic organisms and the intake design and operation parameters" of existing STP Units 1 and 2 for evaluating potential impacts with the proposed new units (ENSR 2008b).

From June 2007 through May 2008, the aquatic ecology of the Colorado River was characterized for an approximately 9-mi stretch extending from the GIWW north to the FM521 bridge. The Lower Colorado River in the vicinity of the site has not been characterized except for studies associated with the STP site. These studies, associated with licensing of existing STP Units 1 and 2, were conducted in 1974, 1976, 1983 and 1984. This study was the first one to be conducted since the Corps completed the diversion channel of the Colorado River in 1993, diverting the flow of the river into Matagorda Bay rather than flowing directly into the Gulf. Results of the study were used to compare the aquatic communities, current flow, and salinity patterns to those prior to the 1992 diversion channel construction (ENSR 2008c).

There are no known aquatic surveys of the transmission corridors for existing STP Units 1 and 2. Only a 20-mi section of the Hillje transmission line would be disturbed by construction activities for proposed Units 3 and 4. Maintenance and operation practices for the transmission lines are consistent with state regulations for protection of aquatic life (STPNOC 2009a).

2.5 Socioeconomics

This section describes the socioeconomic baseline of the proposed site. It describes the characteristics of the 50-mi region surrounding the STP site, including population demographics, density, and use that form the basis for assessing the potential social and economic impacts from building and operating the proposed two new nuclear units. These impacts are for the region[(a)] surrounding the proposed site. This discussion emphasizes the socioeconomic characteristics of Matagorda, Brazoria, Calhoun, and Jackson Counties, although it considers the entire region within a 50-mi radius of the proposed site. STPNOC assumed that the residential distribution of the proposed Units 3 and 4 construction and operational workforces would resemble the residential distribution of STPNOC's current workforce. As of January 2007, approximately 83 percent of the STP employees reside within two counties—Matagorda (60.7 percent) and Brazoria (22.4 percent). The remaining 17 percent are distributed across at least 18 other counties, with less than 5 percent of the employees per county (Table 2-16). STPNOC also assumed that most of the socioeconomic impacts would occur within Matagorda and Brazoria Counties. The review team has also examined the possibility that significant numbers of workers (numbering in the hundreds during the peak building period) may choose to live in Wharton, Fort Bend, Calhoun, Jackson, and Victoria Counties. (Lavaca County and Colorado County are within 50 mi, but currently have almost no STP workers and are at a somewhat greater distance than the other counties mentioned.) In Wharton, Fort Bend, and

(a) For the purposes of this EIS, the relevant region is limited to that area necessary to include social and economic base data for (1) the county in which the proposed plant would be located and (2) those specific portions of surrounding counties and urbanized areas (generally up to 50 mi from the station site) from which the construction/operations work force would be principally drawn, or that would receive stresses to community services by a change in the residence of construction/operations workers.

Victoria Counties, the existing populations are relatively large and the STP plant-related population is small and not as noticeable, so significant socioeconomic impacts are unlikely. Calhoun and Jackson Counties are both close to the STP site and lightly populated. Impacts are more likely there. Most of the data and analysis in this section will be concerned with a socioeconomic impact area containing four counties: Matagorda, Brazoria, Calhoun, and Jackson. The scope of the review of community characteristics is guided by the magnitude and nature of the expected impacts of building, maintaining, and operating the proposed project and by those site-specific community characteristics that can be expected to be affected by these impacts.

Table 2-16. Distribution of STP Employees, January 2007

County	Percent of Total Number of Employees	Cumulative Percent	County Population, 2000
Matagorda	60.7%	60.7%	37,957
Brazoria	22.4%	83.2%	241,767
Wharton	4.5%	87.6%	41,188
Fort Bend	4.1%	91.7%	354,452
OTHER	2.3%	94.0%	N/A
Calhoun	1.6%	95.6%	20,647
Jackson	1.3%	96.9%	14,391
Victoria	1.2%	98.1%	84,088
Harris	0.8%	98.9%	3,400,578
Aransas	less than 0.1%	99.0%	22,497
Austin	less than 0.1%	99.2%	23,590
Fayette	less than 0.1%	99.3%	21,804
Galveston	less than 0.1%	99.5%	250,158
Cass	less than 0.1%	99.6%	30,438
Colorado	less than 0.1%	99.6%	20,390
DeWitt	less than 0.1%	99.7%	20,013
Goliad	less than 0.1%	99.8%	6928
Hood	less than 0.1%	99.9%	41,100
Lavaca	less than 0.1%	99.9%	19,210
Williamson	less than 0.1%	100.0%	249,967
Total	100%	–	–

Source: STPNOC 2009a

The population data for the 50-mi area are based on the 2000 U.S. Census data and were estimated by the applicant with SECPOP 2000, a computer program that calculates population by emergency planning zone sectors (Sandia 2003).[a] In addition, the review team analyzed

(a) Table G-1 in Appendix G provides population summary statistics for all counties within a 50-mi radius of the STP site that were used to assist in narrowing the scope to assess socioeconomic impacts.

the economic, employment, and population trends for the region using additional U.S. Census data sets and population projections from the Texas State Data Center and Office of the State Demographer.

The analytical area is a 50-mi circle centered on the proposed power block and includes all or a portion of nine counties in Texas. Table 2-17 identifies the counties and provides population information for each county within 50 mi of the STP site and Figure 2-24 shows the 50-mi analytical area.

Table 2-17. Counties within 50 mi of the STP Site

County	Resident Population (Year 2000)	Resident Population Estimate (January 1, 2007)
Matagorda County	37,957	36,930
Brazoria County	241,767	291,729
Calhoun County	20,647	20,958
Colorado County	20,390	21,925
Fort Bend County	354,452	503,315
Jackson County	14,391	14,598
Lavaca County	19,210	19,382
Victoria County	84,088	86,756
Wharton County	41,188	42,262

Source: Texas State Data Center 2007

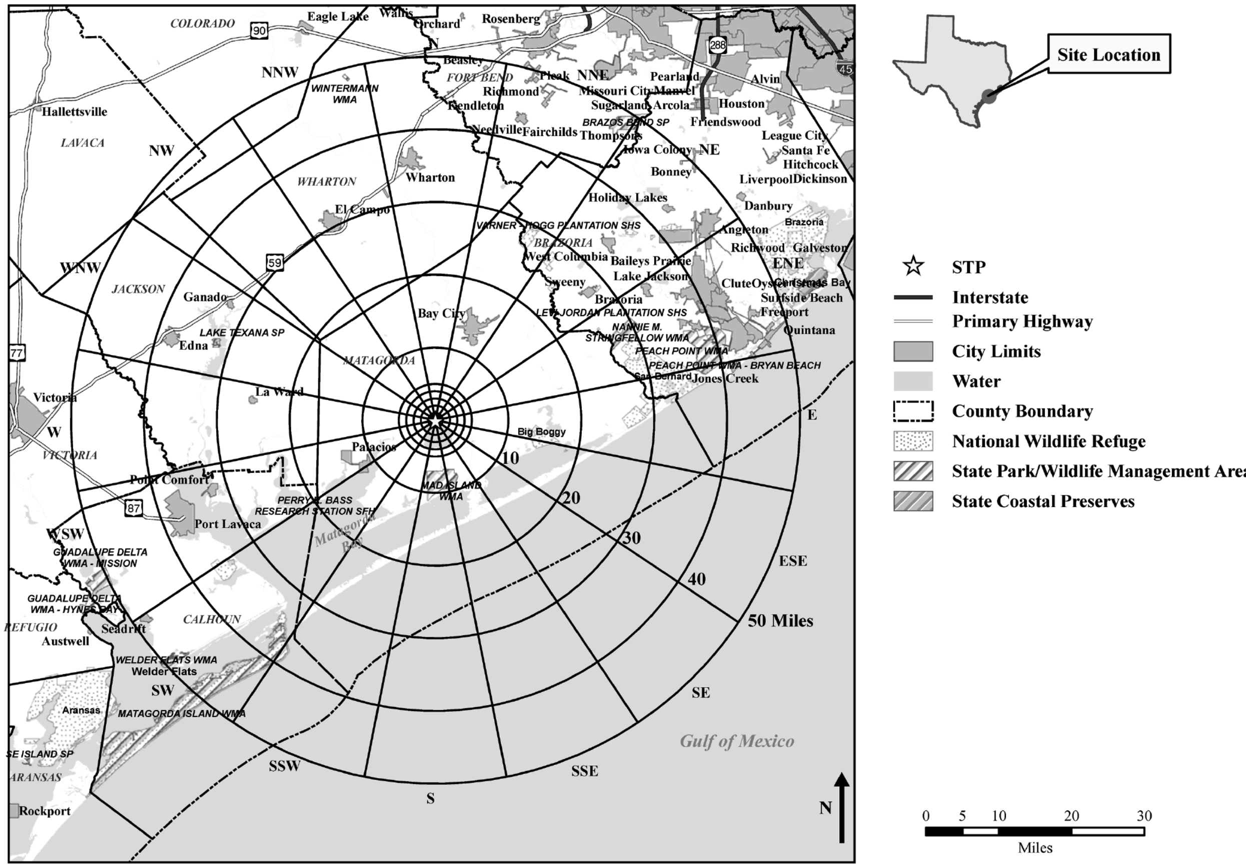

Figure 2-24. Map of Central Texas Gulf Coast, Showing Counties Potentially Affected by the Proposed Units 3 and 4 (STPNOC 2009a)

2.5.1 Demographics

For a historical perspective, the 1940 population of Matagorda County was 20,066 people and over the next 60 years the population almost doubled to 37,957 in 2000. Brazoria County population in 1930 was only 23,114 people but continually rose in urban areas after 1940. Between 1970 and 1980 the population grew 57 percent. Calhoun County, the smallest of the four counties during the 1940's had a 1940 population of 5911 and despite being hit hard by a couple of hurricanes it grew to a population of 20,647 in 2000 with the help of new industry. Also increasing since the 1940s is the Hispanic population of the counties. Unlike the previous counties Jackson County's population has remained fairly constant since World War II. The 1950 population was 12,916 and fifty years later, the 2000 census reported a population of 14,391.

For the purposes of this analysis, the review team divided the total population within the analytical area into three major groups: residents who live permanently in the area; transients who may temporarily live in the area but have a permanent residence elsewhere; and migrant workers who travel into the area to work and then leave after their job is done. Transients and migrant workers are not fully characterized by the U.S. Census, which generally captures only resident populations.

2.5.1.1 Resident Population

Table G-1 in Appendix G shows the estimated population in 2000 within 50 mi of the center of the proposed STP site. In this table, the center of the circle is the same as on Figures 2.5-1 of the ER (STPNOC 2009a), midway between the power blocks for the existing Unit 2 and Unit 3 of the proposed site, with concentric circles in 10 mi increments up to 50 mi from the proposed location. Resident population data for the area surrounding the STP site indicate low population densities and a rural setting. The transient population for 0–10 mi was added to the 2000 resident population for use in the projections, and is reflected in Table G-1. The population projections for radii of more than 10 mi include only residents.

The population growth rates shown in Table 2-18 were calculated for each county based on county projections obtained from the Texas State Data Center. The Texas State Data Center presents population projections by county for the period 2000-2060 by 10-year increments, using standard population cohort-component methods, age-specific birth and death rates calculated from the 2000 Census, and four age/gender specific migration rates. The migration rates are calculated as: a) zero, b) the rates prevailing between 1990 and 2000 (a period of high population growth), c) half the rates between the 1990 and 2000, and d) the rates estimated for the period between 2000 and 2004. Both the Texas State Data Center and STPNOC considered the One-Half 1990–2000 Migration Scenario as the most appropriate population scenario for most counties for use in long-term planning, because migration is expected, but the 1990–2000 rate is not expected to be maintained over the coming years. STPNOC believed that the 2000–2004 Migration Scenario was based on estimates and represented too few years upon which to base a meaningful long-term trend (STPNOC 2009a).

Figure 2-17shows the historical and projected populations for the nine counties closest to the STP site. The statewide Texas rate is provided for perspective. Figure 2-17 shows that the estimated county populations for 2007 generally are less than the county populations projected by any of the methods that include migration. The exceptions are Brazoria and Fort Bend Counties, which continue to feel the strong growth of Houston at their eastern ends. For five of the nine counties (Matagorda, Calhoun, Jackson, Victoria, and Wharton) and for Texas as a whole, the estimated 2000-2007 growth rate for population was less than either Texas State Data Center 2000-2010 rate based on migration during the 1990s. For two counties (Lavaca and Colorado), it was between the two rates. Based on Table 2-18 the review team believes that for most counties in the area surrounding the STP site, a long-term population forecast based on half the 1990-2000 migration rate appears more reasonable than one that continues the rapid in-migration of the 1990s. Much of the more rapid population growth in Brazoria and Fort Bend counties also appears to be centered on their east ends, outside of the 50-mi region.

The nearest population concentration is the Matagorda-Sargent CCD, 8 mi south-southeast of the site with a 2000 population of 3335. The nearest municipality with more than 15,000 residents is Bay City, Texas, 13 mi north-northeast of the STP site, with a 2000 population of 18,667 (STPNOC 2009a). Other municipalities in the 50-mi region, their 2000 populations, and locations relative to STP, are presented in Table 2-19. Although Brazoria and Fort Bend Counties are included in the Houston-Baytown-Sugarland Metropolitan Statistical Area (MSA), the core Houston metropolitan area is slightly outside of the 50-mi region. The core of the Victoria Texas MSA (which includes Calhoun County) is also outside of the 50-mi region. The Houston-Baytown MSA had a 2006 population of 5,542,048 while the Victoria MSA had a 2006 population of 112,461 (STPNOC 2009a).

2.5.1.2 Transient Population

Transients 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. Transient population estimates up to 10 mi radius around the STP site are included in Table G-1, of Appendix G.

The major employment facilities in the area, in addition to STP, include OXEA Corporation and Equistar Chemicals, LP, also known as Lyondell Corporation. OXEA Corporation is located approximately 5 mi north-northeast of STP's plant and employs a total of 194 persons. Equistar, located about 7 mi east of the STP site, employs 155 workers (STPNOC 2008d). In addition, recreational attractions in the area attract thousands of visitors each year. Recreational opportunities in the area include Riverside Park, Baycel Golf Club, Rio Colorado Golf Club, FM 521 River Park, Fisherman's Motel, Lighthouse RV Park, Matagorda Harbor, and the Mad Island WMA. Section 2.5.2.4 discusses recreational activities in the region more thoroughly and ER Table 2.5-24 shows the major sources of recreation in the region surrounding the STP site.

More broadly, Table 2-20 shows the number of hotel nights available, occupancy, and estimated hotel nights stayed in the four counties nearest the STP Site for the year 2006. The available hotel space (about 5200 rooms) would allow 1.9 million room nights, of which about 1.1 million (57 percent) are claimed by guests on an annual basis, for an annual average of about 3000 occupied hotel rooms per night (Texas Tourism 2006).

Table 2-18. Historical and Projected Populations for Counties in the STP Region

	Matagorda		Brazoria		Calhoun		Colorado		Fort Bend		Jackson		Lavaca		Victoria		Wharton		Texas	
Year	Popu-lation	Annual Percent Growth	Popu-Lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth	Popu-lation	Annual Percent Growth
1970	27,913	N/A	108,312	N/A	17,831	N/A	17,638	N/A	52,314	N/A	12,975	N/A	17,903	N/A	53,766	N/A	36,729	N/A	11,196,730	N/A
1980	37,828	3.10%	169,587	4.60%	19,574	0.90%	18,823	0.70%	130,846	9.60%	13,352	0.30%	19,004	0.60%	68,807	2.50%	40,242	0.90%	14,229,191	2.40%
1990	36,928	-0.20%	191,707	1.20%	19,053	-0.30%	18,383	-0.20%	225,421	5.60%	13,039	-0.20%	18,690	-0.20%	74,361	0.80%	39,955	-0.10%	16,986,510	1.80%
2000	37,957	0.30%	241,767	2.30%	20,647	0.80%	20,390	1.00%	354,452	4.60%	14,391	1.00%	19,210	0.30%	84,088	1.20%	41,188	0.30%	20,851,820	2.10%
2007 Estimated	36,930	-0.40%	291,729	2.70%	20,958	0.20%	21,925	1.00%	503,315	5.10%	14,598	0.20%	19,382	0.10%	86,756	0.40%	42,262	0.40%	23,834,206	1.90%
2010 Projected (1990-2000 Migration Rate)	41,924	1.00%	314,415	2.70%	23,171	1.20%	22,655	1.10%	532,988	4.20%	16,069	1.10%	19,593	0.20%	95,665	1.30%	44,844	0.90%	26,058,565	2.30%
2010 Projected (2000-2004 Migration Rate)	39,258	0.30%	308,517	2.50%	21,784	0.50%	22,854	1.10%	556,805	4.60%	14,799	0.30%	19,588	0.20%	89,928	0.70%	44,102	0.70%	25,105,646	1.90%
2010 Projected (Half 1990-2000 Migration Rate)	41,406	0.90%	287,643	1.80%	22,684	0.90%	21,693	0.60%	452,097	2.50%	15,571	0.80%	19,298	0.00%	94,193	1.10%	44,276	0.70%	24,330,612	1.60%
2020	44,715	0.80%	335,925	1.60%	24,427	0.70%	23,113	0.60%	563,873	2.20%	16,745	0.70%	19,665	0.20%	107,437	1.30%	47,381	0.70%	28,005,788	1.40%
2030	47,062	0.50%	383,598	1.30%	25,732	0.50%	24,064	0.40%	682,296	1.90%	17,432	0.40%	19,685	0.00%	117,096	0.90%	49,647	0.50%	31,830,589	1.30%
2040	48,664	0.30%	429,766	1.10%	26,571	0.30%	24,782	0.30%	789,864	1.50%	17,759	0.20%	19,316	-0.20%	125,040	0.70%	50,968	0.30%	35,761,201	1.20%

Sources: Texas State Data Center 2006 and 2007; USCB 1970

Table 2-19. Municipalities in the 50-mi Region Surrounding the STP Site

Municipality	County	2000 Population	Distance from STP (mi)	Direction
Angleton	Brazoria	18,130	45	NE
Bay City	Matagorda	18,667	12	NNE
Edna	Jackson	5899	38	WNW
El Campo	Wharton	10,945	31	NNW
Freeport	Brazoria	12,708	43	ENE
Lake Jackson	Brazoria	26,386	40	NE
Matagorda-Sargent CCD	Matagorda	3335	8	SSE
Palacios City	Matagorda	5153	11	SW
Port Lavaca	Calhoun	12,035	37	SW
Wharton	Wharton	9237	36	N

Source: STPNOC 2009a

Table 2-20 Hotels Nights Available and Sold in Four-County Socioeconomic Impact Area Surrounding the STP Site, 2006

County	Hotel Room-Nights Annual 2006 (Thousand)	Average Percent Occupancy	Estimated Nights Sold 2006 (Thousand)
Matagorda	240.3	49.1	118
Brazoria	650.4	58.7	382
Calhoun	185.2	46.6	86.3
Jackson	23	60.4	13.9
Total	**1099**	**53.7**	**600.2**

Source: Texas Tourism 2006

Accounting for major employers (other than STP), overnight accommodations, major recreation areas, and marinas within the 10 mi radius, a total of 1622 transients could be present within the 10 mi radius (STPNOC 2009b). No comparable estimate is available for the area outside of 10 mi but within 50 mi.

2.5.1.3 Migrant Labor

The U.S. Census Bureau defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another to perform seasonal or temporary employment. During STP scheduled refueling outages, there is an influx of migrant construction labor to the area who are hired by STP to carry out fuel reloading activities, equipment maintenance, and other projects associated with the outage. STP employs approximately 400 contract employees during every refueling outage, which occurs every 18 months for each unit (STPNOC 2009a).

The 2002 Census of Agriculture indicates the migrant farm labor population is within 50 mi of the proposed site. Farm operators were asked whether any hired or contract workers were migrant workers, defined as a farm worker whose employment required travel that prevented the worker from returning to his permanent place of residence the same day. Migrants tend to work short-duration, labor-intensive jobs harvesting fruits and vegetables. Out of 4135 hired farm workers recorded in the four counties closest to the STP site, the 2002 Census of Agriculture records, only a small percentage met the definition of migrant workers. While there is no direct count of migrant labor, 3026 of the farm laborers worked less than 150 days, and only 95 of the 1051 farms reporting the presence of these short-term laborers reported any workers meeting the definition of migrant worker (Census of Agriculture 2002). According to the Matagorda County Agricultural Extension Agency and the Texas Workforce Commission, there are few, if any migrant workers within 10 mi of the plant due to the mechanized nature of the agricultural industry in this area (STPNOC 2009a).

2.5.2 Community Characteristics

For a historical perspective in the 1940s, Matagorda County's economy consisted of significant oil production and farms. Oil has dropped off because of lower oil prices and farms have declined due to consolidation and mechanization but agriculture still remains important. Growth has incurred because of new industries such as the Celanese plant and STP. In the 1940s, Brazoria County saw a large increase in manufacturing jobs, and the 1950s brought service companies such as Monsanto. Farm production also peaked in the 1950s. Later petroleum and mineral production and marketing along with extraction and manufacturing, the chemical industry, fishing and the recreation industry molded the county's economy and development. After World War II the Aloca plant, the Union Carbide and Carbon Chemicals Company and other companies provided job opportunities. During the 1950s, agriculture, manufacturing and mineral-related companies comprised a majority of the local economy. Today, Calhoun County still has an agricultural based economy with cotton, cattle, corn and grain sorghum the chief products but plastics, aluminum manufacturing and other manufacturing are just as important to the county's economy and development. Jackson County saw a significant decrease in farming during the 1930s, however, this was somewhat offset by the discovery of oil in 1934. Agriculture rebounded during World War II and by the 1990s Jackson County was a leading producer of rice and cattle with over 90 percent of the county used for farming and ranching (TSHA 2009a, b, c, d).

The transportation network in the four counties really started developing in the early 20th century through the 1940s with construction of extensive railways to open the area to national markets and encourage immigration. However, since the 1980s, much of the track has been abandoned. Several waterways were developed or improved such as the clearing of a massive log jam on the Lower Colorado River and the creation of the Gulf Intracoastal Canal. There was push to build roads in the 1920s and 1930s after which improvements were made such as replacing ferries with bridges.

The STP site sits near the Gulf Coast in a rural area with several small towns located within 15 mi of the plant. The populations of Calhoun and Matagorda counties are about 60 percent minority, which is just slightly over the state average. Brazoria and Jackson counties are about 45 percent minority, which is below the state average. Calhoun and Matagorda counties have a higher percentage of the population living below the poverty line than the Texas state average. The four-county socioeconomic impact area is described in terms of racial characteristics and income level in Table 2-21.

Table 2-21. Minority and Low-Income Populations (2000 U.S. Census)

County	Percentage Minority	Percentage Below Poverty
United States	30.9%	12.4%
Texas	58.6%	15.4%
Brazoria	43.4%	10.2%
Calhoun	60.6%	16.4%
Jackson	45.8%	14.7%
Matagorda	61.1%	18.5%

Source: USCB 2000b

Further discussion of the demographic composition of the socioeconomic impact area can be found under "Environmental Justice" in Section 2.6. 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 Matagorda, Brazoria, Jackson, and Calhoun Counties include: Bay City (Matagorda County); Angleton (Brazoria County); Brazosport CCD (Brazoria County), which contains the Lake Jackson-Clute-Freeport area; Port Lavaca (Calhoun County); and Edna (Jackson County). Matagorda County's economy is based primarily on ranching (cattle), farming agriculture (rice, cotton, sorghum, and corn), oil and natural gas production and refinement, petrochemical production, electricity generation, and commercial fishing and fisheries. Brazoria County's economy is largely based on petroleum and chemical production, mineral resource extraction (oil, gas, sulfur, salt, lime, sand, and gravel), tourism, cattle ranching, and agriculture (rice, beans, sorghum, nursery plants, corn, cotton, and timber). Houston has a large influence on the economy of northeast Brazoria County. In the four counties most significantly impacted by the development and operation of STP, the government and government enterprises industry employs the greatest number of workers. Other important sectors of employment include state and local government, construction, and retail trade (BEA 2008). Table 2-22 shows industry in the four counties. The U.S. Department of Labor collects data on construction workforce sizes by state and by selected MSAs. Employment in the

U.S. Department of Labor category of Construction and Extraction Occupations, based on data gathered in 2002 through 2005, was 141,650 for the Houston-Baytown-Sugarland MSA (STPNOC 2009a).

The top employers in the four-county socioeconomic impact area are listed in Table 2-23. In addition to STPNOC, only two other large employers are within the 10 mi radius. The first employer is the OXEA Corporation, which is located 5 mi north-northeast of the STP site. The plant produces industrial chemicals and employs approximately 194 workers. The second employer is Lyondell Chemical, which produces polyethylene chemicals. It is located approximately 7 mi east of the STP site and employs approximately 155 workers (STPNOC 2008d).

The STP site currently employs approximately 1300 full-time employees, with an additional 400 contract workers during maintenance outages (STPNOC 2009a). STP is the largest employer in Matagorda County. Table 2-23 shows where the STP site's employees lived in January 2007. The review team simplified its analysis by concentrating on Matagorda, Brazoria, Calhoun, and Jackson Counties. Approximately 86 percent live in these four counties. Although an additional 8.6 percent live in Wharton and Fort Bend Counties, these are relatively large population counties and would not be expected to be significantly affected by the addition of a small number of construction or operations workers employed by the two proposed units. The review team used the distribution of the STP employees as the basis for several demographic assumptions in its economic impact assessment discussed in Chapters 4 and 5 of this EIS.

Table 2-24 shows the number of workers employed and the unemployment rates for Matagorda, Brazoria, Calhoun, and Jackson Counties and the State of Texas for 1995 and 2005. These data show the number of employed workers in Matagorda County and Calhoun County grew more slowly than the state's rate of 1.83 percent per year, adding 0.12 and 0.23 percent respectively per year to employment during the decade, while the much larger Brazoria County grew much faster than the state—2.97 percent per year. Jackson County saw a 2.24 percent decrease in the number of employed workers. Unemployment decreased significantly in all the counties except for Jackson County.

Table 2-22. Employment by Industry, 2005

Industry	Matagorda	Brazoria	Calhoun	Jackson	Total
Total Employment	*16,188*	*121,526*	*12,912*	*7558*	*158,184*
Wage and Salary Employment	10,897	89,190	10,185	5247	115,519
Proprietors Employment	5291	32,336	2727	2311	42,665
Farm Proprietors Employment	983	2158	321	1016	4478
Nonfarm Proprietors Employment	4308	30,178	2406	1295	38,187
Farm Employment	1280	2429	394	1229	5332
Nonfarm Employment	14,908	119,097	12,518	6329	152,852
Private Employment	12,280	101,960	10,980	5196	130,416
Forestry, Fishing and Related Activities	833	538	336	176	1883
Mining	217	1147	268	(D)	1632
Utilities	(D)	261	(D)	(D)	261
Construction	827	17,190	2136	738	20,891
Manufacturing	489	12,515	3004	(D)	16,008
Wholesale trade	309	2829	(D)	258	3396
Retail trade	1746	13,867	1196	667	17,476
Transportation and Warehousing	(D)	3967	195	(D)	4162
Information	100	914	69	92	1175
Finance and Insurance	398	3687	452	230	4767
Real Estate and Rental and Leasing	728	5604	303	131	6766
Professional and Technical Services	473	6323	425	277	7498
Management of Companies and Enterprises	27	107	(D)	0	134
Administrative and Waste Services	808	6621	(D)	124	7553
Educational Services	(D)	1271	(D)	15	1286
Health Care and Social Assistance	(D)	7869	(D)	262	8131
Arts, Entertainment, and Recreation	141	1679	84	31	1935
Accommodation and Food Services	1084	7113	798	293	9288
Other Services, Except Public Administration	1358	8458	603	431	10,850
Government and Government Enterprises	2628	17,137	1538	1133	22,436
Federal, Civilian	95	515	45	36	691
Military	85	691	88	32	896
State and local	2448	15,931	1405	1065	20,849
State government	105	2864	67	46	3082
Local government	2343	13,067	1338	1019	17,767

Source: BEA 2008

Note (D): As reported by the United States Bureau of Economic Analysis, “not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.”

2.5.2.2 Taxes

Several types of taxes would be impacted by proposed Units 3 and 4. The following subsections describe major taxes, their structure and annual dollar yield. Taxes included in this discussion include personal income and corporate franchise taxes, sales and use tax, and property taxes.

1 **Table 2-23**. Major Employers in Matagorda, Brazoria, Calhoun, and Jackson Counties

Employer	Private/Public	Type	Number
Matagorda County[a]			
South Texas Project	Private	Electric Generation and Transmission	1365
Bay City Independent School District	Public	Education	700
Matagorda County Hospital District	Public	Hospital	475
Wal-Mart Associates, Inc.	Private	Retail	300
Palacios Independent School District	Public	Education	270
HEB Grocery	Private	Retail	260
Matagorda County	Public	Public Service	260
Lyondell Chemical Company	Private	Chemical	155
OXEA Corporation	Private	Chemical	194
Brazoria County[b]			
The Dow Chemical Company	Private	Chemical	4570
Texas Department of Criminal Justice	Public	Prison System	2440
Infinity Group	Private	Specialty Contractor	2413
Brazosport Independent School District	Public	Education	2015
Wal-Mart Associates Inc.	Private	Retail	1880
Pearland Independent School District	Public	Education	1810
Alvin Independent School District	Public	Education	1758
Brazoria County	Public	Public Service	1313
Industrial Specialists Inc.	Private	Specialty Contractor	1069
ConocoPhillips	Private	Refining	900
Calhoun County[b]			
Inteplast Group	Private	Chemical	1700
Formosa Plastics	Private	Chemical	1500
Dow Chemical	Private	Chemical	660
Alcoa	Private	Chemical	630
Calhoun County ISD	Public	Education	613
King Fisher Marine Service	Private	Dredging	330
HEB Grocery	Private	Retail	275
INEOS Nitriles	Private	Chemical	N/A
Calhoun County	Public	Government	N/A
Harmony Industrial	Private	Contract Employees	N/A
International Bank of Commerce	Private	Business	N/A
SSI Management Group	Private	Contract Employees	N/A
Seadift Coke LP	Private	Chemical	N/A
Jackson County			
The Inteplast Group Ltd.	Private	Plastic Film	1600

Sources: STPNOC 2009a; CCEDC 2008; STPNOC 2008d; and Exelon Generation 2008.
(a) Data were collected in 2007.
(b) Data undated.

Table 2-24. Employment and Unemployment Statistics for Matagorda, Brazoria, Calhoun, and Jackson Counties

County	Year	Labor Force	Employment	Unemployment	Unemployment Rate
Matagorda	1995	17,430	14,921	2509	14.4%
	2005	16,430	15,097	1333	8.1%
	Avg. Annual Growth Rate	-0.59%	0.12%	-4.69%	
Brazoria	1995	105,654	97,672	7982	7.6%
	2005	134,404	126,697	7707	5.7%
	Avg. Annual Growth Rate	2.40%	2.97%	-3.51%	
Calhoun	1995	9548	8660	888	9.3%
	2005	9407	8863	544	5.8%
	Avg. Annual Growth Rate	-0.15%	0.23%	-3.87%	
Jackson	1995	8514	8170	344	4.0%
	2005	6668	6341	327	4.9%
	Avg. Annual Growth Rate	-2.43%	-2.24%	-0.49%	
Four-County Total	1995	141,146	129,423	11,723	8.3%
	2005	166,909	156,998	9911	5.9%
	Avg. Annual Growth Rate	1.67%	2.13%	-1.55%	
Texas	1995	9,572,436	8,985,635	586,801	6.1%
	2005	11,225,882	10,626,606	896,276	5.3%
	Avg. Annual Growth Rate	1.59%	1.83%	5.27%	

Sources: BLS 2008 and STPNOC 2009a

Personal Income and Corporate Franchise Taxes

The State of Texas does not levy a personal income tax on individuals. Texas's primary business tax is the franchise tax, imposed on each taxable entity organized in Texas or doing business in Texas. In 2006, the State of Texas received $2.6 billion (3.6 percent of its total net revenue of $72.4 billion) from franchise taxes. The revised franchise tax base as of January 1, 2008, is the taxable entity's margin. Margin equals the lowest of three calculations: total revenue minus cost of goods sold, total revenue minus compensation, or total revenue times 70 percent. The tax rates are 0.5 percent of the margin for entities primarily engaged in wholesale or retail trade and 1.0 percent for all other taxable entities (STPNOC 2009a). STPNOC qualifies as an "other taxable entity" and, therefore, is subject to the 1.0 percent tax rate.

Sales and Use Taxes

The State sales tax rate for Texas is 6.25 percent of the sale price of taxable goods and services. Local jurisdictions, including cities, counties, transit authorities, and some special purpose districts, may also impose a local sales tax after voter approval but may not exceed two percent altogether. The State of Texas received $18.3 billion (25 percent of its revenue) from sales tax collections in 2006 (STPNOC 2009a).

Neither Matagorda County nor the special purpose districts in the county levy sales tax. Cities in Texas may impose additional sales tax, up to the maximum of 2 percent, for the following purposes: sales tax for general fund purposes (1 percent); additional sales tax for property tax reduction (up to 0.5 percent); sales tax for street maintenance (0.25 percent); sales tax for industrial and economic development (up to 0.5 percent); and sales tax for sports and community venues (up to 0.5 percent). The cities of Bay City and Palacios in Matagorda County impose the maximum 2 percent tax rate, making the total sales tax 8.25 percent in these cities. Brazoria, Calhoun and Jackson counties all have a county tax of 0.5 percent and the larger economic centers in these counties generally have a 1.5 percent tax for a total sales tax of 8.25 percent (Texas Comptroller 2008).

The State of Texas currently imposes a 6 percent hotel occupancy tax on rooms in a hotel costing at least $15 per day; however, stays of at least 30 consecutive days are exempt from the tax. Texas received $308 million (0.4 percent of its revenue) from this tax in 2006. Cities and some counties are eligible to adopt a hotel occupancy tax on rooms costing at least $2 per day. To implement a local occupancy tax a majority vote by the governing body is required and the tax revenues must be used to directly promote tourism and the convention and hotel industry. The City of Bay City has imposed a 7 percent sales tax above the 6 percent state sales tax on eligible hotel rooms (STPNOC 2009a).

Property Taxes

Most private property owners pay property taxes to the county and a local school district; however, other local jurisdictions to whom property owners pay taxes may include the host city, hospital district, and junior college district. The sole local source of tax revenue for school districts is the property tax (STPNOC 2009a). Property values are set by the county appraisal district and the tax rate is set by the governing body of each local jurisdiction. Tax rates are expressed as an amount per $100 of assessed value. The tax levy is determined by multiplying the total taxable value by the total tax rate per $100 of value. Total tax rates can include an M&O rate (day to day maintenance and operations), an I&S rate (interest and sinking fund rate), or both (STPNOC 2009a).

Matagorda County is more likely to be impacted by property taxes related to new nuclear units at the STP site than Brazoria, Calhoun, and Jackson Counties, because the STP site is within the Matagorda County boundaries. The 2005 total county property tax rate for Matagorda County was $0.31 per $100 of assessed value, all part of the M&O rate. Matagorda County levied approximately $8.1 to $8.2 million annually in property taxes between 2001 and 2005; and the owners of the STP facility are their largest property taxpayers. For the first half of this decade, STP property tax payments to the county, excluding the hospital and special districts, represented nearly three-fourths of Matagorda County's total tax revenues. Table 2-25 presents the total property taxes collected by the county, the total property taxes the STP owners have paid to Matagorda County, and the percent of the total county property taxes that are paid by the owners (STPNOC 2009a).

Table 2-25. Matagorda County Property Tax Information, 2000-2005 (in millions of dollars)

Year	Total Taxable Value	Total County Levy	STP Payments to County[(a)]	STP Payments as % of Total[(a)]
2001	$2788	$8.18	$5.97	72.9
2002	$2559	$8.23	$6.10	74.1
2003	$2580	$8.21	$6.10	74.3
2004	$2551	$8.12	$6.10	75.1
2005	$2655	$8.19	$6.10	74.5
2006	N/A	N/A	$6.10	N/A

Source: STPNOC 2008b
(a) Reflects payments only to Matagorda County; does not include payments to the Hospital District or other special districts.

The STP owner's agreement with Matagorda County allows it to pay a service fee in lieu of property taxes with a revenue cap of $6.1 million. The owners also have a similar agreement with the local hospital district, capped at $2.7 million. The STP site is within the boundaries of four additional special taxing districts: Navigation District #1, Drainage District #3, the Palacios Seawall District, and the Coastal Plains Groundwater District. The owners pay the standard millage rates assigned by these taxing districts each year. Table 2-26 shows the districts, tax rates, and owner payments to each taxing entity for 2001 through 2006. (STPNOC 2009a).

Schools are funded solely through local property taxes. Districts are designated either "property rich" (Chapter 41) or "property poor" (Chapter 42) based on a wealth benchmark, calculated as the district's total assessed property valuation divided by the total number of students. Those districts with a total wealth per student above the State benchmark are considered Chapter 41 and those below the benchmark are Chapter 42. The Chapter 41 "property wealthy" districts are required to send a portion of their local property tax revenue in to the State for redistribution to Chapter 42 districts. As with property taxes paid to local jurisdictions, school property taxes consist of both M&O and I&S components and Chapter 41 districts are allowed to keep all I&S collections (STPNOC 2009a). Recent changes by the Texas legislature in 2006 to provide residential tax relief has placed an annual cap of Independent School District (ISD) property tax rates used to fund M&O. Under the new rules, if school boards set a property tax rate above the State cap, the rate would have to be approved in a "rollback" election. The M&O portion of the rollback tax rate is the tax rate that would needed to raise eight percent more operating funds than the previous year. The exception to the rollback election would be if a district was responding to a natural disaster (STPNOC 2008d).

Table 2-26. Property Tax Statistics for Matagorda County and Special Districts 2001-2006 (in millions of dollars)

Year	Taxing District	Rate/$100 of Assessed Valuation	Levy	Other Fees	Total STP Payment
2001	Matagorda County	$0.29	$3.36	$2.61	$5.97
	Matagorda County Hospital	0.12524	$1.43	$1.12	$2.55
	Navigation District #1	0.03981	$0.46	$0.00	$0.46
	Drainage District #3	0.019	$0.22	$0.21	$0.42
	Palacios Seawall	0.03487	$0.40	$0.37	$0.77
	Total STP Owner Payments		**$5.86**	**$4.30**	**$10.17**
2002	Matagorda County	$0.32	$2.96	$3.14	$6.10
	Matagorda County Hospital	0.1507	$1.39	$1.00	$2.39
	Navigation District #1	0.03981	$0.37	$0.00	$0.37
	Drainage District #3	0.0246	$0.23	$0.00	$0.23
	Palacios Seawall	0.0422	$0.39	$0.00	$0.39
	Coastal Plains Groundwater [2]	0.005	$0.05	$0.00	$0.05
	Total STP Owner Payments		**$5.37**	**$4.14**	**$9.51**
2003	Matagorda County	$0.32	$2.88	$3.22	$6.10
	Matagorda County Hospital	0.1614	$1.46	$1.00	$2.46
	Navigation District #1	0.03981	$0.36	$0.00	$0.36
	Drainage District #3	0.0276	$0.25	$0.00	$0.25
	Palacios Seawall	0.0454	$0.41	$0.00	$0.41
	Coastal Plains Groundwater	0.005	$0.05	$0.00	$0.05
	Total STP Owner Payments		**$5.41**	**$4.22**	**$9.63**
2004	Matagorda County	$0.32	$2.32	$3.78	$6.10
	Matagorda County Hospital	0.20999	$1.53	$1.00	$2.53
	Navigation District #1	0.03981	$0.29	$0.07	$0.36
	Drainage District #3	0.0322	$0.23	$0.02	$0.25
	Palacios Seawall	0.0454	$0.33	$0.08	$0.41
	Coastal Plains Groundwater	0.005	$0.04	$0.01	$0.05
	Total STP Owner Payments		**$4.73**	**$4.96**	**$9.69**
2005	Matagorda County	$0.31	$1.95	$4.15	$6.10
	Matagorda County Hospital	0.2124	$1.34	$1.00	$2.34
	Navigation District #1	0.03981	$0.25	$0.00	$0.25
	Drainage District #3	0.0322	$0.20	$0.00	$0.20
	Palacios Seawall	0.0354	$0.22	$0.00	$0.22
	Coastal Plains Groundwater	0.005	$0.03	$0.00	$0.03

Table 2-26. (contd)

Year	Taxing District	Rate/$100 of Assessed Valuation	Levy	Other Fees	Total STP Payment
	Total STP Owner Payments		**$4.01**	**$5.15**	**$9.15**
2006	Matagorda County	$0.27	$2.44	$3.66	$6.10
	Matagorda County Hospital	0.17214	$1.57	$1.00	$2.57
	Navigation District #1	0.03758	$0.34	$0.00	$0.34
	Drainage District #3	0.022	$0.20	$0.00	$0.20
	Palacios Seawall	0.02528	$0.23	$0.00	$0.23
	Coastal Plains Groundwater	0.00433	$0.04	$0.00	$0.04
	Total STP Owner Payments		**$4.82**	**$4.66**	**$9.48**

Source: STPNOC 2009a

STP owners pay taxes to the Palacios ISD where STP is the largest property taxpayer, representing an average of 83 percent of Palacios ISD revenues between 2000 and 2005. Palacios ISD is considered a Chapter 41 or "property wealthy" district and therefore is required to send a portion of their tax collections to the State for redistribution. Table 2-27 shows Palacios ISD's total revenues, the portion sent to the State and the STP owners' contributions between 2000 and 2005 (STPNOC 2009a).

Table 2-27. Palacios Independent School District Property Tax Revenues and Disposition 2000-2005 (in millions of dollars)

Year	Total District Revenue	STP Owner Total Pmts to ISD	STP Owner Payments as a Portion of Revenues to State	Excess Percentage (goes to State)	Revenue Remaining in District	STP Owner Portion Remaining in District	STP Owner Payments as % of Revenues Remaining in District
2000	$14.90	$12.78	$5.38	42.1%	$8.63	$7.40	85.8
2001	$15.94	$15.78	$8.54	54.1%	$7.32	$7.24	99.0
2002	$15.29	$12.94	$5.78	44.7%	$8.46	$7.15	84.6
2003	$14.92	$12.40	$5.22	42.1%	$8.63	$7.18	83.1
2004	$13.87	$10.55	$3.76	35.6%	$8.93	$6.79	76.0
2005	$12.88	$9.19	$2.72	29.6%	$9.07	$6.48	71.4
Total	**$87.80**	**$73.63**	**$31.39**			**$42.24**	

Source: STPNOC 2009a

Revenues and Expenditures

Matagorda County's total general revenues for 2006 were $17.1 million. Ninety-one percent of its general revenues are from property taxes, of which the STP owners paid $6.1 million (35.6 percent). Expenditures, including general revenues and restricted funds, were $17.9 million. Since Brazoria County is part of the Houston metropolitan area, it is more urbanized than Matagorda County. In 2006, Brazoria County's General Fund revenues were $66.5 million, with property taxes contributing 84 percent and expenditures for 2006 were $66.5 million (STPNOC 2009a). Jackson County's general revenues for 2007 were $7.2 million, with taxes representing $5.2 million and expenditures were $5.5 million (Jackson County 2008). Calhoun County's general revenues for 2007 were an estimated $22.6 million and expenditures were approximately $9.97 million (Calhoun County 2008). STP is not a significant contributor to tax revenues in Brazoria, Calhoun, or Jackson Counties.

2.5.2.3 Transportation

The STP site's transportation network includes State highways, U.S. highways, FM roads, county roads, two railroad networks, nine regional airports and a waterway via the Lower Colorado River. Public transportation in Matagorda County is provided by RTransit. RTransit provides services by appointment to the rural general public, elderly, and persons with disabilities (STPNOC 2009a). In its current configuration and mission of serving special needs, RTransit would have no impact on, and would be unaffected by, the proposed Units 3 and 4 at STP.

Roads

No interstate highways are located within the 50-mi vicinity, but there are two U.S. highways. Highway 59 runs northeast-southwest connecting Fort Bend, Wharton, Jackson and Victoria Counties and Highway 87 runs northwest-southeast and connects Victoria and Calhoun Counties. Many of the roads in the socioeconomic impact area are county roads or FM roads, which are relatively light-duty rural roads. A number of FM and county roads intersect the major highways and connect to the towns within these counties, providing outlying areas access to the State and U.S. Highway system. For example, State Highway 60 runs north-south connecting Highway 59 to FM 521, providing access to the STP site (STPNOC 2009a). Figure 2-25 presents the major road networks in the 50-mi region around the STP site, and Figure 2-26 highlights the most likely employee commuter routes to and from the site on local roads. STPNOC believes that workers commuting from Matagorda County would take one of five routes that connect to FM 521 and access the site. Table 2-28 lists the Matagorda County roadways that STP workers would use to access the plant, the Texas Department of Transportation (TXDOT) road classifications for each road, the number of lanes, the 2005 Average Annual Daily Traffic (AADT) counts at key locations and threshold capacity. Workers

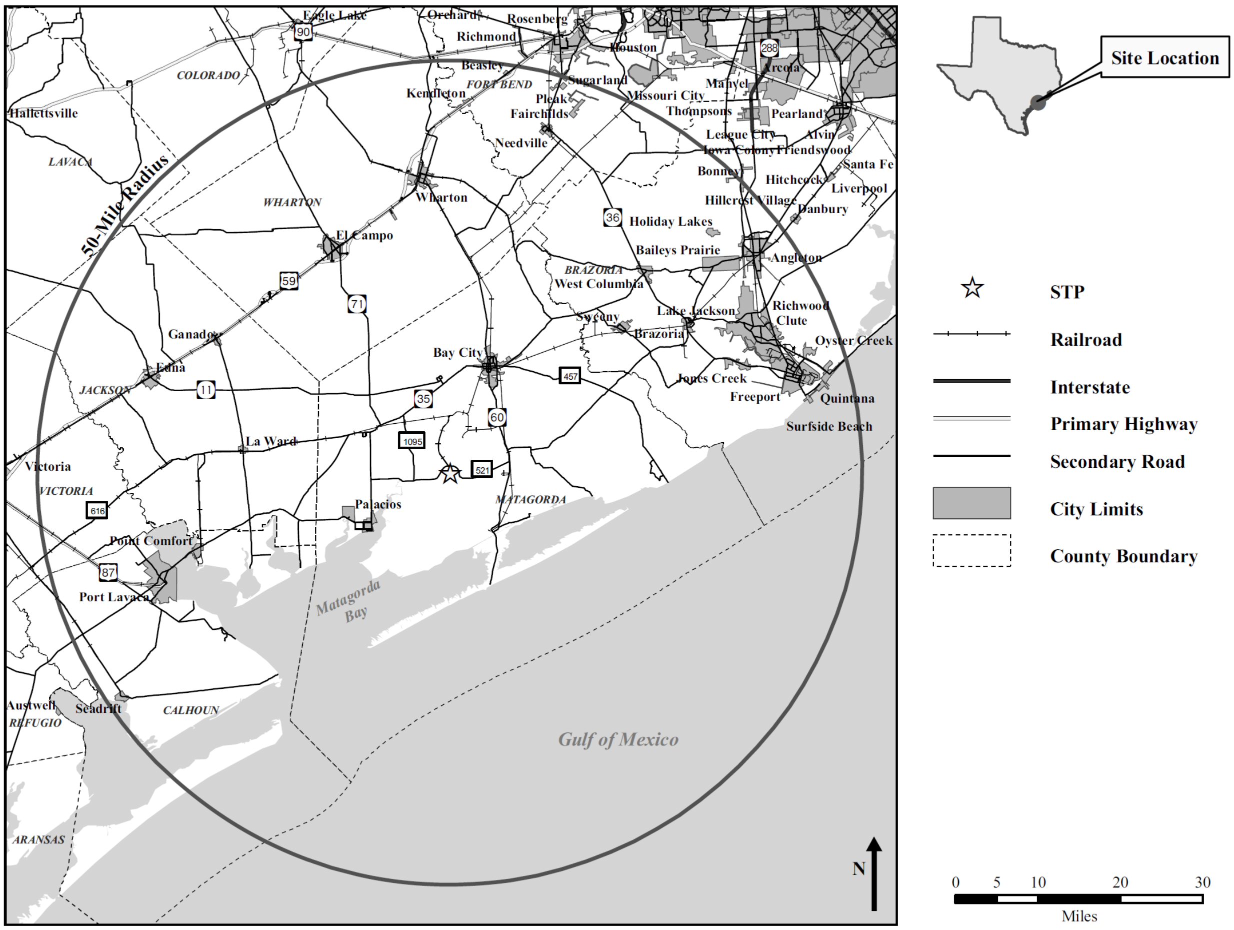

Figure 2-25. Road, Highway and Rail Transportation System (STPNOC 2009a)

commuting from the east side of Matagorda County and all of Brazoria County would likely take Highway 60 south, exiting onto FM 521 west to the STP site. From Calhoun County and Jackson Counties, workers would likely take State Highway 35 and State Highway 111, respectively before connecting to local roads near the site described in Table 2-.

Crowding on roadways is often described by Transportation Research Board “Level of Service” (LOS) designations. LOS defines the flow of traffic on a designated highway. LOS designations can range from LOS A (traffic freely flowing) to LOS F (a point where traffic flow exceeds the design capacity of the highway resulting in severe congestion). There is no Transportation Research Board LOS determination for these Texas roads; however, TXDOT does maintain capacity data for these roads in the form of usage (AADT) and functional class system (STPNOC 2008e).

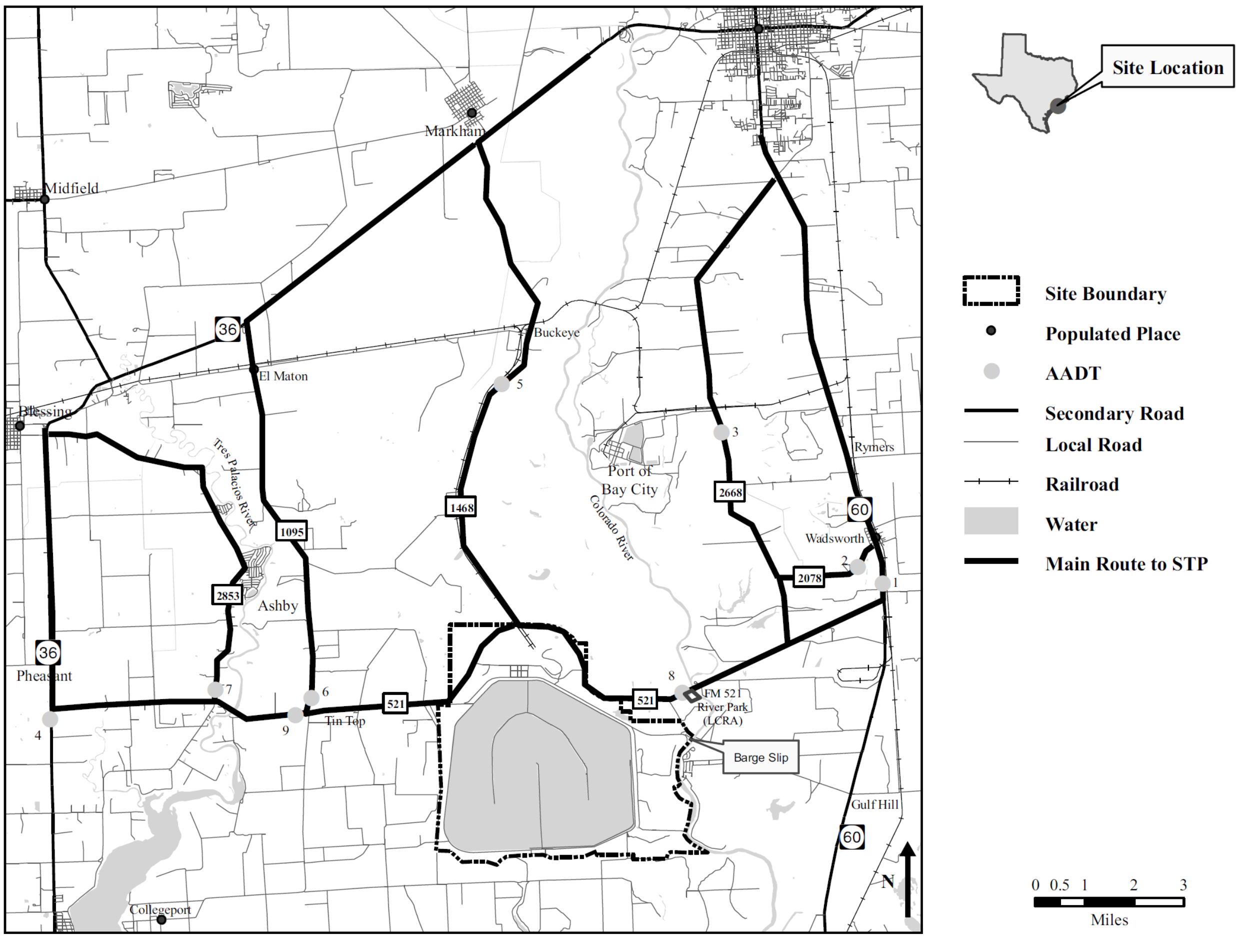

Figure 2-26. Main Routes to STP Site (STPNOC 2009a)

The 2000 Matagorda County population was 37,957 and is expected to increase by 9 percent by 2010 and 18 percent by 2020 (Table 2-18). An average outage work force of approximately 1500 to 2000 additional workers for existing STP Units 1 and 2 would use FM 521 for approximately one month during every refueling outage, scheduled for each reactor, and would add 700 to 800 vehicles per day temporarily to the traffic counts on FM 521 in Table 2-28. (STPNOC 2009a).

Rail

There is no passenger rail service in the four-county socioeconomic impact area, but there are two main freight rail lines near the STP site. The Burlington Northern Santa Fe line runs north-south, ending in Matagorda. The Union Pacific Railroad runs east-west from Brazoria County and continues westward into Jackson County, eventually turning southward along the Texas Gulf Coast and heading toward Mexico. Both lines have spurs leading to industrial facilities.

Table 2-28. Roadway Use Statistics for Most Likely Routes to the STP Site

Roadway and Location[(a)]	Number of Lanes	Type	TXDOT Road Classification	Average Annual Daily Traffic (AADT) for 2005[(b)]	Threshold Capacity (passenger cars per hour)[(c)]
Highway 60 south to FM 521 west	2	Undivided	Rural Major Collector	3880	2300
FM 2078 west to FM 2668 south	2[(d)]	Undivided	Rural Minor Arterial	450	4200
FM 2668 south to FM 521 west	2	Undivided	Rural Major Collector	1100	2300
FM 521 west to Highway 35 west	2	Undivided	Rural Major Collector	1330	2300
FM 1468 south to FM 521 east	2[(d)]	Undivided	Rural Minor Arterial	600	4200
FM 1095 south to FM 521 east	2	Undivided	Rural Major Collector	480	2300
FM 2853 south to FM 521 east	2	Undivided	Rural Major Collector	580	2300
FM 521 west	2	Undivided	Rural Major Collector	2530	2300
FM 521 east	2	Undivided	Rural Major Collector	1543	2300

Source: STPNOC 2008e
(a) The traffic counts (AADTs) identified on Figure 2-26 correspond to those listed in this table.
(b) Traffic counts for a 24-hr time period.
(c) Capacity used in travel demand modeling by TXDOT, metropolitan planning organizations, and local governments. The capacity is typically based on level of service (LOS) C (stable flow) based on the Transportation Research Board Highway Capacity Manual. LOS A or B (free flow to reasonably free flow) may also be used as the threshold capacity level in less congested urban areas.
(d) Rural Minor Arterial value form Suburban Fringe Column.

STPNOC reports that a 9 mi railroad spur that heads north from the site to the main east-west rail line is currently “out-of-service.” This line formerly served the STP site and would be repaired to support building Units 3 and 4. The only railcars with access to this railroad spur are consigned to the STP site (STPNOC 2009a). STPNOC states it would follow all environmental requirements and use protective measures while repairing the spur (STPNOC 2008e).

Waterways

The STP site is located 10 mi north of Matagorda Bay on the west side of the Lower Colorado River. The U.S. Coast Guard is the primary enforcer of regulations related to barges making STP deliveries while TPWD also patrols the river to enforce State regulations. Located on the east side of the STP site is a barge slip used for delivery of major equipment during construction of the first two units at STP. It is expected to be used for deliveries associated with proposed Units 3 and 4 (STPNOC 2009a). The STP barge slip is within tidal reaches of the Gulf of Mexico and is not impacted by seasonal low water issues (STPNOC 2008e).

Air

The closest major airport in the area is outside the 50-mi radius in Houston. There are two airports in Matagorda County and one in each of the other three counties within the economic impact region. Most of the regional airports primarily support agricultural aviation.

2.5.2.4 Aesthetics and Recreation

Table 2-29 lists the major recreation areas (state parks and WMAs) within 50 mi of the STP site. There are no major recreation facilities such as destination amusement parks or professional sports venues within 50 mi of STP. A variety of annual events are held in Bay City. These include the Matagorda County Fair and Rodeo, which takes place in March. Other annual events held in Bay City that attract outside visitors include the Bay City Chamber Annual Fishing Tournament in May, the Jazz Festival in July, the Shrimporee and Blessing of the Fleet in August, the Bull Blast in October, and the Fisherman's Festival in December (STPNOC 2009a).

Table 2-29. Wildlife Management Areas and Parks within 50 mi of the STP Site

Name	Acreage	Location	Annual Visitors	Overnight Facilities
Wildlife Management Areas				
Matagorda Island	56,688	Calhoun County	1100	Primitive Camping
Mad Island	7200	9 mi east of Collegeport – Matagorda County	1200	None
Peach Point	11,938	West of Freeport near Jones Creek, Brazoria County	2700	None
D.R. Winterman	246	Egypt, Wharton County	Less than 10	None
Mad Island Marsh Preserve	7063	South east of Collegeport, Matagorda County	1700	None
Big Boggy National Wildlife Refuge	5000	Wadsworth, Brazoria County	250	None
San Bernard National Wildlife Refuge	45,311	Matagorda and Brazoria Counties	32,000	None
Brazoria National Wildlife Refuge	43,388	Angleton, Brazoria County	35,000	None
Nannie M. Stringfellow Wildlife Management Area	3664	8 mi from Brazoria, Brazoria County	300	None
Parks				
Brazos Bend State Park	5000	Needville, Fort Bend County	206,000	Campsites with water and electricity
LCRA Hollywood Bottom	36	Along the Colorado River south of Wharton, Wharton County	3700	Camping with limited facilities
LCRA Matagorda Bay Nature Park	1600	Mouth of the Colorado River on the Matagorda Peninsula -Matagorda County	25,000[(a)]	Tent camping on beach 70 site RV-park with full utility hook-ups
LCRA FM-521 River Park	13	4 mi west of Wadsworth on FM 521-Matagorda County	3000	None

Source: STPNOC 2008d
(a) This number reflects how many overnight RV stays that have occurred since the park opened.

The closest state park to the STP site is Brazos Bend in Needville (Fort Bend County), approximately 35 mi from the STP site. Birding is a major tourist attraction in the 50-mi STP region and Matagorda County has ranked first in the North American Audubon CBC for the past nine years. The Great Texas Coastal Birding Trail goes through many areas within 50 mi of STP and 14 State-recognized birding sites are located in Matagorda County. These sites include pull-outs along FM 2031 (as well as other local roads) and the Matagorda County Birding Nature Center, with trails and observation platforms (TPWD 2009c). With its 110 ac of man-made seasonally flooded prairie wetlands that host many species of wintering ducks and roosting geese, the STP site is a stop along the Birding Trail. There is an observation area and tours are available through the Visitors Center. Migrant shorebirds and other water birds can be seen onsite in the spring (STPNOC 2009a).

The Matagorda Bay area recreation activities include camping, hiking, bicycling, surfing, swimming, beach combing, bird watching, nature study, fishing, passenger ferry, on-island shuttle and scheduled tours. With the exception of peak times, Matagorda Beach and Sargent Beach receive less than 100 visitors a day. There are two local outfitters providing guided tours of the Colorado River and an annual fishing tournament that occasionally uses the Colorado River (STPNOC 2008a).

Existing STP Units 1 and 2 do not have cooling towers. Instead, they have a 7000-ac MCR. The 13-mi embankment of the MCR is visible from the southeast along the Colorado River and other points surrounding the site. The tallest structures on the site are the 145-ft high reactor containment domes, which are visible from FM 521, the closest road to the site. They are also visible from secondary roads from points 6.5 to 7 mi to the southwest. The terrain surrounding the site is rather flat and treeless, so there is little to screen the site from area roadways. No STP site facilities can be seen from Matagorda Bay, the Intracoastal Waterway or from any of the recreation areas listed in Table 2-29 (STPNOC 2009a).

2.5.2.5 Housing

Approximately 86 percent of current STP 1 and 2 employees reside in Brazoria (22.4 percent), Calhoun (1.6 percent), Jackson (1.3 percent) and Matagorda (60.7 percent) counties. An additional 14 percent are distributed across at least 16 other counties (see Table). Within 50 mi of the proposed site, there are residential areas in and near cities and towns, smaller communities, and farms.

Rental property is scarce in the rural areas of the region, but is available in the larger municipalities such as Bay City, Palacios, Edna, Port Lavaca, Angleton, Pearland, Alvin, and the Brazosport CCD (Lake Jackson-Clute-Freeport) area. In the vicinity of the STP site, housing structures are generally isolated, single-family homes. Newer residential developments are primarily associated with the towns or cities in the socioeconomic impact area.

Table 2-30 provides the number of housing units and vacancies for the four-county socioeconomic impact area: Brazoria, Calhoun, Jackson, and Matagorda. While some more recent data are available for some larger counties in Texas, this was not true for all of the four counties of interest. Consequently, year 2000 data are presented in this analysis for consistency across counties. While the review team believes the data will differ between 2000 and when building begins, the review team also believes that most of the housing markets would be larger and more able to accept additional population and, therefore, use of more current population data would not change the conclusions of this report. In 2000, there were a total of 126,022 housing units in the socioeconomic impact area, with an average vacancy rate of 13.8 percent. The vacancy rates for Calhoun, Jackson, and Matagorda counties were higher than the average rate for the four-county socioeconomic impact area, while the vacancy rate for Brazoria County was lower than the average (USCB 2000a).

Table 2-30. Regional Housing Information by County for the Year 2000

County	Total Housing Unit	Occupied	Owner Occupied	Renter Occupied	Vacant Housing	Percent Vacancy
Brazoria	90,628	81,954	60,674	21,280	8674	9.6%
Calhoun	10,238	7442	5417	2025	2796	27.3%
Jackson	6545	5336	3936	1400	1209	18.5%
Matagorda	18,611	13,901	9282	4619	4710	25.3%
Total	**126,022**	**108,633**	**79,309**	**29,324**	**17,389**	**13.8%**

Source: USCB 2008a

Of 4710 vacant housing units in Matagorda County in 2000, 685 were for rent and 244 were for sale. Also, of the 4710 vacant units, 709 were mobile homes and 224 were in the category of RVs, boats, vans, etc. Of 8674 vacant housing units in Brazoria County, 3168 were for rent and 984 were for sale. Of the 8674 vacant units, 1535 were mobile homes and 176 were in the category of RVs, boats, vans, etc (STPNOC 2009a). Of 2796 vacant housing units in Calhoun County in 2000, 385 were for rent and 114 were for sale. Also, of the 1209 vacant units, 518 were mobile homes and 38 were in the category of RVs, boats, vans, etc. Of 1209 vacant housing units in Jackson County in 2000, 256 were for rent and 67 were for sale. Also, of the 2796 vacant units, 204 were mobile homes and 14 were in the category of RVs, boats, vans, etc. (USCB 2000c, d, e, f, g, h). A total of 5903 vacant housing units were available for sale or rent in the two counties.

Vacant housing units for seasonal, recreational, or occasional use were approximately 2407 in Matagorda County, 1496 in Brazoria County, 1751 in Calhoun County and 228 in Jackson County. Hotel/Motel data for the four-county socioeconomic impact area in 2006 is presented in Table 2-20 (STPNOC 2009a; USCB 2000c, d, e, f, g, h). There were approximately 1099 hotel rooms per night available with an average occupancy of about 54 percent.

2.5.2.6 Public Services

Water Supply and Waste Treatment

The STP site consumed 422 million gallons of water in 2005 from five onsite groundwater wells. Approximately five percent of this water was used for sanitary and drinking uses. From 2001 through 2006 STP used approximately 1.1 million gallons per day (MGD) on average for all purposes pertaining to existing STP Units 1 and 2. The STP site is permitted to withdraw an average of 2.7 MGD (STPNOC 2009a).

Water assessment and planning in Texas is performed on a regional basis rather than a county or city basis and all four counties in the socioeconomic impact area are in different planning regions. Each region is made up of several different counties and is represented by a Regional Water Planning Group, composed of representatives from a variety of interests that prepares a regional water plan for the region. Matagorda County is in Region K. Brazoria County is located in Region H, which also includes the City of Houston. Calhoun County is located in Region L (includes San Antonio) and Jackson County is located in Region P. Below is a brief overview of each region's water issues from 2010 to 2060. More information on surface water and groundwater issues can be found in Section 2.3.

Region K's population is projected to increase nearly 100 percent between 2010 and 2060 to 2.7 million people (representing 5 percent of the projected Texas population); however, water demands are not projected to increase as significantly. Water demand in 2060 for Region K is expected to be about 1.3 million ac-ft, up slightly from the 2010 level of about 1.1 million ac-ft. The Colorado River and its tributaries are the primary surface water supply sources and five primary aquifers provide groundwater supplies. Due to reservoir sedimentation and expired water supply contracts, Region K expects its total water supply to decrease from 1.18 million ac-ft in 2010 to 888,000 ac-ft in 2060. Water demand would be 400,000 ac-ft more than water supply. However, water management strategies for Region K are expected to provide 860,000 ac-ft of additional water supply by 2060. Water management strategies for Region K to meet 2060 demand include reuse, seawater desalination, conservation and the LCRA-SAWS Water Project. The LCRA-SAWS Water Project includes off-channel reservoirs, agricultural water conservation, additional groundwater development, and new and/or amended surface water rights (STPNOC 2009a).

Region H population is expected to represent 23 percent of the State's population in 2010 (5.8 million people) and increase 89 percent to 10.9 million people in 2060. Total water demand is projected to be 2.3 million ac-ft in 2010 and 3.4 million ac-ft in 2060. Total water supply is projected to decrease due to reduced supplies in the Gulf Coast Aquifer because of district subsidence regulations from 2.71 million ac-ft in 2010 to 2.56 million ac-ft in 2060. Region H plans to meet the 2060 deficit of 800,000 ac-ft using several water management strategies including reuse, seawater desalination and conservation. These strategies are expected to provide 1.3 million ac-ft of water by 2060 (STPNOC 2009a).

Although Region L population is expected to increase approximately 75 percent between 2010 and 2060, water demand is expected to increase less dramatically. Water demand is projected to increase from 985,000 ac-ft in 2010 to 1.27 million ac-ft in 2060, while year 2060 water supplies are projected to be 1.02 million ac-ft. Region L water management plans to compensate for this deficit include coordinated use of surface water and groundwater, reuse, groundwater and seawater desalination, conservation and the LCRA-SAWS Water Project. These strategies are expected to provide 730,000 ac-ft of additional water by 2060 (TWDB 2006c).

Region P population is expected to remain relatively stable between 2010 and 2060 (less than 50,000). Water demand is expected to decrease slightly during that same period. Region P is projected to see a decrease in water demand from 226,000 ac-ft in 2010 to 207,000 ac-ft in 2060. The total water supply is estimated to remain constant at 209,000 ac-ft per year throughout the 2010 to 2060 time period. Region P is expected to meet their 2010 deficit by pumping additional groundwater during the irrigation season, then allowing water levels to recover. Water management plans for Region P include conservation for municipal users only, the continued use of good agricultural practices, and fees for groundwater export out of the region (TWDB 2006a).

Table 2-31 describes water suppliers in the four-county socioeconomic impact area, their current capacities, and their average daily production. Currently, there is excess production capacity in water supply facilities.

Local governments provide wastewater treatment and TCEQ regulates it. Plant capacity is based on an average usage over a period of time and therefore, short-term usage may exceed the overall capacity (STPNOC 2008d). Once a plant has exceeded 75 percent of permitted average daily or annual average flow for three consecutive months, the permitted plant must begin engineering and financial planning for expansion/upgrades of the facility. Once the facility reaches 90 percent of permitted average daily flow for three straight months, it must obtain TCEQ authorization to begin building. There are a few systems in the area which have occasionally exceeded permitted capacity, but none that have done so for 3 months in a row. Table 2-32 details public wastewater treatment facilities in the socioeconomic impact area, the average flow rates for their plant designs, and their average monthly processing. The rural areas of each county are on septic systems (STPNOC 2009a).

Table 2-31. Water Supply, Capacity, and Average Daily Consumption by Major Water Supply Systems in Matagorda and Brazoria Counties

System Name	Population Served[(a,b)]	Primary Water Source[(b)]	Total Production (MGD)[(c)]	Max Purchased Capacity (MGD)[(c)]	Average Daily Consumption (MGD)[(c)]
		Brazoria County			
City of Alvin	17,916	Groundwater	8.739	4.75	1.307
City of Angleton	19,167	Purchased Surface Water	5.112	2.016	1.91
City of Clute	13,836	Purchased Surface Water	2.08	0	0.361
City of Freeport	25,058	Purchased Surface Water	0	2	1.4
City of Lake Jackson	25,890	Purchased Surface Water	6.696	2	3.1
City of Pearland	56,877	Purchased Surface Water	13.54	0	3.14
County Subtotal	*158,744*		*36.167*		*11.218*
		Calhoun County			
Calhoun County Rural Water System	3705	Purchased Surface Water	2.26	0	0.205
City of Point Comfort	2751	Surface Water	1.152	0	0.128
City of Port Lavaca	13,269	Purchased Surface Water	0	2	1.14
City of Seadrift	2331	Groundwater	2.304	0	0.104
Port O'Connor MUD	3810	Purchased Groundwater	1.044	0	N/A
County Subtotal	*25,866*		*6.76*		*1.577*
		Jackson County			
City of Edna	5899	Groundwater	3.16	0	0.544
City of Ganado	1847	Groundwater	2.923	0	0.199
Jackson County WCID 1	741	Groundwater	0.346	0	0.047
Jackson County WCID 2	480	Groundwater	0.324	0	0.057
County Subtotal	*8967*		*6.753*		*0.847*
		Matagorda County			
City of Bay City	19,263	Groundwater	8.856	4.403	2.409
City of Palacios	5100	Groundwater	1.973	1.224	0.542
County Subtotal	*24,363*		*10.829*		*2.951*

Sources: STPNOC 2007; EPA 2008; TCEQ 2008b
(a) Data selected based on major populations served per county. Year of data not provided. Data extracted from TCEQ database that is updated continuously.
(b) EPA 2008.
(c) TCEQ 2008b.
WCID = Water Control and Improvement District, MUD = Municipal Utilities Department.

Table 2-32. Designed Capacity and Maximum Water Treated in Wastewater Treatment Systems in Brazoria, Calhoun, Jackson, and Matagorda Counties

System Name	Plant Designed Average Flow (MGD)	Average Wastewater Processed (MGD)	Time Period
Brazoria County			
Oak Manor MUD	0.080	0.026	January 2006 – December 2006
City of Sweeny	0.975	0.396	January 2006 – December 2006
City of Alvin	5.000	2.396	January 2006 – December 2006
Commodore Cove Improvement District	0.060	0.024	January 2006 – December 2006
City of Brazoria	0.750	0.422	January 2006 – December 2006
City of Lake Jackson	4.000	2.868	January 2006 – December 2006
City of West Columbia	1.600	0.646	January 2006 – December 2006
Brazoria County FWSD No. 1	0.140	0.034	January 2006 – December 2006
City of Pearland (STP No. 2)	3.100	1.517	January 2006 – December 2006
City of Pearland (STP No. 3)	1.750	1.692	January 2006 – December 2006
City of Freeport	2.250	0.839	January 2006 – December 2006
City of Freeport	0.300	0.008	January 2006 – December 2006
City of Clute	4.000	2.713	January 2006 – December 2006
City of Hillcrest Village	0.150	0.082	January 2006 – December 2006
City of Angleton	3.600	1.465	January 2006 – December 2006
City of Angleton	0.250	0.093	January 2006 – December 2006
City of Danbury	0.504	0.157	February 2006 – November 2006
City of Oyster Creek	0.500	0.194	January 2006 – December 2006
City of Pearland	0.950	0.457	January 2006 – December 2006
Brazoria County MUD No. 3	2.400	1.064	January 2006 – December 2006
City of Pearland	2.000	1.394	January 2006 – December 2006
City of Pearland	0.250	0.341	January 2006 – December 2006
City of Manvel Outfall 001A and Outfall B	0.100	0.060	January 2006 – December 2006
Brazoria County MUD 21	0.250	0.125	January 2006 – December 2006

Table 2-32. (contd)

System Name	Plant Designed Average Flow (MGD)	Average Wastewater Processed (MGD)	Time Period
Calhoun County			
City of Point Comfort	0.2	0.057	September 2006 – August 2007
City of Port Lavaca	1.5	1.24	October 2006 – September 2007
City of Seadrift	0.3	0.15	September 2006 – August 2007
Port O'Connor MUD	0.6	0.11	September 2006 – August 2007
Guadalupe-Blanco River Authority	0.03	0.009	September 2006 – August 2007
South-Central Calhoun County W.	0.075	0.021	August 2006 – July 2007
Jackson County			
City of Edna	1.8	0.713	September 2006 – August 2007
City of Ganado	0.35	0.201	September 2006 – August 2007
City of La Ward	0.013	0.0017	September 2006 – August 2007
Jackson County WCID No. 1	0.062	0.042	August 2006 – July 2007
Jackson County WCID No. 2	0.045	0.045	October 2006 – September 2007
Matagorda County			
City of Palacios	0.800	0.512	January 2006 – December 2006
Matagorda County WCID No. 6	0.193	0.065	January 2006 – December 2006
City of Bay City	4.300	2.420	January 2006 – December 2006
Markham MUD	0.300	0.042	January 2006 – December 2006
Matagorda County WCID No. 5	0.075	0.046	January 2006 – December 2006
Beach Road MUD	0.050	0.027	January 2006 – December 2006
Lower Colorado River Authority	0.025	0.003	August 2006 – December 2006

Sources: STPNOC 2009a and Exelon Generation 2008
WCID = Water Control and Improvement District.
MUD = Municipal Utilities Department.
N/A = Not Available.

Police, Fire and Medical

The Matagorda County Emergency Management Office is the lead agency responsible for emergency management planning in Matagorda County and coordinates with both the Governor's Division of Emergency Management and the STP Emergency Response Organization when responding to emergencies. Table 2-33 and Table 2-34 provide police and fire information for the four county socioeconomic impact area. Emergency management officials consider police and fire protection adequate at this time (STPNOC 2009a).

1 **Table 2-33**. Law Enforcement Personnel 2005

Political Jurisdiction	Total Law Enforcement Employees	Total Police Officers[(a)]	Total Civilians[(b)]
Brazoria County			
Brazoria County	279	164	115
Alvin	70	43	27
Angleton	47	36	11
Brazoria	10	6	4
Clute	31	22	9
Danbury	1	1	0
Freeport	36	27	9
Lake Jackson	58	43	15
Manvel	10	8	2
Oyster Creek	9	5	4
Pearland	121	91	30
West Columbia	15	8	7
Total	687	454	233
Calhoun County			
Calhoun County	56	22	34
Point Comfort	1	1	0
Port Lavaca	25	19	6
Seadrift	2	2	0
Total	84	44	40
Jackson County			
Jackson County	24	14	10
Edna	11	9	2
Ganado	4	3	1
Total	39	26	13
Matagorda County			
Matagorda County	70	40	30
Bay City	45	33	12
Palacios	20	15	5
Total	135	88	47
Total All Counties	**945**	**612**	**333**

Source: FBI 2006

(a) Individuals who ordinarily carry a badge and a firearm and have full arrest powers.

(b) Personnel such as clerks, radio dispatchers, stenographers, jailers, and mechanics.

Table 2-34. Fire Protection Personnel[a]

Fire Dept Name	Dept Type	Number of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non Firefighting (Civilian)	Non Firefighting (Volunteer)
Brazoria County							
Alvin Volunteer Fire Department	Volunteer	2	0	65	0	2	0
Angleton Fire Department	Volunteer	3	0	34	0	0	0
Brazoria Fire Dept	Volunteer	1	0	26	0	0	0
Brookston Volunteer Fire Department	Volunteer	1	0	10	0	0	2
Clute Volunteer Fire Department	Volunteer	2	0	31	0	0	1
Columbia Lakes Volunteer Fire Department	Volunteer	1	0	16	0	0	0
County Road 143 Volunteer Fire Department	Volunteer	1	0	12	0	0	4
Damon Volunteer Fire Department	Volunteer	1	0	12	0	0	4
Demi-John Volunteer Fire Department	Volunteer	1	0	16	0	0	6
Freeport Fire Department	Mostly Volunteer	2	9	15	0	0	0
Iowa Colony Volunteer Fire Department	Volunteer	1	0	16	0	0	5
Jones Creek Volunteer Fire Department	Volunteer	1	0	20	0	0	0
Lake Jackson Volunteer Fire Department	Volunteer	2	0	52	0	0	5
Liverpool Volunteer Fire Department	Volunteer	1	0	12	0	0	6
Manvel Volunteer Fire Department	Volunteer	2	0	23	5	0	0
Old Ocean Volunteer Fire Department	Volunteer	2	0	14	0	0	0
Pearland Volunteer Fire Department	Volunteer	4	0	55	0	0	0
River's End Volunteer Fire Department	Volunteer	1	0	10	0	0	20
Rosharon Volunteer Fire Department	Volunteer	1	0	14	0	0	0
Surfside Volunteer Fire Department	Mostly Volunteer	1	1	8	0	0	5
Sweeny Fire and Rescue	Volunteer	1	0	30	0	0	10
The Danbury Volunteer Fire Department	Volunteer	1	0	14	0	1	0
Wild Peach Volunteer Fire Department	Volunteer	1	0	21	0	0	0

Table 2-34. (contd)

Fire Dept Name	Dept Type	Number of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non Firefighting (Civilian)	Non Firefighting (Volunteer)
Calhoun County							
Magnolia Beach Volunteer Fire Department	Volunteer	1	0	11	0	0	2
Olivia-Port Alto Volunteer Fire Department	Volunteer	1	0	20	0	0	0
Port Lavaca Fire Department	Mostly Career	2	16	11	0	1	0
Port O'Connor Volunteer Fire Department	Volunteer	1	0	20	0	0	10
Seadrift Volunteer Fire Department	Volunteer	1	0	15	0	0	2
Thomaston Volunteer Fire Department	Volunteer	1	0	8	0	0	12
Jackson County							
Edna Fire Department	Mostly Volunteer	1	8	22	0	1	0
Ganado Volunteer Fire Department	Volunteer	1	0	0	26	0	0
La Ward Volunteer Fire Department	Volunteer	1	0	15	0	0	3
Matagorda County							
Bay City Volunteer Fire Department	Volunteer	1	0	46	0	0	0
Blessing Voluntary Fire Department	Volunteer	1	0	12	0	0	0
Carancahua Volunteer Fire Department	Volunteer	1	0	12	0	0	8
Markham Volunteer Fire Department	Volunteer	1	0	20	0	0	5
Matagorda Volunteer Fire Department	Volunteer	2	0	22	0	0	25
Midfield Volunteer Fire Department	Volunteer	1	0	17	0	0	25
Palacios Volunteer Fire Department	Volunteer	2	0	25	0	0	0
Van Vleck Volunteer Fire Department	Volunteer	1	0	8	0	0	0
Total All Counties		**54**	**34**	**810**	**31**	**5**	**160**

Source: USFA 2008

(a) Data is from the U.S. Fire Administration National Fire Department Census. Responses are voluntary and the USFA estimates that, as of 2008, approximately 85% of the nation's fire departments have responded.

Table 2-35 presents hospital use and medical practitioner data by county. There are a total of eight hospitals in the four county socioeconomic impact areas. Four of those hospitals are in Brazoria County, with over 213 beds and 766 physicians. Calhoun and Jackson counties each have one hospital with 25 and 54 staffed beds and 20 and 4 doctors respectively. Matagorda County has two hospitals with 83 staffed beds and at least 41 doctors.

Table 2-35. Hospital Data for Brazoria, Calhoun, Jackson and Matagorda Counties

Facility Name	Staffed Beds	Admissions [(a)]	Census [(b)]	Outpatient Visits [(a)]	Personnel [(c)]	No. of Physicians
Brazoria County						
Alvin Diagnostic and Urgent Care Center	NA	NA	NA	NA	NA	NA
Angleton Danbury Medical Center	43	2385	21	46,745	257	NA
Brazosport Regional Health System	156	5812	61	107,883	491	NA
Sweeny Community Hospital	14	274	2	15,560	123	NA
Total	213	8471	84	170188	871	766
Calhoun County						
Memorial Medical Center	25	1385	13	29,674	349	NA
Total	25	1385	13	29674	349	20
Jackson County						
Jackson County Hospital District	54	403	32	NA	108	NA
Total	54	403	32	NA	108	4
Matagorda County						
Matagorda County General Hospital	66	2222	21	34,912	329	NA
Palacios Community Medical Center	17	391	2	5846	27	NA
Total	83	2613	23	40,758	356	41
Total All Counties	**375**	**12872**	**152**	**240,620**	**1684**	**831**

Sources: STPNOC 2009a and Exelon Generation 2008
(a) Total during a recent 12-month period.
(b) Average daily census during a recent 12-month period.
(c) Hospital personnel list does not include doctors that serve patients in the hospital, but are not employed by the hospital.
NA – Not Available.

Low-income residents are able to access low-cost medical care through two organizations in Matagorda County: the Matagorda County Hospital District Public Health Clinic (Public Health Clinic) and the Matagorda Episcopal Health Outreach Program. The Public Health Clinic is a county organization that assists residents through three programs: the Indigent Care Program, the Low-Income Program, and Reduced Rates for the Uninsured Program. The Matagorda Episcopal Health Outreach Program is funded and operated by a faith-based non-governmental organization and provides mobile medical services to low-income and uninsured populations. Low-income residents in Brazoria, Calhoun and Jackson counties are able to access low-cost care from the County Health Department (STPNOC 2009a).

Social services in the four-county socioeconomic impact area are provided by State and local governmental and non-governmental organizations. The United Way helps support many organizations in the four counties. STPNOC executives and employees have been active in many of these same organizations. The primary state-level organization that provides social services is the Texas Health and Human Services Commission. The Commission oversees the Department of Aging and Disability Services, the Department of Assistive and Rehabilitative Services, the Department of Family and Protective Services, and the Department of State Health Services, which, collectively, provide the following services: Medicaid, Children's Health Insurance Program, Temporary Assistance for Needy Families, Food Stamps and Nutritional Programs, Family Violence Services, Refugee Services, and Disaster, Assistance (STPNOC 2009a). Table 2-36 shows the list of United Way agencies in Matagorda County, together with their client bases and their funding.

Education

A total of 17 school districts with 136 schools supported a 2005-2006 student enrollment of 69,709 (Table 2-37) (NCES 2008) in the socioeconomic impact area. In addition, there are 12 private schools with a 2005-2006 student enrollment of approximately 1496 students. There are two colleges approximately 50 mi from the STP site (STPNOC 2009a). The public school systems in the four-county socioeconomic impact area are organized into ISDs. Table 2-37 and Table 2-38 provide summary data on the public and private schools, respectively, in the four-county socioeconomic impact area.

Brazoria County has the largest number of school districts and the most expansion, because Houston is encroaching on it. Alvin ISD expects its population to double in the next 10 years. Local school officials at Angleton ISD stated they would have extra capacity with the new construction and renovation plans currently underway and Columbia-Brazoria ISD stated they already have extra capacity. Bay City ISD is likely to be impacted more than other districts due to the proximity of the STP site. Local officials at Bay City ISD stated that facilities currently are adequate and that they have a new high school, though they also note that, depending on the age and location of in-migrating children, portable buildings may be needed (Scott and Niemeyer 2008. Capacity data were not available on the private schools in the socioeconomic impact area, although student–teacher ratios were available. Private schools do not have the same obligation to serve as public schools, so their prospective enrollment levels and capacities are more optional.Brazosport College awards both Baccalaureate and Associate Degrees and is approximately 54 mi from STP in Lake Jackson, Texas. The college's 2007 enrollment in both credited and non credit courses was 34,484 (Brazosport College 2008). Wharton County Junior College awards Associate Degrees. The main campus, which had a 2006 enrollment of 6089, is located approximately 55 mi from STP in Wharton, Texas (STPNOC 2009a). A branch campus of Wharton County Junior College opened in Bay City in 2008. Due to the current aging workforce at nuclear power plants and the expansion of the STP plant, the branch campus offers a program in Nuclear Power Technology (WCJC 2008).

Table 2-36. United Way Agencies of Matagorda County

Matagorda County United Way Agencies	Number of Clients Last Fiscal Year	% Budget From United Way For 2001	$ Received From United Way & Grants Received Using United Way Funding As Matching Funds	% Of Budget From United Way & Grants Matched By United Way Funds
Matagorda County United Way & HELPLINE	9000	100%	$30,000	100%
American Red Cross- Bay City Chapter	17,000	45%	$49,500	51%
Association for Retarded Citizens	69	48%	$31,000	48%
Bay City Day Care	400	7%	$32,500	10%
Bay City Community/ Salvation Army Food Pantry	9000	32%	$4500	32%
Boy Scouts	1132	1%	$10,000	1%
Boys & Girls Club-Palacios	369	19%	$46,000	95%
Caring & Sharing Food Pantry	10,332	26%	$12,000	53%
Court Appointed Special Advocates	746	16%	$93,900	99%
Council on Substance Abuse	1321	3%	$473,454	99%
DARE-BCISD	2000	3%	$1000	3%
DARE-TISD	600	3%	$1000	3%
Economic Actions Committee	2043 utilities/nutrition	8%	$45,617	12%
4-H Marine---Sea Masters	142	25%	$1000	25%
Friends of Elder Citizens	425 daily meals	9%	$423,000	76%
Girl Scouts	224	1%	$9500	1%
Kids in Distress	25	79%	$11,695	84%
Literacy Volunteers of America	62	30%	$34,500	100%
Matagorda Episcopal Hospital Outreach Program	2657	6%	$68,862	24%
Rainbow Land Day Care	70 daily	23%	$55,580	100%
Salvation Army - Bay City Service Unit	1228	10%	$29,757	25%
Teen Court	1685	19%	$85,000	100%
Women's Crisis Center	1600	6%	$510,793	91%
Total Dollars Received			$2,060,158	

Source: Matagorda County United Way, as reported in STPNOC 2008b

Table 2-37. Public School Statistics in the Four-County Socioeconomic Impact Area, 2005-2006

	Schools	Students	Student Teacher Ratio	Capacity	Available Capacity
Brazoria County					
Alvin ISD	20	13,266	15.7	(a)	(b)
Angleton ISD	13	6444	16.1	8700	2300
Brazosport ISD	21	13,260	15.9	13,043+	(b)
Columbia-Brazoria ISD	6	3056	15.2	3450 to 3600	400–500
Damon ISD	2	164	12.2	164	0
Danbury ISD	4	759	13.4	Not available	(c)
Pearland ISD	21	15,543	17	19,500	4000
Sweeny ISD	4	2086	15.2	2,300+	200+
Calhoun County					
Calhoun County ISD	9	4326	16	Not available	Not available
Jackson County					
Edna ISD	5	1472	13.5	Not available	(d)
Ganado ISD	2	658	11.8	Not available	Not available
Industrial ISD	4	989	11.5	Not available	Not available
Matagorda County					
Bay City ISD	8	4140	14	4600	500
Matagorda ISD	1	56	7	112	56
Palacios ISD	6	1638	13.9	Not available	(e)
Tidehaven ISD	5	889	11.9	1050	161
Van Vleck ISD	5	963	12	Not available	Not available
Total	**136**	**69,709**	**-**		

Sources: NCES 2008 and STPNOC 2009a
(a) Student population expected to nearly double in the next 10 years. Extensive building development program is underway.
(b) Some excess capacity once ongoing building program completed.
(c) District is in the process of preparing a facilities study. New construction expected in the next 5 years.
(d) District just completed construction of a new elementary school.
(e) District is in the process of preparing a facilities study.

STPNOC has partnered with community leadership, ISD leaders, educators, colleges, business owners, and other industry in the development of a community- and regional-based education alliance called the Gulf Coast Industry Education Alliance. Their goal is to have a “Grow Your Own” community-based workforce. They are accomplishing this by working with the region’s middle schools and high schools to get students in the right classes for a career in nuclear energy. The Alliance also works with State and national funding agencies to identify available funds for expanding existing laboratories, developing student skills, and attracting and retaining of teachers (STPNOC 2009a).

Table 2-38. Private School Statistics in the Four-County Socioeconomic Impact Area, 2005-2006

Private School	Location	Grade Levels	Enrollment	Student/ Teacher Ratio
Brazoria County				
Brazosport Christian School	Lake Jackson	pK-12	293	9.7
Carden-Jackson School	Pearland	pK-8	118	8.7
Columbia Christian School	West Columbia	pK-12	88	8.6
Hope Christian Learning Center	Pearland	8-12	7	7
Living Stones Christian School	Alvin	K-12	207	9.7
Montessori School of DT	Pearland	pK-1	63	12.7
Our Lady Queen of Peace Catholic School	Richwood	pK-8	311	9.5
Pearland Heritage Christian Academy	Monaville	K-7	26	6.5
St. Helen Catholic School	Pearland	K-8	249	17.2
Sweeny Christian School	Sweeny	pK-5	67	10.5
Calhoun County				
Our Lady of the Gulf Catholic School	Port Lavaca	K-8	67	NA[a]
Jackson County				
None				
Matagorda County				
Holy Cross School	Bay City	pK-6	133	12.4
Total			**1496**	

Source: STPNOC 2008a
(a) This information is not available.

2.6 Environmental Justice

Environmental justice refers to a Federal policy established under Executive Order 12898 that requires each Federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations (59 FR 7629).[a] The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040).

(a) 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. To see the US Census definition and values for 2000, visit the US Census website at: http://ask.census.gov/.

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 50-mi region surrounding the site. The characterization in this section forms the analytical baseline from which the determination of potential environmental justice effects would be made. The characterization of populations of interest 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, such as Native American settlements.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the STP site, employing a geographic information system and the 2000 Census to identify minority and low-income populations. The review team verified its analysis by field inquiries to numerous agencies and groups (Appendix B).

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 block group whether the percentage of any minority or low-income population is great enough to identify that block group as a minority or low-income population of interest. If either of the two criteria discussed below is met for a census block group, that census block group is considered a minority or low-income population of interest warranting further investigation. The two criteria are whether:

- the population of interest exceeds 50 percent of the total population for the block group or
- the percentage of the population of interest is 20 percent (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 two part criteria is not in and of itself sufficient for the review team to conclude that disproportionately high and adverse impacts exists. Likewise, the lack of census block groups meeting the above criteria cannot be construed as evidence of no disproportionately high and adverse impacts. Accordingly, the review team also conducts an active public outreach and on-the-ground investigation in the region of the plant to determine whether minority and low-income populations may exist in the region that are not identified in the census mapping exercise. To reach an environmental justice conclusion, starting with the identified populations of interest, the review team must investigate all populations in greater detail to determine if there are potentially significant environmental impacts that may have disproportionately high and adverse effects on minority or low-income communities. To determine whether disproportionately high and adverse effects may be present, the review team considers the following:

Health 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

4. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
5. Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those on the general population?
6. Do the environment effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard? (NRC 2007a)

If this investigation in greater detail does not yield any potentially disproportionate and adverse impacts on populations of interest, the review team may conclude that there are no disproportionately high and adverse affects. If, however, the review team finds any potentially disproportionate and adverse effects, the review team would fully characterize the nature and extent of that impact and consider possible mitigation measures that may be used to lessen that impact. The remainder of this section discusses the results of the search for potentially affected populations of interest.

Minority Populations: Census data for Texas characterizes 11.5 percent of the population as Black, 0.6 percent as American Indian or Alaskan Native, 2.7 percent as Asian, 0.1 percent as Native Hawaiian or other Pacific Islander, 11.7 percent as some other race, 2.5 percent as multiracial, 29 percent aggregate of minority races and 32 percent as Hispanic ethnicity (STPNOC 2009a).

Figure 2-27 through Figure 2-30 show the location of all census block groups that meet the criteria for any of the minority populations identified for environmental justice purposes. Of the 230 block groups within the 50-mi radius of the STP site, the review team identified 19 census block groups that have significant Black or African American populations (Figure 2-28). One block group located in Matagorda County has a significant Asian population (Figure 2-29).

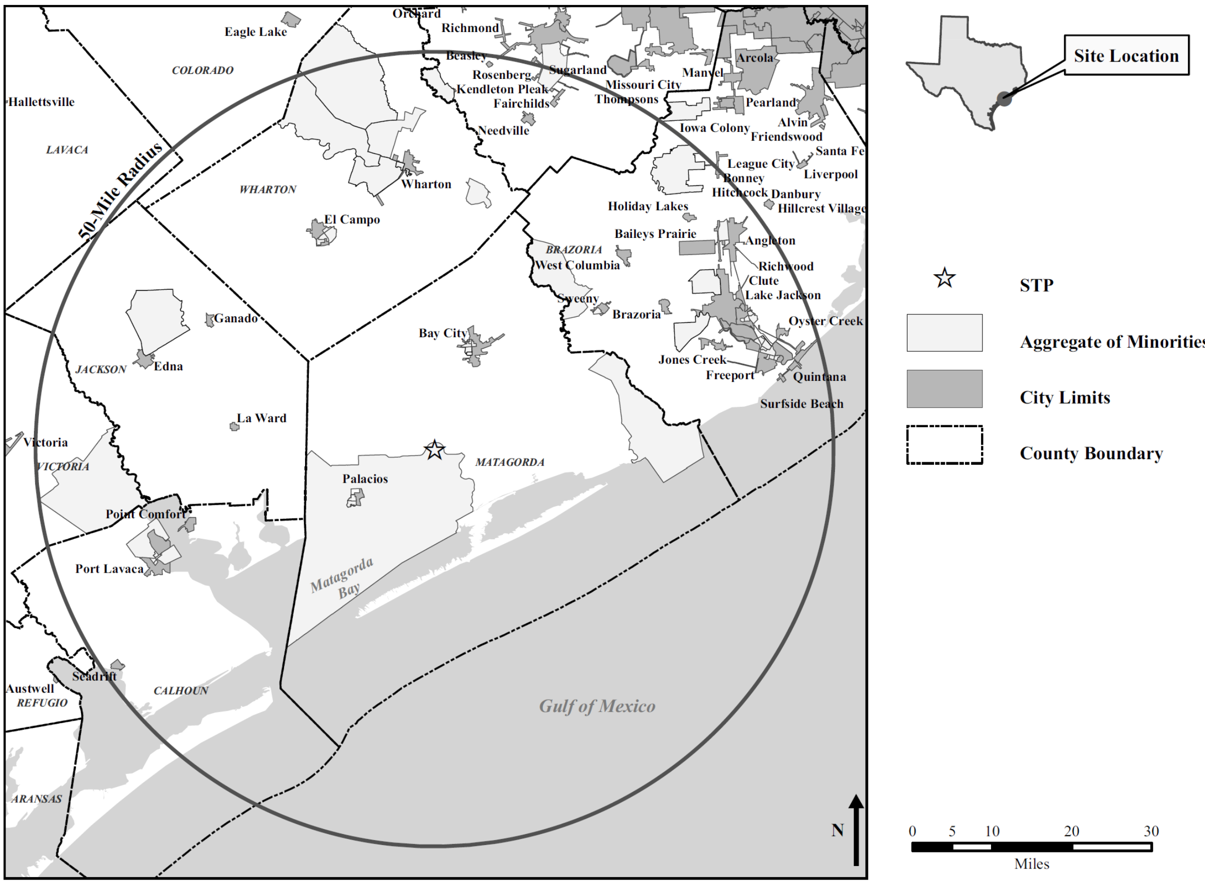

Figure 2-27. Aggregate Minority Populations in Block Groups Meeting Environmental Justice Selection Criteria (STPNOC 2009a)

Significant Hispanic populations exist in 30 census block groups in the region (Figure 2-30). Six block groups have significant “some other race” population and 22 block groups in the region have significant aggregate minority populations (Figure 2-27) (STPNOC 2009a).

Low-Income Populations: STPNOC used census data to identify low-income households within the analytical area. The data indicates that 14 percent of Texas households are low income. There are six block groups in the STP region with significant low income populations. Three of these block groups are located in Wharton County, two in Matagorda County and one in Brazoria County (STPNOC 2009a). The geographic location of the low income block groups are shown in Figure 2-31.

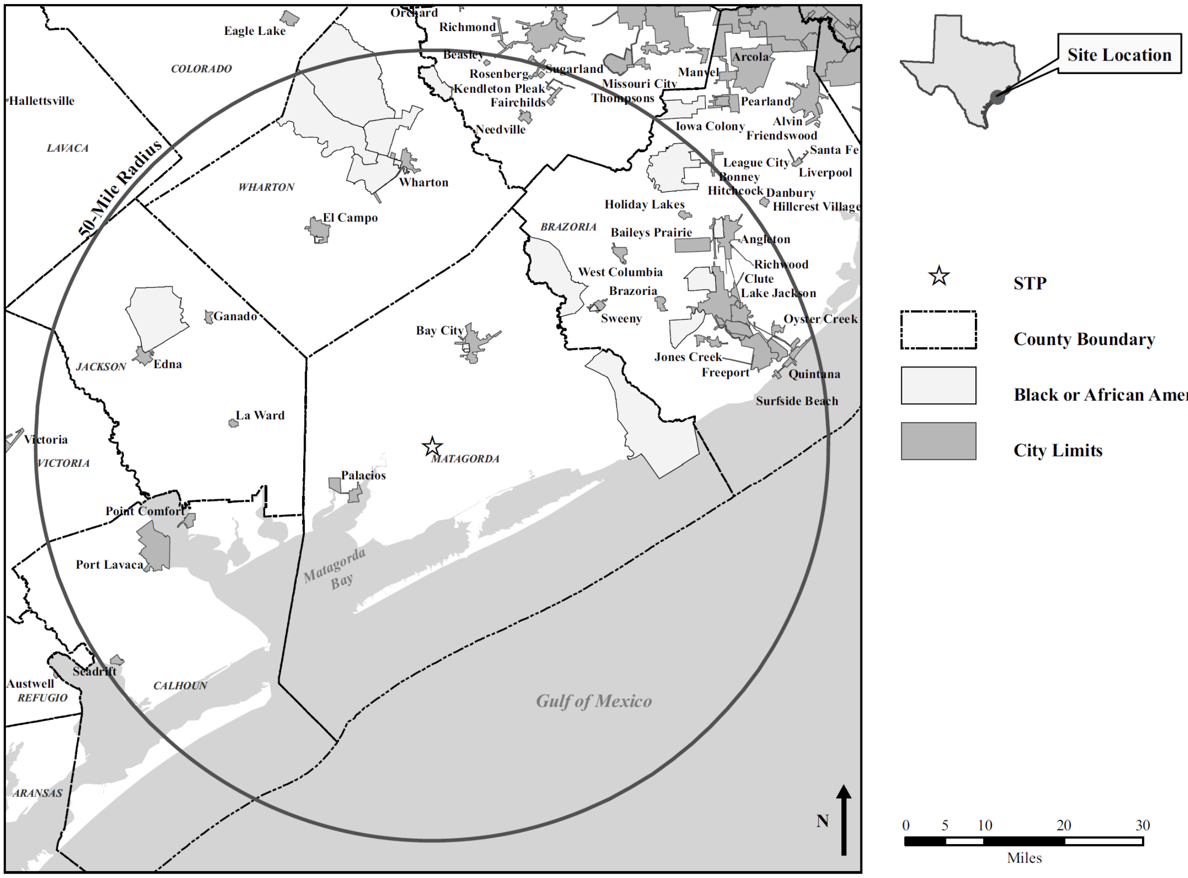

Figure 2-28. Black or African American Populations in Block Groups Meeting Environmental Justice Selection Criteria (STPNOC 2009a)

2.6.2 Scoping and Outreach

During the development of its ER, STPNOC interviewed community leaders of the minority populations within the analytical area (STPNOC 2009a). The review team built upon this base and performed additional interviews within the analytical area that had the potential for the greatest environmental and socioeconomic effects. The review team interviewed local, State, and county officials, business leaders, and key members of minority communities within the four county socioeconomic impact area to assess the potential for disproportionate environmental and socioeconomic effects that may be experienced by minority and low-income communities impacted by building and operating the proposed Units 3 and 4 (STPNOC 2009a, Scott and Niemeyer 2008). Advanced notice of public scoping meetings was provided by the review team in accordance with NRC guidance. These activities did not identify any additional groups of

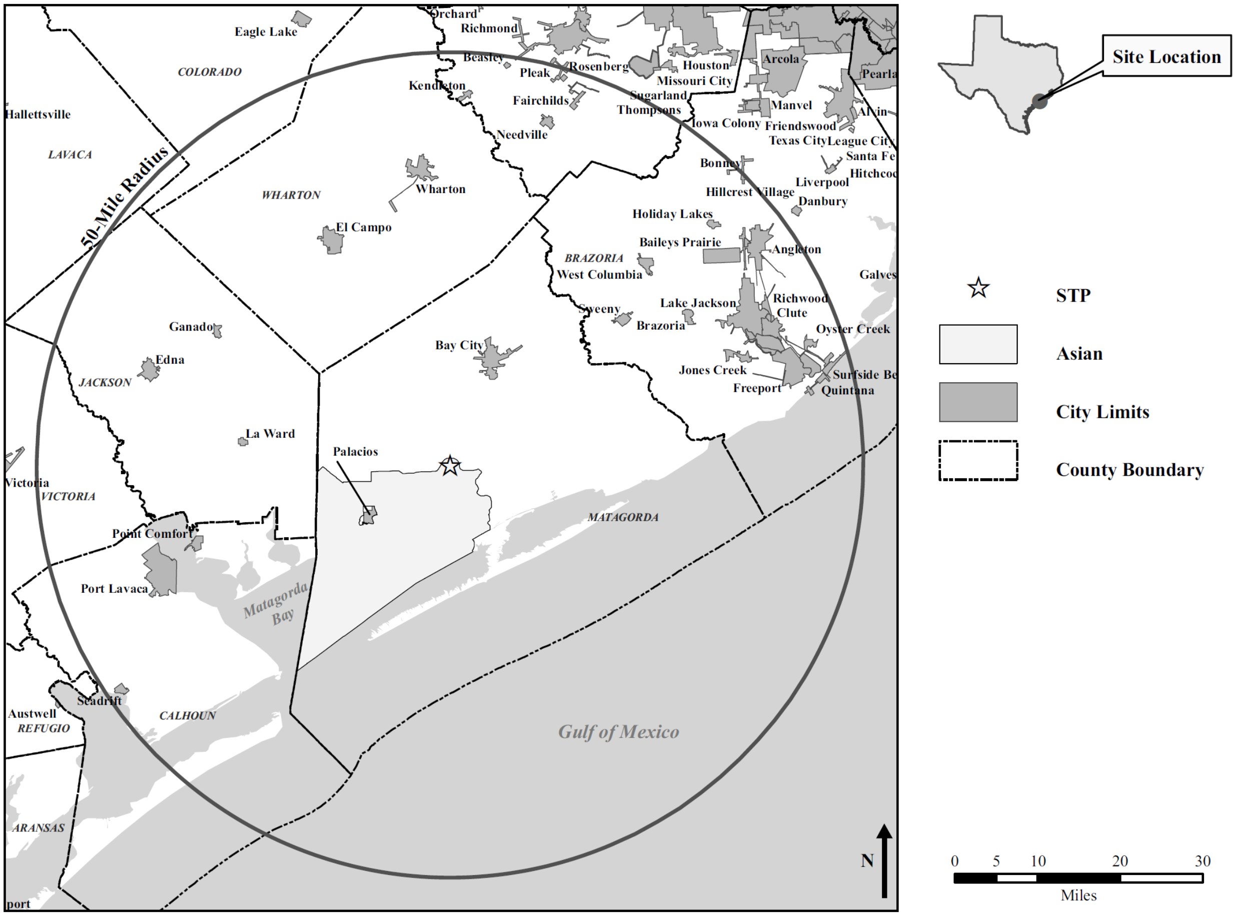

Figure 2-29. Asian or Pacific Islander Populations in Block Groups Meeting Environmental Justice Selection Criteria (STPNOC 2009a)

minority or low-income persons not already identified in the geographic information system analysis of Census data, except for an isolated community on the banks of the Lower Colorado River downstream from the plant that may include significant numbers of low-income individuals (although not identified on census maps as either low income or minority) who may be engaged in subsistence fishing.

2.6.3 Subsistence and Communities with Unique Characteristics

For each of the identified low-income and minority populations, it is necessary to determine if any of those populations appears to have a unique characteristic at the population level that would cause an impact to disproportionately affect them. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, close proximity to the plant, subsistence activities, or lack of basic health care, 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 would 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 a determination is made whether the impact is disproportionate when compared to the general population. Through its review of the applicant's ER, its own outreach and research, and through scoping comments, the review team identified two communities with potentially unique characteristics for further considerations within the vicinity of the STP site. The review team assesses the subsistence and special characteristics of these populations in Sections 4.5.5 and 5.5.4.

The review team considered STPNOC's documented outreach process on environmental justice issues and conducted its own interviews with local officials in Bay City and Palacios. The review team also considered public comments related to the proposed project. Finally, the review team performed literature reviews for academic studies and performed internet searches for documented subsistence activities by minority and low-income populations. The review team did not find any indications that any populations had unique characteristics or practices that could potentially lead to a disproportionately high and adverse impact in the Matagorda County area.

The review team's outreach and scoping activity did not identify any special socioeconomic circumstances or potential environmental pathways.

2.6.4 Migrant Populations

The U.S. Census Bureau 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 their permanent place of residence. From an environmental justice perspective, there is a potential for such groups in some circumstances to be disproportionately affected by emissions in the environment. However, in the four-county area surrounding the STP site the 2002 Census of Agriculture found only 95 out of 1051 farms employing 3026 short-term farm laborers reported individuals meeting the definition of migrant farm workers, and only 72 of those farms were found in Matagorda County, which would not add many low-income or minority individuals to those already present in the resident population, even if all of the migrant workers were minority or low-income individuals. Based on the average number of short-term workers per farm in the four-county area, the review team estimates that the total number of migrant workers is about 300 in the four-county area, most of who work in Matagorda County. No information was available concerning their actual location of employment within the county.

2.6.5 Environmental Justice Summary

The review team found low-income, Black, Hispanic, Asian, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses. Consequently, the review team performed additional analyses before making a final

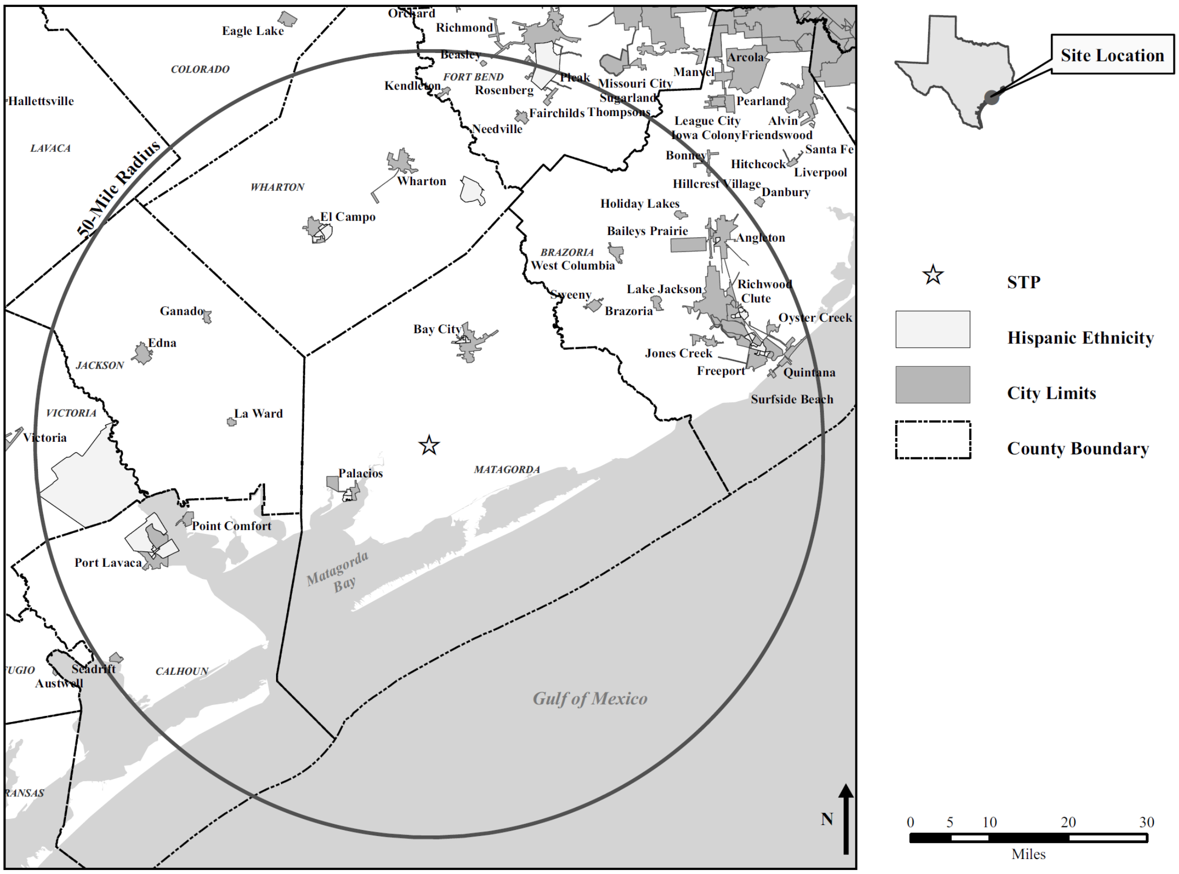

Figure 2-30. Hispanic Populations in Block Groups Meeting Environmental Justice Selection Criteria (STPNOC 2009a)

environmental justice determination. Based on the information in the STPNOC ER, public input, and its own outreach and analysis, the review team determined that because there are minority and low-income populations of interest in the region and particularly because some of these live in close proximity to the proposed site, impacts to these communities must be considered in greater detail, as discussed in Section 2.6.1. The result of the review team's analyses can be found in Section 4.5 for construction effects and 5.5 for operational effects.

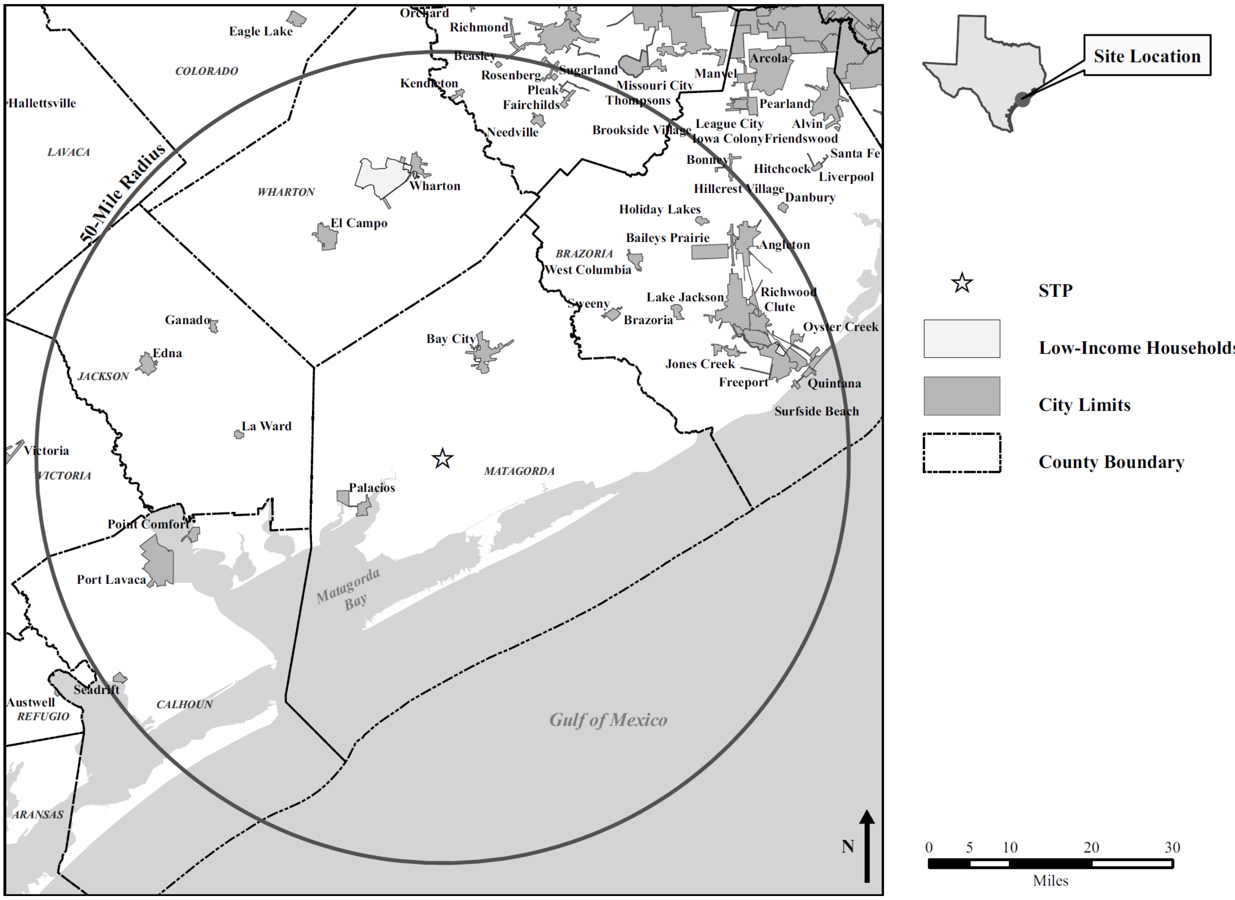

Figure 2-31. Aggregate Low Income Populations in Block Groups Meeting Environmental Justice Selection Criteria (STPNOC 2009a)

2.7 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the review team has elected to use the National Environmental Policy Act of 1969, as amended (NEPA) process to comply with the obligations imposed under Section 106 of the National Historic Preservation Act (NHPA). The review team determined that the physical area of potential effect (APE) for the COL review is the area at the power plant site and the immediate environs that may be impacted by land-disturbing activities associated with building and operating two new nuclear generating units. The visual APE for the STP site is determined by the maximum distance from which the tallest structures associated with proposed Units 3 and 4 can be seen from offsite locations.

This section discusses the historic and cultural background in the STP site region. It also details the efforts that have been taken to identify cultural resources in the physical and visual APEs and the resources that were identified. A description of the consultation efforts is also provided. The assessments of effects from building and operating the proposed new units are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

The area in and around the COL site has a rich cultural history and a substantial record of significant prehistoric and historic resources. The Colorado River system flows through the area and influenced settlement in the area. The archaeological record indicates that prehistoric occupation of the area was as follows (Hester 1995; Turner and Hester 1985):

- Paleoindian (pre-7800 B.C.) – The earliest inhabitants of Texas during the late Pleistocene are associated with the Clovis Complex based upon the presence of the Clovis fluted point that is commonly found throughout North America. Clovis is commonly associated with hunting of the extinct Mammoth and other large Pleistocene fauna. The Clovis people either were replaced or transitioned to the Folsom Complex, which flourished between 8800 and 8200 B.C. The hallmark artifact of the Folsom period is the Folsom fluted point, which is often found in association with forms of bison that are presently extinct. After Folsom, evidence of sites dating to the later stages of the Paleoindian period are identified by a range of finely made paleoindian projectile points.

- Early Archaic (7800 B.C. to 250 B.C.) – The Archaic represents a time when people became more settled and broadened their use of flora and fauna. While the early phases of this period are not well understood, later phases are generally well documented by numerous distinctive triangular points and large barbed specimens found across Texas.

- Middle Archaic (6000 B.C. to 2500 B.C.) – An increase in the number of archaeological sites dating to this period suggests an increase in population. An increase in economic complexity is suggested by the greater diversity of stone tools. Regional differentiation begins to appear, with sites in South Texas often characterized as shell midden. Burial sites begin to appear and exotic items suggesting commercial trade are found.

- Late Archaic (2500 B.C. to 700 B.C.) – This period is characterized by distinct types of projectile points and stone tools, suggesting continued economic diversification and regionalization.

- Late Prehistoric (700 B.C., to 1500 A.D.) – The Late Prehistoric era is marked by the introduction of the bow and arrow and pottery. Although the hunting and gathering lifeways of the Archaic period continue, "the material culture, hunting patterns, settlement types and other facets of Late Prehistoric times mark a fairly distinctive break with the past."

The historic period can be traced to the 1500s when the Spanish and French explored the Texas Coast (Hall and Ford 1973). At that time, the Native American groups living in the areas were collectively known by the Europeans as the Karankawa. The French attempted to settle the Matagorda Bay area in 1685 and again in 1718, but neither was successful, largely due to conflict with the Karankawa Indians. True settlement of the area commenced when Stephen F. Austin obtained a grant from the Mexican government in 1821 to permit 300 American families to settle along the Colorado River. When an additional 3000 families were allowed to settle in the area in 1828, population increased rapidly. Matagorda County was created in 1837, shortly after Texas gained its independence from Mexico. Farming in the Matagorda region concentrated on sugar and cotton production and, following the Civil War, cattle ranching.

2.7.2 Historic and Cultural Resources at the Site

The following information was used to identify the historic and cultural resources at the STP site:

- Original Construction FES (NRC 1975),
- Original Environmental Report (NRC 1975), which included the Texas Archaeological Survey Report (Hall and Ford 1973),
- Original Operation EIS (NRC 1986),
- South Texas Project Units 3 and 4 Environmental Report (STPNOC 2009a),
- Information obtained from the Texas Archaeological Site Files (STPNOC 2009a), and
- Information obtained from the Matagorda County Museum Archives and Collections Department.

STPNOC conducted a review of records maintained by the National Park Service and the Texas Historical Commission to identify important cultural and historic resources located within 10 mi of the project site (STPNOC 2009a). This review identified six Texas Historic Landmarks and two Historic Texas cemeteries, all of which were more than 6 mi from STP. One of these places, the Matagorda Cemetery, located 9 mi southeast of STP, is the only site listed in the National Register of Historic Places located within 10 mi of the project site. A search of the Texas Archaeological Research Laboratory at the University of Texas at Austin indicated that 35 archaeological properties have been identified within 10 mi of the plant, none of which have been evaluated for listing in the National Register. Four of these archaeological properties are historic sites and are recorded as State archeological landmarks, as maintained by the Texas Archaeological Research Laboratory at the University of Texas at Austin; one is a cistern, one is a farmstead, one is a refuse scatter, and one is a homestead ruin. The remaining thirty-one sites are prehistoric. Of these, three are described as only a projectile point find, five are lithic scatters, and twenty-three are shell middens. The majority of prehistoric sites are located in the Mad Island WMA more than 7 mi south of the STP site (STPNOC 2009a).

The number of archaeological sites recorded within 10 mi of the plant site is likely more a reflection of the small amount of area that has been archaeologically surveyed than it is a reflection of the number of archaeological sites that exist. Regional settlement patterns would suggest that prehistoric people lived along the Colorado River and that archaeological evidence of their habitation should exist. Few surveys, however, have been conducted along the Colorado River in the area adjacent to the plant to confirm this pattern.

The archaeological sites record search indicated that prehistoric sites, most characterized as shell middens, have been located adjacent to the STP site. When the Texas Archaeological Survey visited the STP site to survey for archaeological resources, the majority of the site was heavily vegetated. "The area investigated included sufficient acreage to construct an additional two reactor units. The investigations included a pedestrian surface survey with limited subsurface testing and an historic records search." In December 2006, STPNOC contacted the State Historic Preservation Officer (SHPO) and requested an additional review under Section 106 (STPNOC 2009a). Concurrence was obtained from the State that there would be no impacts to historic properties in January 2007 (Martin 2007). Therefore, no further cultural resource investigations were required by the State.

When construction of existing STP Units 1 and 2 was completed in the 1980s, much of the plant site was extensively disturbed by construction. As documented in aerial photographs, the new areas proposed for proposed Units 3 and 4 were disturbed by the existing STP Units 1 and 2 construction (STPNOC 2009a).

In 2007, NRG and its cultural resource contractor EarthTech, conducted a reconnaissance-level cultural resources assessment of the STP site. They reviewed existing information for the STP site and the area within a 10-mi diameter. Based on the literature review, EarthTech concluded that any sites that may have existed onsite would no longer retain their cultural integrity because the area was heavily disturbed (STPNOC 2009a).

During the site visit in February 2008, the NRC staff reviewed the documentation used by the applicant to prepare the cultural resource section of the ER. The staff also visited the Matagorda County Museum and Archives located in Bay City. According to the Matagorda County Museum and Archives, the remains of a circa 1900 farmstead are located on the STP site (Rodgers 2008). However, no activity related to building or operating the plant is planned for this area. The archives also identified another home of historic significance that had previously been located adjacent to and northeast of the STP site. 'The Tadmore,' an octagon-shaped house constructed in the mid-1800s was a well-known local landmark. After years of neglect and inclement weather, the home is no longer standing.

2.7.3 Consultation

In January 2008, the NRC initiated consultation on the proposed action by writing the Texas State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (NRC 2008b). Also in January 2008, the NRC initiated consultations by writing to five Native American Tribes with historical ties to the Matagorda Bay coastal region (See Appendix F for complete listing). In the letters, NRC provided information about the proposed action, indicated that review under the NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited participation in the identification and possible decisions concerning historic properties, and invited participation in the scoping process.

On February 5, 2008, as part of its NEPA scoping process, the NRC elected to conduct a public scoping meeting in Bay City, Texas. No comments or concerns regarding historic and cultural resources were raised at this meeting or in the scoping process. Subsequent to the NRC initiating consultation with the Texas SHPO, the Advisory Council, and the Tribes, the Corps elected to participate as a cooperating agency with the NRC under the updated Memorandum of Understanding between the NRC and the Corps.

2.8 Geology

A detailed description of the geological, seismological, and geotechnical engineering conditions at the STP site is provided in Section 2.5 of the STPNOC FSAR (STPNOC 2009b) as part of the combined license (COL) application. A summary of the long-term and short-term geologic impacts of the proposed STP project is addressed in ER Section 2.6 (STPNOC 2009a). A description of the hydrogeologic setting of the proposed site is addressed in the ER as well (STPNOC 2009a). The regional and site-specific geologic descriptions provided by the applicant as part of the safety analysis for this COL application (Section 2.5 of the FSAR) are based on the results of field and subsurface investigations conducted during pre-application activities for proposed Units 3 and 4 (STPNOC 2009a, b) and the most current published geologic data, in addition to the results of the site characterization studies conducted prior to and during construction of Units 1 and 2. The NRC staff's independent assessment of the site safety issues related to the proposed STP site will consider the applicant's detailed analysis and evaluation of geological, seismic, and geotechnical engineering data. The NRC staff's detailed evaluation of the applicant's geological characterization for the STP site will be addressed in the NRC staff's Safety Evaluation Report (in process).

The STP site is located within the Coastal Plain physiographic province which forms a broad band parallel to the Texas Gulf Coast (Ryder 1996) which is also described as the Gulf Coastal Plains physiographic province by the Bureau of Economic Geology research unit at the University of Texas at Austin (TBEG 1996). The STP site lies in the Coastal Prairies sub-province of this physiographic province and exhibits a relatively flat topography with land elevation ranging from sea level on the coast to 300 ft above sea level along the western boundary of the province (TBEG 1996). The land surface elevation in the immediate vicinity of the STP site is 30 ft MSL. Figure 2-16 shows the stratigraphic column that represents the geology beneath the STP site.

For the purposes of considering the hydrogeological setting in the vicinity of the STP intake structure on the Colorado River, an apparent feature is the incision in the sediments by the river to an elevation of approximately 14 ft below MSL (STPNOC 2009a). At the nearby STP site, this would imply direct communication between the Colorado River and the Upper Shallow Aquifer (STPNOC 2009a).

Within the Coastal Prairies physiographic sub-province, the STP site is located within the Coastal Lowlands Aquifer System (TBEG 1996) which is comprised of a wedge of southeasterly dipping sedimentary deposits of Holocene age through Oligocene age. The thickness of the aquifer ranges from 0 ft at the up-dip limit of the aquifer system in the northwest to approximately 1000 to 2000 ft in Matagorda County at the down-dip limit of the system in the southeast. Sediments in the Coastal Lowlands Aquifer System varies from zero at the western boundary, where it is in contact with the Vicksburg-Jackson confining unit at the land surface, to as much as 6000 ft below sea level where the base of the aquifer is defined by groundwater with a dissolved-solids concentration of more than 10,000 milligrams per liter (Ryder 1996). Within Texas, the Coastal Lowlands Aquifer System in the vicinity of the STP site, part of the Gulf Coast Aquifer system, has not been declared a sole source aquifer by the Environmental Protection Agency (EPA 2009a, b, c).

Within Matagorda County, there are approximately 368 active oil and gas wells; 120 oil and 248 gas wells (Texas Railroad Commission 2009a, b, c); active energy exploration is ongoing in the region. Of these wells, STPNOC noted that there are seven oil wells, nine oil/gas wells, and 26 gas wells in the site vicinity (STPNOC 2008a). In Texas, subsurface mineral rights may be separate from surface land ownership rights. Co-owners of STP own or control all of the mineral interests within and underlying the STP site, and have the ability to acquire any outstanding mineral interests in the subsurface that may be required for safe operation of the facility (STPNOC 2008a). In addition to oil and gas exploration, numerous byproducts of the refining process are also extracted and made commercially available by chemical producers in Matagorda County, (i.e., OXEA Corporation's Bay City Plant and Lyondell Chemical Company's Equistar facility). The USGS mineral industry survey for sand and gravel producers (USGS 2008) did not identify principal producers of construction sand and gravel in Matagorda County, Texas. The USGS did not identify principal producers of crushed stone in Matagorda County (USGS 2009d). The source or sources of sand and gravel for the backfill and concrete necessary to construct proposed Units 3 and 4 are not identified (STPNOC 2009b). However, the applicant states that the bulk of the structural fill will come from offsite sources. Structural fill for existing STP Units 1 and 2 was obtained from the Eagle Lake/Gifford Hill source which is approximately 55 mi north of the STP site (STPNOC 2009b).

2.9 Meteorology and Air Quality

The following sections describe the climate and air quality of the STP site. Section 2.9.1 describes the climate of the region and area in the immediate vicinity of the STP site, 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 STP site is located in Matagorda County, near the Gulf of Mexico in the southeastern portion of Texas. Its climate, which is classified as maritime subtropical, is marked by relatively short, mild winters, long, hot summers, and mild springs and falls. The Azores high-pressure system is the source of maritime tropical air masses much of the year. Occasional cold continental air masses displace the maritime air during the winter.

The closest first-order National Weather Service station is Victoria, Texas, about 53 mi west of the site. This station represents the general climate at the STP site. The National Weather Service (NWS) station at Corpus Christi, Texas, about 100 mi southwest is also representative of the site, and is more indicative of the diurnal variation of weather at the site because of its proximity to the coast. Representative meteorological data have also been collected at the Palacios Municipal Airport about 13 mi west southwest of the site. In subsequent sections, the review team relies on the climatological and storm characteristics for these sites in estimating long-term characteristics for the STP site.

The following climatological statistics are derived from local climatological data for Palacios, Victoria, and Corpus Christi. Temperatures are more variable in the winter than in the summer because of the differences in air mass source regions. Daytime maximum temperatures range from about 65°F in January to about 94°F in July and August; nighttime minimum temperatures range from about 47°F in January to about 75°F in July and August. Monthly average wind speeds range from about 10 mph in September to about 14 mph in March and April. Precipitation ranges from about 2 in. per month in February peaking to about 4 to 5 in. per month in May and June and again in September and October. Snow occurs during more than 50% of the winters, but snowfall is generally limited to trace amounts. The STP site is flat with no topographic features that would cause the local climate to deviate significantly from the regional climate.

On a larger and longer-term scale, climate change is a subject of national and international interest. The GCRP (Karl et al. 2009) has provided valuable insights regarding the state of knowledge of climate change. The projected change in temperature from ‘present day’ (1993-2008) over the period encompassing the licensing action (i.e., to the period 2040 to 2059 in the GCRP report) in the vicinity of the STP site is an increase of between 0 to 3°F. While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation from the ‘recent past’ (1961-1979) to the period 2080 to 2099 was presented; the GCRP report forecasts a decrease of between 10 to 15 percent (Karl et al. 2009).

Based on the assessments of the GCRP and the National Academy of Sciences’ National Research Council, the EPA determined that potential changes in climate caused by greenhouse gas (GHG) emissions endanger public health and welfare (74 FR 66496). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. As a result of the determination by the EPA and the recognition that mitigative actions are necessary to reduce impacts, the review team concludes that the effect of GHG on climate and the environment is already noticeable, but not yet destabilizing. In CLI-09-21, 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 (NRC 2009b). 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 that is essential in a NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment during the period of the proposed action on other resource assessments.

2.9.1.1 Wind

Wind at the STP site is consistent with the dominant influence of the Azores high and the coastal location of the site. The seasonal variation of the prevailing directions shows a predominance of southeasterly winds except in January, July and August when south winds prevail, and November and December when northerly winds prevail (STPNOC 2009a). The coastal location of the site is expected to lead to typical onshore (southeast) winds during the day and offshore winds at night. Also, because the diurnal fluctuation of land temperatures is greater than the fluctuation of water temperatures and the land-water temperature difference is greater during the day than it is at night, the review team expects that the daytime onshore wind speeds would be greater than the nighttime offshore speeds. Wind direction persistence is generally limited to 4 hr or less; persistence of 8 hr or longer occurs less than 10 percent of the time, and persistence of 12 hr or longer occurs less than 4 percent of the time.

2.9.1.2 Temperature

Neither the ER (STPNOC 2009a) nor the FSAR (STPNOC 2009b) provide onsite temperature information for the STP site. Consequently, the review team determined that the average temperatures at site are consistent with the temperature data from Palacios, Victoria and Corpus Christi presented above. Based on data in Table 2.7-4 of the ER for observations at 15 NWS and cooperative observing stations and the climatological record for the Corpus Christi NWS station, the temperature extremes at the site would be about 10°F and 108°F. These values are within the ranges of extremes observed; i.e., 4°F to 13°F and 102°F to 112°F for lows and highs, respectively.

2.9.1.3 Atmospheric Moisture

The STP meteorological system measures dewpoint temperature. However, neither the ER nor the FSAR presents onsite atmospheric moisture data. Consequently, the review team determined that the relative humidity data for Palacios and the Corpus Christi NWS station are representative of the STP site. Relative humidities for 0600 local standard time (LST) approximate the daily maximum values. Monthly average 0600 LST relative humidities range from about 86 percent in December to about 94 percent in August. Relative humidities for 1200 LST approximate the daily minimum relative humidity. Monthly average 1200 LST relative humidities range from a high of about 67 percent in January to low of about 56 percent in July. Climatological statistics for Corpus Christi and Victoria indicate that STP site could expect heavy fog 30 to 40 days per year. Palacios fog data included in the ER are consistent with this expectation. The likelihood of fog is greatest from November through March and least from June through August.

2.9.1.4 Severe Weather

The site can experience severe weather in the form of thunderstorms, tornadoes, and tropical storms. Thunderstorms are the most frequent severe weather events. They occur on an average of about 55 days per year at Victoria, and about 31 days per year at Corpus Christi. The majority of the thunderstorms occur from May through September. It is likely that the frequency of thunderstorms at the STP site is closer to that of Corpus Christi, because of the site's proximity to the coastline, than to Victoria. Tropical cyclones, including hurricanes and tropical storms, pass near the STP site an average of about once every other year and an average of about two to three hurricanes pass near the site every 10 years. Nine hurricanes have made landfall between Corpus Christi and Galveston since 1950; the most recent being hurricanes Humberto in 2007 and Ike in 2008. Tornadoes are the least frequent of these extreme weather events. Using tornado statistics from 1950 through 2003 and the methodology outlined in NUREG/CR-4461, *Tornado Climatography of the Contiguous United States* (Ramsdell and Rishel 2007), the NRC staff estimates that the probability of a tornado striking the nuclear island at the STP site is about 2×10^{-4} yr^{-1}.

2.9.1.5 Atmospheric Stability

Atmospheric stability is a derived 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 1.23, Revision 1 (NRC 2007b). When the temperature decreases rapidly with height, the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited. Typically, the atmospheric stability is classified as neutral to unstable during the day and neutral to stable at night. Cloudiness and high winds tend to decrease both stability and instability resulting in more nearly neutral conditions.

Measurements at the 10- and 60-m levels of the STP meteorological tower are used to determine atmospheric stability for the STP site. On an annual basis, the atmosphere at the STP site is stable about 46 percent of the time, neutral about 29 percent of the time, and unstable about 25 percent of the time. These percentages vary seasonally with more frequent stable and unstable conditions in the summer and early fall, and more frequent neutral conditions in the winter and early spring (STPNOC 2009a)

Large water bodies, notably the Gulf of Mexico and the STP MCR, have the potential to affect atmospheric stability. The STP meteorological tower is sufficiently far from both the Gulf and the MCR that the review team concludes that it is unlikely that either has an effect on determining atmospheric stability for the environmental review.

2.9.2 Air Quality

The discussion on air quality includes the six common “criteria pollutants” for which the EPA has set national ambient air quality standards (ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead). The air quality discussion also covers heat-trapping “greenhouse gases” (primarily carbon dioxide) which have been the principal factor causing climate change over the last 50 years (Karl et al. 2009).

The STP site is in central Matagorda County, Texas at the southern edge of the Metropolitan Houston-Galveston Intrastate Air Quality Control Region (40 CFR 81.38). The Corpus Christi-Victoria Intrastate Air Quality Control Region (40 CFR 81.136) lies immediately south and west of Matagorda County. All of the counties in these Air Quality Control Regions adjacent to the STP site are in compliance with the National Ambient Air Quality Standards (40 CFR 81.344) except Brazoria County to the north; Brazoria County is classified Non-Attainment/Severe relative to the 8-hr ozone standard and lead for which no designation has been made. There is no mandatory Class I Federal Area where visibility is an important value within 100 mi of the STP site.

Carbon dioxide concentration has been building up in the Earth’s atmosphere since the beginning of the industrial era in the mid-1700s, primarily due to the burning of fossil fuels (coal, oil, and natural gas) and the clearing of forests. Human activities have also increased the emissions of other greenhouse gases such as methane, nitrous oxide, and halocarbons. These emissions are increasing the optical thickness of heat-trapping gases in the Earth’s atmosphere, causing global surface temperatures to rise (Karl et al. 2009).

2.9.3 Atmospheric Dispersion

As described in Section 2.9.4, the NRC staff visited the meteorological measurement system at the site and reviewed the available information on the design of the meteorological measurement program, and evaluated data collected by the program. Based on this information, the NRC staff concludes that the program provides data that represent the affected environment onsite meteorological conditions as required by 10 CFR 100.20. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34, 10 CFR Part 50, Appendix I and 10 CFR 52.79.

2.9.3.1 Short-Term Dispersion Estimates

STPNOC calculated short-term dispersion estimates using 3 years of onsite meteorological data (STPNOC 1997, 1999, and 2000). These estimates which were provided in ER Section 2.7.5.2 were based on distances to the Exclusion Area Boundary (EAB) and outer boundary of the Low Population Zone (LPZ) in ER Table 2.7-13. The exclusion area and LPZ are defined in 10 CFR 50.2. STPNOC (2009f) revised these distances in response to an NRC request for additional information (NRC 2009a) and recalculated the dispersion estimates. Based on its review of the revised dispersion estimates, the NRC staff determined that the revised estimates did not appropriately reflect realistic dispersion conditions at the site. Consequently, using the revised EAB and LPZ distances, the NRC staff calculated site-specific short-term dispersion estimates for the EIS design basis accident review.

The NRC staff's short-term dispersion estimates for use in design basis accident calculations are listed in Table 2-39. They are based on the PAVAN computer code (Bander 1982) calculations of 1-hr and annual average χ/Q values from a joint frequency distribution of wind speed, wind direction and atmospheric stability. These values were calculated for the shortest distances from a release boundary envelope that encloses the Unit 3 or Unit 4 release points to the EAB and to the LPZ. The EAB χ/Q value listed in Table 2-40 on the following page is the median 1-hr χ/Q, which is assumed to persist for 2 hr. The LPZ χ/Q values listed in Table 2-40 on the following page were determined by logarithmic interpolation between the median 1-hr χ/Q, which was assumed to persist for 2 hr, and the annual average χ/Q following the procedure described in Regulatory Guide 1.145 (NRC 1983).

Table 2-39. Atmospheric Dispersion Factors for Proposed Unit 3 and 4 Design Basis Accident Calculations

Time period	Boundary	χ/Q (s/m^3)
0 to 2 hours	Exclusion Area Boundary	3.64×10^{-5}
0 to 8 hours[(a)]	Low Population Zone	2.53×10^{-6}
8 to 24 hours[(a)]	Low Population Zone	2.23×10^{-6}
1 to 4 days[(a)]	Low Population Zone	1.70×10^{-6}
4 to 30 days[(a)]	Low Population Zone	1.15×10^{-6}

(a) Times are relative to beginning of the release to the environment.

Table 2-40. Maximum Annual Average Atmospheric Dispersion and Deposition Factors for Evaluation of Normal Effluents for Receptors of Interest

Receptor	Downwind Sector	Distance (mi)	No Decay χ/Q (s/m^3)	2.26-Day Decay χ/Q (s/m^3)	8-Day Decay χ/Q (s/m^3)	D/Q (1/m^2)
EAB	NW	0.52	1.5×10^{-5}	1.5×10^{-5}	1.4×10^{-5}	1.0×10^{-7}
Site Boundary	NNW	0.69	8.1×10^{-6}	8.1×10^{-6}	7.3×10^{-6}	6.4×10^{-8}
Residence	WSW	2.18	6.3×10^{-7}	6.2×10^{-7}	5.1×10^{-7}	1.8×10^{-9}(a)
Meat Animal	WSW	2.18	6.3×10^{-7}	6.2×10^{-7}	5.1×10^{-7}	1.8×10^{-9}(a)
Veg. Garden	WSW	2.18	6.3×10^{-7}	6.2×10^{-7}	5.1×10^{-7}	1.8×10^{-9}(a)
Unit 4 Reactor	WNW	0.17	8.3×10^{-5}	8.3×10^{-5}	8.0×10^{-5}	3.4×10^{-7}

(a) 3.03 mi NNW

2.9.3.2 Long-Term Dispersion Estimates

Long-term dispersion estimates for use in evaluation of the radiological impacts of normal operations were calculated by STPNOC using the XOQDOQ computer code (Sagendorf et al. 1982). This code implements the guidance set forth in Regulatory Guide 1.111 (NRC 1977) for estimation of atmospheric dispersion (χ/Q) and deposition factors (D/Q) for use in evaluation of the consequences of normal reactor operations. In July 2009, STPNOC (STPNOC 2009f; g) revised the distances used for calculating χ/Q and D/Q estimates for specific receptors of interest including the closest point of the EAB, the closest residence, the closest meat animal, and the closest vegetable garden. The revised distances, which are from the closest reactor building vent, and χ/Q and D/Q estimates are not included in Revision 3 of the ER.

The results of the STPNOC calculations are presented in Table 2-40 for receptors of interest. Table 2-40 also includes χ/Q and D/Q estimates at the Unit 4 location for releases from Unit 3 for use in estimating Unit 4 construction worker doses after Unit 3 begins operation. Table 2.7-16 in the ER presents annual average atmospheric dispersion and deposition factors for 22 distances between 0.25 and 50 mi from the release point for each of 16 direction sectors.

2.9.4 Meteorological Monitoring

There has been a meteorological monitoring program at STP site since July 1973. The initial measurements were to provide the onsite meteorological information required for licensing of the existing STP Units 1 and 2. Measurements have continued in support of the existing STP Units 1 and 2 operations. The meteorological system was upgraded to enhance reliability in December 1994 and again in 2005 (STPNOC 2009a). The 1994 system provided the data used by STPNOC in preparation of the COL application.

The 1994 and 2005 instrument systems are described in Section 6.4 of the STPNOC ER (STPCNOC 2009a). The primary meteorological tower is situated about 1.3 mi east of the proposed location of proposed Units 3 and 4. The primary meteorological tower instruments include wind speed and direction and temperature sensors at 10 m and 60 m above ground, dew point temperature at 10 m above ground, and precipitation and solar radiation near ground level. A 10-m backup meteorological tower is located about 0.4 mi south of the primary tower. Instrumentation on the backup tower consists of wind speed and direction and temperature at 10 m. Table 6.4-4 of the ER lists the instrumentation in the 1994 measurement system and compares instrument specifications with criteria set forth in NRC guidance and industry standards.

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 this information, the NRC staff concludes that the program provides data that represent the affected environment onsite meteorological conditions as required by 10 CFR 100.20. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the environmental review evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34, 10 CFR Part 50, Appendix I and 10 CFR 52.79.

2.10 Nonradiological Health

This section describes aspects of the environment at the STP site and within the vicinity of the site associated with nonradiological human health impacts. The section provides the basis for evaluation of impacts to human health from building and operation of the proposed Units 3 and 4. Building activities have the potential to affect public and occupational health, create impacts from noise, and impact health of the public and workers from transportation of construction materials and personnel to the STP site. Operation of the proposed Units 3 and 4 has the potential to impact the public and workers at the STP site from operation of the cooling system, noise generated by operations, electromagnetic fields (EMF) generated by transmission systems, and transportation of operations and outage workers to and from the STP site.

2.10.1 Public and Occupational Health

This section describes public and occupational health at the STP site and vicinity associated with air quality, occupational injuries and etiological agents (i.e., disease causing microorganisms).

2.10.1.1 Air Quality

Public and occupational health can be impacted by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996). Air quality for Matagorda County is discussed in Section 2.9.2. Fugitive dust and other particle material (including PM_{10} (particle matter less than

10 microns) and $PM_{2.5}$) can be released into the atmosphere during any site excavations and while grading is being conducted. Most of these activities that generate fugitive dust are short in duration, over a small area, and can be controlled using watering, application of soil adhesives, seeding, and other best management practices (STPNOC 2009a). Mitigation measures to minimize and control fugitive dust are required for compliance with all Federal, State, and local regulations that govern such activities (NRC 1996; STPNOC 2009a).

Exhaust emissions during normal plant operations associated with on-site vehicles and equipment as well as from commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire 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. Diesel generators and supporting equipment would be in place for emergency-use only but would be started regularly to test that the systems are operational. Emissions from nonradiological air pollution sources are permitted by TCEQ. The ER states that the current permit for STP operations was renewed on January 25, 2006, and is valid until January 25, 2011. STPNOC also complies with TCEQ's permit for operation of portable and emergency engines and turbines (Title 30, Section 106.511). The authorization states that the maximum annual operating hours for the emergency diesel generators for Units 1 and 2 as well as any future systems shall not exceed 10 percent of the normal annual operating schedule for the primary equipment.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. The U.S. Bureau of Labor Statistics provides reports that account for occupational injuries and illnesses as total recordable cases, which includes those cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The State of Texas also tracks the annual incidence rates of injuries and illnesses for electric power generation, transmission and distribution workers. These records of statistics are used to estimate the likely number of occupational injuries and illnesses for operation of Units 1 and 2 and predict the likely number of cases for the proposed new units.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures to minimize worker exposures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with the STP site. Currently, the STP site has programs and personnel to promote safe work practices and respond to occupational injuries and illnesses for Units 1 and 2. Procedures are in place with the objective to provide personnel who work at the STP site with an effective means of preventing accidents due to unsafe conditions and unsafe acts. They include safe work practices to address hearing protection, confined space entry, personal protective equipment, heat stress, electrical safety, ladders, chemical handling, storage, and use, as well as other industrial hazards. Personnel are provided training on STPNOC safety procedures. In addition, STPNOC requires contractors to develop and implement safety procedures with the intent of preventing injuries, occupational illnesses, and deaths (STPNOC 2009a).

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities at the STP site that encourage the growth of disease causing microorganisms (etiological agents). Thermal discharges from Units 1 and 2 into the MCR and then into the Colorado River have the potential to increase the growth of thermophilic microorganisms. As mentioned in Section 2.3.3.1, the segment of the Colorado River adjacent to the STP site is listed by TCEQ as impaired by the presence of bacteria. The types of organisms of concern for public and occupational health include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp.), and free-living amoeba (such as *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 water-borne diseases in Texas indicates that the incidence of most of these diseases is not common. Outbreaks of Legionellosis, Salmonellosis, or Shigellosis that occurred in Texas from 1996 to 2006 were within the range of national trends in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes (CDC 1997, 1998b, 1999, 2001, 2002b, 2003, 2004b, 2005, 2006b, 2007, and 2008d). Texas does have higher incidences of infection by *Naegleria fowleri* compared to most other States in the country. Infection with *N. fowleri* causes the disease primary amebic meningoencephalitis (PAM), a brain infection that leads to the destruction of brain tissue and is fatal (CDC 2008c). From 1995 to 2007, there were three waterborne disease outbreaks in Texas (one each in 1998, 1999, and 2002). None of the outbreaks were from recreational exposure to untreated water, e.g., swimming or boating in a river (CDC 1998a, 2000, 2002a, 2004a, 2006a, 2008a, b). From 1972 to 2007, there have been 36 occurrences of PAM in Texas, ranging from zero to five cases per year. All of these cases were fatal, exposures occurred during the months of June through September, and four exposures occurred in lakes and one occurred in a river. In a review of documentation of PAM cases in Texas dating back to 1972, none of the cases of PAM appear to be from exposure to waters in Matagorda County (CDC 1998a, 2000, 2002a, 2004a, 2006a, 2008a, b; LCRA 2007c; TDSHS 1995, 1997). The review team contacted the CDC in October 2009 and confirmed that there have been a few cases of PAM in the State of Texas since 2007; however, these cases were not in Matagorda County (CDC 2009).

2.10.2 Noise

Sources of noise at the STP site are those associated with operation of Units 1 and 2, including transformers and other electrical equipment, circulating water pumps, and the public address system. The STP site is located on 12,220 ac surrounded by farmland and the Colorado River. There are 10 residences within 5 mi of the STP site, with the closest residence about 1.5 mi west-southwest of the EAB (STPNOC 2009a). The rural surroundings and enclosure of noise-generating equipment in facilities help to mitigate onsite noise perceived by offsite receptors. There are no measurements of noise at the STP site (STPNOC 2009a).

Activities associated with building the new units at the STP site would have peak noise levels in the range of 100- to 110-decibels on the A-weighted scale (dBA). As illustrated in Table 2-41, noise strongly attenuates with distance. A decrease of 10-dBA in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the source these peak noise levels would generally decrease to the 80- to 95-dBA range and at distance of 400 ft, the peak noise levels would generally be in the 60- to 80-dBA range. For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler 1982).

Regulations governing noise associated with the activities at the STP site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910, *Occupational Health and Safety Standards*, and 40 CFR Part 204, *Noise Emission Standards for Construction Equipment*. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. Although several Texas municipalities have noise ordinances, the State of Texas does not have noise regulations covering rural areas that would be applicable to the STP site.

Table 2-41. Construction Noise Sources and Attenuation with Distance.

Source	Noise Level (dBa) (peak)	Noise Level (dBa) Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84–89	78–83	72–77	66–71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80–89	74–82	68–77	60–71
Dozer	107	87–102	81–96	75–90	69–84
Generator	96	76	70	64	58
Crane	104	75–88	69–82	63–76	55–70
Loader	104	73–86	67–80	61–74	55–68
Grader	108	88–91	82–85	76–79	70–73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et. al 1980

2.10.3 Transportation

The highway and rail transportation network surrounding the STP site is shown in Figure 2-2. According to the ER (STPNOC 2009a), all roadways in the area are composed of a treated bituminous surface. The sole access road to the STP site for operations workers at Units 1 and 2 is FM 521. FM 521 is fed from the east by US Highway 60, from the north by FM 1468, and from the west by US Highway 35 and FM 1095. Existing traffic for Units 1 and 2 will continue to enter the site via the east entrance to the plant. There are north and west entrances to the site that may be used in the future. There is a 9-mi railroad spur north of the site that could be used in the future to transport heavy components and oversized equipment to the STP site for building of the proposed new units. The rail line would be upgraded and the rail route to Buckeye would be reestablished (STPNOC 2009a). Some large equipment items could also be transported to the STP site by barge. Heavy components would be transported by barge to the existing STP barge slip on the Lower Colorado River (Figure 2-3). The components would be offloaded from the barge and transported to the construction site by truck. A 2.5-mi heavy haul route, entirely within the site, would be built from the barge slip to the construction site.

2.10.4 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMF. Public and worker health can be compromised by acute and chronic exposure to EMF from power transmission systems, including switching stations (or substations) on-site and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency (ELF). In comparison, television transmitters have frequencies of 55 to 890 MHz and microwaves have frequencies of 1000 MHz and greater (NRC 1996).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1996). 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, where the current 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, storing the electric charge, but isolated from the ground. A person standing on the ground can receive an electric shock from 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 (NESC) criteria and adherence to the standards for transmission systems regulated by the Public Utility Commission of Texas (PUCT).

Long-term or chronic exposure to power transmission lines have been studied for a number of years. These health effects were evaluated in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996) for nuclear power in the United States, and are discussed in the ER (STPNOC 2009a). The GEIS (NRC 1996) reviewed human health and EMF and concluded:

> 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

A radiological environmental monitoring program (REMP) has been conducted around the STP site since operations began in 1988. This program measures radiation and radioactive materials from all sources including the existing units at STP. The REMP includes the following exposure pathways: direct radiation, atmospheric, aquatic and terrestrial environments and groundwater and surface water. A pre-operational environmental monitoring program was conducted beginning in 1986 to establish a baseline to observe fluctuations of radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1988 and Unit 2 started in 1989, the monitoring program continued to assess the radiological impacts on workers, the public and the environment. The results of this monitoring for the STP site are documented in annual reports entitled “Annual Radiological Environmental Operating Report” and “Annual Radioactive Effluent Release Report”. These reports show that exposures or concentrations in air, water, and vegetation are comparable to, if not statistically indiscernible from, pre-operational levels, with minor exceptions. The NRC’s Liquid Radioactive Release Lessons Learned Task Force Report (NRC 2006) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, STPNOC summarized results of groundwater sampling performed by STPNOC around the STP site in its annual environmental operating report for 2007 (STPNOC 2008a).

As discussed in Section 2.3, drinking water in the area is obtained from deep aquifer wells, which are monitored quarterly. No tritium has been detected from monitoring of these wells. Tritium is released to the MCR. Monitoring shows that levels of tritium in the shallow aquifer around the MCR originating from the liquids discharged to the MCR are below the EPA drinking water standard (40 CFR Part 141) (see Section 5.9.6 for additional details on tritium monitoring).

2.12 Related Federal Projects and Consultation

The staff reviewed the possibility that activities of other Federal agencies might impact the issuance of COLs to STPNOC. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS. As discussed in Chapter 1, the Corps is a cooperating agency for preparation of this EIS.

Federal lands within a 50-mi radius of the STP site include the Big Boggy and San Bernard National Wildlife Refuges administered by the FWS. The 5000-ac Big Boggy National Wildlife Refuge borders Matagorda Bay and is approximately 9 mi southeast of the STP site (STPNOC 2009a). The 45,311-ac San Bernard National Wildlife Refuge contains coastal prairies and salt marshes in southern Matagorda and Brazoria counties. There are no wilderness areas or rivers included in the national wild and scenic rivers system within the 50-mi region. The closest Native American Tribal reservations are more than 50 mi from the STP site (STPNOC 2008f).

The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing this EIS, the NRC consulted with the FWS and NOAA Fisheries. A list of key consultation correspondence is identified in Appendix F.

2.13 References

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3.0 Site Layout and Plant Description

The South Texas Project Electric Generating Station (STP) site is located in Matagorda County, Texas. STP Nuclear Operating Company (STPNOC) applied to the U.S. Nuclear Regulatory Commission (NRC) for combined construction permits and operating licenses (COLs) for proposed Units 3 and 4. In addition to the COL application, STPNOC will need to apply for a permit from the U.S. Army Corps of Engineers (Corps) to conduct activities that result in alteration of waters of the United States. The proposed new units would be situated wholly within the existing STP site and adjacent to existing STP Units 1 and 2. The site is situated approximately 10 mi north of Matagorda Bay, 70 mi south-southwest of Houston, and 12 mi south-southwest of Bay City, Texas, along the west bank of the Colorado River.

This chapter describes the key plant characteristics that are used to assess the environmental impacts of the proposed actions. The information is drawn from STPNOC's Environmental Report (ER) (STPNOC 2009a), its Final Safety Analysis Report (FSAR) (STPNOC 2009b), and supplemental documentation from STPNOC as referenced.

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment of the proposed site and its vicinity, this chapter describes the physical layout of the proposed plant. This chapter also describes the physical activities involved in building and operating the plant and associated transmission lines. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. Section 3.1 describes the external appearance and layout of the proposed plant. Section 3.2 describes the major plant structures and distinguishes structures that interface with the environment from those that do not interface with the environment or that interface with the environment temporarily. Section 3.3 describes the activities involved in building or installing each of the plant structures. Section 3.4 describes the operational activities of the plant systems that interface with the environment. References cited are listed in Section 3.5.

3.1 External Appearance and Plant Layout

The 12,220-ac STP site currently contains two pressurized water reactors and their associated facilities, which occupy approximately 300 ac. The two existing Units 1 and 2 share a 7000-ac Main Cooling Reservoir (MCR) and a much smaller Essential Cooling Pond (ECP). Figure 2-1 in Chapter 2 provides the relative location of proposed Units 3 and 4, the MCR, and the Colorado River. Since the new reactors would look similar to the existing reactors, the photograph in Figure 3-1 taken at ground-level of the existing reactors is illustrative of the horizon in the direction of the proposed Units 3 and 4.

Figure 3-1. Representative Ground-Level Photograph of STP Units 1 and 2 (STPNOC 2009a)

The proposed location for Units 3 and 4 is northwest of Units 1 and 2. The proposed new units would have a shared Exclusion Area Boundary (EAB) and a shared plant access road with the existing units. The vent stack for proposed Unit 3 would be the tallest new structure at approximately 249 ft above grade, which is of similar elevation to the highest point of the existing units. Units 3 and 4 would rely on the MCR as the main condenser heat sink just as Units 1 and 2 do currently. However, the proposed new units would not rely on the ECP as an Ultimate Heat Sink (UHS) in the event of an emergency; instead, Units 3 and 4 would rely on mechanical draft cooling towers as the UHS.

3.2 Proposed Plant Structures, Systems, and Components

This section describes each of the major plant structures: the reactor power system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the discussion of the impacts of building the proposed Units 3 and 4 in Chapter 4. Only the structures that interface with the environment are important to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power Conversion System

STPNOC has proposed building and operating two boiling water reactor (BWR) steam electric systems using the U.S. Advanced Boiling Water Reactor (ABWR) design. The NRC certified the ABWR design in May 1997. The ABWR is a single-cycle, forced-circulation, BWR, with a rated power of 3926 MW(t); General Electric (GE) Nuclear Energy sponsored the design certification application. The design incorporates features of the BWR designs in Europe, Japan, and the United States, and uses improved electronics, computer, turbine, and fuel technology. The U.S. ABWR design is similar to the international ABWR design, which was built at the Kashiwazaki Kariwa Nuclear Power Generation Station, Units 6 and 7, by the Tokyo Electric Power Company, Inc.

The NRC staff's formal review of the design certification application was initiated on March 31, 1989, when GE submitted its application for final design approval (FDA) and standard design certification for the U.S. ABWR design. The NRC staff issued the FDA, along with the "Final Safety Evaluation Report (FSER) Related to Certification of the Advanced Boiling Water Reactor Design" NUREG-1503 (NRC 1994) on July 13, 1994. On May 12, 1997, the NRC noticed the issuance of the U.S. ABWR final design certification rule in the *Federal Register* (62 FR 25800). Applicants intending to build and operate a plant based on the U.S. ABWR design may do so by referencing the design certification rule, as set forth in Appendix A to Title 10, Part 52, of the Code of Federal Regulations (CFR). On August 11, 1997, the NRC issued a revised FDA based on the updated standard safety analysis report.

This ABWR design is rated at 3926 MW(t), with a design gross electrical output of approximately 1356 MW(e) and a net output of 1300 MW(e). The reject heat from the unit to the environment, principally the atmosphere, is 2626 MW(t). Heat created in the reactor core is transferred to high-pressure and low-pressure turbines, which turns a generator creating electricity. Figure 3-2 provides an illustration of the reactor power conversion system.

3.2.2 Structures, Systems, and Components with a Major Environmental Interface

The review team divided the plant structures, systems, and components into two primary groups: those that interface with the environment and those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structures, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere. The interaction of structures, systems, or components with environmental interfaces 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 relevant to a National Environmental Policy Act of 1969, as amended (NEPA) review and are not discussed further in this EIS. However, such internal processes are considered by the NRC staff in the ABWR design certification documentation and in the NRC safety review of the STPNOC COL application. This section describes the structures, systems, and components with a significant plant-environment interface.

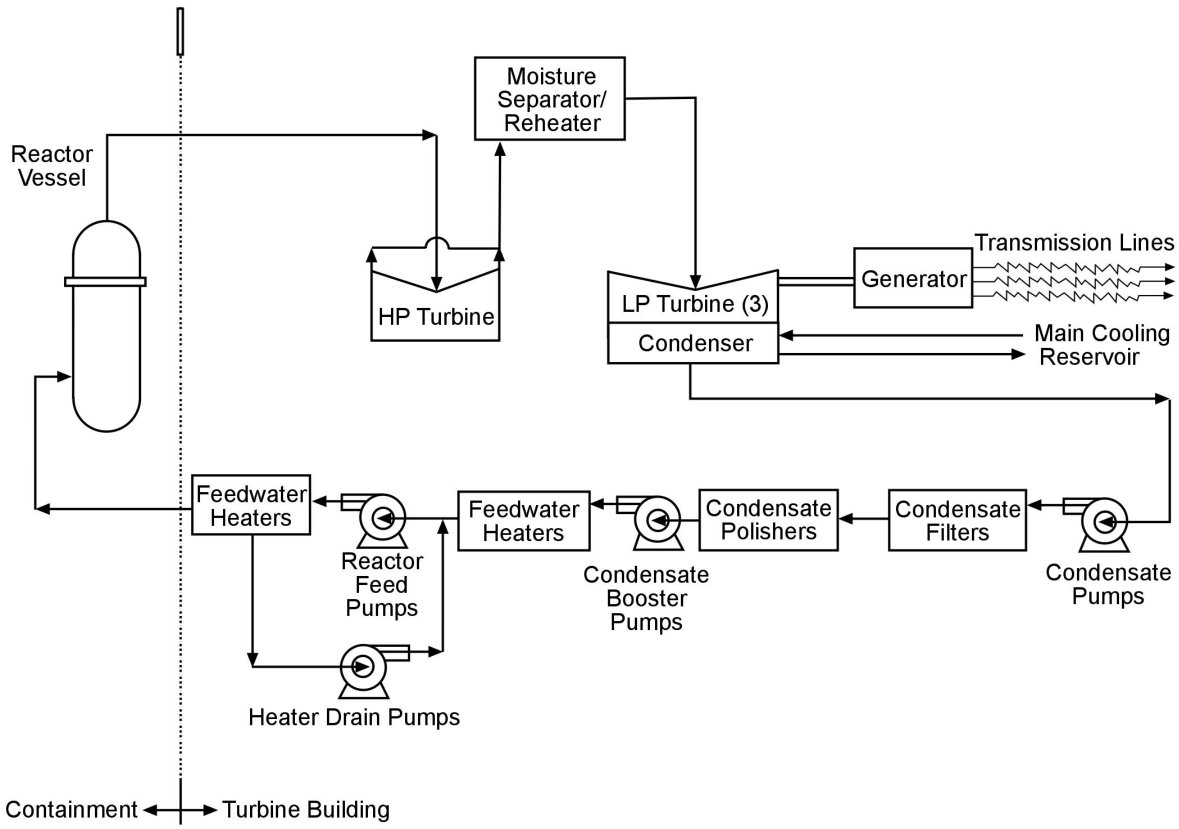

Figure 3-2. Simplified Flow Diagram of Reactor Power Conversion System (STPNOC 2009a)

The remaining structures, systems, and components are discussed in Section 3.2.3, inasmuch as they may be relevant in the review team's consideration of impacts discussed in Chapters 4 and 5. Figure 3-3 illustrates the STP site layout with a grid overlay used to reference the locations of various plant structures and activity areas as they are described in the following sections. Existing STP Units 1 and 2 are located primarily in the E-6 to F-6 quadrants. Proposed Units 3 and 4 structures would be located primarily in the C-4, C-5, D-4, and D-5 quadrants.

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater drainage system affect both the recharge to the subsurface and the rate and location that precipitation drains into adjacent creeks and streams. Impervious areas 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. The stormwater management system, including site grading, drainage ditches and swales, provides a safety function to keep locally intense precipitation from flooding safety-related structures.

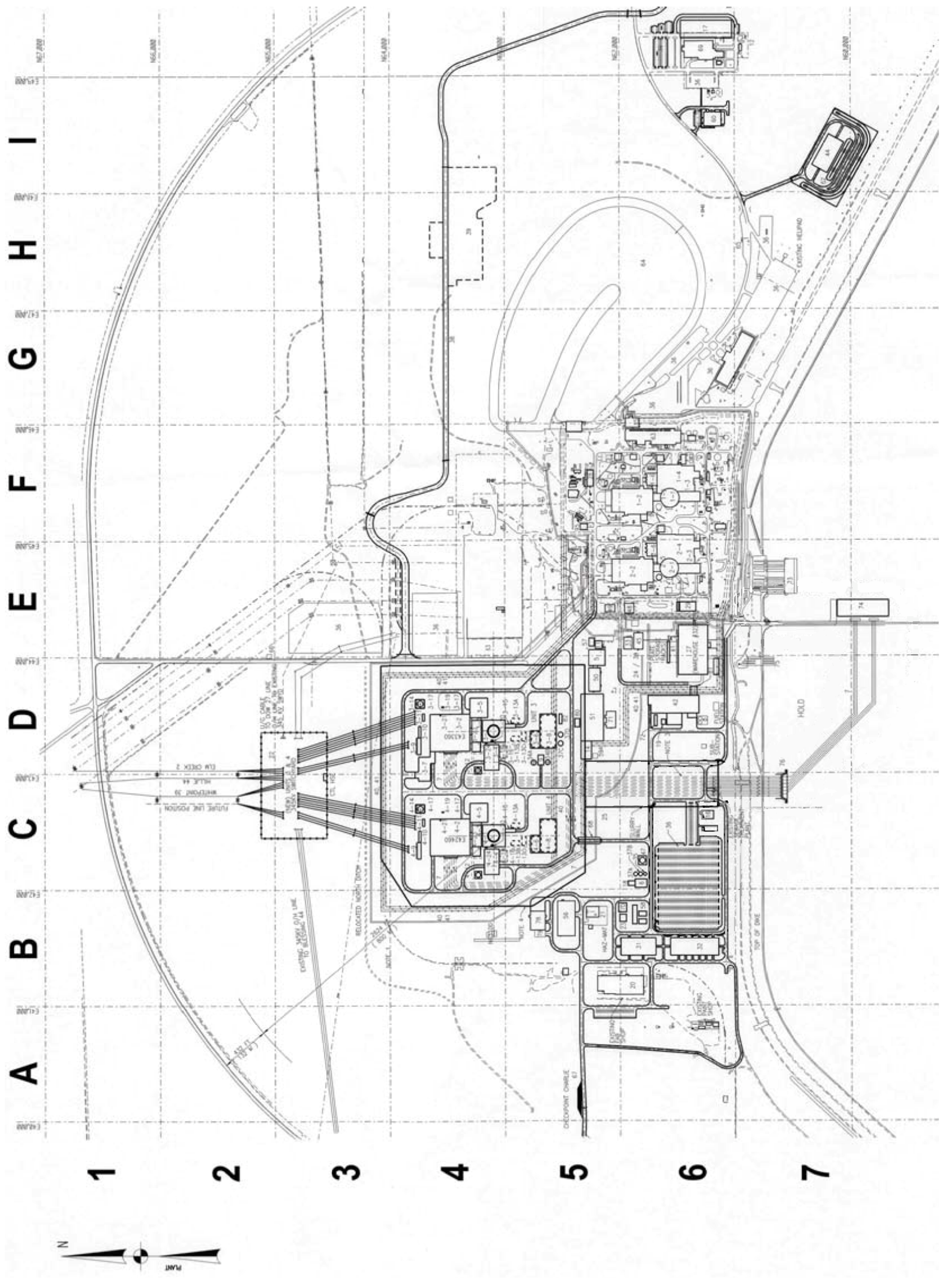

Figure 3-3. STP Site Layout Map

Figure 3-3 illustrates the site drainage for STP site in quadrants B-3 through D-3. The grading of the surface topography directs water away from safety structures and into ditches that drain away from the site into drainage ditches and creeks.

3.2.2.2 Cooling Water System

The circulating water cooling system and its principal components represents one of the largest interfaces between the proposed Units 3 and 4 and the environment. Cooling water would be withdrawn from the north shore of the MCR adjacent to the plant site through an intake structure located on the baffle dike; it would then circulate through the main condensers for proposed Units 3 and 4 after which it would return to the MCR through a shared discharge structure. Water lost from the MCR through ground seepage, evaporation, and release to the Colorado River is replaced with water withdrawn from the Colorado River at the Reservoir Makeup Pumping Facility (RMPF) located to the east of the proposed units. Water would be released from the MCR to the Colorado River to maintain water quality in the MCR. Water returned to the Colorado River enters the Colorado River through the discharge structure located on the west bank of the river approximately 2 mi downstream of the RMPF. The RMPF, the discharge structure on the Colorado River, and the MCR are components with a major plant-environment interface. All of these structures currently exist to support the operation of Units 1 and 2.

While principally installed for the purpose of providing water to cool the proposed Units 3 and 4 for 30 days following an accident, the two Unit 3 and 4 cooling towers are available as helper towers to provide for heat rejection to the atmosphere during normal operations. Blowdown from the cooling towers is returned to the MCR. All of these components are systems with a plant-environment interface.

Reservoir Makeup Pumping Facility

The RMPF is located along the west bank of the Colorado River. The RMPF was originally designed to support four units. Currently, only half of the vertical traveling screens are operational and are used to support the operation of Units 1 and 2. To support four unit operation the remaining intake screens in the RMPF would be refurbished or replaced. The RMPF would be refurbished and modified solely within its existing footprint and not result in any disturbances within the Colorado River.

The RMPF would withdraw water through a 406-ft-long intake structure located parallel to the shoreline. The RMPF consists of 18 traveling screens, each 13.5 feet wide, with the bottom of the screens located 10 feet below mean sea level (MSL) in the Colorado River (water surface elevation in the Colorado River at the intake structure is 0 ft MSL). Vertical trash racks with a four inch opening are located in front of the traveling screens. Short trash racks are also installed perpendicular to the river flow along the upstream and downstream margins of the intake structure. The traveling screens have a mesh size of 3/8 in. The surface area of the 18 traveling screens is 2430 ft^2. Water from the river flows through the trash racks, then through traveling screens, and then over a weir into a small embayment before entering the intake pumps. The intake pumps pump the cooling water through pipelines into the MCR (STPNOC 2009a). New pumps to pump water to the MCR in support of proposed Units 3 and 4 would be installed.

The RMPF vertical traveling screens are operated intermittently coincident with water withdrawals from the river. Rotation of the intake screens vary with debris loading. The design maximum approach velocity of the RMPF screens is approximately 0.5 ft/sec (STPNOC 2008). Organisms that swim through the trash racks can move laterally along the face of the intake structure and exit through the trash racks oriented perpendicular to the river flow located along the upstream or downstream margins of the structure. Fish and other organisms as well as debris impinged on the intake screens would be washed from the traveling screens and deposited in a sluice and discharge line and returned to the Colorado River. The point of return is at the downstream end of the intake structure, approximately 2 ft below normal water elevation (STPNOC 2008).

Discharge Structure

Discharge from the MCR enters the Colorado River along the west bank through a series of seven 36-in. pipes directed downstream at an angle of 45-degrees from the shore. The discharge structures are located about 2 mi downstream of the RMPF. The pipes entering the river are spaced 250 ft apart. No change to the existing discharge structure is proposed.

Main Cooling Reservoir

The MCR is a 7000-ac engineered impoundment enclosed by an engineered embankment. The applicant reported that, at the maximum normal operating pool of 49 ft MSL, the reservoir contains approximately 202,700 ac-ft of water. Dikes within the MCR increase the travel time of cooling water from the circulating water system discharge structure to the circulating water intake structure. The rejected heat from the existing and proposed units would enter the MCR in the form of sensible heat in the circulating water system. As the heated water circulates in the MCR, the heat is gradually dissipated to the environment through evaporation, conduction, and long-wave radiative cooling. Additional intake and discharge structures in the MCR for from the proposed Units 3 and 4 would be required.

Ultimate Heat Sink Cooling Towers

The UHS for Units 3 and 4 would consist of two water storage basins that would hold a sufficient amount of water to cool the units for 30 days of operation following an accident, without the need for makeup water and without exceeding design basis temperature and chemistry limits.

The UHS would have mechanical draft cooling towers contiguous with the basins that would receive makeup water from groundwater wells, with backup from the MCR. The UHS cooling tower blowdown would discharge to the MCR. As stated above, the cooling towers could be operated to provide supplemental cooling of water in the circulating water system.

Circulating Water Intake Structure

A 131-ft by 392-ft concrete structure located within the MCR footprint would house eight pumps for the two proposed units. The structure would include traveling screens and trash racks. This structure is located in quadrants E-7 and E-8 of Figure 3-3. Pipes carrying water to the plant would run to the turbine building.

Circulating Water Discharge Structure

The water return from Units 3 and 4 turbine buildings would enter the MCR through a new discharge structure. The discharge structure would include a weir and a stilling basin to dissipate the velocity of the returning water before it enters the MCR. This structure is located in quadrant C-7 of Figure 3-3.

Water Supply Wells

STPNOC plans to use groundwater as the source for makeup water for proposed Units 3 and 4 UHS, service water for the power plants, and water for sanitary and potable water systems. (STPNOC 2009a).

3.2.2.3 Other Permanent Plant-Environment Interfacing Structures, Systems, or Components

Diesel Generators

Diesel generators would be installed on the site to provide a backup source of power when the normal power source is disrupted. Three generators per unit would be installed in the proposed reactor buildings. Combustion emissions would be released to the atmosphere from the generators only during emergency operations and periodic testing. The reactor buildings housing the diesel generators are located in quadrants C-4 and D-4 of Figure 3-3.

Combustion Turbine Generators

One combustion turbine generator would be installed in each of the proposed unit's turbine buildings. The operation of the generators results in combustion emissions to the atmosphere. Combustion turbine generators are used during off normal conditions and, therefore, are safety related. The turbine buildings where the combustion turbine generators are located in quadrants C-4 and D-4 of Figure 3-3.

Roads

The workforce and a portion of plant materials would enter and exit the site via roads. Solid waste and radwaste are expected to be transported to the site via roadways.

Slurry Wall

To reduce the amount of water entering deep excavation for each unit's reactor buildings, STPNOC proposed the combined use of a slurry wall and dewatering wells. A slurry wall reduces the permeability of the soil surrounding the excavation and thereby reduces the water entering the excavation. While the purpose of the slurry wall is for the purpose of building the plant, it would remain in place and continue to reduce the permeability of the affected areas during operations.

Fill Borrow Pit

STPNOC indicated that fill material would be from qualified onsite borrow pits or qualified offsite borrow pits or both. The use of borrow pits would conform to local zoning requirements.

Railroad Lines

A portion of the plant materials needed for plant construction and operation would enter and exit the site via a railroad line on the site. An existing nine-mile spur that ran from the STP site to Buckeye, Texas is no longer in service. The service would be reestablished and the railroad line upgraded by installing new ballast or rail sections within the existing rail bed. The rail line is located in quadrants D-1 to E-3 to B-3 of Figure 3-3.

Barge Facility and Colorado River Navigation Channel

Dredging of the barge slip would be required to allow particularly heavy components and heavy equipment to be delivered to the site. Although there are no current plans to dredge the Colorado River Navigation Channel, it is possible dredging might be needed in the future.

Main Drainage Channel

The Main Drainage Channel (MDC) is an open ditch that eventually drains into Little Robbins Slough. A portion of the existing MDC would need to be relocated.

Radwaste Facility

Liquid, gaseous, and solid radioactive waste-management systems (SWMS) collect the radioactive materials would be produced as byproducts of operating the proposed Units 3 and 4.

These systems process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits, as described in Section 3.4.3.

Sanitary Waste Treatment Plant

STPNOC proposes to replace the existing sanitary waste plant for Units 1 and 2 with a new facility to support the combined sanitary needs of all four units. The proposed sanitary waste treatment plant is located in quadrants C-6 of Figure 3-3.

Power Transmission Structures

As discussed in Section 2.2.2, STPNOC does not own or operate the existing transmission lines that serve the STP site. Except for upgrading the transmission lines from the STP site to Hillje Substation, STPNOC has determined that no additional offsite transmission line corridors or expansion of existing corridors would be required to support Units 3 and 4 (STPNOC 2009a).

New onsite power transmission system components that would be needed to connect proposed Units 3 and 4 to the grid are (STPNOC 2009a):

- a new 345-kV switchyard to serve Units 3 and 4
- a new 345-kV tie-line from Units 1 and 2 to the new 345-kV switchyard
- five existing transmission lines redirected into the Units 3 and 4 345-kV switchyard.

The transmission system activities for Units 3 and 4 primarily would involve installation activities on the STP site. In addition, two existing transmission lines running approximately 20 mi from the STP site to the Hillje Substation located northwest of the STP site would be upgraded (STPNOC 2009a). The upgrade would involve reconductoring the two lines to accommodate the additional load of Units 3 and 4. In addition, some of the transmission line towers would be replaced to support the replacement conductors (STPNOC 2009a). The two transmission lines that would be upgraded are owned by CenterPoint Energy and American Electric Power Texas Central Company (STPNOC 2009a). Towers to support 345-kV transmission lines are made of steel and are built to meet the National Electrical Safety Code (STPNOC 2009a).

3.2.2.4 Other Temporary Plant-Environment Interfacing Structures

Some temporary plant-environment interfacing structures would need to be removed before proposed Units 3 and 4 operation commences; for example, a concrete batch plant. The impacts from the operation and installation of these structures are discussed in Chapter 4.

Dewatering Wells

Dewatering wells are used to lower the water table in areas that would otherwise be flooded by the influx of groundwater. Groundwater wells are planned to dewater deep excavations in the power block region.

Cranes and Crane Footings

Crane footings would be fabricated, and cranes would be erected on the site to build the plant.

Concrete Batch Plant

A concrete batch plant would be located in quadrant H-4 and I-4 of Figure 3-3. This area would house the equipment and facilities needed for delivery, materials handling and storage, and preparation of concrete.

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. The impacts of these structures to the environment were determined by the review team to be of such minor significance that the structures are not discussed in Chapter 5.

Power Block

The power block refers to the reactor building, the control building, the turbine building, the radwaste building, service buildings, and associated structures. The footprints of the reactor building, the control building, the turbine building, the radwaste building, and the service building are 198 ft by 188 ft, 185 ft by 89 ft, 317 ft by 350 ft, 128 ft by 218 ft, and 168 ft by 156 ft, respectively. These structures are located in quadrants C-4 and D-4 of Figure 3-3. The turbine building is the tallest building reaching 140 ft above grade. The power block contains many safety-related structures, systems, and components.

Pipelines

The review team assumed that pipelines would follow existing roads or roads created while building the new units. Therefore, the installation of pipelines would be limited to areas already disturbed. Major pipelines include pipes running to and from each unit's turbine buildings and the MCR.

UHS Water Storage Basins

The UHS water storage basins are engineered concrete structures 292 ft by 144 ft rectangular basins and 89.5 ft tall that would be built partially below grade. These basins provide water for cooling during off normal conditions and are safety related.

Miscellaneous Buildings

A variety of small buildings would exist throughout the site 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.

Parking

A new parking area would also be graded and paved. This parking area is located in quadrant B-6 and C-6 of Figure 3-3.

Laydown Areas

Multiple laydown areas would be established to support fabrication and erection activities while building the plant and may be maintained as laydown areas for future maintenance and refurbishment of the plant. Laydown areas are graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas. The locations of two new laydown areas are shown in quadrants A-3 to A-5 and B-4 to B-5 of Figure 3-3.

Switchyard

The location of the proposed switchyard is shown in quadrants C-3 and D-3 of Figure 3-3. The switchyard would remain free of vegetation.

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) and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction (defined at 10 CFR 50.10(a)) 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 permit from the Corps) may occur before, during, or after NRC-authorized construction activities. These activities are termed "preconstruction" in 10 CFR 51.45(c) 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, transmission lines, sanitary treatment system, potable water system), dredging; and procurement or fabrication of components occurring at other than the final, in-place location at the site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4.

This section describes the structures and activities associated with building proposed Units 3 and 4. This section also characterizes the major activities for the principal structures to provide the requisite background for the assessment of environmental impacts. However, it does not represent a discussion of every potential activity or a detailed engineering plan. Table 3-1 provides general definitions and examples of activities that would be performed in building the new units.

Table 3-1. Descriptions and Examples of Activities Associated with Building Units 3 and 4

Activity	Description	Examples
Clearing	Removing vegetation or existing structures from the land surface.	Cutting forest in an area to be used for construction laydown.
Grubbing	Removing roots and stumps by digging.	Removing stumps and roots from area that was cleared for construction laydown.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Minor leveling of the site from its current relatively level terrain.
Hauling	Transporting material and workforce along established roadways.	Driving on new access road by construction workforce.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas and site drainage.	Paving parking area.
Well drilling	Drilling and completion of wells.	Drilling wells for dewatering or water supply.
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from excavation of base for reactor building.
Grouting	Installing low-permeability material in the subsurface around deep excavation to minimize movement of groundwater.	Installing slurry wall around excavation for the reactor building
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 to support fabrication of basemat for the reactor.

Table 3-1. (Contd)

Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Placing pipelines; setting foundations for small buildings.
Erection	Assembling all modules into their final positions including all connection 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 and pouring concrete; laying rebar for basemat.
Dredging	Removing substrates and sediment in navigable waters including wetlands.	Enlarging the barge slip.
Dredge placement	Placing fill material in areas not designated as wetlands. These materials can come from dredging wetlands.	Placing sediments removed from the barge slip and navigation channel in a Corps approved placement area.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining switchyard free of vegetation during building.
Filling of aquatic resources	Discharging dredge and/or fill material into waters of the United States including wetlands.	Placing a culvert for a roadway.

3.3.1 Major Activity Areas

STPNOC (2009a) has stated that activities required to build the new units would occur primarily within the boundaries of the 12,220-ac site and in areas that have been previously disturbed. Dredging the navigation channel and obtaining offsite fill material, if needed, are examples of activities that would be conducted offsite.

Landscape and Stormwater Drainage

The existing site grade would be raised to 34 ft MSL in the vicinity of safety-related structures such as the reactor building and UHS block. The STP Site Drainage and Layout Map, shown in Figure 2-12 of Chapter 2, also shows the site grade for proposed Units 3 and 4. Stormwater would drain based on the local ground slope.

Reservoir Makeup Pumping Facility

Refurbishment activities of the RMPF would include new pumps and screens within the existing structure’s footprint.

Roads

New onsite roads would be graded and paved.

Slurry Wall

The slurry wall would be installed into the Upper Aquifer in the power block area.

Railroads

The existing railroad bed would be restored.

Barge Facility

Dredging would be required before barge shipments are offloaded at the barge slip under normal flow conditions. Dredge spoils would be hauled to a spoils disposal site approved by the Corps.

Main Drainage Channel

The MDC from the site would be relocated via shallow excavation of the new course.

Power Transmission System

Building the transmission system would involve the erection and fabrication of switchyard and transmission lines. .

Sanitary Waste Treatment Plant

Building the sanitary plant would involve limited fabrication and erection.

Dewatering Wells

Wells would be drilled using standard drilling practices into the Upper Aquifer.

Cranes and Crane Footings

Fabricating footings, building retaining walls, and erecting cranes would be needed to build the larger plant structures.

Concrete Batch Plant

Erecting the temporary concrete batch plant would occur on a cleared, graded area.

Power Block

The power block is composed of the reactor building, the radwaste building, the turbine building, service buildings, and associated structures. Deep excavation and extensive fill placement and large-scale fabrication and erection activities are involved. These deep excavations are expected to require installation of dewatering wells. An onsite concrete batch plant would fabricate concrete for numerous pours. Various components would be hauled to the site via rail, barge, and road. Many of these structures would be erected using components having been delivered as large modules and installed via crane.

Circulating Water Intake

Cofferdams would be required around the area within the MCR where the intake would be fabricated and erected to allow continued use of the MCR by Units 1 and 2. Once the installation is complete, the cofferdams would be removed and the site inundated again.

Circulating Water Discharge

Cofferdams would be required around the area within the MCR where the discharge would be fabricated and erected to allow continued use of the MCR by Units 1 and 2. Once the installation is complete, the cofferdams would be removed and the site inundated again.

Pipelines

The largest pipelines would be those connecting the circulating water from the turbine building and the MCR. These would require shallow excavation.

UHS Water Storage Basins

Deep excavation would be required to construct the reinforced concrete walls and floor of the safety-related UHS water storage basins. Structural fill would be placed around these basins.

Miscellaneous Buildings

Excavating for shallow foundations would be required before fabrication and erection of miscellaneous buildings.

Parking

Parking areas would be graded and paved.

Laydown Areas

Laydown areas would be graded and covered with gravel.

Supply Wells

Wells would be drilled using standard practices to the design depth.

Switchyard

Clearing and grading would be required for the proposed switchyard and the fabrication and erection of electrical switching structures would need to occur.

3.3.2 Summary of Resource Commitments During Construction and Preconstruction

Table 3- provides a list of the significant resource commitments of construction and preconstruction. The values in this table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in the ER (STPNOC 2009a), and the review team determined that the values are not unreasonable.

Table 3-2. Summary of Resource Commitments Associated with Building Proposed Units 3 and 4

Resource Area	Value	Description
All Resource Areas	7.5 years	Duration of preconstruction and construction activities for two proposed units
Land Use, Terrestrial Ecology, Cultural and Historic Resources (Site and Vicinity)	540 ac	Disturbed area footprint: 300 ac permanently disturbed 240 ac temporarily disturbed
Hydrology-Groundwater	95 ft below grade	Excavation depth to which dewatering would be required
	1062 gpm	Allowable monthly average groundwater withdrawal based on groundwater use permit
	491 gpm	Expected highest monthly groundwater-use rate
Socioeconomics, Transportation, Air Quality	5950 workers	Peak construction workforce – month 26 through month 35 of construction schedule
	9021 maximum number of workers onsite	• 1238 Units 1 and 2 operations staff • 733 Units 3 and 4 operations staff (approaching end of construction period) • 5950 construction workers and • 1100 outage workers (e.g., refueling)
Terrestrial Ecology, Nonradiological Health, Socioeconomics	108 dBA	Peak noise level
	69–84 dBA	Noise level 400 ft from activity

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 are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by the applicant in the FSAR portion of its application (STPNOC 2009b) and are reviewed by the NRC in its safety evaluation report (in progress).

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), the radioactive and nonradioactive waste management systems (Sections 3.4.3 and 3.4.4), and summarize the values of parameters likely to be experienced during operations (Section 3.4.5).

3.4.1 Description of Operational Modes

The operational modes for proposed Units 3 and 4 considered in the assessment of operational impacts on the environment (Chapter 5) are normal operating conditions (including periodic testing of standby diesel generators) and emergency shutdown conditions. These are the nominal conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are alternate modes to normal plant operation during which water intake, cooling tower evaporation, water discharge, and radioactive releases may change from nominal conditions. There would be a shift in the operation of the two cooling systems from the MCR to the UHS cooling towers during these alternate modes.

3.4.2 Plant-Environment Interfaces During Operation

This section describes the operational activities related to structures with an interface to the environment.

3.4.2.1 Circulating Water System – Intakes, Discharges, Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. The circulating water system (CWS) for the proposed Units 3 and 4 is similar to the CWS for STP Units 1 and 2; it will transfer heat from the main condenser to the MCR, where the heat content of the circulating water is transferred to the ambient air primarily via radiation and evaporative cooling. During normal plant operation, the CWS would dissipate approximately 8.656×10^9 Btu/hr for each unit, or 1.732×10^9 Btu/hr for both units, of waste heat. In addition to its primary function as the UHS, the cooling towers are available as helper towers during normal operations. When used as helper towers, evaporation to the atmosphere would be 283 gpm; only half of the cells would be used during normal operations. The induced and natural evaporation from the MCR is dictated as a function of the air temperature, water temperature, humidity, and wind speed. In addition to evaporative losses, a small percentage of water is also lost in the form of droplets (drift) from the cooling tower; air impacts from cooling tower operation would also include visible plumes. STP estimates that the two proposed units would require approximately 1242 gpm of groundwater during normal operation and 4108 gpm during shorter-term peak demand periods as the source for makeup water for proposed Units 3 and 4 UHS, service water for the power plants, and water for sanitary and potable water systems (STPNOC 2009a).

The RMPF operation would be variable, based on conditions in the MCR and conditions in the Colorado River. The RMPF was designed for a maximum diversion capacity of 1200 cfs; while it currently has the screening and pumping capacity installed for 600 cfs to meet the needs of Units 1 and 2, new pumps and screens would be installed at existing designated locations within the RMPF for an additional 600 cfs to meet the needs of proposed Units 3 and 4. The MCR discharge would periodically discharge water in the MCR to the Colorado River. Heated water would be discharged to the MCR through the MCR Cooling Water Discharge Structure (STPNOC 2009a).

3.4.2.2 Landscape and Drainage

The landscape and drainage would determine the path that precipitation takes on the land surface. In addition, the land cover, soil moisture content, and soil type would determine the rate of recharge to the subsurface. The MDC is the primary pathway that stormwater from around proposed Units 3 and 4 would leave the site.

3.4.2.3 Essential Service Water System – Ultimate Heat Sink

Proposed Units 3 and 4 would each have a six-cell mechanical draft cooling tower that serves as the UHS. The UHS mechanical draft cooling towers would receive makeup water from groundwater wells, with backup from the MCR. Evaporation to the atmosphere from the UHS cooling towers would be 1061 gpm during shutdown (emergency) conditions; when used in this mode, all of the cells would be used. The UHS cooling towers would discharge to the MCR. Potential air impacts from cooling tower operation include visible plumes and drift.

3.4.2.4 Emergency Diesel Generators

Diesel generators would be installed on the site to provide a backup power source. Three generators per unit would be installed in the proposed reactor buildings. Diesel generators are intended to be used during off-normal conditions and, therefore, are safety related. Periodic testing of the generators to ensure working status contributes to combustion emissions to the atmosphere when the generators are running.

3.4.3 Radioactive 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 proposed Units 3 and 4. These systems would process radioactive liquid and gaseous effluents to maintain releases within regulatory limits and to levels as low as is reasonably achievable (ALARA) before releasing them 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"). The radioactive waste-management systems are not shared between the existing Units 1 and 2 and proposed Units 3 and 4. Radioactive materials in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in ABWRs. 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 into the reactor coolant. Neutron activation of the primary coolant system would also add radionuclides to the coolant.

STPNOC proposed to make changes to the design of liquid, gaseous, and solid waste management systems included in the reference ABWR Design Control Document (GE 1997). The specific radioactive waste-management systems for the proposed two new units at the STP site are described in Chapter 11 of the FSAR (STPNOC 2009b). The change in the liquid waste-management system includes the use of mobile technology and eliminates the forced circulation concentrator system. The change in the gaseous waste management system involves changes to the charcoal adsorber system. The change in the solid waste-management system eliminates the solidification, incineration, and compacting process. The liquid and gaseous radioactive source terms for the ABWR design were provided by STPNOC in ER Tables 3.5-1 and 3.5-2 (STPNOC 2009a) and were based on its FSAR (STPNOC 2009b).

The offsite dose calculation manual (ODCM) for the South Texas Project (STPNOC 2006) describes the methods and parameters used for calculating 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 effluents from STP. Operational limits for releasing liquid and gaseous effluents are also specified in the ODCM to ensure compliance with NRC regulations. The systems used for processing liquid waste, gaseous waste, and solid waste are described in the following sections.

3.4.3.1 Liquid Radioactive Waste-Management System

Figure 3.5-1 in the ER (STPNOC 2009a) is a diagram of the liquid and solid waste-management systems. The Liquid Waste Management System (LWMS) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation and anticipated operational occurrences, including refueling operations. The LWMS is managed using several process trains consisting of tanks, pumps, ion exchangers, filters, and radiation monitors. Normal operations include processing of (1) reactor coolant system wastes, (2) floor drains and other wastes with potentially high suspended solid contents, (3) detergent wastes, and (4) chemical wastes.

The LWMS routes batch discharges to the MCR. The discharge is monitored and administratively controlled to assure that it meets requirements of 10 CFR Part 20. Calculated dose to the maximally exposed individual (MEI) from liquid effluents is evaluated in Section 5.9.2. The LWMS is designed to comply with Regulatory Guide 1.143 guidance regarding liquid radwaste treatment systems. The LWMS is also designed to maintain the exposure of people in unrestricted areas ALARA (10 CFR Part 50 Appendix I). No subsystems of the LWMS and the radwaste building that house the LWMS are shared between proposed Units 3 and 4 (STPNOC 2009a). Units 3 and 4 will each have their own independent LWMS.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system (GRWMS) functions to collect, process, and discharge radioactive gaseous wastes. The GRWMS is illustrated in Figure 3.5-2 of the ER (STPNOC 2009a). Gaseous radionuclides would be generated during normal operation of Units 3 and 4. They include gaseous fission products and gaseous radionuclides formed by neutron activation of the reactor coolant and contained gases. These gases are retained in the plant systems and removed in a controlled fashion through the gaseous waste management system. The GRWMS collects waste from multiple sources and delays its release to allow short-lived radionuclides to decay. The remaining gaseous radionuclides are released in a controlled manner to the environment through the plant stack, a monitored release point. The GRWMS processes and controls the release of gaseous radionuclides to the environs to maintain the exposure of people in unrestricted areas ALARA (10 CFR Part 50 Appendix I). Calculated doses to the MEI from gaseous effluents are evaluated in Section 5.9.2. Radioisotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel during operation. Some of these gases escape to the reactor coolant system through cladding defects then subsequently decay to stable isotopes. Some of these gases are released to the environment via plant ventilation or are delayed by activated carbon adsorbers and then released through the GRWMS. In addition, various neutron activation products, such as argon-41, are formed directly in the reactor coolant during operation and are also delayed by the activated carbon adsorbers, and then released through the GRWMS.

Major process equipment of the GRWMS includes the following:

1. process piping starting from the final steam dilution jets of the main condenser evacuation system (not a part of the off-gas system)

2. integral recombiners, including a preheater section, a recombiner section, and a condenser section
3. cooler-condensers
4. activated charcoal adsorbers
5. high efficiency particulate air filter
6. monitoring instrumentation, and
7. process instrumentation and controls.

The GRWMS is housed in a reinforced concrete structure to provide adequate shielding. The charcoal adsorbers are installed in a temperature-monitored and controlled vault, which is located in the turbine building to minimize piping.

3.4.3.3 Solid Radioactive Waste-Management System

The solid radioactive waste-management system (SWMS) treats, stores, packages, and disposes of dry or wet solids. The SWMS is illustrated in Figure 3.5-1 of the ER (STPNOC 2009a). The SWMS Process Flow Diagram is provided in Figure 11.2-1 of the FSAR (STPNOC 2009b). Solid radioactive waste can be either dry or wet solids, and the source can be an operational activity, maintenance, or another function. Non-fuel solid wastes are generated from separating and treating radioactive material from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, rags, and other trash generated from plant design modifications, operations, and maintenance activities. The SWMS is designed to handle both normal and anticipated operational occurrences. The annual total estimated volume of solid waste to be shipped would be about 475 cubic meters per year (m^3/yr) (STPNOC 2009a).

Solid wastes may be shipped to a waste processor for volume reduction before disposal at a licensed disposal facility. Wet solid wastes include spent resins and sludge from powdered resins and filter backwashing. Spent resins and filters are typically dewatered before packaging for shipment to a licensed offsite processing or disposal facility.

3.4.4 Nonradioactive Waste Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for the two new units. This category of nonradioactive effluent includes gaseous emissions, liquids, hazardous waste, mixed waste, and solids.

3.4.4.1 Solid Waste Management

Activated sludge from the existing Units 1 and 2 is currently disposed by land application at a rate of 30,000 to 40,000 gallons per year. The sludge from the new West Sanitary Waste Treatment System (WSWTS) and Nuclear Training Facility (NTF) systems for the existing Units 1 and 2 and proposed Units 3 and 4 would be disposed of by land application.

Nonradioactive solid wastes that would be created during the construction and operation of proposed Units 3 and 4 include industrial refuse such as paper, metal, wood, and batteries. STPNOC has a recycling program for metal and paper waste and ships batteries to a registered battery recycling facility. These recycling efforts would continue with the addition of Units 3 and 4. Non-recyclable solid waste would be deposited in an onsite landfill consistent with Texas Commission on Environmental Quality (TCEQ) regulations or shipped to an offsite landfill (STPNOC 2009a).

STPNOC is currently a small quantity generator of hazardous waste, based on the amount of waste generated by Units 1 and 2 (STPNOC 2009a). This status could be upgraded with the addition of the two new units. The treatment, storage, and disposal of hazardous wastes generated at the two new units would be managed and disposed in the same appropriate manner as the existing units' hazardous waste.

3.4.4.2 Liquid Waste Management

Water chemistry for various plant water uses would be controlled with the addition of biocides, algaecides, corrosion inhibitors, pH buffering, scale inhibitors, and dispersants. Chemical and biocides similar to those currently used for existing Units 1 and 2 are expected to be used for proposed Units 3 and 4. Table 3-3 provides a list of water treatment chemicals currently used for STP Units 1 and 2 to treat biofouling and algae, and to provide for pH buffering, corrosion inhibition, scale inhibition, and silt dispersion. Chemical and biocidal additives and waste streams from various water treatment processes and drains are returned to the MCR where they are subjected to dilution, aeration, vaporization, and chemical reactions. In addition, a dedicated drain system collects waste water from the turbine building, the reactor building, the hot machine shop, and the control building to separate any solids from the liquid effluent for deposition into dual settling basins. The nonradioactive effluents are then discharged into the MCR. Water from the MCR may be discharged to the Colorado River subject to the limitations of the STP site's existing National Pollutant Discharge Elimination System (NPDES) permit (STPNOC 2009a). Impacts to surface water quality are discussed in Sections 4.2.3.1 and 5.2.3.1, respectively.

Table 3-3. Representative Water Treatment Chemicals Used for STP Units 1 and 2

Ammonium bisulfite	Molluscide (quaternary amine)
Antifoam	Phosphate
Biocide (sodium bromide)	Polymers
Boric Acid	Sodium bisulfate
Calcium hypochlorite	Sodium chloride
Coagulant	Sodium hydroxide
Corrosion Inhibitors	Sodium hyperchlorite
(ethanolamine, sodium metaborate, sodium nitrite)	Sulfuric acid
Dispersant	Tolytriazole
Hydrazine	Zinc
Lithium Hydroxide	

Source: STPNOC 2009a

STPNOC currently uses two sanitary waste systems that are in compliance with State regulations and the Federal Water Pollution Control Act (Clean Water Act). One system serves the existing Units 1 and 2, WSWTS, and the other system serves the NTF. Both systems would be replaced by newer systems to accommodate the expansion of the facilities by the addition of Units 3 and 4. The new WSWTS will be designed to treat sanitary waste at a rate of 300,000 gallons per day, and the new NTF system will be designed to treat sanitary waste at a rate of 100,000 gallons per day (STPNOC 2009a).

Liquid waste from sanitary treatment systems would use the existing outfalls for discharge of effluents from the new WSWTS and NTF systems to the MCR. A new or amended permit would need to be submitted to TCEQ to comply with water quality requirements for the added capacity for treatment, discharge, and monitoring of liquid wastes of the new systems (STPNOC 2009a).

Other industrial liquid wastes such as oil, diesel fuel, and antifreeze are collected and sent to recycling centers. Non-recyclable liquid wastes such as paint, electrohydraulic fluid, and solvents are shipped offsite to appropriate waste collection facilities (STPNOC 2009a).

3.4.4.3 Gaseous Waste Management

STPNOC currently has gaseous emissions, primarily from diesel generators and the combustion turbine generator, that are subject to air permits issued by the TCEQ. The addition of Units 3 and 4 would require additional diesel and combustion turbine generators with attendant emissions regulated under an amended or new TCEQ permit. No other sources for gaseous emissions are currently planned at the STP site (STPNOC 2009a).

3.4.4.4 Hazardous and Mixed Waste Management

Mixed wastes contain both hazardous and low-level radioactive waste. Small amounts of mixed waste could be generated during maintenance, refueling, and laboratory activities. STPNOC does not expect Units 3 and 4 to generate mixed waste in substantial quantities; if mixed waste is generated, then it is expected to be 0.5 m^3/yr or less. The mixed waste from Units 3 and 4 would be handled and managed similarly to Units 1 and 2, in accordance with the applicable Federal and State regulations (STPNOC 2009a).

3.4.5 Summary of Resource Parameters During Operation

Table 3- provides a list of the significant resource commitments involved in operating Units 3 and 4 that are relevant to more than one resource evaluation. The values in this table, combined with the affected environment described in Chapter 2, provide a part of the basis for the operational impacts assessed in Chapter 5. These values were stated in the ER (STPNOC 2009a) and supplemental RAI responses (STPNOC 2009c), and the review team has determined that the values are not unreasonable.

Table 3-4. Parameters Associated with Operation of Proposed STP Units 3 and 4

Resource Area	Normal Operating Condition	Maximum Condition	Description
Socioeconomics	959 workers	2059 workers	Normal condition for two plants; Maximum occurs during refueling outages lasting 15 to 35 days Table G-2 of this EIS indicates 1100 workers for an outage
Terrestrial Ecology, Radiological Health, Socioeconomics	140 ft	140 ft	Height of tallest building (Turbine building).
	249 ft	249 ft	Height of tallest structure (vent stack).
Hydrology – Groundwater	47gpm	491 gpm	Range of monthly groundwater use during initial testing
	975 gpm	3434 gpm	Groundwater withdrawal rate for all systems combined.
	50 gpm	91 gpm	Groundwater withdrawal rate for makeup water
	40 gpm	140 gpm	Groundwater withdrawal rate for potable water.
	885 gpm	3203 gpm	Groundwater withdrawal rate for UHS makeup-water

Table 3-4. (contd)

Hydrology – Surface Water	21,600 gpm long-term average basis for 93% heat load.	23,190 gpm full heat load	Water obtained from Colorado River, precipitation and groundwater discharge to MCR
	22,799 gpm	47,489 gpm	Total required Colorado River water to MCR
	23,190 gpm	49,000 gpm	MCR forced evaporation rate
	0 gpm	138,240 gpm	MCR blowdown to Colorado River
Hydrology – Groundwater,	566 gpm	2122 gpm	UHS evaporation rate
Hydrology – Surface Water,	5 gpm	10 gpm	UHS drift rate
Terrestrial Ecology, Meteorology/Air Quality	24 gpm	13 gpm (under maximum water use condition)	UHS seepage
Hydrology – Groundwater, Hydrology – Surface Water,	290 gpm	1058 gpm	Blowdown rate to MCR
Terrestrial Ecology	391 gpm	1511 gpm	Plant effluent discharge to MCR
Aquatic Ecology	<0.5 fps	0.5 fps	Intake screen approach velocity
Terrestrial Ecology, Socioeconomics,	65 dBA		Cooling tower sound level at 50 ft
Nonradiological Health	51 dBA		Cooling tower sound level at 400 ft
Radiological Health, Transportation, Need for Power	3926 MW(t)		Rated and design core thermal power of an ABWR
	1356 MW(e)		Gross Electrical Output and Nominal rating of turbine-generator
	56 MW(e)		Station load per unit
Radiological Health	95 percent		Expected annual capacity factor
Meteorology/Air Quality	1.732 × 1010 Btu/hr	1.732 × 1010 Btu/hr	Waste heat to atmosphere
	55.5 ft	55.5 ft	UHS cooling-tower height

Sources: STPNOC 2009a and STPNOC 2009c

3.5 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, “Standards for Protection against Radiation.”

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, “Domestic Licensing of Production and Utilization Facilities.”

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

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4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with building the proposed Units 3 and 4 at the South Texas Project Electric Generating Station (STP) site as described in the application for combined licenses (COLs) submitted by STP Nuclear Operating Company (STPNOC). As part of its application, STPNOC submitted (1) an Environmental Report (ER) (STPNOC 2009a), which discusses the environmental impacts of constructing the new nuclear units and provides information used as the basis for the environmental review, and (2) a Final Safety Analysis Report (STPNOC 2009b), which addresses safety aspects of construction and operation.

As discussed in Section 3.3 of this environmental impact statement (EIS), the U.S. Nuclear Regulatory Commission's (NRC's) authority related to building new nuclear units is limited to "activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57426). The NRC has defined "construction" according to the bounds of its regulatory authority. 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 10 CFR 51.45(c). 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, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

As described in Section 1.1.3, the U.S. Army Corps of Engineers (Corps) is a cooperating agency on this EIS consistent with the updated Memorandum of Understanding (MOU) signed with the NRC (Corps and NRC 2008). The NRC and the Corps 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 the environmental information and analyses needed by the NRC to make a license/permit decision and all the information needed by the Corps to perform analyses, draw conclusions, and make a permit decision in the Corps' Record of Decision (ROD) documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC and Corps team. The review team was composed of NRC staff and its contractors and staff from the Corps.

The information needed by the Corps includes information to perform (1) analyses to determine that the proposed action is the least environmentally damaging practicable alternative (LEDPA), and (2) its public interest assessment. To perform the public interest assessment, the Corps considers the following public interest factors: conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, and mineral needs.

Many of the impacts the Corps must address in its LEDPA analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a permit from the Corps would be preconstruction activities. On June 4, 2009, with subsequent submittal on October 28, 2009, STPNOC submitted a Permit Determination Request to the Corps Galveston District for activities associated with constructing and operating Units 3 and 4 (STPNOC 2009e). On November 10, 2009, the Corps notified STPNOC that the proposed project would require a U.S. Department of the Army permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act of 1899 (Corps 2009a).

While both NRC and the Corps must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321, et seq.), both agencies also 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.). The Corps' regulatory authority related to the proposed action is based on Section 10 of the Rivers and Harbors Act (33 USC 403, et seq.), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps, and Section 404 of the Clean Water Act (33 USC 1344, et seq.), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the Corps. Therefore, the applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a Corps permit. The permit would typically be issued following the Corps' evaluation and public feedback in the form of public comments on its draft environmental review. Because the Corps is a cooperating agency under the MOU for this EIS, the Corps' ROD of whether to issue a permit will not be made until after public comment has been received on this NRC/Corps draft EIS and the final EIS is issued.

The collaborative effort between the NRC and the Corps 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. Consistent with the MOU, the staffs of the NRC and the Corps collaborated (1) in the review of the COL application and information provided in response to requests for additional information (developed by the NRC and the Corps) and (2) in the development of the EIS. NRC regulations (10 CFR 51.45(c)) require 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 Corps in the environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of COLs and the preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a). Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) 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.

For most environmental resource areas (e.g., terrestrial ecology), the impacts are not the result of either solely preconstruction or solely construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction 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 on land use, meteorology and air quality, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, nonradiological and radiological health effects, nonradioactive waste, and applicable measures and controls that would limit the adverse impacts of building the new units. An impact category level—SMALL, MODERATE or LARGE—of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas, for example, in the socioeconomic area where the impacts of taxes are analyzed, the impacts may be considered beneficial and would be stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation measures of adverse impacts, where appropriate, are presented in Section 4.11. A summary of the construction impacts and the proportional distribution of impacts based on construction and preconstruction is presented in Section 4.12. Citations for the references cited in this chapter are listed in Section 4.13. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10.

The review team's evaluation of the impacts of building Units 3 and 4 draws on information presented in STPNOC's ER and supplemental documents, and the Corps' permitting documentation, as well as other government and independent sources.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with building Units 3 and 4 at the STP site. Topics discussed include land-use impacts at the STP site and in the vicinity of the site and land-use impacts in transmission line corridors and other offsite areas.

4.1.1 The Site

Proposed Units 3 and 4 would be located northwest of existing Units 1 and 2. The proposed location for Units 3 and 4 is entirely within the existing STP site. There are no zoning regulations currently applicable to the STP site.

All project activities for building Units 3 and 4, including ground-disturbing activities, would occur within the existing STP site boundary and on land that was previously disturbed during building of Units 1 and 2. The area that would be affected on a long-term basis as a result of permanent facilities at the STP site would be approximately 300 ac (STPNOC 2009a). Permanent impacts include disturbance to areas proposed for the power block for Units 3 and 4; the switchyard; the cooling tower area; and the intake, pipeline, and discharge areas for the cooling water system. These activities would result in a permanent land-use change from open space. An additional approximately 240 ac would be disturbed for temporary facilities including a concrete batch plant, material storage areas, laydown areas, heavy haul road, parking areas, borrow areas, and spoils storage (STPNOC 2009a). These activities would result in a temporary land-use change; STPNOC committed to restore temporarily disturbed areas after completion. STPNOC states in its ER that all preconstruction and construction activities would be conducted in accordance with Federal, State, and local regulations (STPNOC 2009a).

Parking lots, soil borrow areas, and storage areas for spoils would generally be west of the Unit 3 and 4 construction area. A heavy haul road would be constructed by STPNOC from the Unit 3 and 4 powerblock area to the existing road to the barge slip. The heavy haul road would be approximately 2.5 mi long and 50 ft wide (STPNOC 2009a) and would result in a permanent land use change from open space. Temporary laydown areas would be located to the north and south of the Unit 3 and 4 power block area, resulting in a temporary land use change. STPNOC committed to restore temporarily disturbed areas after completion of the project. With the exceptions of the barge slip expansion, dredging of the Colorado River's navigation channel if needed, and upgrade of the Reservoir Makeup Pumping Facility (RMPF), most of the major project activities would not take place within a floodplain. The existing rail spur to the STP site would be upgraded, but there would be no associated land-use impacts. The new switchyard to serve Units 3 and 4 would be located approximately 650 ft north of Units 3 and 4 (STPNOC 2009a).

Approximately 162 ac of natural and man-made wetlands are on the STP site. The man-made wetlands totaling 110 ac (the Texas Prairie Wetlands Project [TPWP]) are located approximately 1800 ft north of the Essential Cooling Pond (ECP). These wetlands would not be disturbed by project activities. The Corps has identified 29 smaller wetland areas totaling 17.6 ac on the site; one of the wetlands (WET001) is near the northwest corner of Unit 4 (Corps 2009b). Kelly Lake is 34 ac. STPNOC would avoid these sites while building facilities (STPNOC 2009a).

The only Unit 3 and 4 facilities that would be located in the Colorado River floodplain are those that would be shared with and have already been constructed for use by Units 1 and 2. Therefore, there would be minimal or no additional land-use impacts to these areas. These facilities are the RMPF, the Main Cooling Reservoir (MCR) blowdown discharge pipes, the MCR spillway discharge structure, and the barge facility. The remainder of the Unit 3 and 4 facilities would be constructed in areas located above the elevation of the floodplain (STPNOC 2009a). Material from any dredging activities in or adjacent to the Colorado River would be placed in a man-made upland dredge material placement area located between the MCR and the Colorado River (STPNOC 2009e).

After completion of Units 3 and 4, STPNOC committed to restore areas used for project support by grading, landscaping, and planting to enhance the overall site appearance. Previously vegetated areas cleared for temporary facilities would be revegetated, and harsh topographical features created during the project would be contoured to match the surrounding areas (STPNOC 2009a). Because a relatively small percentage of uplands and no wetlands at the STP site would be permanently converted to new land-use categories, the land-use impacts of building Units 3 and 4 would be minor.

Based on information provided by STPNOC and the review team's independent review, the review team concludes that the combined land-use impacts of construction and preconstruction would be SMALL, and no further mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities; the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL.

4.1.2 Transmission Lines and Offsite Areas

As discussed in Chapter 3, no new offsite transmission corridors or expansion of existing corridors are planned for proposed Units 3 and 4. The power transmission system for the new units would not require new transmission lines or corridors, but would use five of the nine 345-kV transmission lines that currently connect to existing STP Units 1 and 2 (STPNOC 2009a); a portion of the system would be upgraded, perhaps necessitating the use of board roads within wetlands, resulting in temporary impacts. Activities associated with building the new onsite switchyard and connecting transmission lines would occur in areas previously disturbed during site development activities associated with Units 1 and 2 (STPNOC 2009a).

A few other offsite land-use changes in the region would be expected as a result of project activities. STPNOC would construct a new Emergency Operations Facility (EOF) in Bay City, Texas, where the new offices for Units 3 and 4 would be located (STPNOC 2009a). Possible changes include the conversion of some land in surrounding areas to temporary or permanent housing developments (e.g., recreational vehicle parks, apartment buildings, single-family condominiums and homes, and/or manufactured home parks) and retail development to serve construction workers. Additional information on roads, housing, and recreation-related infrastructure impacts is in Section 4.4.4. While the precise land-use impacts cannot be predicted, the review team determined that any land-use changes would not be inconsistent with local zoning and land-use plans. The land-use impacts of project activities in transmission line corridors and offsite areas would be minor, and additional mitigation would not be warranted.

Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the combined offsite land-use impacts from preconstruction and construction activities related to transmission corridors and the new EOF would be SMALL, and that no additional mitigation would be warranted. NRC's 2007 Limited Work Authorization (LWA) rule (72 FR 57426) specifically indicates that transmission lines and other offsite activities are not included in the definition of construction. Therefore, the NRC staff concludes that there would be no offsite land-use impacts associated with NRC-authorized construction activities.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts that would be associated with building of large industrial projects and are not much different than those experienced during the building of STP Units 1 and 2. Prior to initiating building activities, including any site-preparation work, STPNOC would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. The following is a list of the hydrological-related authorizations, permits, and certifications potentially required from Federal, State, regional, and local agencies. Additional detail regarding the items below is contained in Appendix H.

- Rivers and Harbors Appropriation Act of 1899 Section 10 Permit. This permit is issued by the Corps to regulate structures and/or work in navigable waters of the United States such as the Colorado River.
- Clean Water Act Section 401 Certification. This certification is issued by the State of Texas and ensures that the project does not conflict with State water-quality standards.
- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Construction and Industrial Stormwater Permits. These permits would regulate point source discharges to surface water. U.S. Environmental Protection Agency (EPA) stormwater regulations established requirements for stormwater discharges from various activities, including building activities. EPA has delegated the authority for administering the NPDES program in the State of Texas to the Texas Commission on Environmental Quality (TCEQ), which issues the Texas Pollutant Discharge Elimination System (TPDES) permits.

- Clean Water Act Section 404 Permit. The Department of the Army permit is required for the discharge of dredge and/or fill material into waters of the United States, including wetlands.
- Public Drinking Water System Permit. This permit is issued by the TCEQ to ensure a safe drinking water supply for public use. The permit addresses water sources, storage, and distribution and ensures that the State drinking quality standards are met. STPNOC would need to modify its existing permit for the planned expansion.
- Groundwater Well Drilling and Operating Permits. These permits are issued by the Coastal Plains Groundwater Conservation District (CPGCD) to ensure that groundwater use complies with the rules of the CPGCD (CPGCD 2009) and Texas State law (i.e., Texas Water Code Chapter 35 "Groundwater Studies" and Water Code Chapter 36 "Groundwater Conservation Districts").

4.2.1 Hydrological Alterations

Building the proposed Units 3 and 4 at STP would alter several surface-water bodies and some of the aquifers underlying the site. Surface-water bodies that may be affected include the sloughs located on the site (including Little Robbins Slough), the MCR, the existing Main Drainage Channel (MDC) in the proposed area where Units 3 and 4 would be located, and proposed site drainage channels that flow to the Colorado River and to the West Branch of the Colorado River. Groundwater aquifers that may be affected include the Upper and Lower Shallow Aquifers into which the slurry wall, excavation, and fill would penetrate, and the Deep Aquifer in which one or more additional production wells would be installed.

As stated in Section 3.2, an approximately 2-mi-long heavy haul road would be built from the barge slip to the proposed location of proposed Units 3 and 4. There is a potential for alteration of drainage and recharge patterns on the STP site because of the heavy haul road.

Chapter 2 describes the modification to the RMPF needed to support the operation of the proposed units. The installation of the new pumps in the existing RMPF would not affect the Colorado River. The intake screens that require refurbishment or replacement can be lifted out and placed back in without substantial alteration of the intake structure. Dredging would occur in the RMPF forebay, in the Colorado River along the intake screens, and in the barge slip area as needed to remove accumulated sediment. Dredging would be performed in accordance with existing or future permits issued by the Corps (SPTNOC 2009a). The impact on the Colorado River from these activities would be temporary and limited in extent to the immediate vicinity of the structures.

As stated in Section 3.3, erection of new transmission line towers would occur on existing pads. STPNOC stated that it would implement erosion control measures for areas that may be adjacent to surface water bodies to minimize sediment and other pollutant discharge. As stated in Section 3.3 above, the refurbishment of the existing railroad on the STP site would be limited to ballast placement and replacement of some rail sections. Implementation of best management practices (BMPs) should minimize alterations to wetlands and surface-water bodies near the STP site.

4.2.2 Water-Use Impacts

STPNOC has proposed no surface water use for building the proposed Units 3 and 4.

STPNOC currently holds a groundwater use permit to withdraw from the Deep Aquifer an average of approximately 1860 gallons per minute (gpm) (3000 acre-feet per year [ac-ft/yr]) (CPGCD 2008). This operating permit allows STPNOC to withdraw a total of 2.93×10^9 gallons (9000 ac-ft) of water over an approximately 3-year period. Under the terms of the permit, STPNOC may exceed 3000 ac-ft in an individual year; however, STPNOC cannot exceed the 9000 ac-ft limit over the period of the permit (approximately 3-years). STPNOC plans to use groundwater as the source for potable and sanitary water, concrete batch plant operation, concrete curing, cleanup activities, dust suppression, placement of engineered backfill, and piping hydrotests and flushing.

Based on a monthly evaluation of water requirements during building activities and the initial testing of the proposed units, STPNOC estimates that development of the two proposed units would require groundwater during the building activities ranging from approximately 10 to 228 gpm, and during initial testing ranging from 47 to 491 gpm (STPNOC 2009c). STPNOC would use groundwater up to its current permitted limit to support both the operation of the two existing units, and building and initial testing of the two proposed units. The applicant noted that short-term peak site groundwater demands in excess of the permit limit would be met through a maintained water storage capacity during building and initial testing of the proposed units.

Potential offsite impact on the groundwater resource during the development of the two proposed STP units is bounded by an annual groundwater use of 1062 gpm (1713 ac-ft/yr). This is the maximum usage allowed under the groundwater use permit held by STP after deducting for operation of STP Units 1 and 2 (see Section 2.3.2.2). A potential offsite impact is evaluated based on the decline in hydraulic head in the Deep Aquifer using a conservative analysis based on withdrawal from an onsite well pumped at a representative value, i.e., 500 gpm. Drawdown is evaluated at the property line and at a point 2500 ft from the well because that is the distance allowed by the CPGCD between groundwater production wells (CPGCD 2009). The well location and minimum depth to top of screen is assumed to meet CPGCD requirements of a minimum set back of 100 ft from the property line with a screen beginning no higher than 200 ft below ground surface. The review team assumed that the proposed production well would be similar to the existing production wells at the STP site. Existing production wells are pumped at 500 gpm and extend down to approximately 700 ft below the ground surface (BGS) (STPNOC 2009a).

The hydraulic head in the Deep Aquifer was between 40 and 60 ft below mean sea level (MSL) in the vicinity of the STP site during site characterization activities for the proposed units in 2006 (STPNOC 2009a). Using hydraulic properties typical of the STP site (see Table 2-3), the drawdown caused by a production well 100 ft from the site property line pumped continuously for a 5.25- to 7-year building period (STPNOC 2009a) at the expected rate of 500 gpm would be approximately 30 ft. Thus, for a single well being pumped, and adjacent wells idle, the hydraulic head in the vicinity of the property line would be approximately 90 ft below MSL. The top of the Deep Aquifer lies between 250 and 300 ft BGS, and the land surface is approximately 27 ft MSL; therefore, the top of the aquifer is at the elevation 223 ft below MSL. Thus, the aquifer would remain confined with a confining pressure of approximately 133 ft.

At a distance 2500 ft from the production well, the nearest allowed well location per CPGCD rules (CPGCD 2009), the drawdown would be approximately 18 ft based on the assumptions discussed above. The hydraulic head would be approximately 78 ft below MSL. Because of the well-spacing rules of the CPGCD (CPGCD 2009), the location 2500 ft from an STP production well is the likely location of an adjacent offsite well, and the estimated hydraulic head is indicative of the likely impact to adjacent land owners.

If two adjacent groundwater production wells were pumped, the combined drawdown would be approximately 48 ft (i.e., 30 + 18) at the property line and approximately 36 ft (i.e., 18 x 2) at a 2500 ft distant point. Thus, for an offsite well located 2500 ft from production wells the hydraulic head would be approximately 96 ft below MSL (i.e., 60 + 36), and the confining pressure on the Deep Aquifer would be approximately 127 ft.

The calculated drawdown values are shown in Table 4-1 for both the 500 gpm pumping rate of a single well, and the overall 1062 gpm rate available under STPNOC's groundwater use permit. Use of a 500 gpm rate is consistent with current and proposed STPNOC production well operation. The 1062 gpm pumping rate is included to show an absolute maximum impact; however, it is conservative because it is an estimate of drawdown assuming a single production well produces all the groundwater for proposed Units 3 and 4. A further conservatism is given by not considering any recharge to the aquifer. Results of the 1062 gpm case conservatively bound an estimate of adjacent well drawdown (i.e., 62.9 ft versus ~47.4 ft, and 37.9 ft versus ~35.6 ft).

The Deep Aquifer, which would be the source of groundwater during Units 3 and 4 building activities, has been affected by long-term regional irrigation demand. Land surface subsidence since 1900 is estimated to be less than 1 ft over most of Matagorda County (LCRA 2007a), and in excess of 1 ft in the northwest corner of Matagorda County because of groundwater production associated with gas/petroleum exploration and sulfur mining (LCRA 2007a). STPNOC currently uses five production wells to produce groundwater in support of STP Units 1

Table 4-1. Drawdown in Feet at the STP Property Line (100 ft) and a Point 2500 ft from a Production Well

Pumping Rate (gpm)	Distance (ft)	
	100	**2500**
500	29.6	17.8
1062	62.9	37.9

time = 7 yr building period; transmissivity = 31.379 gpd/ft (geometric mean); coefficient of storage = 0.00022; drawdown calculated using the this formula

and 2 operations, and may install and operate one or more additional well to decrease the pumping rate at each well and to reduce the drawdown impacts (STPNOC 2009c). The existing distributed wellfield design reduces the potential for subsidence. They are placed and operated so that no sustained pumping occurs within 4000 ft of the existing or proposed units, and the CPGCD requires that wells be no closer than 2500 ft apart. The highest rated existing wells can pump 500 gpm, and it is assumed that new wells, if needed, would produce 500 gpm (STPNOC 2009a). By withdrawing the water from the existing and proposed wells, the stress on the Deep Aquifer would be distributed spatially across the STP site, minimizing local drawdown and the potential for subsidence.

Since building the proposed new units would use an estimated 1062 gpm (1713 ac-ft/yr) of Deep Aquifer groundwater, that quantity of groundwater would no longer move downgradient and discharge into Matagorda Bay and the Colorado River estuary (STPNOC 2009a). Thus, one impact of developing the proposed units is a reduction of 1062 gpm (1713 ac-ft/yr) in the Deep Aquifer flow into the bay and estuarine environment. The reduction equates to 2.37 cubic feet per second (cfs) and compares to the average minimum monthly flow of the Colorado River near Bay City of 327 cfs (month of August) (STPNOC 2009a), the average maximum monthly flow of the Colorado River near Bay City of 14,123 cfs (month of June) (STPNOC 2009a), and the minimum Matagorda Bay monthly target inflow of 1008 cfs for the month of August (STPNOC 2009a).

As discussed in Chapter 3, STPNOC proposes to install a slurry wall to minimize the groundwater entering the power block excavation area from the Shallow Aquifer. STPNOC estimated an upper bound steady-state dewatering discharge of 6700 gpm as groundwater within the slurry cut-off wall is removed initially, and a steady-state of approximately 1000 gpm to maintain a dry excavation. The review team determined that these estimates are reasonable based on the relative hydraulic isolation of the excavation afforded by the slurry wall (STPNOC 2009b). STPNOC would install piezometers or monitoring wells inside and outside the slurry wall to monitor the effect of dewatering on the groundwater elevation. If STPNOC determines that even with the slurry wall excessive infiltration to the excavation site is occurring, wells would be used to pump water from within the excavation area. The water removed from the excavation area would be returned to the aquifer outside the slurry wall, thereby limiting any changes in groundwater surface elevations outside the slurry wall. Thus, the water level elevations in the Shallow Aquifer outside the slurry wall should experience only minimal decline, so the review team expects no detectable impact to nearby landowners. In addition, the potential conflicts over water from the Shallow Aquifer are limited because the Shallow Aquifer provides a lower quality groundwater than the Deep Aquifer, and as a result, wells in the Shallow Aquifer are generally limited to livestock watering. Groundwater for drinking water supplies is drawn generally from the Deep Aquifer. The removal of the dewatering product would occur over a relatively short period of time, and the Shallow Aquifer would recover after project completion.

Because the review team determined that: the Deep Aquifer groundwater resource is sufficient to sustain the projected STP site groundwater use; projected drawdown during building activities, and the presence of sufficient confining head would maintain the Deep Aquifer as a confined aquifer; production wells in the Deep Aquifer would be designed to minimize the potential for subsidence; there would be a relatively small decrease in discharge to Matagorda Bay and the estuarine environment; and because groundwater-use impacts during building activities would be localized and temporary, and recovery from related activity would be short term, the review team concludes that the groundwater-use impacts at the site and from construction and preconstruction activities would be temporary and SMALL and no mitigation is warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that groundwater-use impacts of NRC authorized construction activities would be temporary and SMALL and no mitigation would be warranted.

4.2.3 Water-Quality Impacts

Impacts to the quality of the water resources of the site are expressed for surface water (the Colorado River, onsite wetlands, MCR, and other surface water drainages) and groundwater (the shallow and deep aquifers of the Chicot Aquifer system) features that are most directly affected.

4.2.3.1 Surface Water-Quality Impacts

The State of Texas prohibits the unauthorized discharge of waste into or adjacent to water in the state (Texas Water Code, Section 26.121). The discharge of waste may be authorized under a general permit (Texas Water Code, Chapter 26, Section 26.040). A general permit for stormwater discharges associated with building the proposed STP Units 3 and 4 was obtained by STPNOC’s contractor in October 2009 (STPNOC 2009a; TCEQ 2003). Under this general permit the State requires the development of a stormwater pollution prevention plan (SWPPP) that describes BMPs appropriate for the site and proposed activities. As discussed in Chapter

3, in addition to BMPs, STPNOC would construct new detention ponds and drainage ditches to control delivery of sediment from disturbed areas to onsite water bodies. Sediment carried with stormwater from the disturbed areas would settle in the detention ponds and the stormwater would eventually be discharged to one or more TPDES-permitted outfalls.

Dredging activities in the Colorado river near the RMPF and the barge slip may also result in disturbance of sediments and, therefore, result in a potential increase of turbidity near these locations as well as downstream from these locations. However, the hydrological alterations resulting from site development would be localized and temporary. Permits, certifications, and SWPPP require the implementation of BMPs to minimize impacts. Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the surface water quality impacts at the site and from construction and preconstruction activities would be temporary and SMALL and no further mitigation, other than BMPs discussed above, is warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that surface water quality impacts of NRC-authorized construction activities would be temporary and SMALL and no mitigation other than BMPs would be warranted.

4.2.3.2 Groundwater-Quality Impacts

Development of proposed Units 3 and 4 should not involve intentional discharges to the aquifer system that underlies the STP site. Spills during building activities that might impact the quality of the Shallow Aquifer should be prevented and mitigated by BMPs (Texas Water Code, Chapter 26, Section 26.040). Except where excavation removes it, the Shallow Aquifer is separated from the land surface by a 10- to 30-ft thick low conductivity confining zone.

Spills that reach the Shallow Aquifer would either be intercepted by the excavation slurry wall system including the dewatering system, or travel in groundwater toward the STP site property boundary. Groundwater flow in the Upper Shallow Aquifer away from the proposed units would be to the southeast and the southwest (STPNOC 2008a, 2009f) toward the STP site property boundary. Excavation of the confining unit separating the Upper and Lower Shallow Aquifers provides an opportunity for spills seeping into the Upper Shallow Aquifer to also seep into the Lower Shallow Aquifer. The Deep Aquifer confining zone is a 100- to 150-ft-thick layer of clay and silt that serves to isolate the Deep Aquifer from the Shallow Aquifer. Thus, the Deep Aquifer is not as viable a pathway for spills that reach groundwater as the Shallow Aquifer.

Hydraulic head data reported by the applicant (STPNOC 2009a, 2009f) suggest plausible pathways and areas of discharge from the Upper and Lower Shallow aquifers. To the southeast side of the STP site these discharge areas include (1) the unnamed surface water tributary draining to Kelly Lake (7300 ft), (2) groundwater wells completed in the Shallow Aquifer (ranging from 7300 to 9000 ft), (3) Kelly Lake (11,200 ft), and (4) the Colorado River (17,800 ft). To the southwest side of the STP site these discharge areas are (5) a groundwater well completed in the Upper Shallow aquifer (6000 ft) and (6) the Little Robbins Slough (6000 ft). STP notes that a southwest migration pathway in the Lower Shallow Aquifer is less likely because of observed lower hydraulic conductivities in the aquifer to the southwest of proposed Unit 4 and an observed low and seasonally varying hydraulic gradient to the southwest as compared to a higher and continuous gradient to the southeast (STPNOC 2009f).

Based on the hydraulic conductivity, hydraulic gradient, and effective porosity values provided by STPNOC and presented in Table 2-3, the following estimates of travel time from the proposed units to the nearest accessible environment can be made (STPNOC 2009f). In the Upper Shallow Aquifer the representative value of travel time to the nearest southeast exposure point is 154 years with a range from 57 to 400 years. The representative value of travel time in the Upper Shallow Aquifer for the southwest exposure point is 330 years with a range from 117 to 821 years. The net result of a higher hydraulic conductivity and a lower hydraulic gradient in the Lower Shallow Aquifer are comparable if somewhat shorter travel times to the southeast exposure points. For the Lower Shallow Aquifer the representative value of travel time to the nearest southeast point of exposure is 125 years with a range from 77 to 182 years.

These travel times allow time for cleanup and remediation to occur. Any spill within the excavation should be isolated from the surrounding aquifer by the slurry cut-off wall and dewatering pumps and, therefore, should be more readily cleaned up and remediated.

A potential offsite impact on the quality of the groundwater resource during the building of the proposed Units 3 and 4 is saltwater intrusion or encroachment resulting from pumping at the annual average allowable rate under the existing STPNOC groundwater use permit (i.e., 1062 gpm/ 1713 ac-ft/yr). Production wells at the STP site are completed in the upper portion of the Deep Aquifer with up to 500 ft of screen, well bottom at 700 ft BGS, and pumping capacity of 500 gpm. The Lower Colorado River Authority (LCRA) (2007b) evaluated the design of wells and their production rate with regard to saltwater intrusion or encroachment (see Section 2.3.3.2 in Chapter 2), and based on the LCRA study findings the review team concludes the existing and proposed well designs at the STP site would minimize the potential for lateral or vertical saltwater intrusion.

Based on the consideration of potential impact from spills and saltwater intrusion, information provided by STPNOC and the review team's independent evaluation, the review team concludes that the groundwater-quality impacts at the site from construction and preconstruction activities would be temporary and SMALL and no further mitigation, other than BMPs as discussed above, is warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that groundwater-quality impacts of NRC-authorized construction activities would be temporary and SMALL and no mitigation, other than BMPs discussed above, would be warranted.

4.2.4 Water Monitoring

Surface water, groundwater, and stormwater monitoring would take place during building activities for the proposed Units 3 and 4 at STP.

During building activities for Units 3 and 4, a SWPPP would be in effect in accordance with TCEQ regulations (Texas Water Code, Chapter 26, Section 26.040). The SWPPP may include a monitoring program. As described in Section 2.3.1.3 above, STPNOC would also continue monitoring all outfalls permitted under the existing TPDES permit for STP Units 1 and 2.

During the period prior to site disturbance, groundwater levels would be monitored at 2 wells completed in the Upper Shallow aquifer, and 13 well pairs which provide observations in both the Upper and Lower Shallow aquifers (STPNOC 2009a). During detailed design of proposed Units 3 and 4, current STP groundwater monitoring programs would be reviewed to identify necessary modifications to incorporate monitoring of the proposed units. The review would consider needed water level and water quality measurements for the Deep and Shallow aquifers, subsidence monitoring in the vicinity of proposed Units 3 and 4, and operational accident monitoring (STPNOC 2009b). The reviewed and modified groundwater monitoring programs would be used to monitor groundwater in the Deep and Shallow aquifers during the construction, preconstruction, and preoperational monitoring periods. Groundwater monitoring during construction and preconstruction would be used to track the groundwater changes during those activities. STPNOC committed to use BMPs including well head protection to protect the aquifers from impact (STPNOC 2009a).

4.3 Ecological Impacts

This section describes the potential impacts to ecological resources from building the proposed Units 3 and 4 at the STP site, including the activities associated with upgrading a 20-mi section of existing 345-kV transmission lines to connect the units to the grid.

4.3.1 Terrestrial and Wetland Impacts

This section provides information on the site-preparation activities for Units 3 and 4 at the STP site and the impacts on the terrestrial ecosystem. Topics discussed include terrestrial resource impacts at the STP site and those impacts that would be associated with replacing towers and upgrading two of the six 345-kV transmission lines traversing a 20-mi section of the corridor connecting the STP site with the Hillje Substation.

4.3.1.1 Impacts to Terrestrial Resources – Site and Vicinity

Building Units 3 and 4, as discussed in Chapter 3, would result in approximately 540 ac being disturbed on the STP site. Approximately 300 ac would be permanently altered due to development of new facilities and a new heavy haul road (STPNOC 2009a).

Impacts to Habitats

Building Units 3 and 4 would affect portions of various habitat types. The proposed power block area for the two new units would consist of industrial land (existing facilities, buildings and parking areas) and a mowed maintained field containing a large drainage ditch running east-west through the site. The proposed project area also includes scattered small palustrine wetlands, scrub-shrub habitat, mixed grassland habitat where abandoned farmlands existed prior to the existence of STP Units 1 and 2, and maintained and disturbed fields that are routinely mowed (STPNOC 2009a). These open grassland/shrubland habitats are dominated by sea myrtle, *(Baccharis halimifolia)* dewberry (*Rubus* spp.), and bluestem (*Andropogon* spp.) grasses as described in Section 2.4.1. No forested habitat would be affected by site-preparation or building activities. Table 4-2 provides estimates of the total number of acres that would be required for each activity and the associated habitat types that would be permanently affected (ENSR 2008a). After the completion of the new units, the areas used for temporary building support would be graded, landscaped, and replanted to enhance the overall site appearance (STPNOC 2009a).

Table 4-2. Estimated Acreage Affected by Proposed Activities by Habitat Type and Land Use

Proposed Activities	Existing Facilities	Maintained and Disturbed Areas	Mixed Grassland	Other	Scrub Shrub	Wetland	Main Cooling Reservoir
Switchyard					12		
Parking		12					
New Spoils Area		0.1			36		
Concrete Batch Plant			4.3				
Laydown Area	1	19			15		
Fabrication Shops	1						
Comp Building	0.2						
Radioactive Waste Storage Building	0.2	2.4		1.4	8.5		
Haul Road		1.7	2.5	0.3	4.4		
Unit 3 Power Block	18.4	13.8			0.7		

Table 4-2. (contd)

Proposed Activities	Existing Facilities	Maintained and Disturbed Areas	Mixed Grassland	Other	Scrub Shrub	Wetland	Main Cooling Reservoir
Unit 4 Power Block	17.8	14.1			0.3		
New Circulating Water Intake Structure				3.2			29.2
Relocated Drainage Ditch		0.5			7		
Additional Area	3.5	10			3.3		
Total Affected Acreage[(a)]	42.1	73.6	6.8	4.9	87.2	0	29.2

(a) STPNOC's revised total area disturbed is 300 ac; however, the habitat type(s) of the additional 56 ac of disturbance was not identified. Regardless of habitat type of the additional 56 ac, the conclusion in this EIS is unlikely to change.
Sources: ENSR 2008a and STPNOC 2009a

Twenty-nine wetlands totaling approximately 17.6 ac were identified by Corps (Corps 2009b). Three of the wetlands identified on the site occur within or near the footprint (including laydown and spoil areas). The large man-made managed wetlands would not be expected to be affected by any building and development activities (STPNOC 2009a). STPNOC indicated that it would avoid all delineated and known wetlands and thus avoid any direct impacts to the wetland areas on the site (STPNOC 2009a). The applicant states that appropriate methods to stabilize areas, prevent erosion and sedimentation, and reduce polluted runoff would comply with applicable laws, regulations, permit requirements, good engineering and building practices, and recognized BMPs for all proposed activities. STPNOC would use silt fences and other erosion control devices, as needed, to help mitigate the possibility of surface water runoff from proposed activities affecting the STP site's wetlands and surface water drainage features.

Impacts to Wildlife

Activities that would affect wildlife at the STP site include heavy equipment operation, outdoor lighting, and noise that may displace or destroy wildlife that inhabit the disturbance areas. Less mobile animals such as reptiles, amphibians, and small mammals are expected to incur greater mortality than more mobile animals such as birds and larger mammals. Although surrounding scrub-shrub, grassland, and wetland habitat would be available for displaced animals during building activities, movement of wildlife into surrounding areas would increase competition for available habitat and could result in increased predation and decreased fecundity and recruitment for certain species. These conditions could lead to a temporary reduction in population size for particular species. When building is completed, species that can adapt to disturbed or developed areas may readily re-colonize portions of the area where suitable habitat remains or is replanted or restored.

Site preparation, development and building activities would permanently affect approximately 300 ac on the STP site. The majority of the building and development would occur on maintained and industrial areas in proximity to existing infrastructure for STP Units 1 and 2. This change in habitat availability and extent would not be likely to increase fragmentation of on-site habitats available for wildlife.

Building of the heavy haul road would disturb approximately 9 ac and travel around to the east of the existing ECP and then south toward the barge slip. A total of seven culverts would be used to span drainage areas associated with the new roadway. Three of the proposed road crossings have existing culverts but these would be replaced in order to support the expected vehicle traffic; three additional culverts would be needed to span existing drainages, and one culvert would be added as part of preparing a new drainage area. A site assessment conducted by STPNOC in August 2009 documented several characteristics of the drainage areas as part of the Corps' permit application. Terrestrial wildlife and fringing wetland or in-stream vegetation were observed in four of the six existing drainages, including alligators and mammals at one of the culvert sites. These drainages are "routinely maintained or disturbed (i.e., mowed)" and the aquatic habitat was determined to be of "low to moderate quality." There are no proposed changes to the heavy haul road in the vicinity of Kelly Lake. Based on this assessment, the impacts to the terrestrial resources from the preparations for the heavy haul road are likely to be minimal, and no mitigation actions are anticipated or warranted (STPNOC 2009d).

The existing barge slip that was built for Units 1 and 2 would be re-excavated and expanded for use with the proposed Units 3 and 4 (STPNOC 2009e). The excavation would involve approximately 1/3 ac of terrestrial habitat alongside the existing slip. Vegetation on the area to be excavated consists of common successional species and no unique habitats would be lost. Thus, the impacts on terrestrial resources of excavating and clearing required to expand the existing barge slip area would be minimal.

A large number of water birds and shorebirds use the aquatic and terrestrial habitats on the STP site. The TPWP provides a relatively protected habitat for wintering water birds on the site. Because the managed wetland lies approximately 1000 ft from the proposed project site and the duration of the activities is limited, the long-term presence of water birds on the site should not be affected. Colonial water birds nesting on the dikes in the MCR are not likely to be affected by the building and development activities or by the increase in the water level and resulting loss of shoreline habitat because there is plenty of suitable habitat located elsewhere in the vicinity.

Noise is another potential building and development-related activity that could affect wildlife at the STP site. Noise from heavy equipment power tools and building activities can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense (Larkin 1996). Response to noise disturbance cannot be generalized across species or among genera (Larkin 1996).

Although noise levels in building areas can be high (up to 100 decibels on the A-weighted scale (dBA) at 100 ft from sources of noise) and of varying duration, these high local noise levels would not be expected to propagate far beyond the boundaries of the site (STPNOC 2009a). At 400 ft from the source of 100 dBA noise, noise levels would generally drop to 60–80 dBA, which is below the noise levels known to startle small mammals and waterfowl (Golden et al. 1980). However, even with this attenuation, some displacement of local small mammals and birds due to noise is expected during building activities. This displacement may be permanent for some species and temporary for others. In general, the impacts from noise are considered generally short-term and localized and would likely be negligible for most species.

Two mechanical draft cooling towers for the Unit 3 and 4 would be erected above the ultimate heat sink (UHS) basin reaching a height of approximately 119 ft above grade. Building these structures along with the 249-ft-tall vent stacks for the new units presents an increased potential for avian collision and mortality. Avian mortality from collisions with man-made structures is often a concern with very tall structures, and it varies relative to species-specific characteristics such as size, flight behavior, and habitat use, as well as weather, landscape features, and the size/type of equipment/structures (Brown 1993). Several studies have reported bird mortality also occurs from birds striking shorter structures (100 to 200 ft), but is usually related to poor visibility and weather conditions (Avatar 2004). STP Units 1 and 2 have not experienced any major bird kills (STPNOC 2009a). The additional number of bird collisions, if any, would not be expected to cause a noticeable reduction in local bird populations. Avian collisions during building of Units 3 and 4 are expected to be negligible.

Workers commuting to the STP site arrive primarily via two-lane roads and the volume of traffic on these roads and particularly on road Farm-to-Market (FM) 521 would increase substantially (STPNOC 2009a). Increased traffic on FM 521 and feeder roads would likely increase traffic-related wildlife morbidity and mortality. Local wildlife populations could suffer declines if road-kill rates were to exceed the rates of reproduction and immigration. Although road kills are an obvious and visible source of wildlife mortality, traffic mortality rates rarely limit population size except for special situations (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible) (Forman and Alexander 1998).

The STP site lies within the Central Flyway migratory route for birds. Light pollution during facility development and building could potentially disorient flying birds and bats. Possible mitigation measures could include turning off unnecessary lights at night, using lights that are turned downward or hooded (directing light downward), and using lower-wattage lights as appropriate to minimize impacts on wildlife. Given the limited time period for building, long-term impacts of additional lighting would likely be minimal.

4.3.1.2 Terrestrial Resources – Transmission Line Corridors

Because no new offsite transmission corridors would be required for proposed new units, the discussion of potential impacts to habitats and wildlife resources in transmission corridors is limited to consideration of the impacts of upgrading the 20-mi STP-to-Hillje corridor.

Impacts to Habitats in Transmission Corridors

Potential impacts to habitats and wildlife would primarily involve those activities associated with building a 345-kV tie-line from STP Units 1 and 2 to the new 345-kV switchyard on the STP site property, and upgrading of two existing transmission lines that lead toward the Hillje Substation (STPNOC 2009a). American Electric Power (AEP) would take the lead role with CenterPoint Energy to plan the upgrades to their respective transmission lines. The Public Utility Commission of Texas (PUCT) regulations impose standards of construction and operation of transmission facilities, which state that rebuilding, upgrading, or relocation of existing electric transmission facilities shall comply with PUCT standards of construction and operation, and that in determining standard practice, PUCT shall be guided by the provisions of the American National Standards Institute, Incorporated, the National Electrical Safety Code (AEP et al. 2007), and applicable codes and standards that are generally accepted by the industry, except as modified by PUCT. AEP and CenterPoint Energy are required to construct, install, operate, and maintain their respective transmission lines in accordance with the National Electrical Safety Code, and AEP would continue to operate and maintain its respective transmission lines after they are upgraded. In rebuilding or upgrading existing electric transmission facilities, AEP and CenterPoint Energy are directed to implement mitigation measures adapted to the specifics of each project in accordance with 16 Texas Administrative Code (TAC) 25.101(d). Mitigation may include requirements such as selective clearing of the transmission line corridor to minimize the disturbance to flora and fauna, implementing erosion control measures, using board roads to cross wetlands for tower construction, reclamation of sites with native species of grasses, forbs and shrubs, and returning the site to its original contours and grades (STPNOC 2009a).

The new onsite transmission corridor between the new switchyard for proposed Units 3 and 4 and the existing switchyard for STP Units 1 and 2 would be approximately 600 ft wide and occupy approximately 12 ac (STPNOC 2009a). The connecting transmission line would lie in areas that were previously disturbed during the process of building STP Units 1 and 2. The new switchyard for proposed Units 3 and 4 would require grading and clearing of approximately 12 ac of scrub-shrub habitat on the site.

Impacts to Wildlife in Transmission Corridors

Because no new transmission corridors would be required, the ecological impacts would primarily be associated with noise/movement of equipment and workers involved in changing out conductors and installing replacement towers along the STP-to-Hillje corridor. A variety of birds, small mammals, and larger mammals (white-tailed deer [*Odocoileus virginianus]*) could be disturbed by this activity (STPNOC 2009a). Impacts of these limited activities are expected to include temporary displacement of wildlife and potential mortality of less-mobile species such as reptiles, amphibians, and small mammals that are at risk of being driven over by vehicles. The transmission lines associated with STP are located primarily in agricultural lands and rangelands (STPNOC 2009a), and few animals are expected to use the corridors for activities other than foraging or possibly resting. Some ground-nesting birds (e.g., northern bobwhite, [*Colinus virginianus*] wild turkeys [*Meleagris gallopavo*] eastern meadowlark [*Sturnella magna*], horned lark [*Eremophila alpestris*] and killdeer [*Charadrius vociferus*]) in adjacent habitats could be affected temporarily if they are present and if the work was done during the spring/early summer nesting period. If work is carried out in the non-nesting periods, impacts to nesting birds and wildlife are expected to be negligible.

4.3.1.3 Important Terrestrial Species and Habitats

This section describes the potential impacts to Federally listed or proposed threatened and endangered terrestrial species (Table 2-8) and associated designated and proposed critical habitat resulting from building new units on the STP site and the upgrades to the 20-mi STP-to-Hillje transmission corridor. Potential impacts to species listed by the State of Texas as threatened or endangered (Table 2-9) are also presented in this section, as well as the impacts of building activities on recreationally or commercially important species and important ecological habitats.

The proposed location of Units 3 and 4 does not provide important habitat for any sensitive terrestrial species, including those Federally or State-listed as threatened or endangered, those proposed for listing as threatened or endangered, or candidates for listing as threatened or endangered. Federally listed species known to occur on the STP site include the American alligator (*Alligator mississippiensis*), which is listed as threatened. In addition, the Northern Aplomado falcon (*Falco femoralis septentrionalis*) has been observed within 10 mi of the STP site.

Federally Listed Species

American Alligator — In 1967, the American alligator was classified by U.S. Fish and Wildlife Service (FWS) as Federally endangered throughout its range, including Texas. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the Federally endangered American crocodile (*Crocodylus acutus)* in the remainder of its range (52 FR 21059). The reclassification helps prevent excessive take of the alligator and protects the American crocodile. Alligators use the wetland and aquatic features of the STP site and can be found in areas associated with large drainage ditches, such as the MDC and the MCR. Alligators would be expected to move away from building areas once activities commence and would be unlikely to stay in areas where heavy equipment continued operating, but similar habitat is available on the STP site. Impacts to alligators would likely be minimal.

Northern Aplomado Falcon — The Northern Aplomado falcon also resides in Matagorda County and has been observed in nearby habitats at the Clive Runnels Mad Island Marsh Preserve, which is within 10 mi of the STP site. This species has been reintroduced to the Texas Gulf Coast over the past 15 years on Matagorda Island, which is more than 35 mi from the STP site (TWPD 2003). No Northern Aplomado falcons were observed during the ecological surveys conducted on the site; however, these birds could use the habitats on STP for foraging. Aplomado falcon habitat almost always contains an open grassland component with either scattered islands of shrubs or trees or woodland and forest borders (TPWD 2003). If falcons were to use the STP site as a foraging area, building activities and associated noise would likely cause these birds to avoid the disturbance area and use other habitats in the vicinity. Because these birds have not been observed on the site, adverse effects of proposed development on Northern Aplomado falcons are expected to be unlikely.

No Federally listed species have been reported within 2 mi of the STP-to-Hillje transmission corridor (TNDD 2009). However, because the transmission corridor lies within the Central Migratory Flyway, individuals may fly over or through the area.

State-Listed Species

Six species listed as threatened by the State of Texas have been observed on or near the STP site and the STP-Hillje transmission corridor. The brown pelican (*Pelecanus occidentalis*) has been observed on the STP site in the vicinity of the MCR. The pelican was recently delisted as a Federal species of concern, but remains listed as threatened by the State of Texas. The bald eagle (*Haliaeetus leucocephalus*) is a resident on the site and nests within the STP site boundary. The bald eagle is State-listed as threatened and also occurs within 2 mi of the STP-to-Hillje corridor. The white-faced ibis (*Plegadis chihi*), reddish egret (*Egretta rufescens*), peregrine falcon (*Falco peregrinus*), and white-tailed hawk (*Buteo albicaudatus*) have been observed during the annual Christmas Bird Count (NAS 2009). Another State species of concern, coastal gay-feather (*Liatris bracteata*), is also found within 2 mi of the transmission corridor that would be upgraded.

Brown Pelican — Brown pelicans were recently observed in and around the STP site and may use the MCR for foraging, drinking, or resting (STPNOC 2009a). On November 17, 2009, (74 FR 59443), the FWS delisted the brown pelican due to recovery. A review of the best available scientific and commercial data indicates that the species is no longer in danger of extinction, or likely to become so within the foreseeable future. The effective date of the rule is December 17, 2009.

Brown pelicans nest on small, isolated coastal islands in Texas where they are safe from predators such as raccoons (*Procyon lotor*) and coyotes (*Canis latrans*). Although brown pelicans nest on Dressing Point Island within 20 mi of the site (TPWD 2003), the pelicans would not likely nest or reside in the habitats found on the STP site. No brown pelicans were observed in the land areas proposed for development. Noise and activities associated with building the additional circulating water intake structure (CWIS) on the MCR may disturb pelicans that spend time at the MCR and cause birds to avoid the disturbance area. However, because the MCR is large, these birds would be likely to move to other portions of the MCR to rest and drink. Similarly, noise and building activities associated with upgrades and modifications to the RMPF may disturb pelicans in the vicinity of the RMPF on the Colorado River. However, the pelicans would likely avoid the area and use other parts of the river during that time. Thus, potential impacts of building activities and disturbance on brown pelicans are expected to be minimal.

Bald Eagle — Based on information received from the Texas Parks and Wildlife Department (TPWD) and recent ecological survey data (STPNOC 2009a), an active bald eagle nest is located on the STP site near its eastern boundary, and a second nest site is located along the Colorado River near the site. Although recently delisted under the Endangered Species Act (ESA) (72 FR 37345), the bald eagle remains protected under the Bald and Golden Eagle Protection Act of 1940 (16 USC 668-668d). In 2007, new Federal management guidelines for bald eagles were enacted for all bald eagles in the lower 48 states that established a single recommended protection zone to extend out 660 ft from each eagle nest (FWS 2007). In addition, TPWD has established primary management zones for nest sites that extend from 760 to 1500 ft from the nest and secondary management zones that extend 1 mi from nest sites where activities are restricted and avoidance of disturbance is recommended (TPWD 2009b). No building and development activities related to the proposed Units 3 and 4 would occur within 1 mi of the eagle nests, and no impacts to bald eagles are anticipated.

Peregrine Falcon — Peregrine falcons are migratory through the State, and use the Texas Gulf coastline as a staging area during spring. During each migration, falcons assemble on the Texas coast, taking time to feed and rest before continuing northward. They take advantage of the abundant prey along the open coastline and tidal flats (TPWD 2003). Peregrine falcons could fly over the STP site during spring migration from Mexico and might hunt in some habitats onsite. However, these birds were not observed during recent ecological surveys of the proposed project areas, and no known nesting sites occur on the STP site. If falcons were found to use the STP site as a hunting area, building activities and associated noise would likely cause them to avoid the disturbance area and use other habitats in the vicinity. No peregrine falcons were noted during ecological surveys on the site, and no impacts are expected from building and site preparation activities on the STP site. There are no reported occurrences of peregrine falcons along the STP-Hillje transmission corridor; in addition, the Avian Protection Plan for transmission along this corridor includes protective measures to avoid potential impacts to avian species (STPNOC 2009d).

White-tailed Hawk — White-tailed hawks have been observed on the STP site and potentially use a variety of the habitats found on the STP site for hunting and resting. Recent ecological surveys of the proposed project areas did not observe any white-tailed hawks and did not detect any nest sites. However, white-tailed hawks typically nest in shrubs and short trees (Kuvlesky and Kane 2008), and could use portions of the scrub-shrub habitat outside the disturbed area for nesting. Building activities and associated noise would likely cause these birds to avoid the disturbance area and use other habitats in the vicinity. Impacts to white-tailed hawks are expected to be negligible.

Wading Birds — The white-faced ibis and the reddish egret are both wading birds that frequent marshes and ponds and potentially could use the managed prairie wetland habitat or possibly other open water and emergent wetlands found on the STP site. Proposed project activities are relatively distant (~200 yd) from the Texas Prairie Wetlands but could affect the use of the wetlands for foraging and resting by waterbirds during the period of development. However, the managed wetland is distant enough that noise levels should be less than levels that would cause birds to startle (60-80 dBA) (STPNOC 2009a). Building and development activities would avoid wetlands on the site. Therefore, impacts to wading birds and other waterbirds are expected to be minimal.

State-Listed Species Not Observed at STP — Seven additional wildlife species listed as threatened in Texas and two plant species that are considered species of concern by the State have the potential to occur on the STP site and the STP-to-Hillje transmission corridor. However, surveys of proposed project areas did not find evidence of these species (ENSR 2007a).

Wood storks (*Mycteria americana*) historically were observed in the emergent wetlands and bottomland forest wetlands on the STP site (NRC 1975), but would not be likely to use the shrub-scrub and grassland habitats that exist within the disturbance footprint. No wood storks have been observed during the Christmas Bird Count surveys of the site. The sooty tern (*Sterna fuscata*) is primarily a pelagic bird and in eastern North America nests on islands in the Gulf of Mexico from Texas to Louisiana (TPWD 2005; NatureServe Explorer 2009). This species is not likely to use or occur in the habitats found on the STP site.

Reptile species that potentially could occur on the STP site include the Texas scarlet snake (*Cemophora coccinea linerii*), the Texas tortoise (*Gopherus berlandieri*), the smooth green snake (*Liochlorophis vernalis*), and the timber rattlesnake (*Crotalus horridus*). Although these species were not noted during any of the ecological surveys on the site, they potentially could use the scrub-shrub and grassland habitats. The Texas horned lizard (*Phrynosoma cornutum*) is less likely to be found on the STP site because it prefers more arid areas with sparse vegetation.

Coastal gay-feather and threeflower snakeweed (*Thurovia triflora*) are forbs that are endemic to the coastal prairie grasslands and coastal gay-feather occurs within 10 mi of the STP site. These species are not likely to occur in the successional vegetation and habitats found in proposed project areas on the site. Previous use of the site for agriculture and rangeland before construction of STP Units 1 and 2 has significantly altered the vegetation community (STPNOC 2009a).

Ecologically Important Terrestrial Habitats and Species

Because the proposed project area consists primarily of existing facilities and successional vegetation and habitats, it does not provide any special or unique habitats or plant communities. None of the proposed project area is designated as critical habitat by the FWS, and areas designated as critical habitat are not found on the STP site or along the associated transmission line corridors.

A number of palustrine emergent and palustrine scrub-shrub wetlands occur on the STP site including the Texas Prairie Managed Wetlands. Potential impacts of proposed building and development to wetland habitats are described in Section 4.3.1.1.

The STP-to-Hillje transmission line corridor travels across lands that are primarily used for agriculture or grazing livestock. Because of the associated land use, no known unique plant communities or habitats occur in the corridor. Wetland habitats do occur in the corridor but are unlikely to be permanently affected by any of the proposed building activities associated with upgrading and replacing existing towers. Access to lines and towers might cause temporary impacts to wetlands resulting from the placement of board roads for use with heavy equipment (STPNOC 2009a). Potential impacts to the wetland habitats in this transmission corridor are expected to be negligible. Therefore, impacts to ecologically valuable habitat and species would be minimal.

Commercially and Recreationally Valuable Species

Species defined as "important" in NUREG-1555 (NRC 2000) because they are commercially or recreationally valuable exist within the proposed site disturbance footprint and include game species such as white-tailed deer, gray and fox squirrels (*Sciurus* spp.), mourning doves (*Zenaida macroura*), and northern bobwhites. However, the area within the disturbance footprint does not provide high quality or unique habitat for these game species. Also, the proposed project area's value as wildlife habitat is affected by its proximity to STP Units 1 and 2 and infrastructure, with higher levels of associated human activity and noise. The surrounding area has ample habitat for these species such that it would be able to accommodate animals displaced as a result of proposed land-clearing and building activities. Therefore, impacts to commercially and recreationally valuable species would be minimal.

4.3.1.4 Terrestrial Monitoring

No monitoring of terrestrial resources is planned during the building activities onsite or in the transmission corridor. Regulatory agencies have not required ecological monitoring of the STP site or its associated transmission line corridors since the period of reservoir filling (mid 1980s), and there is no ongoing monitoring. The addition of proposed Units 3 and 4 would not require any significant changes to the current practices for maintenance of the corridors, including vegetation management for the transmission line system.

4.3.1.5 Summary of Impacts to Terrestrial Resources

In summary, site preparation and building activities for proposed Units 3 and 4 would result in the permanent loss of approximately 300 ac, and the temporary additional disturbance of approximately 240 ac. Areas temporarily affected by site preparation and building activities would be revegetated. Areas permanently lost to new facilities include significant acreage of maintained areas associated with existing facilities. Building Units 3 and 4, and the upgrades to the 20-mi section of the 345-kV transmission lines would be done according to Federal and State regulations, permit conditions, existing procedures, and BMPs, such as minimizing removal of existing vegetative cover, maintenance of existing drainage patterns, prohibitions of restrictions of equipment and vehicles around and through water bodies, and restrictions on fill activities. Wetlands in the disturbance footprint would be avoided, and no permanent losses of wetlands are expected (STPNOC 2009a). STPNOC is required to comply with conditions of the 404 permit from the Corps including any required mitigation. BMPs would be applied to prevent sedimentation, runoff, and erosion that could affect wetland habitats. Based on quality of the habitat lost and the proximity of the proposed building and development activities to existing facilities and infrastructure, the staff concludes potential impacts to upland and wetland wildlife habitats on the STP site and associated transmission corridors would be negligible.

The staff has determined that the related impacts of habitat loss, noise, collisions with elevated structures, increased light pollution, and increased traffic may adversely affect onsite wildlife. However, these impacts would be temporary, minor, and mitigable. The destruction, temporary displacement and reduced productivity, and re-colonization of wildlife also apply to offsite disturbances that would result as the transmission line towers would be replaced and upgraded. The potential impacts associated with these disturbances would also be temporary, minor, and mitigable.

No Federally or State-listed threatened or endangered species, critical habitat, or suitable habitats associated with potentially identified species were observed during pedestrian surveys of the proposed disturbance area (STPNOC 2009a; ENSR 2007a). One Federally listed species (American alligator) has been observed within the STP site in wetland and aquatic habitats (see Section 2.4.1). Five species listed as threatened by the State of Texas have been observed recently on the STP site: the bald eagle, white-faced ibis, reddish egret, peregrine falcon, and white-tailed hawk. The brown pelican, State-listed as endangered, has been observed near and on the MCR and the Colorado River. None of the Federally listed species would be expected to occupy or make any significant use of the habitats within the disturbance footprint for the proposed units. The six State-listed species also would not be expected to occupy or make significant use of habitats in these areas.

Based on the review team's independent evaluation of the threatened and endangered species surveys, historical records, life history information, known threatened and endangered species locations, and information provided by STPNOC in its ER (STPNOC 2009a), the review team concludes the impacts on terrestrial Federally and State-listed threatened and endangered species from building activities on the STP site would negligible, and further mitigation would not be warranted.

Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the impacts of preconstruction and construction activities to terrestrial and wetland ecological resources, including threatened and endangered species, on the site would be SMALL, and no mitigation measures are proposed at this time. However, the Corps may require mitigation as a stipulation for issuing the required Corps permit. The LWA rule (72 FR 57426) specifically states that transmission lines and heavy haul roads are not included in the definition of construction. Based on these analyses, and because the NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, and no mitigation measures have been identified at this time.

4.3.2 Aquatic Impacts

Impacts on the aquatic ecosystem from building the proposed Units 3 and 4 at STP would mainly be associated with onsite water bodies, the Colorado River, and upgrading a 20-mi section of existing 345-kV Hillje transmission lines. Onsite water bodies include the MDC, the Little Robbins Slough, the MCR, and wetlands. Impacts to the Colorado River would include improvements to the existing RMPF, and the barge slip – all systems that were built for existing STP Units 1 and 2. No new transmission corridors are required for proposed Units 3 and 4.

4.3.2.1 Aquatic Resources – Site and Vicinity

Sloughs, Drainage Areas, Wetlands, and Kelly Lake

Site preparation and development activities for the proposed Units 3 and 4 that would potentially affect the onsite water bodies include the relocation and removal of drainage areas, building of culverts for a heavy haul road from the barge slip to the proposed power blocks, and management of groundwater and stormwater during the site preparation and development activities. STPNOC has indicated that they would avoid all delineated and known wetlands during these activities (STPNOC 2009a). Relocation of the MDC would eliminate those aquatic organisms currently in the drainage (ER Figure 2.3-6) (STPNOC 2009a). In 2007, several species were surveyed in the MDC (ENSR 2007b), and were discussed in Section 2.4.2.1. These species (e.g., mosquitofish [*Gambusia affinis*], various sunfish species) likely moved into the MDC from Little Robbins Slough. Upon relocation of the MDC, these species are likely to recolonize the channel when the flows are reconnected to the slough. Overall, given the stability of regional populations and the likelihood of recolonization, affects on regional aquatic communities would be minimal as a result of activities on or near on-site water bodies.

A total of seven culverts would be used to span waters associated with the new roadway. Three of the proposed road crossings have existing culverts but these would be replaced in order to support the expected vehicle traffic. Three other culverts would be needed to span existing drainages. One culvert would be added as part of preparing a new drainage area. A site assessment of the drainage areas conducted by STPNOC in August 2009 in support of the Corps' permit application documented several characteristics including waterbody type, stream flow, flow type, bank slope, stream depth and width, water appearance, substrate, width of riparian zone, channel condition and observed disturbances, and aquatic habitats. Aquatic organisms were observed in four of the six existing drainages, including in-stream vegetation, aquatic insects, clams, and fish. These drainages are "routinely maintained or disturbed (i.e., mowed)" and the aquatic habitat was determined to be of "low to moderate quality." There are no proposed changes to the heavy haul road in the vicinity of Kelly Lake. Based on this assessment, the impacts to the aquatic resources from the preparations for the heavy haul road are likely to be minimal and no mitigation actions are anticipated or warranted (STPNOC 2009d).

Preparation of the foundation for the proposed power blocks would require dewatering activities because the depth of the foundation is below the groundwater level, as well as collection of rain water that enters the excavated areas. The removal rate of groundwater from the region of the power block foundations would change with time; the estimates initially are to be 6700 gpm and then declining to approximately 1000 gpm (due to the surrounding slurry wall slowing the rate of groundwater intrusion). The groundwater and stormwater would be collected and discharged into the MCR (STPNOC 2009d). Such disposal would have little impact on aquatic resources in the MCR because turbidity would be low, water temperature would be similar to ambient temperatures, and any chemical spills would require treatment according to the SWPPP and spill prevention plan prior to disposal.

Impacts to aquatic ecology from onsite preparation activities are most likely to be associated with management of erosion and sedimentation associated with stormwater. Temporary and permanent erosion and sediment control measures would be needed to minimize the flow of disturbed soils into the ditches and wetlands. These measures would be described in the SWPPP that would be submitted and approved by TCEQ as part of the TPDES general permit relating to stormwater discharges for building activities (TCEQ 2008). Check dams, rip-rap, detention basins, and sediment barriers may be part of the systems established to collect stormwater drainage to allow sediment and other debris to be captured before it passes into protected waters. Temporary measures would include minimal clearing and maintenance of existing vegetative cover, silt fencing, mulching, and erosion control blankets. Permanent measures would include reestablishing natural drainage patterns, vegetated swales, and permanent seeding/plantings (STPNOC 2009a, 2008b).

Main Cooling Reservoir

A new CWIS as well as a new discharge structure for proposed Units 3 and 4 would be added to the MCR. A permanent sheet pile cofferdam would be installed on the west side of the north separation dike for the intake and pumphouse. A temporary cofferdam would be erected on the interior of the MCR embankment for the installation of the discharge structure, located next to the existing discharge structure for STP Units 1 and 2. The cofferdams, once in place, would help reduce erosion and sedimentation around the disturbance areas and minimize impacts to the aquatic community in the MCR (STPNOC 2009a). The noise generated during installation of the cofferdam and new structures would disturb the aquatic organisms in the vicinity of the structures but the region of disturbance would likely be small because the noise would likely be attenuated quickly considering the depth and size of the MCR. Therefore, impacts to aquatic species and habitat in the MCR are expected to be minimal.

Colorado River

Preparations along the Colorado River for facilities associated with the proposed new units would be limited to the RMPF, the barge slip and barging traffic to the STP site (STPNOC 2009a, d). The intake screens on the RMPF would be removed from the water and either refurbished or replaced, and would involve little underwater disturbances that would be localized to the front of the intake structure. New pumps for proposed Units 3 and 4 would be installed behind the intake structure and would not result in any disturbances within the river. To maintain proper support of the discharge structure for all four units (the two existing and two proposed),STPNOC plans on restoring the revetment along 1600 ft of shoreline on the west bank of the Colorado River, beginning at the MCR spillway and extending down the river to the STP site property line. They have requested approval from the Corps to conduct the restoration work as part of the existing permit with the Corps or under the Nationwide Permit No. 13 for bank stabilization activities. There are no other plans for changing the spillway at the MCR or the discharge structure along the river for the proposed new units (STPNOC 2009a).

The existing barge slip that was built for Units 1 and 2 would be re-excavated and expanded for use with the proposed Units 3 and 4 (STPNOC 2009d). Dredging around the existing barge terminal is anticipated and would be conducted in accordance with the necessary dredging permits (STPNOC 2008b). Material to be dredged is predominantly silty-clay soils with approximately 6 in. of “detritus and silt soils” on the surface. Dredged material would be placed in the designated onsite location that is currently used for storage of material removed during maintenance activities with the RMPF (STPNOC 2009d). When the barge slip for Units 1 and 2 was built, a sheet pile wall was installed in the river to control sedimentation and limit downstream increases in turbidity and siltation (STPNOC 2009a). At that time, an estimated area of less than one ac of benthic habitat was destroyed during the building of the barge slip (STPNOC 2009a). The areal extent and types of disturbances to the shoreline and in the river for the re-excavation and expansion of the slip for transporting the barged materials for Units 3 and 4 is anticipated to be similar to or less than the disturbances during the building of Units 1 and 2 (STPNOC 2009d). The aquatic resources around the barge slip would likely recolonize after removal of the sheet pile wall and barging activities are completed.

Delivery of major equipment for Units 3 and 4 would be by barging the material to the site, and the barges could interact with aquatic organisms (e.g., sea turtles) along the route to STP. The cargo that would be barged to the site includes prefabricated modules, large components fabricated overseas, and bulk commodities. STPNOC has stated that no firm shipping contracts have been developed for transportation of the materials to the STP site. However, STPNOC has indicated that the current plans call for prefabricated modules and components fabricated overseas to be shipped to the Port of Freeport (or points north) where they would be transferred from ocean-going ships to inland barges. The inland barges would then enter the Gulf Intracoastal Waterway (GIWW) and move south to the confluence of the Colorado River and proceed upstream to the site. The ports in Matagorda Bay to the south of the site currently do not have adequate facilities for the transfer of heavy cargo from ocean-going vessels to inland barges. Therefore, transport of these materials would not involve the Matagorda Ship Channel or the diversion canal in Matagorda Bay (STPNOC 2009d).

STPNOC plans to ship bulk commodities (e.g., aggregate or structural fill materials) via inland barge. Access to the Colorado River by the barges would depend on the source of the materials, and could be transported either from the north or south along the GIWW. However, no bulk commodity traffic is expected to traverse the diversion canal in Matagorda Bay or the Matagorda Ship Channel (STPNOC 2009d).

Activities in the Colorado River are likely to be short in duration, and due to erosion and sedimentation controls, the activities are not likely to release significant quantities of sediment or silt. Increase in turbidity is not likely to be transported far down the river. Thus, impacts from building the proposed Units 3 and 4 at STP are likely to be negligible for aquatic resources in GIWW and Matagorda Bay.

4.3.2.2 Aquatic Resources – Transmission Line Corridors

No new offsite transmission corridors would be required for proposed Units 3 and 4. Potential impacts to aquatic ecological resources in transmission corridors are limited to consideration of the impacts from site preparation activities and placement of the new 345-kV switchyard for Units 3 and 4, 345-kV tie-line from Units 1 and 2 to the new 345-kV switchyard, and from upgrading the 20-mi STP-to-Hillje corridor.

The onsite addition of a new switchyard for proposed Units 3 and 4 and tie-line to existing Units 1 and 2 are proposed for areas that have previously been disturbed (Figure 3-1). The new switchyard would be placed on the north side of the relocated MDC, and the lines would span across the MDC. There are wetlands in the vicinity of the tie-line from Units 1 and 2 to the new switchyard. The building plans indicate that all ditches and wetlands would be avoided by building activities (STPNOC 2009a). Impacts to aquatic resources in onsite wetlands and ditches would be minimized by temporary and permanent measures for erosion and sediment control as required under TCEQ's SWPPP (TCEQ 2008). Such measures include: minimizing removal of existing vegetative cover, maintenance of existing drainage patterns, prohibitions or restrictions of equipment and vehicles around and through water bodies, use of silt curtains and other sediment transport barriers, and restrictions on fill activities. Upon completion of activities, areas affected would be restored (STPNOC 2009a, 2008b).

Offsite, there would be some modification or replacement of towers on the transmission line from the STP site to the Hillje Substation (STPNOC 2009a). Activities would primarily be associated with existing pads for the towers, and vehicles would access the pads using existing roads. Access to lines and towers might require temporary impacts to wetlands resulting from the placement of board roads for use with heavy equipment. Erosion of soils and stormwater drainage are likely to be the only impacts to aquatic resources along the STP-to-Hillje transmission corridor (STPNOC 2009a). Affects from sedimentation would be limited by temporary and permanent measures for erosion and sediment control as required under TCEQ's SWPPP (TCEQ 2008; STPNOC 2009a).

4.3.2.3 Important Aquatic Species and Habitats

This section describes the potential impacts to important species and habitats from the preparation of the facilities for the proposed Units 3 and 4 at the STP site, and the upgrades for the STP-to-Hillje transmission corridor. The general life histories of these species are presented in Section 2.4.2.

Important Species

Potential impacts on species listed in Table 2-14 from construction and preconstruction activities in the vicinity of the site and associated transmission lines are discussed categorically in this subsection.

Commercial and Recreational Species

Activities for preparation of the proposed Units 3 and 4 facilities are primarily onsite and along the Colorado River at the STP site. Barging of materials (e.g., large equipment and bulk commodities) to the STP site would involve traffic in the waterways beyond the Colorado River, from Matagorda Bay and Port Freeport, and in the GIWW. Commercially and recreationally important species that are found onsite (e.g., black drum [*Pogonias cromis*] and blue crab [*Callinectes sapidus*]) are in water bodies that are not open to the public (e.g., in the MCR) and have limited ability to contribute to the populations found offsite. Impacts to those species would primarily be associated with erosion and sedimentation control. Stormwater and groundwater removed during preparation of the foundations for the proposed power blocks would be managed according to the SWPPP and discharged into the MCR. The aquatic resources in the MCR would experience negligible impacts from this disposal since the quality of the discharged water would be similar to that in the MCR (STPNOC 2009d).

Activities associated with the barge slip would temporarily affect commercially and recreationally important species in the Colorado River. Re-excavation and expansion of the existing barging slip would affect approximately one ac of aquatic habitat in the Colorado River. Commercial and recreational species in the river could be displaced from the affected shoreline while the sheet pile wall is put in place and during excavation activities. Sediment would be dislodged and turbidity in the vicinity of the sheet pile wall would increase for a short period of time. Barge traffic delivering material to the site would create cavitations that might cause fish avoidance temporarily in the vicinity of the barge slip.

The improvements planned for the RMPF, dredging at the barge slip, and barge traffic would have limited impacts on commercially and recreationally important species. Commercially and recreationally important species in the Colorado River were discussed in Section 2.4.2.3. These activities would be short in duration, impacts from increased turbidity and siltation would be limited by control measures, and damaged or affected benthic habitat would be small (likely less than 1 ac) and benthic species would recolonize after activities at the barge slip are completed. Most commercially and recreationally important species in the vicinity of these activities would likely avoid the area during these activities.

Invasive Species

Taxa such as *Corbicula*, giant salvinia (*Salvinia moesta*), and *Hydrilla* were not reported in the onsite water bodies and have not been found in high densities in the Colorado River in the vicinity of STP (STPNOC 2009a). Disturbances to onsite water bodies could encourage invasive species to proliferate by allowing them to establish in the new habitats created by opening up drainage areas before the indigenous species can recolonize the area. Since these organisms have not been noted in the existing onsite water bodies, there does not seem to be a mechanism for the introduction of invasive species to the disturbed areas. The amount of area in the Colorado River that is being disturbed is minimal and probably not enough area to allow the invasive species a great advantage.

Ecologically Important Species

Primarily ecologically important species are benthic aquatic invertebrates or fish that are foraged by other species of concern. Site preparation and development activities can suspend sediments in water bodies that are likely to affect benthic invertebrates and fish. Dredging can remove benthic organisms. As discussed above, impacts from sedimentation would be controlled using a variety of measures (e.g., stormwater management for onsite activities and sheet pile walls in the MCR and Colorado River). Impacts from erosion and sedimentation would likely be temporary and minimal. Benthic organisms that are lost during dredging activities would likely recolonize the affected areas with time. The presence of abundant forage fish within the Lower Colorado River is summarized in Table 2-14. Activities associated with refurbishing the intake structure and re-excavating the barge slip may affect the presence or habitat utilization of these forage species in the vicinity of these activities. However, these impacts are expected to be temporary as fish should return to these areas within the Colorado River following completion of site preparation and development activities.

Species with Designated Essential Fish Habitat

The Lower Colorado River, GIWW, and Matagorda Bay are considered essential fish habitat (EFH) within Ecoregion 5 of the Gulf of Mexico, as designated by the Gulf of Mexico Fishery Management Council in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801 et seq.). No habitats of particular concern occur in either water body or in associated nearshore areas (GMFMC 2004). Section 2.4.2.3 and the EFH assessment in Appendix F discuss the species and life stages with designated EFH in the vicinity of the STP site and associated transmission corridors.

Spanish and king mackerel (*Scomberomorus maculatus* and *S. cavalla*, respectively) have not been collected in the Colorado River in 1983-1984 or 2007-2008 (ENSR 2008b). The river would be potential foraging habitat for the mackerel. Improvements at the RMPF would not likely affect the mackerels. During dredging at the barge slip, the mackerels might avoid the area due to changes in turbidity from sedimentation or during erection and dismantlement of any sedimentation control systems in the river (e.g., sheet pile walls).

Gray (mangrove) snapper (*Lutjanus griseus*) were collected within the first 3 mi of the river and the GIWW in 2007-2008 (ENSR 2008b). Juvenile gray snapper are likely to be the most common in the Colorado River. However, the habitat in the river does not include regions of sea grass or other areas for protection. Organisms would most likely avoid the area during activities in the river. The benthic habitat disturbed by dredging would likely recover and support benthic invertebrates that are a food source for the gray snapper.

Red drum (*Sciaenops ocellatus*) have been collected in the MCR and all along the Colorado River in 2007-2008 (ENSR 2008b, c). This is one of the species that has not been collected during past surveys of the Colorado River but are known to be in Matagorda Bay and the GIWW. Red drum were collected with all types of sampling gear, indicating that the species was well distributed in the river. Presence of the species in the MCR indicates that larvae or juveniles were entrained at the RMPF. During activities in the Colorado River, the red drum juveniles and adults would most likely avoid the area. The benthic habitat disturbed by dredging would likely recover and support benthic invertebrates that are a food source for the red drum.

Brown, pink, and white shrimp (*Farfantepenaeus aztecus, F. duorarum,* and *Litopenaeus setiferus*, respectively) have been collected in the MCR and all along the Colorado River in 1983-1984 and 2007-2008 (ENSR 2008b, c; NRC 1986). White and brown shrimp were more abundant at the confluence of the river and the GIWW than farther up the river. These shrimp species are an important commercial resource in Matagorda Bay. Improvements at the RMPF are not likely to affect the shrimp. Dredging at the barge slip would temporarily remove habitat for the shrimp and their food source.

Gulf stone crabs (*Menippe adina*) have not been collected in the Colorado River in 1983-1984 or 2007-2008 (ENSR 2008b). While all lifestages of this species of stone crab are listed as occurring in the Colorado River to just beyond the FM 521 bridge; the habitat, salinity, and temperature of the river is not likely to support many of the organisms, and they are most likely to be found in Matagorda Bay. Improvements at the RMPF are not likely to affect stone crab. Dredging at the barge slip would temporarily remove habitat for the stone crab and their food source.

<u>Federally and State-listed Species</u>

Section 2.4.2.3 discusses the 12 species Federally listed as protected by the FWS and NMFS under the ESA in Matagorda County and the coastline of Texas. Of these species, only the threatened Atlantic green turtle (*Chelonia mydas*), the endangered hawksbill turtle (*Eretmochelys imbricata*), and the endangered Kemp's ridley turtle (*Lepidochelys kempii*) are likely to be in the vicinity of the routes for barging material and equipment to the STP site. Sea turtles can be affected by barging traffic. The speed of the barges is low enough that turtles that come in contact with the barges or are entrained in the cavitations created by the moving barges would not be severely damaged (National Research Council 1990). There have been no reports of stranded turtles due to barges in Matagorda Bay or the GIWW between Matagorda Bay and Port Freeport. More detailed information in support of a joint consultation with the FWS can be found in the biological assessment in Appendix F.

The State-listed species in Matagorda County include three threatened species (blue sucker [*Cycleptus elongates*], smooth pimpleback [*Quadrula houstonensis*], and Texas fawnsfoot [*Truncilla macrodon*]) as well as four rare and protected species (American eel [*Anguilla* *rostrata*], Gulf Coast clubtail [*Gomphus modestus*], creeper [*Strophitus undulates*], and pistolgrip [*Tritogonia verrucosa*]). The blue sucker would be located in the Colorado River and not likely be in the onsite water bodies. This species was not collected during the aquatic surveys of the river in the 1970s, 1980s, and 2007-2008. Blue suckers move upstream in the spring to areas with riffles for spawning. Since spawning habitat is not within the vicinity of the STP site, activities in the Colorado River associated with the RMPF, shoreline restoration, and maintenance dredging for the proposed Units 3 and 4 would not likely affect eggs and larvae of the species. Juvenile and adult blue suckers forage in the deeper channels of the river and are strong enough swimmers to avoid activities in the river (TPWD 2009a).

The two State-listed threatened freshwater mussels in Matagorda County are likely to be found in different water bodies at STP. The smooth pimpleback could be found in the MCR and the Colorado River in the vicinity of STP since the species prefers small to moderate rivers as well as reservoirs, tolerates the flow regimes of the MCR and river, and prefers the type of substrate found in the MCR and river. However, since the species does not tolerate dramatic water level fluctuations, it is not likely to be found in the other onsite water bodies. The smooth pimpleback has not been reported in the surveys of aquatic organisms at the STP site (NRC 1975, 1986; ENSR 2007a, b, 2008b, c). There is no information on the reproduction of the smooth pimpleback (e.g., glochidia are unreported) (Howells et al. 1996; TPWD 2009a). Activities in the Colorado River could remove adult mussels if the substrate is removed. If habitat for the smooth pimpleback is found in the area, TPWD might require mitigation activities (e.g., mussels could be collected and relocated).

Texas fawnsfoot has not been reported in the surveys of aquatic organisms at STP (NRC 1975, 1986; ENSR 2007a, b, 2008b, c). What little is known about the species is that it has been found in river systems similar to the Colorado River and in flowing rice irrigation canals, but the Texas fawnsfoot has not been found in impoundments. Thus, Little Robbins Slough and the Colorado River might be suitable habitat for the species. In addition, the ponds and drainage areas that are located along the transmission corridor could be appropriate habitat for the Texas fawnsfoot. There is no information on the reproduction of the Texas fawnsfoot (e.g., glochidia are unreported) (Howells et al. 1996; TPWD 2009a). If habitat for the Texas fawnsfoot is found in the area, TPWD might require mitigation activities (e.g., mussels could be collected and relocated).

The American eel is a State-listed protected species that was collected in the MCR during the impingement sampling for the CWIS for Units 1 and 2 (ENSR 2008c). The American eel was not collected in the Colorado River, but has been collected in Matagorda Bay (STPNOC 2009a). The adult eel collected in the MCR most likely was entrained as a larvae moving up the Colorado River from the Gulf and the Bay. Activities in the Colorado River associated with the RMPF, shoreline restoration, and maintenance dredging for the proposed Units 3 and 4 would not likely affect juvenile or adult life stages of the species because they are motile and can avoid the area. However, larvae could be lost during dredging activities since they are not strong enough swimmers to avoid activities in the river.

Gulf Coast clubtail, a dragonfly, is a State-listed protected species in Matagorda County. Little Robbins Slough and Colorado River could have the appropriate habitat for the early life stages of the clubtail (TPWD 2009a), but were not reported in any surveys of on-site water bodies and the river (NRC 1975, 1986; ENSR 2007a, 2008b, 2008c). Habitat could be lost from on-site activities but the SWPPP could minimize impacts to the early life stages of the clubtail by managing water flow in basins and minimizing turbidity that could change their habitat. Clubtails in the Colorado River could be lost or their habitat removed by activities associated with the RMPF, shoreline restoration, and maintenance dredging for the proposed Units 3 and 4. If habitat for the Gulf Coast clubtail is found in the area, TPWD might require mitigation activities.

The protected State-listed creeper and pistolgrip are known to be in the Colorado River drainage, and the on-site water bodies and Colorado River could have the appropriate habitat for these freshwater mussels (TPWD 2009a). However, these species were not reported in any surveys of on-site water bodies and the river (NRC 1975, 1986; ENSR 2007a, 2008b, 2008c). Habitat for these mussels could be lost from on-site activities, but the SWPPP could minimize impacts by managing water flow in basins and minimizing turbidity that could change their habitat. Adult mussels could be lost or their habitat removed by activities associated with the RMPF, shoreline restoration, and maintenance dredging for the proposed Units 3 and 4. If habitat for these mussels is found in the area, TPWD might require mitigation activities (e.g., mussels could be collected and relocated).

Important Habitats

The Mad Island Wildlife Management Area (WMA) and Clive Runnells Family Mad Island Marsh Preserve are to the southwest of the STP site and are important habitats for aquatic organisms associated with Matagorda Bay and the Gulf of Mexico. These waterbodies are connected to the drainages on the STP site, particularly Little Robbins Slough, and the slough is an important contributor of freshwater to these important habitats (NRC 1975, 1986; STPNOC 2009a). Stormwater management during site preparation and development activities has the greatest potential to change the water quality and quantity in the slough and thus affect the wetlands and marshes to the south of the site. STPNOC has indicated that groundwater (from dewatering activities associated with the building the proposed power block) and stormwater would be collected and disposed into the MCR and not into the onsite waterbodies like the Little Robbins Slough. The portion of the Colorado River along the STP site up to the bridge for FM 521 is considered EFH within Ecoregion 5 (GMFMC 2004). Section 2.4.2.3 discusses the species and life stages included under EFH for the Colorado River. NRC and the Corps are jointly consulting with NMFS per Magnuson-Stevens Fishery Conservation and Management Act, and the supporting EFH assessment is included in Appendix F. Building activities proposed for

Units 3 and 4 in and around the Colorado River include improvement at the RMPF and dredging around the barge slip. Improvements at the RMPF would not likely affect the fish species because they would avoid the area for the duration of the activities. During dredging at the barge slip, the fish species might avoid the area due to changes in turbidity from sedimentation or during erection and dismantlement of any sedimentation control systems in the river (e.g., sheet pile walls). The loss of benthic habitat would discourage the fish from returning to the area until their food source and protective habitat recolonizes the area. Improvements at the RMPF are not likely to affect the benthic invertebrates (shrimp and stone crab), but dredging at the barge slip would temporarily remove habitat for the shrimp and their food source.

4.3.2.4 Aquatic Monitoring

No monitoring of aquatic resources is planned for the site preparation and development activities onsite or in the transmission corridor. Regulatory agencies have not required ecological monitoring of the STP site or its associated transmission line corridors since the mid 1980s (once the MCR was filled with water), and there is no ongoing monitoring. Monitoring of stormwater during site preparation and development activities for proposed Units 3 and 4 under TCEQ's SWPPP would be limited to assessing water quality and does not include monitoring aquatic organisms. Inspections of temporary and permanent measures for erosion and sediment control would be required to assure that those measures are functioning appropriately and are protective of the environment (TCEQ 2008; STPNOC 2009a).

4.3.2.5 Potential Mitigation Measures for Aquatic Impacts

Restoration within the vicinity of areas affected by site preparation and development activities would be required prior to notice of termination for the SWPPP. Most likely restoration activities would include the removal of erosion and sedimentation control systems (e.g., sediment transport barriers), re-grading stream beds and banks that might have been damaged, and re-vegetation.

Habitat for State-listed threatened freshwater mussels may be onsite and in the Colorado River. If the smooth pimpleback or Texas fawnsfoot are found, TPWD might require mitigation activities (e.g., mussels could be collected and relocated).

4.3.2.6 Summary of Impacts to Aquatic Resources

Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the impacts of preconstruction and construction activities to the freshwater, estuarine, and marine aquatic biota and habitats, including impacts on aquatic threatened and endangered species and other important species would be SMALL, and no mitigation measures are proposed at this time. The LWA rule (72 FR 57426) specifically indicates that transmission lines and heavy haul roads are not included in the definition of construction. Based on the expectation that no NRC-authorized construction activities would affect freshwater, estuarine and marine biota and habitats from NRC-authorized construction activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL.

4.4 Socioeconomic Impacts

Building activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of building activities and of the construction workforce on the region. Unless otherwise specified, the primary source of information for this section is the ER (STPNOC 2009a).

The planned building activities would differ significantly from those required to build the original STP Units 1 and 2. Although some activities would be similar, STP Units 1 and 2 were constructed almost entirely onsite. For proposed Units 3 and 4, many of the components of the U.S. Advanced Boiling Water Reactor (ABWR) nuclear units would be delivered pre-assembled, thus reducing onsite building labor requirements. Although the review team considered the entire region within a 50 mi radius of the STP site when assessing socioeconomic impacts, the primary region of interest for physical impacts is the area within a 10-mi radius. As described in Section 2.5, with regard to social and economic impacts, the entire 50 mi radius is considered, but primarily includes Brazoria, Calhoun, Jackson and Matagorda Counties. Based on commuter patterns, populations, and the distribution of residential communities in the area, the review team found minimal impacts on other counties within the 50 mi radius in Texas.

4.4.1 Physical Impacts

Building activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, and dust. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses potential building impacts that may affect people, buildings, and roads.

4.4.1.1 Workers and the Local Public

The site for proposed Units 3 and 4 is located within an existing power plant facility that includes land developed for industrial use, farmland, and undeveloped natural and man-made wetlands. Three other industrial facilities are also located within the 10-mi radius. The LCRA Park is about 6 mi east of the STP site. There are 10 residences within 5 mi of the STP site, with the closest residence about 1.5 mi west southwest of the Exclusion Area Boundary (EAB) (STPNOC 2009a).

All building activities would occur within the STP site boundary and would be performed in compliance with applicable regulatory agencies and permit requirements. While approximately

5170 people live within 10 mi of the STP site (Appendix G), the people most vulnerable to noise, fugitive dust, and gaseous emissions resulting from building activities include construction workers and personnel working onsite, people working or living immediately adjacent to the site, and transient population such as temporary employees, recreational visitors and tourists (STPNOC 2009a).

Construction workers would have adequate training and personal protective equipment to minimize the risk or potentially harmful exposures. Emergency first-aid care would be available at the site, and regular health and safety monitoring would be conducted during building. People working onsite or living near the STP site would not experience any physical impacts greater than those that would be considered an annoyance or nuisance. Building activities would be performed in compliance with local, State, and Federal regulations and site-specific permit conditions (STPNOC 2009a).

Building projects are inherently noisy, but the STP site is fairly isolated from populated areas. If exceptionally noisy building activities would be necessary, STPNOC would provide public announcements or notifications. Such activities would be performed in compliance with site-specific permit conditions and local, State, and Federal regulations (STPNOC 2009a).

Matagorda County is part of the Metropolitan Houston-Galveston Intrastate Air Quality Control Region. All areas within the Metropolitan Houston-Galveston Air Quality Control Region are classified as attainment areas under Nation Ambient Air Quality Standards, with the exception of the Houston-Galveston-Brazoria 8-Hour Ozone Non-attainment Area. The Houston-Galveston-Brazoria area holds non-attainment status for ground-level ozone under the 8-hour standard and is classified at “moderate” with a maximum attainment date of June 15, 2010 (STPNOC 2009a). Temporary and minor effects on local ambient air quality could occur as a result of normal building activities. As noted in Section 4.7.1, all equipment would be serviced regularly and all building activities would be conducted in accordance with Federal, State, and local emission requirements. Therefore, the review team concludes that project-related physical impacts to workers and the local public would not be significant. Section 4.7 contains a complete review of air quality impacts during preconstruction and construction activities.

4.4.1.2 Buildings

Building activities would not affect any onsite or offsite buildings. Onsite safety related buildings have been constructed to safely withstand any possible impact, including shock and vibration, from activities associated with building new reactors at the STP site (10 CFR Part 50, Appendix A). Except for the existing structures on the STP site, no other industrial, commercial, or recreational structures would be directly affected by the development of the new facility. Therefore, the review team concludes that project-related physical impacts to buildings would not be significant.

4.4.1.3 Roads

Public roads and railways would transport materials and equipment. The transportation network within the four county economic impact area is rural, fed by traffic from urban roadways. STPNOC's building activities are expected to impact the two-lane roadways in Matagorda County, particularly FM 521. No significant alterations or development of new roads would be needed, but some roads may need minor repairs or upgrades such as patching cracks and potholes, adding run lanes, and reinforcing soft shoulders. STPNOC would repair any damage to public roads, markings, or signs caused by building activities to pre-existing conditions or better (STPNOC 2009a).

The site access road that exits onto FM 521 would be maintained with clearly marked signs. Construction workers would use either the north or west entrances to the plant rather than the primary East Site Access Road, reserved for traffic for Units 1 and 2. The effect of this system would be to spread out traffic arrivals and departures and to minimize bottlenecks at the plant entrances. A planned heavy haul road from the STP barge facility on the Colorado River to the site would be private and contained within the site boundary. STPNOC would select hauling routes based on equipment accessibility, existing traffic patterns, and noise restrictions, logistics, distance, costs, and safety. Impacts in the surrounding vicinity would be minimized by avoiding routes that could adversely affect sensitive areas, such as residential neighborhoods, hospitals, schools, and retirement communities. STPNOC also would restrict activities and delivery times as much as possible to daylight hours (STPNOC 2009a). Therefore, the review team concludes that project-related physical impacts to roads would be minor.

4.4.1.4 Aesthetics

Approximately 540 ac on the STP site would need to be cleared and excavated to build the proposed Units 3 and 4. All of the clearing and excavation would occur on the STP site; however, it may be visible from offsite roads, particularly FM 521 (depending on the activities being performed). Clearing and building activities along the riverfront of the Colorado River would be visible from the river. No new transmission corridors would be built for Units 3 and 4 but upgrading current transmission lines in the Hillje transmission line corridor is necessary (STPNOC 2009a). The STP site is already aesthetically altered by its existing nuclear power plant. Therefore, the review team concludes that project-related physical impacts on aesthetics would be minor.

4.4.1.5 Summary of Physical Impacts

All building activities would occur within the STP site boundary in areas of previous disturbance. Based on the information provided by STPNOC in its ER (STPNOC 2009a) and the NRC's own independent review, the review team concludes that the overall physical impacts of building on workers and the local public, buildings, roads, and aesthetics near the STP site would be

SMALL, and additional mitigation, beyond the applicant's commitments, would not be warranted.

4.4.2 Demography

The following assessment of population impacts is based on STPNOC's estimated peak project workforce analysis. The proposed project schedule assumes approximately 7 to 8 years to build both units, each being in commercial operation by 2017. STPNOC reviewed several NRC studies to determine in-migration assumptions. The highest number of people onsite at any given time (approximately month 26 of the building schedule) is 9021 which includes (STPNOC 2009a):

- 1238 Unit 1 and 2 operations staff
- 733 Unit 3 and 4 operations staff
- 5950 construction workers, and
- 1100 outage workers.

STPNOC determined the best estimate for the in-migrating workforce for building proposed Units 3 and 4 was 50 percent or 2975 workers. Also STPNOC assumes that in-migrating workers would settle into the socioeconomic impact area in the same pattern as the current STPNOC employees and approximately 80 percent of these workers would bring a family. Using an average family size for the workforce of 3.25 people, this would bring the total in-migrating project-related population to 8330 (7735 in-migrating family members and 595 workers without family). The Units 3 and 4 operations workforce was assumed by STPNOC to be 733 at the time of the peak building activities, all of whom would be in-migrating. For comparison purposes, the review team will also use 733 operations workers and an average family size of 2.74 for the operating workforce (Section 5.4) resulting in total in-migrating operations-related population of 2008. Therefore, the total expected in-migrating population (building and operations) at the time of peak building activity would be 10,338.

The review team believes that the above assumptions are plausible and assumes that if the in-migrating population follows the same pattern as the existing workforce, then 86 percent (8891 people) of the in-migrating population would live in the socioeconomic impact area: Brazoria County (2316 people or 22.4 percent), Matagorda County (6275 people or 60.7 percent), Calhoun County (165 people or 1.6 percent) and Jackson County (134 people or 1.3 percent). The review team believes the remaining 1462 (14 percent) in-migrating population would settle throughout other counties within the 50 mi region. Most of the rest of the construction workers likely would come from the Houston area and Victoria area and would count as residents of the region. With these assumptions, there would be net population increase of less than one percent in Brazoria, Calhoun, and Jackson Counties and a 16 percent increase in population for Matagorda County. Given the magnitude of the estimated population increases, the review team determined the influx of workers because of STP project activities would only impose minor and temporary demographic impacts in Brazoria, Calhoun, and Jackson Counties; however, Matagorda County would likely experience a noticeable but temporary impact. If the in-migration rate for construction workers were significantly larger than assumed or if more workers brought families, then it is possible that impacts could be greater than shown in the remainder of this section. However, there are large nearby supplies of construction workers in the cities of Houston and Victoria, and in Brazoria County. In addition, given the propensity of construction workers to either commute long distances or relocate temporarily to a job site without families, the review team believes that the impact of in-migration, especially to the smaller counties, would not be larger than that assumed.

Figure 4-1 characterizes the size of the workforce for the entire project. STPNOC estimates NRC-regulated activities to be 66 months long, peaking in year three after the approval of the COL. Also shown is the 24 months of preconstruction activity. Not only does the figure show the construction workforce but also the operations workforce for STP Units 1 and 2 and proposed Units 3 and 4, along with the supplemental outage workers who would be added to the operations workforce (STPNOC 2008c). A corresponding table showing total estimated numerical values by month for the STP workforce is in the supporting documentation in Appendix G.

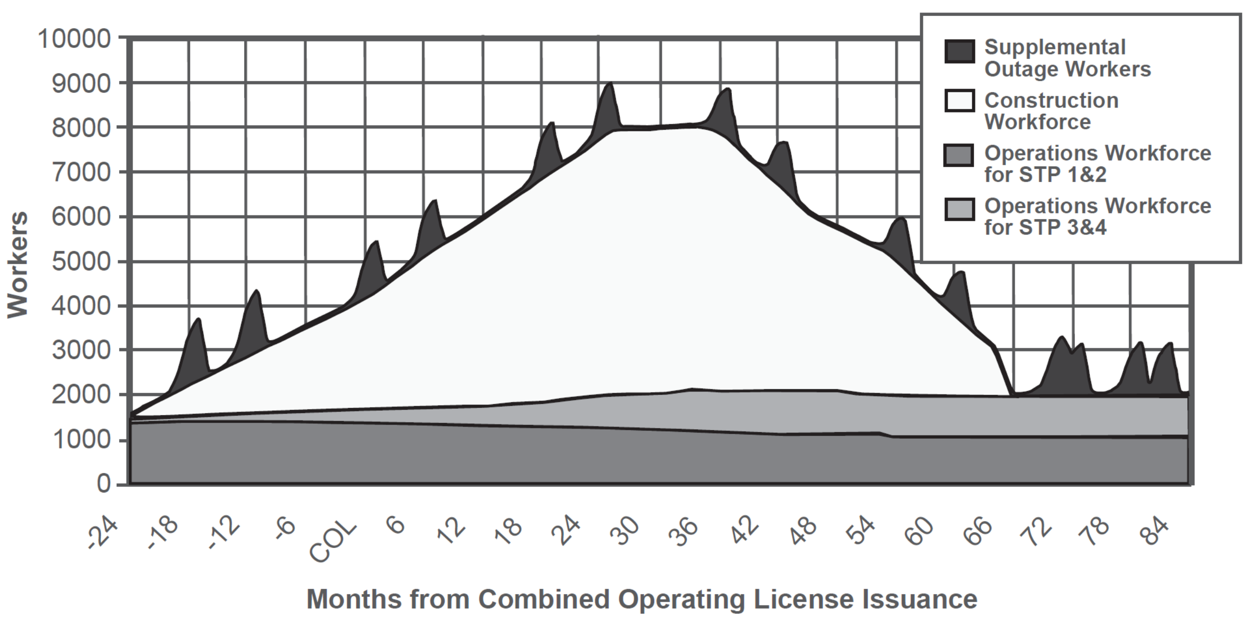

Figure 4-1. Total Workforce, STP Units 3 and 4 (STPNOC 2009a)

Based on its independent analysis, the review team concludes that the demographic impacts of building activities would be MODERATE in Matagorda County and SMALL elsewhere.

4.4.3 Economic Impacts to the Community

This section evaluates the social and economic impacts on the area within 50 mi of the STP site as a result of building the proposed Units 3 and 4. The evaluation assesses the impacts of building Units 3 and 4 and the demands placed by the larger workforce on the surrounding region.

4.4.3.1 Economy

The impacts of building on the local and regional economy depend on the region's current and projected economy and population. For this analysis, the review team assumed site-preparation would begin in 2010 with a commercial operation date of 2016 for Unit 3 and 2017 for Unit 4.

The in-migration of approximately 3708 workers, most bringing their families, would create new indirect jobs in the area through a process called the "multiplier effect." Each dollar spent on goods and services by one person becomes income to another, who saves some money but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves a portion and re-spends the rest, and so on. The percentage by which the sum of all spending exceeds the initial dollar spent is called the "multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings and a special set of multipliers was provided by BEA to STPNOC for Matagorda and Brazoria Counties (STPNOC 2008c). The review team determined through its own assessment of the area that a more appropriate area of economic impact could be a four-county area rather than the two counties used by the applicant (Matagorda, Brazoria, Calhoun, and Jackson); the impact multipliers for this larger area would also be larger than for Matagorda and Brazoria alone. However, given the sparseness of population and lack of industry in the area, the review team believes the BEA multipliers used by the applicant work as a reasonable approximation for this analysis.

For every in-migrating construction worker, STPNOC estimates an additional 0.61 jobs would be created in the socioeconomic impact area. Therefore the 2975 construction workers would create 1815 indirect jobs for a total of 4790 jobs. For every in-migrating operations worker, STPNOC estimates an additional 1.47 jobs would be created in the economic impact area. Therefore the 733 operations workers would create 1078 indirect jobs for a total of 1811 jobs. The grand total of jobs (direct and indirect) would be 6600. The review team expects some of the indirect jobs to be filled by unemployed individuals living in the four counties and possibly by spouses of in-migrating construction workers.

The employment of a large construction workforce over a 7- to 8-year period would have positive economic impacts on the surrounding region. STPNOC estimated that if each in-migrating construction worker earned $53,000 a year, and each in-migrating operations worker averaged $72,000 per year, then this large pool of jobs would inject, in the peak employment year, more than $200 million into the regional economy, thus reducing unemployment and stimulating new business opportunities for housing and service-related industries (STPNOC 2009a, STPNOC 2008d). The largest economic impacts likely would be felt in the Matagorda County, particularly in the town of Bay City, since it would house the largest percentage of employees. Economic impacts would not be significant in Brazoria County due to its large population or in Calhoun and Jackson Counties due to their assumed low increase in population.

After peak project employment in year three, the construction workforce would start to decline and produce a decline in related payrolls. There would be a corresponding decline in economic impacts for the four counties of the economic impact area. The loss of project-related jobs would mean a decrease in indirect jobs through the "multiplier effect." However, this decline would lag the loss in project-related jobs and would be cushioned by the operations workforce. Even though there would be fewer operations workers during building than the number of exiting construction workers, they would be permanent residents and would therefore induce a larger per-worker "multiplier effect" (see Section 5.4).

The review team concludes that beneficial economic impacts could be experienced throughout the 50-mi region surrounding the site as a result of building activities at the STP site. In Matagorda County these potential economic impacts would be noticeable and beneficial in size while economic impacts elsewhere would be minor and beneficial.

4.4.3.2 Taxes

Several tax revenue categories would be affected by building proposed Units 3 and 4. These include taxes on wages, salaries, and corporate profits; sales and use taxes on building-related purchases; workforce expenditures: property taxes related to the new units; and personal property taxes on owned real property.

Personal and Corporate Franchise Taxes

As stated in Section 2.5.2.2, the State of Texas does not levy a personal income tax. Because the franchise tax is calculated based on revenues, no franchise taxes would be assessed during building activities. The above mentioned multiplier effect in Section 4.4.3.1 could have an indirect effect on the franchise tax. The franchise tax revenue may increase if firms generate more revenue from construction workers spending money in their place of business. Since no franchise taxes would be paid during the building phase the franchise tax impact would be small.

Sales and Use Taxes

The area around the proposed site would experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food) by the construction workforce. The region would also experience an increase in the sales and use taxes collected from construction materials and supplies purchased for the project. STPNOC estimates it would spend $32.3 million a year on goods and services during construction of the new units (STPNOC 2008b). Any expenditures made by Nuclear Innovation North America (NINA), the taxable owners of Units 3 and 4 (as a municipal utility, CPS Energy is not taxable) would be subject to two percent local sales tax in Bay City or Palacios on top of the 6.25 percent State sales tax. Previously, NINA and CPS Energy each had 50 percent ownership share of proposed Units 3 and 4 (STPNOC 2009a). NINA and CPS Energy, however, have been in negotiations and on February 17, 2010, reached a proposed settlement agreement where NINA would have an ownership share of 92.375 percent and CPS Energy would have a 7.625 percent ownership interest[a](NINA 2010, CPS 2010). Matagorda County would likely receive a substantial benefit from sales tax revenue due to its proximity to the STP site, its relatively small population, and its economic base, Matagorda County would likely receive a substantial benefit from sales tax revenues. Brazoria County also may see an increase in sales and use tax revenues; however, it would likely be a much smaller percentage because of its larger sales and use tax base. Both Calhoun and Jackson Counties are expected to have limited STP-related population growth and to provide only limited services to the Units 3 and 4 development project; thus, any impact on sales and use tax revenues would likely be minimal.

Property Taxes

The STP owners paid $6.1 million dollars in property taxes in 2005, which represents three-fourths of Matagorda County's total tax revenues (see Table 2-23). The STP owners paid property taxes not only to the county but also to the Matagorda County Hospital District, the Navigation District #1, the Drainage District #3, the Palacios Seawall District, and the Palacios Independent School District (ISD). Tax payments would be based on the cost of building Units 3 and 4 and determined in accordance with state law using mutually agreed on appraisal formulas (STPNOC 2009a). Tax abatements are available to the taxable owners of Units 3 and 4 because of Matagorda County's status as a Federal Historically Underutilized Business Zone and Texas Strategic Investment Area. Details about such a tax abatement are unavailable at this time. STPNOC would likely pay taxes on behalf of the taxable owners of STP Units 3 and 4 to the above districts before operation begins. Although the amount currently is unknown, the payments are likely to represent a noticeable beneficial impact for Matagorda County.

(a) On February 17, 2010, NINA stated that the agreement was subject to final documentation and CPS Board approval (NINA 2010). CPS Energy indicated that the proposed settlement would be considered at its February 22, 2010, Board of Trustees Meeting (CPS 2010).

Between 2000 and 2005, about 71 percent to 99 percent of Palacios ISD revenues were attributed to STP Units 1 and 2. An increased appraised value in the district would increase the tax payments made to the ISD, though the amount that the district would get to keep under the State's wealth equalization laws is dependent on factors such as how many new students were to enroll into the district. Unless Palacios ISD sees an increase in enrollment, the extra tax dollars would go to the State. New legislation allows school districts to reduce the taxable value of development of nuclear plants. STP would be allowed to defer the effective date of the abatement for up to 7 years after the date of the agreement (STPNOC 2009a). The agreement would also allow the district and NRG to share in the tax savings. The money the district may receive would not be subject to the state's equalization laws and would not have to be sent back to the State. Palacios ISD Board of Trustee approved and signed a tax abatement agreement with NRC Energy on June 9, 2008 (STPNOC 2009a). Overall, property tax payments to the Palacios school district during the Units 3 and 4 project likely would be minor because the district would have to send the money back to the State; however, if they enter into an abatement agreement with NRG, impacts could be noticeable for the school district.

Another source of revenue from property taxes would be housing purchased by some construction workers. In-migrating workers may construct new housing, which would add to the counties' taxable property base, or these workers could purchase existing houses, which would drive housing demand and housing prices up, thus slightly increasing values (and property taxes levied). The increased housing demand would have little effect on tax revenues in the more populated areas.

4.4.3.3 Summary of Economic Impacts to the Community

Based on its independent analysis, the review team concludes that the economic impacts of building activities would be MODERATE and beneficial in Matagorda County and SMALL and beneficial elsewhere. The review team expects project-attributable sales tax revenue impacts would be SMALL and beneficial in the economic impact area. The review team concludes that building-related property tax revenue impacts also would be MODERATE in Matagorda County and the Palacios ISD, but SMALL elsewhere. Based on the information provided by STPNOC in its ER (STPNOC 2009a) and the review team's independent review, the review team concludes that the overall economic impacts of building activities on communities near the STP site would be MODERATE and beneficial, with SMALL beneficial impacts elsewhere, and no mitigation would be warranted.

4.4.4 Infrastructure and Community Service Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education.

4.4.4.1 Transportation

Building impacts on transportation and traffic would be most obvious on the rural roads of Matagorda County, specifically State Highway 60, FM 521, and State Highway 35. Project-related impacts on traffic are determined by five elements:

- the number of vehicles and timing of shifts for STP workers (building, operations, and outage workforces),
- the number of shift changes for the construction workforce per day,
- the number and timing of truck deliveries to the site per day,
- non-STP-related traffic and its projected growth in Matagorda County, and
- the capacity and usage of the roads.

STPNOC's description of expected traffic patterns near the plant (STPNOC 2008b) leads the review team to expect that most project traffic would pass through the intersection of FM 1468 and FM 521. The review team believes the intersection of FM 1468 and FM 521 is a potential choke point. Table 4-3 shows the review team's estimate of the expected project-related traffic versus capacity on FM 521, the road most likely to be adversely affected. STPNOC's analysis in their ER assumed three shifts, the first shift including 70 percent of the total labor force, 25 percent in the second shift, and five percent in the third shift. STPNOC assumed one person per vehicle.

Table 4-3. Calculation of Traffic Impacts on FM 521 from Building Activities at Proposed Units 3 and 4, Months 26-35

Traffic Component	No. of Vehicles Trips at Peak Hr (End of Day Shift Change)
Non-STP Traffic, 10 Percent at Shift Change (After 2010)	152
STP 1 and 2 Plant Workers, Day Shift (70% of Workforce)	867
STP 1 and 2 Plant Workers, Evening Shift (25% of Workforce)	310
STP 3 and 4 Construction and Operations Workers, Day Shift (70% of Workforce)	4678
STP 3 and 4 Construction and Operations Workers, Evening Shift (25% of Workforce)	1671
Total Traffic at Peak	7677
Maximum Traffic Threshold (10 percent of 55,200 trips per day)	5520
Available Capacity	-2157

Source: Staff calculations based on STPNOC 2008b.
Note: Outage workers are not included because they would be on 12.5-hour shifts and would not be changing crews at this time of day. Contractors and truck deliveries would be required to arrive and depart at alternate times than shift change workers to alleviate traffic congestion, and thus are not factored into the above analysis.

While the Texas Department of Transportation does not provide Level of Service (LOS) assessments on roads under its jurisdiction, it does rate “capacity,” which roughly corresponds to a LOS “C” (stable flow). As discussed in Section 2.5.2.3, FM 521 is the main access route to STP and is of special concern. In the Texas Department of Transportation rating system, FM 521 is a two-lane, rural major collector with a threshold capacity of 55,200 vehicles per day or 2300 vehicles per hour. The daily traffic on FM 521 north of STP, measured by the 2005 Average Annual Daily Traffic count, was 4073 vehicles, 2530 vehicles in the westerly direction and 1543 in the easterly direction in a single 24-hour period. STPNOC has assumed about one worker per commuting vehicle to estimate project peak traffic. STPNOC has estimated that about 67 percent of current vehicle traffic is STP plant-related, about 2730 vehicle-trips per day (about 1365 workers times one vehicle per worker, twice daily, distributed 70 percent to day shift, 25 percent to evening shift and 5 percent to night shift), with the other 33 percent attributable to non-STP traffic. The review team expects non-STP traffic, 1343 vehicle trips, to grow proportionately with county population, 9 percent by 2010 and 18 percent by 2020 (STPNOC 2008b). This would increase non-STP traffic from 1344 vehicle trips per day per day to 1465 in 2010 and 1586 in 2020. STPNOC assumed that 10 percent of this traffic would be present during the day/evening shift change. STPNOC also assumed that 95 percent (70 percent plus 25 percent) of STP Units 1 and 2 worker vehicles and 95 percent (70 percent plus 25 percent) of proposed Units 3 and 4 construction workforce vehicles would be involved in the day/evening shift change at STP (STPNOC 2008b). The review team added 95 percent of operations workforce vehicles to this estimate. Added to that are 146 non-STP vehicle-trips; this assumes that 10 percent occur during the evening shift change. STPNOC also assumed that the maximum hourly threshold was 10 percent of the daily value of 55,200 vehicle trips, or 5520 (STPNOC 2008b).

When added to the current estimated peak hour traffic, the peak hour project-related traffic would create a cumulative traffic estimate that significantly exceeds road capacity near the plant during months 26 through 35 of the development period, with the implicit LOS rating falling significantly below “C.” The overall impact in the county, however, likely would be noticeable. Traffic impacts are likely to be isolated to areas near the plant and only at shift changes. They likely would be much lower at off-peak hours and other locations.

To mitigate these impacts, STPNOC identified mitigation measures that could be part of a project management traffic plan produced before development begins. The traffic management plan could include such mitigating measures as installing turning lanes at the STP site entrance, establishing a centralized parking area away from the site and shuttling construction workers to the site, encouraging carpools, and staggering project shifts so they do not coincide with operational shifts (STPNOC 2009a). The review team believes that the STP operator and the building contractor could alleviate the most serious traffic impacts by changing shift times, by encouraging carpooling, and by other traffic control measures.

In addition to the construction workforce analyzed above, STPNOC would employ approximately 1500 to 2000 workers per unit for approximately 17 to 35 days for each outage scheduled for each reactor every 18 months. Outage workers would also use FM 521 to access the site, but would be on 12.5 hour shifts and would not be on the road at the same time as peak shift change. Truck deliveries would not be allowed during shift change (STPNOC 2008b). Rail spur equipment/material deliveries would be scheduled for non-peak traffic times Non-plant related traffic is minimal and is not expected to be impacted by occasional rail traffic crossing FM 521. Therefore, the review team concludes that noticeable traffic impacts in Matagorda County from the project would warrant mitigation to the extent practicable so they do not become destabilizing.

Rail and Waterways

STPNOC expects to receive heavy oversized equipment from a 9 mi railroad spur north of the plant. Though this spur is currently not in use, when reactivated it is not expected to impact other methods of transportation. STPNOC also plans to use a barge slip along the Lower Colorado River (3.5 mi SE of the STP site). Heavy equipment and other deliveries would be offloaded and brought to the site on a special heavy haul road (2.5 mi long). The barge slip is patrolled by the TPWD and the LCRA manages the water quality and supply. STPNOC plans on cooperating with the appropriate authorities for barge deliveries including the U.S. Coast Guard-licensed barge transport contractors, Texas Parks and Wildlife Department, and the Corps (STPNOC 2009a). The review team expects only minor impacts to railways and waterways from these activities.

4.4.4.2 Recreation

Building Units 3 and 4 is not expected to impact the Audubon Christmas Bird Count or the Great Texas Coastal Birding Trail. Visitors to the FM 521 River Park may be impacted by the increased traffic on FM 521 during shift change; however, it is unlikely that a majority of visitors would be there the same time as shift change. This park has a boat landing, trails, and picnic areas. Air and noise pollutants would be limited to the STP site (STPNOC 2009a). Because the impacts of building would be localized and isolated from major population centers and recreation areas, the review team concludes impacts to recreation resources would be minimal.

4.4.4.3 Housing

The assumptions behind the review team's estimated in-migration of workers were established in Section 4.4.2 of this chapter. If the entire workforce that is required to build proposed Units 3 and 4 originated within a reasonable commuting distance of the STP site, there would be no impact on housing demand. STPNOC noted that housing choice decisions would be influenced by workers' expected length of time at the work site; whether they are accompanied by household members; the cost, availability, and condition of local housing; and the distance from the family home. Additional factors such as the capacity and quality of local schools and the cost of vehicle fuel could influence a worker family's decision regarding accompanying the worker to the socioeconomic impact region, in turn influencing the type of housing selected (STPNOC 2008b). However, the review team expects that approximately 3708 workers would migrate into the region. Table 2-28 provides information on housing stock in Brazoria, Matagorda, Calhoun, and Jackson Counties.

The review team's assumptions in Section 4.4.2 indicate the workforce would require approximately 831 housing units in Brazoria County, 2251 in Matagorda County, 59 in Calhoun County, and 48 in Jackson County. Based on statistics from the 2000 U.S. Census of Population and Housing, all of the counties will most likely have available housing units and could absorb the influx of workers. For example, Brazoria County had 8674 vacant units in 2000; Matagorda County had 4710, Calhoun County had 2796, while Jackson County had 1209 vacant units (Section 2.5.2.5). Some construction workers would choose to rent a room in a local hotel or motel while others relocating might bring campers or mobile homes for the duration of their employment.

Temporary RV parks would likely provide housing to a number of construction workers during the building of proposed Units 3 and 4. Matagorda County, Bay City, and Palacios currently do not have a land use or zoning plan (STPNOC 2009a). Local officials stated additional housing units (both houses and apartments) could be constructed in Matagorda County for development of the new units (Scott and Niemeyer 2008). The increased demand for housing may increase the price of rental units. The higher prices and increased demand for housing could lead to an increase in the rate of new home and temporary housing construction. By the time the peak workforce arrives, market forces would have helped alleviate the housing/rental prices. STPNOC would maintain communication with local and regional government organizations to provide information to decision makers (STPNOC 2009a). The review team concludes that while minor housing impacts would occur in Brazoria, Calhoun, and Jackson Counties, more noticeable impacts would occur in Matagorda County.

4.4.4.4 Public Services

This section describes the public services available and discusses the impacts of building at the STP site on water supply and waste treatment, police, fire and medical services, education, and social services in the region. The review team recognizes that there is a lag between building-related impacts and the realization of taxes. Therefore the assessments below represent the review team's estimates of impacts without mitigation.

Water Supply Facilities

A detailed description of building-related water requirements and their impacts is presented in Section 4.2. Because STPNOC does not use water from the municipal water system, water usage by the workforce, while onsite, would not impact municipal water suppliers. As stated in Section 2.5.2.6, the STP site consumed 422 million gallons of water in 2005 from five onsite groundwater wells. Approximately five percent of this water was used for sanitary and drinking uses. From 2001 through 2006 STPNOC used approximately 1.1 million gallons per day (MGD) on average for all purposes pertaining to STP Units 1 and 2. The STP site is permitted to withdraw 3000 ac-ft per year (an average of 2.7 MGD) (STPNOC 2009a). STPNOC estimated the total daily groundwater usage at the STP site during building to be approximately 1.7 MGD (includes construction worker personal use and development-related use). During peak development, water usage by STPNOC could exceed its annual permitted amount. STPNOC could implement mitigative measures such as water conservation strategies and optimize the scheduling of water intensive operations (STPNOC 2009a). However, the review team determined, through its analysis, that the building-related impact to the STP site groundwater use likely would be minor during peak development (Section 4.2).

Currently, municipal water suppliers in the socioeconomic impact area have excess capacity (see Table 2-29). The impact to the local water supply systems from building-related population growth can be estimated by calculating the amount of water that would be required by the total population increase. According to a 2003 EPA report on potable water usage, the average person in the United States uses about 90 gpd (EPA 2003). For an assumed building-related population increase of 10,338 people, the estimated water usage increase would be 930,458 gpd. As discussed in Section 2.5.2.6, excess capacity exists that, under the review team's assumptions would result in impacts on water supplies that would not be significant, and additional mitigation would not be warranted.

Wastewater Treatment Facilities

Currently, municipal wastewater treatment facilities in the region have excess capacity (see Table 2-30). The impact to the local waste water treatment systems from building-related population growth can be estimated by calculating the amount of additional volume of waste water that would be required by the total population increase. If the potable water usage about 90 gpd (EPA 2003) were all converted into waste water and then treated for an assumed building-related population increase of 10,445 people, the estimated water treatment increase would be 940,050 gpd. As discussed in Section 2.5.2.6, excess capacity currently exists in the wastewater treatment systems in the economic impact area. Even if all of the 940,050 gpd additional demand for treatment were required just in Matagorda County, the wastewater systems have sufficient excess capacity (2.6 MGD) to accommodate the growth with room to spare. As discussed in Section 2.5.2.6, excess capacity exists that, under the review team's assumptions would result in impacts on wastewater treatment that would not be significant.

Police, Fire, and Medical Facilities

A temporary increase in population from the construction workforce for a new nuclear facility can increase the burdens on local fire and police departments, but this increase is transitory in nature. Once the project has been completed, many of the construction workers would leave the area, relieving those burdens. During building, the temporary increase in demand for community resources could be lower for several reasons. First, larger communities would have an easier time assimilating the influx of new people because the additional new population comprises a smaller percentage of the communities' base populations. Second, the more communities that host new workers, the less pressure each individual community would experience on its infrastructure. Consequently, any incentives STPNOC can provide its employees to move into the area in a planned manner would mitigate (but not remove) this short-term demand. Third, communities can avoid the long-term commitment to the maintenance and operation of infrastructure purchases to fulfill short-term demand increases. Instead of purchasing new fire or police equipment, affected communities could lease vehicles or building space. Additional tax revenues from the influx of construction workers would help offset the cost to expand local police and fire departments.

The 2007 citizen to police officer ratios for Brazoria, Matagorda, Calhoun and Jackson counties were 643:1, 420:1, 476:1 and 561:1, respectively. Matagorda has a larger police force relative to its population. According to local officials the police protection is adequate in the area at this time (STPNOC 2009a). Assuming these same staffing levels, the assumed population increases in Brazoria (2316), Matagorda County (6275), Calhoun County (165), and Jackson County (134) would increase the citizen to police officer ratio to 648:1 (a 1 percent increase) in Brazoria County, 491:1 (a 15 percent increase) in Matagorda County, 480:1 (a 1 percent increase) in Calhoun County and 567:1 (a 1 percent increase) in Jackson County.

The 2007, citizen to firefighter ratios for Brazoria, Matagorda, Calhoun and Jackson counties were 539:1, 228:1, 208:1 and 206:1, respectively and increase to 544:1, 267:1, 209:1 and 208:1, respectively. The increase is a less than one percent increase in Brazoria, Calhoun and Jackson counties but a 15 percent increase in Matagorda County.

Therefore, the review team concludes that the potential impacts of building activities on police and fire services in Brazoria, Calhoun and Jackson counties would be minor, but more noticeable in Matagorda County and additional mitigation may be warranted. STPNOC could mitigate impacts in Matagorda County by communicating with local government officials so that any additional police or fire service expansions are coordinated in a timely manner.

The region is well supplied with hospitals and medical services with four hospitals in Brazoria County and one hospital in each of the other three counties. A new regional hospital opened in Matagorda County in 2009 with 40 departments and 58 beds. STPNOC expects minor injuries incurred during development of proposed Units 3 and 4 to injuries to be treated onsite. More serious injuries would be treated at one of the hospitals in the region or in Houston. According to Table 2-33, there are 375 staffed beds in the four counties with an average daily census of 152. An in-migrating population of 10,338 is a 2.9 percent increase over the 2007 total population for the four counties. A 2.9 percent increase in the average daily census would bring the number to 156, well below the total number of staffed hospital beds in the four counties. Therefore, the review team expects the adverse impacts on medical services near the proposed site would be minimal.

Social Services

Social services in the four county regions are provided by State and local governmental and non-governmental organizations. The Texas Health and Human Services Commission oversees the Department of Aging and Disability Services, the Department of Assistive and Rehabilitative Services, the Department of Family and Protective Services, and the Department of State Health Services, which, collectively, provide the following services: Medicaid, Children's Health Insurance Program, Temporary Assistance for Needy Families, Food Stamps and Nutritional Programs, Family Violence Services, Refugee Services, and Disaster, Assistance (STPNOC 2009a). In addition to government-provided services, there are a number of private, philanthropic, and religious organizations that provide a wide variety of social services within the 50 mi radius of the STP site. For example, Table 2-35 shows the list of United Way agencies in Matagorda County, together with their client bases and their funding.

High wage in-migrating workers will not require economic assistance. Current residents who currently require economic assistance may be hired by STPNOC contractors. Therefore, development of proposed Units 3 and 4 is unlikely to increase the burden on the providers of economic assistance although other social services may see increased in case load, e.g., developmental assistance for children may increase due to population increases. While the counterbalancing effects of new jobs and new families cannot be fully quantified, the review team believes the overall impact of building activities on social services would be minor.

4.4.4.5 Education

The review team expects a net project-related increase of about 2490 school-age children distributed throughout the region. Based on the review team's assumptions concerning the geographic distribution of in-migrating population, 558 children would reside in Brazoria County, 1512 in Matagorda County, 40 in Calhoun County, and 32 in Jackson County. The remaining in-migrating school-age children would be distributed throughout the remaining counties in the region but in such small number that they are not considered in this analysis.

The student populations of public schools of Brazoria, Matagorda, Calhoun, and Jackson Counties are 54,578, 7686, 4326 and 3119 respectively, while the private school populations are 1429, 133, 67, and 0, respectively (see Section 2.5.2.7). In-migrating students would increase the student population by about one percent in Brazoria, Calhoun and Jackson counties. Matagorda County's student population would increase by 20 percent. It is expected that most of these students would enroll into Bay City ISD. According to Bay City school officials, facilities are adequate. They have a new high school but they may need a couple of portable buildings to accommodate the influx of students (Scott and Niemeyer 2008). Other Matagorda County ISD school officials stated they had excess capacity to handle an influx of students. The review team determined that the impacts on Brazoria, Calhoun, and Jackson County school districts would be minimal. The impacts on Matagorda County school districts would be more significant.

4.4.4.6 Summary of Community Service and Infrastructure Impacts

Based on the information provided by STPNOC, interviews with local planners and officials, and the review team's independent review, the review team concludes that the offsite impacts in the vicinity of the site from building Units 3 and 4 on transportation would be MODERATE and adverse during the peak employment period; however, mitigating activities such as those identified by STPNOC could reduce these impacts to SMALL and adverse when implemented. Because the impacts of building would be localized and isolated from major population centers and recreation areas, the review team concludes impacts to recreation resources would be SMALL and adverse. Based on the information provided by STPNOC, interviews with local real estate agents and city and county planners, and the review team's independent review, the review team expects the housing-related and education impacts of building of Units 3 and 4 would be SMALL and adverse in Brazoria, Calhoun, and Jackson Counties and MODERATE and adverse in Matagorda County. Excess capacity exists in public potable water and wastewater systems throughout the region and the review team determined that impacts to these systems would be SMALL and adverse, and mitigation would not be warranted. The review team concludes that the potential project-related impacts of building activities on police and fire services in Brazoria, Calhoun and Jackson counties would be SMALL and adverse, but would be MODERATE and adverse in Matagorda County and additional mitigation may be warranted. The review team expects adverse impacts on medical and social services near the STP site would be SMALL and mitigation would not be warranted. The review team concludes in aggregate, Matagorda County would experience MODERATE and adverse public service and infrastructure impacts from the project. Impacts in the wider region would be SMALL and adverse. Finally, the review team determined the economic impacts of building Units 3 and 4, including tax impacts, would be SMALL and beneficial throughout the region, except for Matagorda County which would experience a MODERATE beneficial impact from property taxes and the Palacios ISD which could do so.

4.4.5 Summary of Socioeconomic Impacts

The review team has assessed the activities related to building the proposed Units 3 and 4 and their potential socioeconomic impacts in the vicinity and region. Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the physical impacts of building activities would be SMALL and no further mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities, the NRC staff concludes that the physical impacts of NRC-authorized construction activities would be SMALL, and no mitigation beyond the applicant's commitments would be warranted.

Social impacts span issues of demographics, economy, taxes, infrastructure, and community services. Based on the information provided by STPNOC, review team interviews with city and county planners, social service providers, and school district officials, the review team concludes that the overall impacts of building activities on the economy in the socioeconomic impact area would be beneficial and SMALL with the exception of a MODERATE beneficial impact in Matagorda County and for the Palacios school district. The effect on tax revenues would also be beneficial and MODERATE in Matagorda County and SMALL beneficial elsewhere. The regional demographic, transportation, housing, police and fire services, and education impacts attributed to building would be SMALL for Brazoria, Calhoun, and Jackson Counties but MODERATE for Matagorda County. The regional aesthetics and recreation, water and wastewater systems, medical systems, and social services impacts attributed to building would be SMALL for all four counties.

The NRC-authorized construction activities represent only a part of the analyzed activities. The NRC staff concludes that the economic- and tax-related impacts of NRC-authorized construction of Units 3 and 4 would be MODERATE and beneficial in Matagorda County. The regional demographic, transportation, housing, police and fire services, and education impacts attributed to building would be SMALL for Brazoria, Calhoun, and Jackson Counties but MODERATE for Matagorda County. The regional aesthetics and recreation, water and wastewater systems, medical systems, and social services impacts attributed to building would be SMALL for all four counties.

4.5 Environmental Justice Impacts

4.5.1 Analytical Considerations

The review team evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.6 could be disproportionately affected by the potential impacts of building STP 3 and 4 at the proposed site. To perform this assessment, the review team: (1) identified all potentially significant pathways for human health, environmental, physical, and socioeconomic effects, (2) determined the impact of each pathway for populations within the identified census blocks, and (3) determined whether or not the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionate impact on minority or low-income people within each census block. The same consideration was given to other minority and low-income populations not identified with particular census block groups. To perform this assessment, the review team followed the methodology described in Section 2.6.1. In the context of construction and pre-construction activities at the STPNOC site, the review team considered the questions outlined in Section 2.6.1. As discussed in Section 2.6.3, the review team did not find any evidence of unique characteristics or practices in the region.

4.5.2 Health Impacts

For all three health-related considerations, the review team determined through literature searches and consultations with NRC staff health physics experts that the expected building-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and therefore cannot impose a disproportionately high and adverse radiological health effect on minority or low-income populations

Section 4.9 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 to the construction workers for the proposed Units 3 and 4 would be SMALL. Therefore, there would be no disproportionately high and adverse impact on low-income or minority construction workers. From the review team's investigation, no offsite project-related potential pathways to adverse health impacts were found to occur in excess of the safe levels stipulated by general health and safety standards Therefore, the review team concludes that the potential for negative impacts from radiological sources would not cause health-related disproportionate and adverse impacts on offsite minority and low-income populations.

As described in Section 4.5.1, the potential environmental and physical effects of pre-construction and construction are generally confined within the boundaries leading to no offsite health impacts on any population group from those effects. Where there are potential offsite non-radiological health effects, the review team did not identify any studies, reports, or anecdotal evidence that would indicate any environmental pathway that would physiologically impact minority or low-income populations differently from other segments of the general population during pre-construction and construction. Moreover, the review team's regional outreach provided no indication of any unique characteristics or practices among minority or low-income populations in the 50-mile region that could lead to disproportionately high and adverse nonradiological health impacts. No impacts would be expected on the migrant farm worker populations identified in Section 2.6.4, even if they were employed near the STP site.

Any increase in traffic accidents due to heavier traffic is unlikely to have a disproportionate impact on any particular population subgroup in the 50-mile region or Matagorda County. The roads nearest the plant will be more crowded and can expect more traffic accidents, but these increases are likely to be located on the principal commuting routes, which are not located in communities with disproportionately large minority or low-income populations. There is no information to suggest that nearby minority or low-income communities would be disproportionately vulnerable to hazards while on the road. Furthermore, in examining communities of minority or low-income people, the review team did not identify any such community that would be affected disproportionately by nonradiological health items. Therefore, non-radiological health effects would not have a disproportionate impact on minority or low-income populations.

4.5.3 Physical and Environmental Impacts

Building a nuclear power plant is very similar in environmental effects to building any large-scale industrial project. For the three environmental and physical considerations the review team determined that the physical impacts from onsite construction and preconstruction activities at the proposed STP Units 3 and 4 would attenuate rapidly with distance. In addition, the review team did not find any evidence of unique characteristics or practices among any minority or low-income populations of interest and expect no disproportionately high and adverse physical or environmental impact would be felt by any minority or low-income population. The following four subsections discuss each of the four primary physical-environmental pathways in greater detail.

4.5.3.1 Soil

Building activities at the STP site represent the largest source of soil-related environmental impacts. However, these impacts would be localized to the site, are sufficiently distant from surrounding populations and have little migratory ability, resulting in no noticeable offsite impacts. As discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority or low-income populations that may result in different soil-related impacts as compared to the general population. The review team concludes soil-related environmental impacts during the development of proposed Units 3 and 4 would have no disproportionate and adverse impacts on any minority or low-income populations within the socioeconomic impact area.

4.5.3.2 Water

Contaminants, including sediments, are not expected to reach the Lower Colorado River in significant amounts because all construction and preconstruction activities would be carried out using BMPs (STPNOC 2009a). As discussed in Section 2.6.2, the review team did identify a river-front community near the Lower Colorado River that may be low-income and may be engaged in subsistence fishing. However, with no contaminants reaching the river, there is no environmental pathway through which aquatic organisms could cause different water-related impacts as compared to the general population. As described in Section 4.2, the review team expects project-related impacts on surface water to be minimal because no use of surface water is proposed and because there would be minimal water quality effects. The review team expects all effects on groundwater to be minimal because all 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 to water sources would be small; and, consequently, there are no disproportionate and adverse water-related impacts on minority and low-income populations to consider.

4.5.3.3 Air

Air emissions are expected from increased vehicle traffic, construction equipment, and fugitive dust from project activities. Emissions from vehicles and construction equipment are unavoidable, but would be localized and minor, and not disproportionately located in the vicinity of identified minority and low-income populations. As discussed in Section 2.6.3, 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 as compared to the general population (STPNOC 2009a; Scott and Niemeyer 2008). Emissions from fugitive dust would be localized within site boundaries, and dust control measures would be implemented to maintain compliance with national ambient air quality standards.

Therefore, the review team determined the negative environmental effects from building-related reductions in air quality would be minor, localized, and short-lived for any population in the vicinity. Consequently, the review team found no disproportionate and adverse impacts on minority and low-income populations because of changes in air quality.

4.5.3.4 Noise

Noise levels during building activities may be as high as 113 dBA within the site, but noise levels attenuate quickly with distance. Because the loudest noise would register approximately 65 dBA at the STP site EAB, which is greater than 1000 ft in all directions from the proposed Units 3 and 4 footprint, the review team determined impacts from the noise of project activities would not lead to offsite noise impacts. In addition, as discussed in Section 2.6.3, 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 noise-related impacts as compared to the general population so there would be no disproportionate and adverse impacts on minority and low-income populations.

4.5.3.5 Summary of Physical and Environmental Impacts

Based on information provided by STPNOC and the review team’s independent review, the review team found no pathways from soil, water, air, and noise that would lead to disproportionate and adverse impacts on minority or low-income populations and, therefore, there would be no physical or environmental impacts on minorities and low-income populations.

4.5.4 Socioeconomic Impacts

Socioeconomic impacts in Section 4.4 were reviewed to evaluate if there would be any project-related activities that could have a disproportionate and adverse effect on minority or low-income populations. That review showed that the likeliest impacts would be from traffic, housing, and education. While there likely would be adverse impacts on traffic in the vicinity of the plant, these impacts are expected to diminish rapidly with distance from the plant. Therefore, given the relatively large distances between the site and the nearest populations of interest, the review team determined that there were no socioeconomic pathways that would reach any minority or low-income communities, and that further investigation for unique characteristics and practices was not warranted.

For the routes closest to the STPNOC site, the review team did not identify any populations of interest or communities with unique characteristics that could potentially result in different traffic impacts as compared to the general population. As discussed in Section 4.4.4.3, the cost of rental housing in Matagorda, Jackson, and Calhoun Counties might escalate due to in-migrating workers bidding up the price of rent, and that the price increase could lead to a short-term MODERATE impact on the general population. However, the review team determined the distribution of low-income and minority populations of interest in Matagorda County indicates any potential adverse impact of rental price increases likely would not occur disproportionately in areas with populations of interest or in communities with unique characteristics. Therefore, given the short-term nature of any potential price increases the review team determined there would not be disproportionately high and adverse impacts on any minority or low-income population or community with unique characteristics from a short-term increase in rental prices..

If large numbers of construction workers' children caused the public schools of Matagorda, Jackson, and Calhoun Counties to become more crowded, the review team expects that the general population within each county would be affected. However, the review team found no evidence of any unique characteristic or practice that would result in any minority or low-income population to be disproportionately affected by such crowding and, therefore, concludes there would be no disproportionate and adverse impacts on minority or low-income populations because of changes in socioeconomic conditions.

4.5.5 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, such as Native American settlements.

4.5.5.1 Subsistence

STPNOC interviewed community leaders of the minority populations within the analytical area in regards to subsistence practices (STPNOC 2009a). The review team also interviewed local, State, and county officials, business leaders, and key members of minority communities within the four county socioeconomic impact area for information on subsistence practices by minority and low-income communities impacted by development of proposed Units 3 and 4. No subsistence practices such as subsistence agriculture, hunting, or fishing were found. However, the riverfront community identified by the review team on the Lower Colorado River downstream from the plant (as discussed in Section 2.6.2) may be a low income community that may be engaged in subsistence fishing. However, the discussion of aquatic resources in Section 4.3.2 did not indicate that there would be any noticeable adverse impact on aquatic resources from construction and pre-construction activities, and no pathways were identified from construction and preconstruction activities that could affect these potential subsistence uses. Many individuals in the Vietnamese community in Palacios are shrimpers; however, most of their catch is sold for profit not for subsistence living. In addition, although building STP Units 3 and 4 could result in temporary minor habitat loss for shrimp, Section 4.3.2 notes that the impact of NRC-authorized construction activities on aquatic resources would be minimal. Consequently, the review team found no disproportionate and adverse impacts on minority and low-income populations because of subsistence activity.

4.5.5.2 High-Density Communities

Based on the analysis in Section 2.6, the minority and low-income populations are scattered throughout the four-county economic impact area and at greater distances throughout the 50-mi region surrounding the STP site. Of particular interest are the Vietnamese and Hispanic populations to the immediate southwest of the STP site, in communities centered on Palacios. However, no published information was identified that suggests that these communities or any other nearby minority populations have unique characteristics or practices that would make them exceptionally vulnerable to environmental emissions from building; nor was there any indication in review team discussions with social service providers and leaders in these communities that the communities were in vulnerable locations or that there were any pre-existing health conditions or cultural practices that would make them vulnerable to environmental emissions from STP Unit 3 and 4 development (STPNOC 2009a; Scott and Niemeyer 2008).

There are no Native American communities within the socioeconomic impact area. In analyzing the various environmental pathways related to proposed Units 3 and 4 development that could affect human populations, the review team notes there are no sources of water or air emissions that are expected to reach as far as the Palacios Asian and Hispanic communities, much less populations at greater distance. Noise, dust, and similar physical impacts are not expected to be noticeable outside the of the STP site.

Based on information provided by STPNOC and the review team's independent review, including visits to the region and interviews with local officials, the review team found no impact pathways from subsistence practices or to high-density communities or any evidence of unique characteristics or practices in the minority and low income populations that may result in different impacts compared to the general population (STPNOC 2009a; Scott and Niemeyer 2008). Consequently, the review team found no disproportionate and adverse impacts on minority and low-income populations because of affects on high-density communities.

4.5.6 Summary of Environmental Justice Impacts

Based on the information provided by STPNOC and the review team's independent review, the review team concludes that there are no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations. Therefore, the environmental justice impacts from construction and preconstruction activities would be SMALL and no additional mitigation would be warranted beyond that which the applicant has outlined in its ER. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities, the NRC staff concludes that the environmental justice impacts of NRC-authorized construction activities would be SMALL.

4.6 Historic and Cultural Resources

NEPA requires that Federal agencies 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), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8(c), "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the NHPA in fulfilling its responsibilities under NEPA.

Construction and preconstruction of new nuclear power plants can affect either known or undiscovered cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and the Corps are required to make a reasonable and good faith effort to identify historic properties in the area of potential effect and, if such properties are present, determine whether or not significant impacts are likely to occur. Identification of historic properties is to occur in consultation with the State Historic Preservation Officer (SHPO), Native American tribes, interested parties, and the public. If significant impacts are possible, then efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no important resources (i.e., places eligible for listing on the National Register of Historic Places or meeting the NEPA definition of important) are present or affected, the NRC and the Corps are still required to notify the SHPO before proceeding. If historic properties are present, then the NRC and the Corps are required to assess and resolve adverse effects of the undertaking.

For a description of the historic and cultural information on the STP site, see Section 2.7. In 2007, the applicant conducted a reconnaissance-level cultural resources assessment of the STP site. It reviewed existing information for the STP site and the area within a 10-mi diameter. The applicant concluded that any sites that may have existed onsite would no longer retain their integrity because the area was heavily disturbed (STPNOC 2009a). In December 2006, STPNOC reported these findings to the Texas Historical Commission (THC); concurrence that there would be no impacts to historic properties was received from the State in January 2007 (STPNOC 2006). Therefore, no further cultural resource investigations were required by the State. During the site visit in February 2008, the NRC staff reviewed the documentation used by the applicant to prepare the cultural resource section of the ER.

The review team did not identify any cultural resources that would be affected because resources that may have existed prior to the construction of STP Units 1 and 2 would have been destroyed during land clearing and construction activities. Further, no historic buildings were identified that could be affected by the visual impacts of the proposed units. The only locations with viewpoints of the facility are located on FM 521 and the Colorado River and there are no historic properties associated with these locations.

STPNOC has agreed to follow procedures if historic or cultural resources are discovered during ground-disturbing activities associated with building proposed Units 3 and 4. These procedures are detailed in STPNOC's Addendum #5 to procedure No. OPGP03-ZO-0025 Rev. 12 (Unanticipated Discovery of Cultural Resources) (STPNOC 2008e); the procedure includes notification of the THC.

For the purposes of NHPA 106 consultation, based on (1) the measures that STPNOC would take to avoid adverse impacts to significant cultural resources during construction and preconstruction activities, (2) the review team's cultural resource analysis and consultation, (3) the STPNOC commitment to follow its procedures should ground-disturbing activities discover cultural or historic resources, and (4) STPNOC consultation with the THC that concluded a finding of no impacts to historic properties (STPNOC 2006), the review team concludes a finding of no historic properties affected (36 CFR Section 800.4(d)(1)).

For the purposes of the review team's NEPA analysis, based on (1) the measures that STPNOC would take to avoid adverse impacts to significant cultural resources during construction and preconstruction activities, (2) the review team's cultural resource analysis and consultation, and (3) the STPNOC commitment to follow its procedures should ground-disturbing activities discover historic or cultural resources, the review team concludes that the potential impacts on historic and cultural resources during construction and preconstruction would be SMALL. Mitigation may be warranted in the event of an unanticipated discovery; these measures would be determined by STPNOC in consultation with Texas SHPO. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities, the NRC staff concludes that the potential impacts on historic and cultural resources from NRC-authorized construction activities would be SMALL, and no mitigation, beyond the applicant's commitments, 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 STP site. The primary impacts of building two new units on local meteorology and air quality would be from dust from land-clearing and building activities, open burning, emissions from equipment and machinery, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

The STPNOC ER (STPNOC 2009a) describes the activities that would be conducted at the STP site in Section 3.9S.1 through 3.9S.5. Sections 3.9S.2.2 and 4.4.1.3 of the ER specifically address air quality impacts associated with land clearing and building activities. Air quality impacts directly associated with these activities are described in the next section (4.7.1); air quality impacts associated with transportation of construction workers are addressed in Section 4.7.2.

4.7.1 Construction and Preconstruction Activities

Development activities at the STPNOC site would result in temporary impacts on local air quality. Activities including earthmoving, concrete batch plant operation and vehicular traffic generate fugitive dust. In addition, emissions from these activities would contain carbon monoxide, oxides of nitrogen, and volatile organic compounds. As discussed in Section 2.9.2, Matagorda County is an attainment area for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.344). As a result, a conformity analysis for direct and indirect emissions is not required (40 CFR 93.153).

Prior to beginning construction and preconstruction activities, STPNOC stated that it would develop a "Construction Environmental Controls Plan" that implements Texas Council on Environmental Quality requirements. This plan would describe the management controls and measures that STPNOC intends to implement to minimize impacts of these activities on air quality. The plan would provide for site inspections and environmental inspection reports that document the results of the inspections (STPNOC 2009a). Current policies and procedures at the STP site address requirements of regulations and permits. These policies and procedures may need to be supplemented to address specific measures to mitigate air quality impacts of proposed Units 3 and 4.

The Construction Environmental Controls Plan would also identify specific mitigation measures to control fugitive dust and other emissions. Section 4.4.1.3 of the ER lists mitigation measures specifically related to dust control that could be used. These measures include:

- Limiting 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
- Revegetating road medians and slopes.

Finally, the plan would include control strategies to minimize daily emissions by phasing the project and performing construction vehicle maintenance.

Preoperational activities would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building two nuclear power plants at the STP site would be of the order of 70,000 metric tons, as compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2009). Appendix I provides the details of the review team estimate for a reference 1000 MW(e) nuclear power plant. Based on its assessment of the relatively small construction equipment carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including greenhouse gas 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 STPNOC and its commitment to conduct "[a]ll site preparation and construction activities…in accordance with federal, state, and local regulations," the review team concludes that the impacts from STP Unit 3 and 4 construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

4.7.2 Traffic

In the ER, STPNOC (2009a) estimates the maximum workforce for proposed Units 3 and 4 would be about 5950 workers and would exceed 5000 for about a 2-yr period. Many of these workers would be doing shift work. STPNOC estimates that about 70 percent of the workforce would be in the first (day) shift, 25 percent would be in the second (swing), and the remaining 5 percent would be in the third (graveyard) shift (STPNOC 2009a). The workforce needed to build Units 3 and 4, combined with the workforce needed for STP Units 1 and 2 (including during outage activities), would have a minimal impact on air quality from criteria pollutants.

The current primary access road to the STP site is a two-lane road that would be likely to experience a significant increase in traffic during shift changes that could lead to periods of congestion and decreased air quality. However, the overall impact caused by increased traffic volume and congestion would be localized and temporary.

STPNOC (2009a) has stated that a construction management traffic plan would be developed before building activities begin. Among other things, the traffic plan would specify separate plant entrances for the operations workforce for STP Units 1 and 2 and the construction workforce for proposed Units 3 and 4. The traffic plan would address traffic mitigation measures that would reduce the impact of increased traffic on air quality. Mitigation measures that are typically used to reduce traffic include encouraging car pools, establishing central parking and shuttling services to and from the site, and staggering shift changes for operating personnel, outage workers, and construction workers.

Construction workforce transportation would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and a typical workforce, the review team estimates that the total construction workforce CO_2 emission footprint for building two nuclear power plants at the STP site would be of the order of 300,000 metric tons; again this is compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2009). Appendix I provides the details of the review team estimate for a reference 1000 MW(e) nuclear power plant. Based on its assessment of the relatively small construction workforce carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction workforce transportation would not be noticeable and additional mitigation would not be warranted.

Based on STPNOC's commitment to develop a construction management traffic plan and the potential mitigation measures listed in the ER, the review team concludes that the impact on the local air quality (including the effects of greenhouse gas emissions) from the increase in vehicular traffic related to construction and preconstruction activities would be temporary and would not be noticeable because appropriate mitigation measures would be adopted.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions during STP site development activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of STP site development on air quality from emissions of criteria pollutants and CO_2 emissions are SMALL and that no further mitigation is 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 would also be SMALL; the NRC staff also concludes that no further mitigation, beyond the applicant's commitments, would be warranted.

4.8 Nonradiological Health Impacts

Nonradiological health impacts to the public and workers from construction- and preconstruction-related activities include exposure to dust and vehicle exhaust, occupational injuries, and noise, as well as the transport of materials and personnel to and from the site. The area around the proposed STP site is predominantly rural, characterized by farmland and occasional wooded tracts, with a population of approximately 6400 within 10 mi of the site (STPNOC 2009a). There are three offsite industrial facilities within a 10 mi radius of the site: Equistar Chemicals LP Matagorda Facility, Celanese Ltd. Bay City Plant, and Oxea Corp Bay City Plant. People who are vulnerable to nonradiological health impacts from construction- and preconstruction-related activities include: construction workers and personnel working at STP; people working or living in the vicinity or adjacent to the site; and transient populations in the vicinity (i.e., temporary employees, recreational visitors, tourists).

4.8.1 Public and Occupational Health

This section discusses the impacts of building the proposed Units 3 and 4 on public nonradiological health and the impacts from site preparation and development on worker nonradiological health. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the STP site.

4.8.1.1 Public Health

STPNOC stated in the ER that the physical impacts to the public from development activities at the STP site would include dust and vehicle exhaust as sources of air pollution during site preparation activities and, if the project is not completed, redress activities (STPNOC 2009a). Operational controls would be imposed to mitigate fugitive dust and vehicular emissions such as paving disturbed areas, water suppression, covering truck loads and debris stockpiles, reduced material handling, limiting vehicle speed, and visual inspection of emission control equipment would be instituted.

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order. STPNOC (2009a) stated that all equipment would be serviced regularly and operated in accordance with local, State, and Federal emission standards. Given the fugitive dust and exhaust emission control measures, it is anticipated that no discernible impact on the local air quality in the vicinity of the STP site would be realized.

There would be no general public access to the proposed plant site and as discussed in Section 2.10, the nearest residence is approximately 1.5 mi west-southwest of the STP site. Given the fugitive dust suppression and vehicle exhaust emission mitigation measures discussed above and the general public's distance away from the STP site, the review team expects that the impacts to nonradiological public health from construction and preconstruction activities would be negligible.

4.8.1.2 Construction Worker Health

U.S. Bureau of Labor Statistics reports take into account occupational injuries and illnesses as total recordable cases, which includes those cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The review team estimated the annual number of recordable cases based on U.S. and Texas total recordable case rates for the year 2007 (BLS 2008a, 2008b). The 2007 recordable incidence rates in utility construction (the number of injuries and illnesses per 100 full-time workers) for the U.S. and Texas were 5.4 and 3.5, respectively. STPNOC (2009a) reports that the average construction workforce for proposed Units 3 and 4 would be approximately 3300 workers during a 67-month period with a peak 12-month workforce of 5950 workers. Based on this assessment, an estimated 178 occupational illnesses or injuries could occur each year.

Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices, and procedures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with construction. The review team expects that STPNOC would fully adhere to NRC, OSHA, and State safety standards, practices and procedures during any activities related to site preparation/excavation or building the proposed facility.

Other nonradiological impacts to workers who are clearing land or building the facility discussed in this section include noise, fugitive dust, and gaseous emissions resulting from site preparation and development activities. Mitigation measures discussed in this section for the public, such as operational controls and practices, would also help limit exposure to workers. Onsite impacts to workers also would be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care and regular health and safety monitoring of personnel also could be undertaken.

4.8.1.3 Summary of Public and Construction Worker Health Impacts

Based on mitigation measures identified by STPNOC in its ER, adherence to permits and authorizations required by State and local agencies, and the review team's independent evaluation, the review team concludes that the nonradiological health impacts to the public and to workers would be minimal, and no further mitigation would be warranted.

4.8.2 Noise Impacts

Development of a nuclear power plant project is similar to other large industrial projects and it involves many noise-generating activities. Regulations governing noise from activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. The ER states that STPNOC does not currently monitor the STP site for noise (STPNOC 2009a). However, the effect of noises generated by operation of STP Units 1 and 2 is attenuated over the undeveloped land surrounding the plant. In addition, most of the existing plant equipment is located inside various plant buildings, which further dampens noises.

Activities associated with building the new units at the STPNOC site would have peak noise levels in the range of 100- to 110 dBA. Construction noise at 10 ft is listed as 110 dBA, and the pain threshold is 120 dBA. As illustrated in Table 2-41, noise strongly attenuates with distance. At a distance of 50 ft from the source the peak noise levels would generally decrease to the 80 to 95 dBA range. There are 10 residences within 5 mi of the STP site, with the closest residence about 1.5 mi away (STPNOC 2009a). At that distance, the noise from site preparation and development would be minimal.

Building activities at the STP site would be expected to take place 24 hours per day, 7 days per week. STPNOC would comply with all applicable Federal and State noise regulations. Furthermore, the ER (STPNOC 2009a) lists a number of measures that would be taken if found necessary to mitigate the potential adverse effects of construction noise. Mitigation measures include mandatory use of hearing protection, inspection and maintenance of construction equipment, restriction of noise-related activities to daylight hours, and restriction of delivery times to daylight hours.

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. As discussed above, it is unlikely that noise levels would be greater than 60 dBA at the nearest residence. More recently, the impacts of noise were considered in NUREG-0586, Supplement 1 (NRC 2002). 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, 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.

Based on the temporary nature of construction activities and the location and characteristics of the STPNOC site, including its large size and exclusion area, as well as the distance to the nearest residences, the review team concludes that the noise impacts from building proposed Units 3 and 4 would be minimal, and further mitigation would not be warranted.

4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the STP Site

This EIS assesses the impact of transporting workers and construction materials to and from the STP site from the perspective of three areas of impact: the socioeconomic impacts, the air quality impacts of dust and particulate matter emitted by vehicle traffic, and potential health impacts due to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 4.4.1.3, and air quality impacts are addressed in Section 4.7.2. The impacts evaluated in this section for two new nuclear generating units at the STP site are appropriate to characterize the alternative sites discussed in Section 9.3 of this environmental impact statement (EIS). Alternative sites evaluated in this EIS include the existing STP site (proposed), and alternative sites at Allens Creek, Red 2, and Trinity 2. There is no meaningful differentiation among the proposed and the alternative sites regarding the nonradiological environmental impacts from transporting construction materials and personnel to the STP site and alternative sites and are not discussed further in Chapter 9.

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the STP site. The assumptions made to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are discussed below. STPNOC estimated that building a new ABWR unit requires approximately 240,000 yd^3 of concrete; 13,000 tons of structural steel and rebar; 6,500,000 linear ft of cable; and 55,000 linear ft of piping (STPNOC 2009a). These quantities would be doubled to account for a two-unit plant. Additional information used to develop the nonradiological impact estimates is as follows:

- The review team assumed that shipment capacities are approximately 13 yd^3 of concrete, 11 tons of structural steel, and 3300 linear ft of piping and cable per shipment. It was assumed that these materials would be transported to the site over an estimated 69-month delivery schedule for site preparation, LWA, if needed, and COL activities outlined in the STPNOC ER (STPNOC 2009a).
- The peak monthly workforce during construction was used to calculate the nonradiological transportation impacts. The peak monthly workforce was obtained by adding the monthly

construction workforce and Unit 3 and 4 operations workforce requirements presented in the ER (STPNOC 2009a) and identifying the month with the maximum workforce. The result is that a maximum of 6850 workers would travel to and from the site on a daily basis during the construction period, including 5950 construction workers and 900 Units 3 and 4 operations workers. The operations workforce continues to rise gradually to a total of 959 workers combined for both new units while the construction workforce decreases in the months following the peak. The review team assumed that one-half of the workers, or 3425 persons, would be assigned to each unit. Assuming average vehicle occupancy of 1.14 persons per vehicle (DOT 2004), there would be about 3000 vehicles per day per unit. Each person was assumed by the review team to travel to and from the STP site 250 days per year.

- The review team assumed the average shipping distance for construction materials to be 50 mi one way based on the region of influence.
- The review team assumed the average commuting distance for construction workers to be 20 mi one way. This assumption is based on U.S. DOT data that estimates the typical commute is approximately 16 mi one way (DOT 2003).
- Accident, injury, and fatality rates for transporting building 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). Rates for the State of Texas were used for construction material shipments, which are typically conducted in heavy-combination trucks. The data provided in Saricks and Tompkins (1999) 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). However, a single source that provided all three rates to estimate the impacts from worker transportation to and from the site was not available. To develop representative commuter traffic impacts, a source was located that provided a Texas-specific fatality rate for all traffic for the years 2003 to 2007 (DOT 2009a). The average fatality rate for the 2003 to 2007 period in Texas was used as the base for estimating Texas-specific injury and accident rates and adjustment factors were developed using national-level traffic accident statistics in *National Transportation Statistics 2007* (DOT 2007). The 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 Texas-specific fatality rate to approximate the injury and accident rates for commuters in the State of Texas.
- The DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) 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 from Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). 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), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 percent 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, to account for the apparent under-reporting. These adjustments were applied to the construction materials, which are transported by heavy truck shipments similar to those evaluated by Saricks and Tompkins (1999) but not to commuter traffic accidents.

The estimated nonradiological impacts of transporting materials to the proposed STP site and of transporting construction workers to and from the site are illustrated in Table 4-4. The estimates would be doubled for building of two units at the STP site. Based on Table 4-4, the nonradiological impacts are dominated by transport of construction workers to and from the STP site. The estimated total annual construction fatalities related to building the facility represent about a 6.5 percent increase above the average 7.4 traffic fatalities per year that occurred in Matagorda County, Texas, from 2003 to 2007 (DOT 2009b). Increases for alternative sites were about 4.0 percent for the Trinity Site in Freestone County, 4.6 percent for the Allens Creek site in Austin County, and 4.8 percent for the Red 2 Site in Fannin County. These increases are small relative to the current traffic fatality risks in the areas surrounding the proposed STP site and alternative sites.

Table 4-4. Estimated Impacts of Transporting Workers and Materials to and from the STP Site for a Single ABWR

	Accidents per Year Per Unit	**Injuries per Year Per Unit**	**Fatalities per Year Per Unit**
Workers	$\mathbf{6.7 \times 10^{+1}}$	$\mathbf{3.1 \times 10^{+1}}$	$\mathbf{4.6 \times 10^{-1}}$
Materials			
Concrete	5.5×10^{-1}	3.3×10^{-1}	2.2×10^{-2}
Rebar, Structural Steel	3.5×10^{-2}	2.1×10^{-2}	1.4×10^{-3}
Cable	5.9×10^{-2}	3.6×10^{-2}	2.3×10^{-3}
Piping	5.0×10^{-4}	3.0×10^{-4}	2.0×10^{-5}
Total – Construction	$\mathbf{6.8 \times 10^{+1}}$	$\mathbf{3.1 \times 10^{+1}}$	$\mathbf{4.8 \times 10^{-1}}$

Based on the information provided by STPNOC, the review team’s independent evaluation, and considering the number of shipments of building materials and the number of workers that would be transported to the site, the review team concludes that the nonradiological health impacts from transporting building materials and personnel to the proposed STP site and alternative sites would be minimal, and no further mitigation would be warranted.

4.8.4 Summary of Nonradiological Health Impacts

As part of its evaluation on nonradiological health impacts, the review team considered the mitigation measures identified by STPNOC in its ER and relevant permits and authorizations required by State and local agencies for building Units 3 and 4. The team evaluated nonradiological impacts to public health and to construction workers from fugitive dust, occupational injuries, noise, and transport of materials and personnel to and from the proposed STP site. No significant impacts related to the nonradiological health of the public or workers were identified during the course of this review. Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that the nonradiological health impacts of construction and preconstruction activities associated with the proposed Units 3 and 4 would be SMALL, and no further mitigation would be warranted. Based on the above analysis, 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 no mitigation, beyond the applicant's commitments, would be warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radiological waste discharges, and exposure from gaseous radiological effluents from the existing STP Units 1 and 2 during the construction phase. For the purposes of this discussion, construction workers are assumed to be members of the public; therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D. STPNOC (STPNOC 2009a) noted that all major building activities are expected to occur outside the STP site protected area boundary for STP 1 and 2, but inside the EAB.

4.9.1 Direct Radiation Exposures

In its ER (STPNOC 2009a), STPNOC identified four sources of direct radiation exposure from the STP site: (1) the waste monitor tanks for STP Units 1 and 2 located south of the units; (2) the Onsite Staging Facility including Warehouse "D" and outside storage areas; (3) the Old Steam Generator Storage Facility; and (4) the proposed Long-Term Storage Facility. In addition, STP identified the proposed Unit 3 (including outdoor Condensate Storage Tank) as a source of direct radiation exposure to proposed Unit 4 construction workers. The NRC staff did not identify any additional sources of direct radiation during the site visit or during document reviews. However, the NRC staff did treat the thermoluminescent dosimeters (TLDs) data differently than STPNOC in estimating the dose to construction workers. The NRC staff's estimate of the direct radiation doses to construction workers are shown in Table 4-5 and calculation details are provided in Appendix G. The numbers in Table 4-5 are different from ER Table 4.5-9 (STPNOC 2009a). In 1986, prior to operation of STP Units 1 and 2, the background exposure rate was measured at the site boundary as 15.4 millirem per quarter (mR/quarter). However, some of the current protected area fence line direct radiation measurements by TLDs are lower than the 1986 site boundary measurements because the protected area was excavated and backfilled with sand and gravel that contained less naturally occurring radiological material than exists in the native clay found near the site boundary. Between 2002 and 2006, the exposure rate along the protected area fence averaged 12.5 mR/quarter; the NRC staff used this number as the background exposure rate for assessing dose rates from existing sources.

Table 4-5. Direct Radiation Doses to Unit 4 Construction Workers

Source	Dose Rate (mrem/yr) at Construction Location	Annual Dose to Worker (mrem)
STP 1 and 2	13.4	3.18
Old Steam Generator Storage Facility	4.5	1.07
Long-Term Storage Facility	1	0.24
Onsite Staging Facility	1	0.24
STP 3	23	5.5
Total for STP 1 and 2	19.9	4.72
Total for STP 1, 2 and 3	42.9	10.2

4.9.2 Radiation Exposures from Gaseous Effluents

Units 1 and 2 at the STP site release gaseous effluents via vents on the roofs of their mechanical auxiliary buildings. The sources of the effluent at STP Units 1 and 2 include containment purging, ventilation systems of the auxiliary building and the turbine building as well as the gaseous waste processing system. The gaseous emissions from proposed Unit 3 would come from the reactor building plant stack. The stack serves as a release point for the reactor building, turbine building and the radwaste building. A Unit 4 construction worker is more likely to receive a higher dose from gaseous effluents than a construction worker on Unit 3, because of the added contribution to dose from Unit 3 operations for approximately one year during completion of construction of Unit 4. Therefore, STPNOC calculated the dose to Unit 4 construction workers as a bounding estimate for construction worker on both Units 3 and 4. STPNOC estimated construction worker dose from STP Units 1 and 2 gaseous effluents using data from 2005 then doubled the result to account for variability in annual releases. The calculated total effective dose equivalent to a Unit 3 construction worker from gaseous effluents from STP Units 1 and 2 was 1.9 mrem. The calculated total effective dose equivalent to a Unit 4 construction worker from potential gaseous effluents from proposed Unit 3 would be 7.0 mrem, therefore the calculated total effective dose equivalent to a Unit 4 construction worker from gaseous effluents from Units 1, 2, and 3 would be about 9 mrem (STPNOC 2009a). The NRC staff reviewed STPNOC’s estimates and concluded that they are reasonable.

4.9.3 Radiation Exposures from Liquid Effluents

STPNOC estimated radiological doses to construction workers from liquid effluents to be small. Although construction workers are not expected to be exposed to water pathways at the construction site, STPNOC assumed that the construction workers receive the same dose as the maximally exposed individual for the water pathway. The pathways for liquid effluents from STP Units 1, 2, and 3 to reach humans are sport fish ingestion and exposure to contaminated shoreline, only. The contribution from the existing Units 1 and 2 was taken from the maximum water pathway dose from 2002 through 2006, as reported in the Radiological Effluent Release Reports. The 2004 water pathway dose was also doubled to account for uncertainty resulting in a dose of 0.032 mrem (STPNOC 2009a).

The liquid effluent dose from proposed Unit 3 to the maximally exposed individual due to sport fish ingestion and shoreline exposure was calculated as 0.00026 mrem. Again, although Unit 4 construction workers would likely not be exposed to those pathways at the construction site, STPNOC assumed that the construction workers received the same doses as the maximally exposed member of the public (STPNOC 2009a). The NRC staff reviewed STPNOC's estimates and concluded that they are reasonable.

4.9.4 Total Dose to Site-Preparation Workers

The NRC staff estimated the annual direct dose to a construction worker of about 10 mrem, assuming an occupancy of 2080 h/y. The maximum radiological dose to construction workers from gaseous and liquid pathways combined was about 9 mrem (1.9 + 7.0 + 0.032 + 0.00026 mrem). Therefore, the estimated annual dose to construction workers would be approximately 19 mrem based on a 2080 h/y occupancy, which is less than the 100 mrem annual dose limit to an individual member of the public found in 10 CFR 20.1301.

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during building of the proposed Units 3 and 4 are well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by STPNOC and the review team's independent evaluation, the NRC staff concludes that the radiological health impacts to construction workers for the proposed Units 3 and 4 would be SMALL, and no further mitigation would be warranted. Radiation exposure from all NRC-licensed activities including operation of South Texas Project Units 1 and 2 is regulated by the NRC. Therefore, 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 environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities for Units 3 and 4. Types of nonradioactive waste that would be generated, handled, and disposed of during building activities include construction debris, municipal waste, spoils, dust, stormwater runoff, sanitary waste, and air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following subsections.

4.10.1 Impacts to Land

Building activities related to the proposed Units 3 and 4 would require environmental compliance with documentation of waste removal for containers, packaging, and unused materials that are brought onto the STP site. STPNOC plans to provide sufficient trash receptacles and management for waste segregation for proper offsite disposal of these types of waste (STPNOC 2009a). Hazardous and nonhazardous solid wastes would be managed following county and State-specific handling and transportation regulations. Waste minimization activities and recycling of certain nonhazardous wastes would be used to further mitigate impacts of solid wastes (STPNOC 2009a).

Excavated materials would be stored onsite in borrow or spoil areas not to exceed 240 ac (STPNOC 2009a). Dredged materials not suitable for use as fill would be placed in a designated onsite spoils area as indicated in the current STPNOC dredge permit for the Colorado River (STPNOC 2009d).

Wastes generated when building proposed Units 3 and 4 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solids, and Corps permits for disposal of dredged spoils, would be obtained and implemented. The review team expects solid waste impacts would be minimal and additional mitigation would not be warranted.

Based on the effective practices for recycling and minimizing waste already in place for STP Units 1 and 2, and the plans to manage solid and liquid wastes in a similar manner in accordance with all applicable State and local requirements and standards, the review team expects that impacts to land from nonradioactive wastes generated during the building of Units 3 and 4 would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts to Water

Surface water runoff from development activities would be controlled under the development and implementation of a SWPPP. STPNOC plans to implement new detention ponds and drainage capacity to accommodate surface water runoff in areas disturbed by building activities (STPNOC 2009a). Water collected in this manner may then be discharged under a TPDES permit. Surface water quality during the development of Units 3 and 4 is discussed further in Section 4.2.3.1.

STPNOC currently has two wastewater treatment facilities that would be replaced to accommodate increased waste generation during project activities. Offsite, both Matagorda and Brazoria County wastewater treatment systems may have the capacity to meet the increased generation of wastewater by the project workforce. Brazoria County is likely to have a smaller increase in population due to the in-migrating labor force, and regional planning for water resources is currently underway. The population increase in Matagorda County is likely to be larger as more of the labor force is expected to reside in this county. County government would require close communication with STPNOC to prepare for and mitigate the increased demand on water resources and wastewater treatment facilities (STPNOC 2009a).

STPNOC would employ the SWPPP for surface water runoff and the TPDES-permitted outfall for effluents would comply with Clean Water Act and TCEQ water quality standards. Sanitary waste discharge would also be compliant with TPDES limitations.

Based on the regulated practices for managing liquid discharges, including wastewater, and the plans for managing stormwater, the review team expects that impacts to water from nonradioactive effluents when building Units 3 and 4 would be minimal and additional mitigation would not be warranted.

4.10.3 Impacts to Air

As discussed in Sections 4.4.1.1 and 4.7.1, fugitive dust generated by site development activities is to be managed: STPNOC plans to control fugitive dust through best management practices such as watering roads and employing covers over materials that are transported in open bed trucks (STPNOC 2009a). Equipment and heavy haul vehicles used for site preparation and development activities would result in air emissions and the increase in vehicle traffic from construction workers involved in building Units 3 and 4 would result in vehicle emissions. Mitigation of increased emissions through lowering maximum speed and inspection of emission control equipment for construction vehicles are measures that would be employed to reduce the emissions of gaseous waste (STPNOC 2009a).

Based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, best management practices for controlling fugitive dust, and vehicle inspection and traffic management plans, the review team expects that impacts to air from nonradioactive emissions while building Units 3 and 4 would be minimal, and no further mitigation would not be warranted.

4.10.4 Summary of Impacts

Solid, liquid, and gaseous wastes generated when building Units 3 and 4 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste, and Corps permits for disposal of dredged spoils, would be obtained and implemented. A revised SWPPP for surface water runoff, and TCEQ permits for permitted releases during the construction period would ensure compliance with the Clean Water Act and TCEQ water quality standards. Air emissions would be generated by vehicles and heavy equipment and site development activities would create fugitive dust when building Units 3 and 4. These air quality impacts would be managed through the use of traffic management plans, vehicle inspections, and best management practices. Based on information provided by STPNOC and the review team's independent evaluation, the review team concludes that nonradioactive waste impacts to land, water, and air 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.

Cumulative impacts to water and air from nonradioactive emissions and effluents at the STP site are discussed in Sections 7.2.2.1 and 7.5, respectively. For the purposes of Chapter 9 (alternatives), the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for the STP site and the alternative sites, and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

4.11 Measures and Controls to Limit Adverse Impacts During Construction Activities

In its evaluation of environmental impacts during building activities for the proposed Units 3 and 4, the review team relied on STPNOC'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 units (e.g., ACE Section 404 Permit and the National Pollutant Discharge Elimination System permit)
- Compliance with existing STP Units 1 and 2 processes and/or procedures applicable to the proposed Units 3 and 4 construction environmental compliance activities for the STP site,
- Incorporation of environmental requirements into construction contracts, and

- Identification of environmental resources and potential impacts during the development of the ER and the COL process.

The review team considered these measures and controls in its evaluation of the impacts of building Units 3 and 4. Table 4-6, which is the review team's adaptation from STPNOC's Table 7.6-1 (STPNOC 2009a) lists measures and controls proposed by STPNOC to limit adverse impacts during building of proposed Units 3 and 4 at the STP site.

4.12 Summary of Preconstruction and Construction Impacts

The impact levels determined by the review team in the previous sections are summarized in Table 4-7. The impact levels for NRC-authorized construction are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined construction and preconstruction activities are similarly noted. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level column.

Table 4-6. Summary of Measures and Controls Proposed by STPNOC to Limit Adverse Impacts During Construction of Proposed Units 3 and 4

Impact Categories	Planned Mitigation and Controls
Land-Use Impacts	
The Site and Vicinity	Conduct construction activities using BMPs in accordance with regulatory and permit requirements. Implement environmental controls required in the SWPPP (Stormwater Pollution Prevention Plan) such as weekly compliance inspections, documentation of runoff controls, etc.
	Clean up and dispose of waste debris from removal of vegetation within the temporary and permanent impact areas. Temporary impact areas would be graded, landscaped to match the surrounding area, and revegetated.
	Restrict stockpiling of soils from spoil mounds and borrow pit soils to designated areas. Stabilize all loose soils onsite through the use of approved erosion control methodologies and soil erosion and sediment control plan.
	Restrict construction to the designated areas within the STP site.
	Avoid wetlands. Use appropriate erosion control measures to prevent turbid water, soil deposition, vegetation removal, etc. from impacting drainage features, wetlands and downstream areas through the approved SWPPP.
	Avoid designated flood zone and other sensitive areas where possible.
	Stagger work shifts and truck delivery times to reduce the additional traffic during peak hours.
Transmission Corridors and Offsite Areas	Minimization of land-use impacts during 345-kV switchyard and transmission line rerouting through the use of existing access points and corridors. Limit construction activities associated with the new onsite switchyard and connecting transmission lines to those areas previously disturbed for construction activities associated with STP Units 1 and 2.

Table 4-6. (contd)

Impact	Planned Mitigation and Controls
Water-Related Impacts	
Hydrologic Alterations	New drainage ditches and other features such as sediment filters would be used to accommodate surface water runoff from altered drainage areas and the newly constructed impervious areas. Avoid all jurisdictional wetlands. Appropriate erosion control measures would be taken on all drainage features and wetlands to prevent turbid water, soil deposition, vegetation removal, etc. from occurring within those areas or downstream areas through the approved SWPPP.
	To decrease the volume of surface water runoff created during dewatering/excavating activities of the deeply excavated areas, a groundwater control system would be installed consisting of a slurry wall and perimeter circuit of deep wells in conjunction with sand drains. All other surface water runoff created during the excavation/dewatering activities would be controlled by a series of ditches that drain the water away from construction activities. Proper erosion controls would be used to contain sediments found in the runoff before it is discharged into any jurisdictional water.
	Local drinking water wells found in the vicinity of the construction area would be unaffected because they are located in the deeper aquifer which is isolated by surficial clays. Dewatering would occur within the shallow aquifer in a limited area for a short period of time. Upon completion of construction, groundwater in the shallow aquifer would return to natural elevations.
Water-Use Impacts	Limit dewatering activities to only those necessary for construction.
Water-Quality Impacts	Develop and implement a construction SWPPP and spill response plan.
	Adhere to applicable regulations and permit requirements found in the TPDES permit. Implement BMPs to prevent the movement of pollutants (including sediments) into wetlands and water bodies via stormwater runoff. BMPs would include the use of erosion control measures such as silt fences to prevent sedimentation and turbid water discharge. Use of vegetated land buffers between water bodies and the construction site would minimize sedimentation impacts.
Ecological Impacts	
Terrestrial Ecosystems	Limit vegetation removal to only those areas needed for construction. Restoration of the temporary impact areas would be completed in a timely manner upon completion of construction.

Table 4-6. (contd)

Impact	Planned Mitigation and Controls
	Effects of increased lighting on birds during construction may be minimized during construction by using downward pointing lighting, hooded lights, and lower wattage lights as appropriate.
	Animal displacement in adjacent habitats due to noise should be temporary in nature. Animals may return to undisturbed habitats upon completion of construction.
	Scheduling work during non-nesting periods would minimize impacts to nesting birds caused by noise/movement.
Aquatic Ecosystems	STPNOC would develop and implement erosion and sediment control plans that incorporate recognized BMPs such as covering all disturbed areas, keeping to a minimum the length of time disturbed soil is exposed to weather, and intercepting and retaining sediment via detention ponds and drainage ditches. Upon completion of construction along stream banks or drainage features, disturbed areas would be rip-rapped or seeded to establish a perennial vegetative cover to prevent erosion.
	STPNOC would divert excess surface water caused by construction activities into sediment settling ponds prior to release into on-site drainage features.
	Dewatering activities would be limited, and collected water would be released into areas that meet the SWPPP and TPDES permits.
	Drainage areas that would be affected by construction represent a small proportion of the drainage areas onsite. These types of habitat are not unique to the area.
Socioeconomic Impacts	
Physical Impacts	Construction workers would use hearing protection for noise. The public would be notified of impending site development activities that may exceed acceptable noise levels. All site development activities would be performed in compliance with local, State, and Federal regulations. Emergency first-aid care would be available at the site, and regular health and safety monitoring would be conducted during site development.
	Minimize the potential for dust emissions by using local, State, and Federal regulations. Prepare a dust control plan containing dust control measures such as watering, stabilization of disturbed areas, phased grading to minimize disturbance acreage, covering haul truck beds, etc. Emergency first-aid care would be available at the site, and regular health and safety monitoring would be conducted during site development.

Table 4-6. (contd)

Impact	Planned Mitigation and Controls
	Equipment would be serviced regularly to reduce exhaust emissions. Equipment would be operated in accordance with local, State, and Federal emission requirements. Site development activities would be phased to minimize peak hour degradation of local ambient air quality. Emergency first-aid care would be available at the site, and regular health and safety monitoring would be conducted during site development.
	STPNOC would alert local government agencies to pending road work and complete road repairs and improvements (i.e., patching cracks and potholes, adding turn lanes, reinforcing soft shoulders) in a timely manner to prevent road degradation in the vicinity.
Social and Economic Impacts	To mitigate traffic impacts, STPNOC could develop and implement a site development traffic management plan that would include such measures as turn lane installation where necessary, establishing a centralized parking area with shuttle service, encouraging carpools, and staggering shifts. Other mitigation methods to mitigate potential impacts include: (1) avoiding routes that could adversely affect sensitive areas (e.g., housing, hospitals, schools, retirement communities, businesses) to the extent possible, and (2) restricting activities and delivery times to daylight hours
	STPNOC would maintain communication with local government and planning officials so that ample time is given to plan for the impact of the site development-related population influx on housing. Mitigation efforts to potential housing shortages would be market-driven (provided by the normal reaction of housing construction to local demand and supply conditions) over time. Site development employment would increase gradually with a peak after 2 or 3 years. This would allow time for construction of new housing. Temporary housing could be constructed as needed.
	STPNOC would maintain communication with local government and planning officials so that ample time is given to plan for the impact of the site development-related population influx on local water and waste water treatment systems. Mitigation strategies could include reuse, seawater desalination, conservation, and the Lower Colorado River Authority/San Antonio Water System Project.
	STPNOC would maintain communication with local government officials so that expansions in police and fire services could be coordinated, planned, and funded in a timely manner. Funding for this expansion would be provided through the increased tax revenues from the development project.
	Short-term solutions to school crowding could be implemented in the form of adding modular classrooms and hiring additional teachers to existing schools. Funding for additional resources would be provided through the increased tax revenues from the site development project.

Table 4-6. (contd)

Impact	Planned Mitigation and Controls
Environmental Justice	Analysis of housing availability in Matagorda County determined that the probability of minority and low-income populations absorbing a disproportionate impact through increased rental rates and housing costs is low. Because of this, specific control efforts--for example, rent controls-- would not be necessary.
Historic and Cultural Properties	Take appropriate actions as required by site procedures following discovery of potential historic or archaeological resources.
Air Quality	Conduct site preparation activities "…in accordance with Federal, State and local regulation." Prepare a Construction Environmental Controls and Construction Management Traffic Plan.
Nonradiological Health Impacts	STPNOC would provide job training and implement procedures to ensure a safe working environment. Provide first-aid capabilities at the construction site.
Radiation Exposure to Construction Workers	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20).
Nonradioactive Waste	Wastes would be handled in accordance with county, State, and Federal regulations. SWPPP would be implemented to manage runoff and releases would conform with State-implemented water quality standards. Air emissions would be reduced by using traffic management plans, implementing BMPs, and using inspected and regularly maintained vehicles and construction machinery.

Source: STPNOC 2009a

Table 4-7. Summary of Construction and Preconstruction Impacts for Proposed Units 3 and 4

Category	Comments	NRC-authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land-Use Impacts			
Site	Some uplands would be permanently converted to new land use categories. Wetlands would be avoided. There would be some land use changes as a result of project activities but they would not be inconsistent with local zoning and land-use plans.	SMALL	SMALL
Transmission Lines and Offsite Areas	There would be no new transmission lines. Off site land-use changes would not be inconsistent with local zoning and land-use plans.	No impact	SMALL
Water-Related Impacts			
Water Use – Surface Water	No surface water use is proposed during construction.	No impact	No impact
Water Use – Groundwater	Because of the use of a slurry wall surrounding the excavation, dewatering should have no impact on groundwater elevation outside the construction zone. Any impact on the groundwater resource from producing water for construction would be of localized and temporary.	SMALL	SMALL
Water Quality – Surface Water	No surface water use is proposed during construction.	SMALL	SMALL
Water Quality – Groundwater	Construction would be conducted using BMP to control spills and stormwater runoff. Spills within the excavation would be effectively isolated by the slurry wall, and drawdown resulting from groundwater production has minimal potential to cause salt water encroachment.	SMALL	SMALL

Table 4-7. (contd)

Category	Comments	NRC-authorized Construction Category Level	Construction and Preconstruction Impact Category Levels
Ecological Impacts			
Terrestrial Ecosystems	Construction activities would have minimal impacts to terrestrial ecological resources and habitat in the vicinity of the STP site.	SMALL	SMALL
Aquatic Ecosystems	Construction activities would have minimal impact on aquatic ecological resources and habitat.	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	Physical impacts of building activities on workers, onsite and offsite buildings, and the general public would be minimal. Traffic control and management measures would protect any local roads during site development.	SMALL	SMALL
Demography	Percentage of construction workers relocating to the region likely would be SMALL relative to the existing population base except in Matagorda County, where the impact could be MODERATE.	SMALL to MODERATE	SMALL to MODERATE
Economic Impacts to Community	Impact of site development would be beneficial to local economies. In Matagorda County beneficial impacts would likely be MODERATE, while impacts elsewhere would be SMALL. Following site development, SMALL to MODERATE negative impacts would be incurred due to loss of jobs and income. For taxes, MODERATE and beneficial in Matagorda County, SMALL elsewhere.	SMALL to MODERATE (Beneficial)	SMALL to MODERATE (Beneficial)

Table 4-7. (contd)

Category	Comments	NRC-authorized Construction Category Level	Construction and Preconstruction Impact Category Levels
Infrastructure and Community Services	Public services are generally adequate in Matagorda County for any temporary influx of workers resulting from site development at the STP site. Some increases may be necessary in the number of fire and police personnel. Impact on education would be MODERATE in Matagorda County and SMALL in the region.	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice Impacts	There are no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations.	SMALL	SMALL
Historic and Cultural Resource Impacts	Based on STPNOC procedures and commitments to follow those procedures, should historical and cultural resources be discovered, the impacts would be SMALL.	SMALL	SMALL
Meteorology and Air Quality Impacts	Emissions of criteria pollutants would be temporary and limited and carbon footprint of construction workforce would not be noticeable.	SMALL	SMALL
Nonradiological Health Impacts	Emission controls and location of the STP site would keep nonradiological health impacts SMALL.	SMALL	SMALL
Radiological Health Impacts	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20).	SMALL	SMALL
Nonradioactive Waste	Impacts to water, land, and air from the generation of nonradioactive waste would be minimal.	SMALL	SMALL

4.13 References

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5.0 Operational Impacts at the Proposed Site

This chapter examines environmental issues associated with operation of the proposed Units 3 and 4 at the South Texas Project Electric Generating Station (STP) site for an initial 40-year period as described by the applicant, STP Nuclear Operating Company (STPNOC). As part of its application for combined construction permits and operating licenses (COLs), STPNOC submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (STPNOC 2009a). In its evaluation of operational impacts, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Army Corps of Engineers (Corps) staffs (hereafter known as the "review team") relied on operation details supplied by STPNOC in its ER, STPNOC's responses to NRC Requests for Additional Information (RAIs), and additional information.

This chapter is divided into 14 sections. Sections 5.1 through 5.12 discuss the potential operational impacts on land use, meteorology and air quality, water, terrestrial and aquatic ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, nonradioactive waste, postulated accidents, and applicable measures and controls 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, 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. 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, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.13. The references cited in this chapter are listed in Section 5.14.

5.1 Land-Use Impacts

This section contains information regarding land-use impacts associated with operation of proposed Units 3 and 4 at the STP site. Section 5.1.1 discusses land-use impacts at the site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts with respect to offsite transmission line corridors and other offsite areas.

Most of the STP site is located within the coastal management zone established by the Texas Coastal Management Program (STPNOC 2009a). As discussed in Section 2.2.1 of this Environmental Impact Statement (EIS), the Texas General Land Office determined in June 2008 that no unavoidable adverse impacts had been found for proposed Units 3 and 4 and that the project would be consistent with the goals and policies of the Texas Coastal Management Program (STPNOC 2009a).

5.1.1 The Site

Onsite land-use impacts from operation of proposed Units 3 and 4 are expected to be minimal because little additional land would be affected other than those lands disturbed during construction and preconstruction activities, which are discussed in Section 4.1. Some land would be used for worker parking and laydown areas during refueling outages. Such land would likely be disturbed while building Units 3 and 4. The anticipated salt drift from the two mechanical draft cooling towers used solely for the Ultimate Heat Sink (UHS) cooling system would occur primarily within the site boundary (discussed further in Section 5.7). The review team determined that there would be minimal impacts on vegetation and no significant land use changes would be expected. Therefore, based on the information provided by STPNOC and the NRC's own independent review, the review team concludes that the land-use impacts of operation at the STP site would be SMALL, and additional mitigation would not be warranted.

5.1.2 Transmission Lines and Offsite Areas

As discussed in Chapter 3, no new offsite transmission corridors or expansion of existing corridors are planned for Units 3 and 4. Consequently, no land-use impacts resulting from operation of transmission lines serving the new units are expected. Transmission line corridor management practices are discussed in Section 5.3.1.2.

Some offsite land-use changes can be expected because of operational activities. Possible changes include the conversion of some land in surrounding areas to housing developments (e.g., recreational vehicle parks, apartment buildings, single-family condominiums and homes, and/or manufactured home parks) and retail development to serve plant workers. Property tax revenue from the addition of two new units could also lead to additional growth and land conversions in Matagorda and Brazoria Counties because of infrastructure improvements (e.g., new roads and utility services). Additional information on operation-related infrastructure impacts is in Section 5.4.4. While the precise land-use impacts cannot be predicted, the review team determined that any land use changes would not be inconsistent with local zoning and land use plans.

Based on the information provided by STPNOC and the review team's own independent review, the review team concludes that the offsite land-use impacts of operating Units 3 and 4 would be SMALL, and additional mitigation would not be warranted.

5.2 Water-Related Impacts

This section discusses water-related impacts to the surrounding environment from operation of the proposed Units 3 and 4 at STP. Details of the operational modes and cooling water systems associated with operation of the proposed units can be found in Chapter 3.

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the site of the proposed new units, these objectives include navigation, recreation, visual aesthetics, a fishery, agriculture, and a variety of beneficial consumptive uses of water. The responsibility for any work in, over, or under navigable waters of the United States is delegated to the Corps. The Texas Commission on Environmental Quality (TCEQ) is responsible for protecting and restoring the quality of Texas' water, air, and land resources.

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, STPNOC must obtain the same water-related permits and certifications as other large industrial facility discharging to a water body. These permits and certifications include:

- Clean Water Act Section 401 Certification. This certification is issued by the TCEQ and would make sure that operation of the plant would not conflict with State water-quality management programs. The TCEQ issued a waiver for the 401 certification for the NRC's action (TCEQ 2010a).

- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge 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 State of Texas to the TCEQ, which issues the Texas Pollutant Discharge Elimination System (TPDES) permits.

- Clean Water Action Section 404 Permit. The Department of Army permit is required for the discharge of dredge and/or fill materials into waters of the United States, including wetlands.

- Rivers and Harbor Act Section 10 Permit. The Section 10 permit would be issued by the Corps for maintenance dredging of the barge slip. However, because the facility has a current Section 10 permit associated with existing STP Units 1 and 2, an additional permit would not be needed.

- Water Rights Permit. STPNOC holds a water rights permit from TCEQ (Registration No. 14-5437) to divert water from the Colorado River for make-up to the Main Cooling Reactor

(MCR). See Texas Administrative Code, Title 30, Part 1, Chapters 295 and 297 and Texas Water Code, Chapter 11.

- Groundwater Use Permit. STPNOC holds an operating permit (Permit No. OP-04122805) from the Coastal Plains Groundwater Conservation District (CPGCD), authorizing the use of groundwater (CPGCD 2008). STPNOC applies for an update of this permit every three years and it would be issued by the CPGCD authorizing continued use of groundwater during the operation of proposed Units 3 and 4. STPNOC would apply for a new permit to construct new wells within the currently permitted groundwater use limit. See Texas Water Code, Chapter 36.

- Multi-Sector Stormwater Permit. A general or individual permit may be required by TCEQ to regulate discharge of stormwater (see Texas Water Code, Chapter 26). In accordance with its general permit, STPNOC has an existing Stormwater Pollution Prevention Plan (SWPPP) (STPNOC 2009a; TCEQ 2001). According to STPNOC, the STP site existing SWPPP would be revised to include the proposed Units 3 and 4 (STPNOC 2009a).

5.2.1 Hydrological Alterations

Most of the hydrologic alterations would occur during construction and preconstruction activities. Affected water bodies include onsite sloughs, an existing drainage ditch, and site drainages that drain to the Colorado River. Section 4.2 describes the water-related impacts that may occur while building Units 3 and 4; this section addresses impacts that may occur during operation of the two proposed units.

Make-up water needed for cooling the proposed new reactors under normal operational mode would be supplied from the Colorado River using the Reservoir Makeup Pumping Facility (RMPF). Additional pumps would be installed in the RMPF for this purpose. A new intake structure and a new discharge structure would be constructed within the MCR as part of the Circulating Water System (CWS) for Units 3 and 4. To support the operation of Units 3 and 4, the MCR normal maximum water surface elevation would be raised from 47 to 49 ft mean sea level (MSL). The MCR is expected to periodically discharge water using the existing discharge pipe to the Colorado River approximately 2 mi below the RMPF (see Figure 2-9). The UHS of proposed Units 3 and 4 would use groundwater and the MCR would act as a backup source. Groundwater would also be used for power block operational uses, fire protection systems, and potable and sanitary systems.

There may be periodic dredging of the RMPF forebay and dredging of the barge slip during the operation of proposed Units 3 and 4 (STPNOC 2009a). The effects of these dredging activities on surface water quality are discussed in Section 5.2.3.1.

Hydrologic alterations during the operation of the proposed new units are expected to be limited to the following activities:

- Alteration of discharge in the Colorado River below the RMPF because of diversion of make-up water to the MCR
- Alteration of discharge and water quality during MCR discharge events
- Alteration of groundwater elevations/potentiometric heads because of operation of water supply wells
- Alteration to site hydrology because of re-grading and re-contouring, placement of new buildings, newly paved areas, and new site drainage ditches.

5.2.2 Water-Use Impacts

A description of water-use impacts to surface water and groundwater is presented in the next sections. The water resource usage by proposed Units 3 and 4 operations is limited to diverting water from the Colorado River for MCR make-up water needs and pumping groundwater for make-up to UHS basins, potable water supply, sanitary uses, and service water needs.

In Texas, water use is regulated by the Texas Water Code. As established by Texas Water Code, surface water belongs to the State of Texas (Texas Water Code, Chapter 11, Section 11.021). The right to use surface waters of the State of Texas can be acquired in accordance with the provisions of the Texas Water Code, Chapter 11. In Texas, surface water is a commodity. Since the Colorado River Basin is currently heavily appropriated, future water users in this basin would likely obtain surface water by purchasing or leasing existing appropriations. Regarding groundwater, Texas law has allowed landowners to pump the water beneath their property without consideration of impacts to adjacent property owners (NRC 2009b). However, Chapter 36 of Texas Water Code authorized groundwater conservation districts to help conserve groundwater supplies. Chapter 36, Section 36.002, Ownership of Groundwater, states that ownership rights are recognized and that nothing in the code shall deprive or divest the landowners of their groundwater ownership rights, except as those rights may be limited or altered by rules promulgated by a district. Thus, groundwater conservation districts with their local constituency offer groundwater management options (NRC 2009b). The existing STP Units 1 and 2 use current STPNOC water rights granted by the TCEQ and the conditions of the existing STPNOC-Lower Colorado River Authority (LCRA) water contract to withdraw surface water from the Colorado River. Groundwater used by STP Units 1 and 2 is withdrawn from the Deep Aquifer under STPNOC's existing CPGCD permit. STPNOC has stated that the proposed Units 3 and 4 would operate within the limits of these existing surface water and groundwater appropriations (STPNOC 2009a).

5.2.2.1 Surface Water

STPNOC's current water rights and diversion conditions are described in Section 2.3.2.1. In addition, STPNOC would have access to 20,000 acre-feet per year (ac-ft/yr) (12,400 gallons per minute [gpm]) of firm water for proposed Units 3 and 4 which would be delivered from LCRA-owned water rights within upstream reservoirs.

According to STPNOC's analysis, Units 3 and 4 would result in an additional induced evaporation of 21,600 gpm (33,840 ac-ft/yr) during normal and 23,190 gpm (37,405 ac-ft/yr) during maximum conditions (STPNOC 2009f). The normal and maximum conditions refer to 93 and 100 percent load factors, respectively (STPNOC 2008a). Based on the assumption that approximately half of the reject heat load would be dissipated via evaporation, the review team determined that STPNOC's estimate of additional induced evaporation for proposed Units 3 and 4 is not unreasonable.

To satisfy the increased surface water demand at the STP site related to operation of proposed Units 3 and 4, STPNOC could use the currently unused portion of the permitted 102,000 ac-ft/yr (63,250 gpm). Existing STP Units 1 and 2 withdrew an average of 22,991 gpm (37,084 ac-ft/yr) from the Colorado River from 2001 through 2006 (STPNOC 2009a). Therefore, an average of 40,260 gpm (64,940 ac-ft/yr) of the currently permitted amount is unused. As stated in Section 2.3.2.1, the currently available surface water resource near the STP site, represented by the average of mean annual discharges during water years 1949 to 2008 at the Bay City U.S. Geological Survey (USGS) streamflow gauge, is estimated to be 2629 cubic feet per second (cfs) (1,180,000 gpm or 1,903,000 ac-ft/yr). As stated in Section 2.3.2.1, the current STP water use for Units 1 and 2 during normal operations is 2 percent (37,100 ac-ft/yr of use with 1,903,000 ac-ft/yr) of available surface water resource and the proposed STP water use for the existing and proposed units during normal operations would be 4 percent (37,100 plus 34,405 ac-ft/yr of use with 1,903,000 ac-ft/yr) of available surface water resource. As stated in Section 2.3.2.1, the current STP water use for Units 1 and 2 during normal operations is estimated to be 3 percent of Texas Water Development Board (TWDB)-estimated Region K water supplies in 2010 (TWDB 2007). The proposed STP water use for all four units during normal operations would be 8 percent of TWDB-estimated water supplies in 2060 if no water management strategies are implemented in Region K. The increase in water use at the STP site to support the operations of Units 3 and 4 would be an increment of 2 percent of the available resource and an increment of 3 percent of the 2010 TWDB-estimated water supplies of Region K. The review team determined that this associated 2 percent decrease in Colorado River discharge below the RMPF would be smaller than the typical accuracy of streamflow measurement and therefore the impact on surface water use in the Colorado River Basin would be minimal.

To support the operation of STP Units 3 and 4, new pumps would be installed in the RMPF to increase the withdrawal capacity to 1200 cfs. The RMPF contains 18 traveling screens, each of 13.5-ft width. The minimum withdrawal from the Colorado River during operation of STP Units 3 and 4 would be 60 cfs, equal to the pumping capacity of the smallest installed pump. Because STPNOC is only allowed to withdraw 55 percent of the discharge in the Colorado River exceeding 300 cfs, the review team estimated that the minimum discharge in the Colorado River for a 60-cfs withdrawal would be 409 cfs. Similarly, the review team estimated that the minimum discharge in the Colorado River to withdraw the maximum of 1200 cfs would be 2482 cfs. No stage-discharge data is available for the Colorado River near the RMPF. Therefore, the review team could not determine the water surface elevation of the Colorado River at the two discharges, 409 and 2482 cfs. The review team conservatively assumed that the water surface elevation in the Colorado River would be at least 0 ft above MSL, which corresponds to average tidal conditions under no upstream freshwater discharge conditions.

The bottom of the travelling screens in the RMPF is located at 10 ft below MSL. Therefore, the review team estimated that the area of the 18 screens would be 2430 ft^2 with the water surface elevation in the Colorado River at 0 ft above MSL. The average approach velocities in front of the traveling screens for withdrawals of 60 and 1200 cfs are estimated by the review team to be 0.025 and 0.49 fps, respectively. It should be noted that the review team's assumption that the water surface elevation in the Colorado River during the withdrawal is conservative and the actual water surface elevation is likely higher, particularly for a discharge of 2482 cfs. Therefore, the review team concludes that the average approach velocities estimated above are the maximum possible for the stated withdrawal conditions.

STPNOC performed a water budget and water quality analysis of the MCR using hypothetical scenarios where the existing units and all four units were assumed to operate over a long period (STPNOC 2008a, 2009c, d, e, f). STPNOC developed a water budget and water quality model of the MCR. Water flowing into the MCR consists of diverted makeup water from the Colorado River and rainfall. Water flowing out of the MCR consists of natural and forced evaporation, seepage, water discharged from the MCR spillway, and water discharged from the MCR to the Colorado River.

As described in Section 2.3.1.1, STPNOC currently diverts water from the Colorado River following a set of rules specified by the STPNOC-LCRA water contract (STPNOC 2009c). To support the operation of proposed Units 3 and 4, STPNOC would withdraw makeup water from the Colorado River and discharge MCR water to the Colorado River to (1) maintain the MCR water level at or above 25 ft above MSL (applicable to two or four-unit operation) and (2) to maintain the MCR water quality below 3000 microsiemens per centimeter (µS/cm) for specific conductivity (STPNOC 2009c) When the MCR water level is between 40 and 49 ft above MSL, STPNOC would only withdraw relatively high-quality water (specific conductivity less than 2100 µS/cm or total dissolved solids less than 1260 milligrams per liter [mg/L]) from the river subject to LCRA water contract conditions (STPNOC 2009c). When the water level in the MCR is between 36 and 40 ft above MSL, STPNOC would withdraw water from the river if its quality is better than MCR water quality subject to LCRA water contract conditions. With the MCR water level at 37 ft above MSL, STPNOC would request LCRA for delivery of firm water. When the MCR water level is between 32 and 36 ft above MSL, STPNOC would withdraw water if the river water conductivity is less than 10,000 μS/cm or its total dissolved solids are less than 6000 mg/L subject to LCRA water contract conditions. When the MCR water level falls below 35 ft above MSL, LCRA would begin delivery of firm water for the MCR and withdrawal of firm water from the river by STPNOC would not be subject to LCRA water contract conditions.

Natural and induced evaporation from the MCR were estimated using a one-dimensional multi-layer thermal model (STPNOC 2009e). The thermal model uses the surface area and volume of the MCR, and time series of relative humidity, dry bulb air temperature, wind speed, cloud cover, and clear sky incoming solar radiation. The thermal model also requires plant operation data including the circulating water flows, electrical output, and MCR water surface elevations. STPNOC calibrated the thermal model using MCR operational data and meteorological data from the Victoria Regional Airport. The calibration was carried out to best fit the measured MCR water temperatures.

To understand the incremental impacts of the long-term operations of Units 3 and 4 on the water and aquatic resources of the Colorado River, STPNOC used the MCR water budget and water quality model to simulate hypothetical operations of (1) the existing units and (2) the existing and proposed units, using the longest period of available streamflow and meteorological records to examine the effects of the proposed units on water use and the effects of MCR discharges on water quality of the Colorado River (STPNOC 2009d, e). The first case, the operation of existing units, represents the base case at the STP site. The second case, the operation of the existing and proposed units, represents the proposed future condition at the STP site. The simulations used the daily water budget of the MCR based on the principle of conservation of mass. The water budget of the MCR used daily inflows into the MCR consisting of the volume of makeup water pumped into the MCR from the Colorado River, the volume of precipitation entering the MCR, and the volume of firm water received from the LCRA and put into the MCR. The daily outflows from the MCR consisted of the volume of natural and induced evaporation, the volume of seepage loss, and the volume of MCR discharge to the Colorado River. The difference between the daily inflows and outflows equaled the net daily change in the volume of water stored in the MCR. The simulations were carried out for two Lower Colorado River streamflow scenarios, (1) historical streamflow (a time period of May 1948 through December 2005); and (2) projected streamflow accounting for Lower Colorado River Authority-San Antonio Water System (LCRA-SAWS) withdrawals (a time period of May 1948 through December 1998). STPNOC conservatively assumed that the four units would operate continuously at 100 percent load.

The review team performed an independent assessment of STPNOC's assumptions, data, and MCR operating rules built into the water budget and water quality model. The review team determined that STPNOC appropriately used the historical and LCRA-SAWS projected streamflows of the Colorado River and meteorological data from nearby stations in the water budget model (STPNOC 2009d). The review team also determined that STPNOC appropriately used water and heat balance equations that are commonly used in practice (STPNOC 2009d, e). The LCRA conditions on water withdrawals from the Colorado River are included in STPNOC's water budget and water quality model. STPNOC reported the calibration of the thermal model using measured MCR water temperatures near the circulating water intake and discharge locations (STPNOC 2009e) STPNOC reported verification of the water budget and the water quality model results with measured MCR water surface elevations and MCR water conductivities (STPNOC 2009e). The review team's assessment of the verification determined that the model simulated the measured MCR water surface elevations and conductivities with acceptable accuracy. The review team also determined that natural and induced evaporation from the MCR were simulated by a thermal model commonly used to predict evaporation from cooling ponds. The review team determined that these estimates are not unreasonable for the MCR and the heat loads of the four STP units. Therefore, the review team used the water budget and water quality model results, provided by STPNOC, to determine the water-related impacts at the STP site. Table 5-1 below summarizes the results of STPNOC simulations.

Table 5-1. Summary Statistics of Simulated Colorado River Streamflow Below the RMPF

		Historical flows		LCRA-SAWS projected flows	
Parameter	**Statistic**	**Existing units operation scenario**	**Existing and proposed units operation scenario**	**Existing units operation scenario**	**Existing and proposed units operation scenario**
Streamflow below RMPF (cfs)	10th percentile	253	253	101	101
	50th percentile (median)	814	795	559	509
	90th percentile	5629	5610	3948	3880

The statistical distribution of streamflow in the Colorado River below the RMPF showed a slight change when the proposed units were added. For both the historical and the projected streamflow scenarios, the maximum change in streamflow due to the incremental water use for the proposed units occurred for the median discharge; the median discharge reduced by 2 percent for historical and 9 percent for the projected discharge scenario from the base case. The 10th percentile streamflow in the Colorado River below the RMPF did not show any change for both streamflow scenarios because the 10th percentile streamflow for both scenarios are less than 300 cfs, which, under the LCRA contract, is the minimum streamflow in the river before STPNOC can withdraw any makeup water for the MCR. The review team concludes that because of this condition, streamflows less than 300 cfs would be unaffected by the operation of the proposed units. The 90th percentile streamflow in the Colorado River below the RMPF showed less than one-half percent reduction from the base case for the historical streamflow scenario and the corresponding reduction for the projected streamflow scenario was 2 percent from the base case. The relatively small change in the 90th percentile flow occurred because the demand for makeup water for the MCR is a small fraction of these flows. The review team concludes that if the required MCR makeup water is withdrawn from the river during periods of high flows, the relative decline in Colorado River streamflow would be minimized.

The review team reviewed STPNOC's water budget and water quality calculations. The conditions used by STPNOC in the MCR water budget and water quality simulations did not prefer any season or streamflow conditions in the Colorado River to commence discharge to the river. If, on any given day, makeup water to the MCR and discharge from the MCR were permitted by the rules specified by LCRA and TCEQ, respectively, the reservoir was operated in the simulations to manage water quality parameters within the MCR. Over the simulation time period using historical flows, the MCR discharged slightly less than 9 percent of the days for the existing units' operation scenario and 9 percent of the days for the existing and proposed units' operation scenario. For the simulations using projected streamflow, the MCR discharged 7 percent and 6 percent of the days for the existing units' operation scenario and the existing and proposed units' operation scenario, respectively. Because the MCR discharge occurred approximately 9 percent of the time for the four-unit operation scenario described above, the review team concludes, based on the results of the simulation model, that on an average, over an extended period, discharge from the MCR during the operation of existing and proposed units could occur as frequently as once in 11 days (9 percent of the time).

Under the historical flow scenario and operation of the existing units, the median streamflow for the Colorado River below the RMPF is 814 cfs. The corresponding median streamflow of the Colorado River below the RMPF when proposed Units 3 and 4 would also be in operation would be 795 cfs. The current TPDES permit allows STPNOC to discharge from the MCR only when the flow in the Colorado River is 800 cfs or greater. Assuming that the same TPDES conditions to apply to proposed Units 3 and 4, the review team determined that during operation of all four units at the STP site, discharges from the MCR would only occur when flow in the Colorado River slightly exceeds the expected median flow. Because the discharges from the MCR would be allowed at 800 cfs, the review team also determined that over a sufficiently long time period, STPNOC could discharge slightly less than 1 in 2 days. Because STPNOC would need to discharge once in 11 days, the review team concludes that sufficient flexibility exists to allow operations of all four units at the STP site.

Because the addition of Units 3 and 4 would result in slight decreases in Colorado River streamflow below the RMPF, slight changes in the frequency of discharge to the Colorado River, and sufficient flexibility for operations of proposed Units 3 and 4, the review team determined that the impact of surface-water use by the proposed units would be SMALL and no mitigation is warranted.

5.2.2.2 Groundwater-Use Impacts

STPNOC currently holds a groundwater use or operating permit to withdraw from the Deep Aquifer an average of approximately 3000 ac-ft/yr (1860 gpm) (CPGCD 2008). This operating permit allows STPNOC to withdraw 9000 ac-ft of water over an approximately 3-year period. Fluctuating use levels within the 3-year period is allowed; however, the total permit level of 9000 ac-ft is absolute. STPNOC plans to use groundwater as the source for makeup water for proposed Units 3 and 4 UHS, service water for the power plants, fire protection systems, and water for potable and sanitary systems. As discussed in Section 3.4.2, STPNOC estimates that the two proposed units would require approximately 975 gpm of groundwater during normal operation and 3434 gpm during shorter-term peak demand periods (STPNOC 2009f). STPNOC would use groundwater up to its current permitted limit to support both existing and proposed units. Based on a monthly analysis of groundwater demand, STPNOC has concluded that site groundwater demand during construction, preconstruction, initial testing, and operation of Units 3 and 4 would be met by the existing groundwater use permit level of approximately 3000 ac-ft/yr. However, short-term peak site groundwater demand would be met through use of a maintained groundwater storage capacity. In the unlikely event of unanticipated peak site water demands, the MCR and Colorado River remain as alternative sources.

The available groundwater resource is estimated at the county level by the CPGCD (Turner, Collie & Braden 2004), which is responsible for issuing permits to drill and operate groundwater wells in Matagorda County. The CPGCD adopted a groundwater availability value of 49,221 ac-ft/yr (30,520 gpm) (Turner Collie & Braden 2004). This value also appears in Region K planning documents by the Lower Colorado Regional Water Planning Group (LCRWPG) (LCRWPG 2006), and is part of the regional water resource estimates appearing in the State water plan (TWDB 2007). The CPGCD estimates the groundwater supply consistent with the existing water supply infrastructure is a constant 35,785 ac-ft/yr (22,189 gpm) through 2050 and that average usage for the period 1980 through 2000 is 30,233 ac-ft/yr (18,746 gpm) (Turner Collie & Braden 2004). The LCRWPG (2006) projected that groundwater resource development strategies could make an additional 29,546 ac-ft/yr available by 2060. This added to the groundwater supply of 35,785 ac-ft/yr would be a groundwater resource of approximately 63,500 ac-ft/yr (39,400 gpm) in 2060.

To satisfy increased groundwater demand at the STP site related to operation of proposed Units 3 and 4, STPNOC would use the currently unused portion of the groundwater permit limit, where the permit limit is approximately 3000 ac-ft/yr (1860 gpm). STPNOC currently uses an average of 798 gpm of groundwater for the operation of existing STP Units 1 and 2 leaving an average of 1062 gpm available for the operation of Units 3 and 4 (STPNOC 2009a). This increase in groundwater use is equivalent to 4.8 percent of the current groundwater supply and represents 5.7 percent of current groundwater use in Matagorda County.

Operational Impacts at the Proposed Site

Potential offsite impact on the groundwater resource during the operation of the two proposed STP units is the result of an annual average normal operation groundwater use of 1062 gpm (1713 ac-ft/yr). This is the maximum usage allowed under the groundwater use permit held by STPNOC. A potential offsite impact evaluated by the review team is the estimated decline in hydraulic head in the Deep Aquifer within the Chicot Aquifer using a conservative analysis based on withdrawal from an onsite well pumped at a representative value, i.e., 500 gpm. Drawdown is evaluated at the property line and at a point 2500 ft from the well because that is the minimum distance allowed by the CPGCD between groundwater production wells (CPGCD 2009). The well location and minimum depth to top of screen is assumed to meet CPGCD requirements of a minimum set back of 100 ft from the property line with a screen beginning no higher than 200 ft below ground surface (BGS). The review team assumed the production well is pumped at 500 gpm and is screened over an approximate 500-ft interval with the well completed at approximately 700 ft BGS. This is typical of existing and proposed production wells at the STP site (STPNOC 2009a, f).

The hydraulic head in the Deep Aquifer was between 40 and 60 ft below MSL in the vicinity of the STP site during site characterization activities for the proposed units, i.e., 2006 (STPNOC 2009a). Using hydraulic properties typical of the STP site (see Table 2-3), the drawdown caused by a production well 100 ft from the site property line pumped continuously for 40 years at the expected rate of 500 gpm would be approximately 33 ft. Thus, for a single well being pumped, and adjacent wells idle, the hydraulic head in the vicinity of the property line would be approximately 93 ft below MSL. The top of the Deep Aquifer lies between 250 and 300 ft BGS, the land surface is approximately 27 ft above MSL, and the top of the aquifer is at the elevation 223 ft below MSL. Therefore, the aquifer remains confined with a confining pressure of approximately 130 ft.

At a distance 2500 ft from the production well, the nearest allowed well location per CPGCD rule (CPGCD 2009), the drawdown would be approximately 21 ft based on the assumptions discussed above. The hydraulic head would be approximately 80 ft below MSL. Because of the rules of the CPGCD (CPGCD 2009), the location 2500 ft from an STP production well is the closest location of an adjacent offsite well, and the estimated hydraulic head is indicative of the highest impact to adjacent land owners.

If two adjacent groundwater production wells were pumped, the combined drawdown would be approximately 54 ft at the property line and approximately 40 ft at a 2500 ft distant point. Thus, for an offsite well located 2500 ft from production wells the hydraulic head would be approximately 100 ft below MSL, and the confining pressure on the Deep Aquifer would be approximately 123 ft.

The review team's calculated drawdown values are shown in Table 5-2 for both the 500-gpm pumping rate of a single well, and the overall 1062-gpm rate available under STPNOC's groundwater use permit. Using a 500-gpm rate is consistent with current and proposed STP production well operation. The 1062-gpm pumping rate is included to show an absolute maximum impact; however, this is conservative because it is an estimate of drawdown assuming a single production well produces all the groundwater for proposed Units 3 and 4. A further conservatism is given by neglecting any recharge to the aquifer. Results of the 1062-gpm case conservatively bound an estimate of adjacent well drawdown (i.e., 69.6 ft versus 53.8 ft, and 44.7 ft versus 42 ft).

Table 5-2. Drawdown at the STP Property Line (100 ft) and a Point 2500 ft from a Production Well

Pumping Rate (gpm)	Distance (ft)	
	100	2500
500	32.8	21.0
1062	69.6	44.7

time = 40 yr; transmissivity = 31,379 gpd/ft (geometric mean); coefficient of storage = 0.00022; drawdown calculated using the this formula

The Deep Aquifer, which would be the source of groundwater during operation of the proposed new units, has been affected by long-term regional irrigation demand. Land surface subsidence since 1900 is estimated to be less than 1 ft over most of Matagorda County (LCRA 2007a), and subsidence in excess of 1 ft in the northwest corner of the County is attributed to groundwater production associated with gas/petroleum exploration and sulfur mining (LCRA 2007a). STPNOC currently uses five production wells to produce groundwater in support of STP Units 1 and 2, and may drill and operate one or more additional well to decrease the pumping rates at each well and reduce the drawdown impact (STPNOC 2009f). The wellfield design helps to minimize the potential for subsidence while producing the necessary groundwater. They are placed and operated so that no sustained pumping occurs within 4000 ft of the existing or proposed units, and the CPGCD requires that wells be no closer than 2500 ft apart. The highest rated existing wells can pump 500 gpm, and it is assumed that new wells would produce 500 gpm (STPNOC 2009f). Thus, the review team concludes that the stress on the Deep Aquifer would be distributed spatially across the STP site, minimizing local drawdown and the potential for subsidence.

Since operation of proposed Units 3 and 4 would use an estimated 1062 gpm (1713 ac-ft/yr) of Deep Aquifer groundwater, that quantity of groundwater would no longer move downgradient and discharge into Matagorda Bay and the Colorado River estuary (STPNOC 2009a). Thus, one impact of operating the proposed units is a reduction of 1062 gpm (1713 ac-ft/yr) in the Deep Aquifer flow into the bay and estuarine environment. The reduction equates to 2.37 cfs and compares to the average minimum monthly flow of the Colorado River near Bay City of 327 cfs (month of August) (STPNOC 2009a), the average maximum monthly flow of the

Colorado River near Bay City of 14,123 cfs (month of June) (STPNOC 2009a), and the minimum Matagorda Bay monthly target inflow of 1008 cfs for the month of August (STPNOC 2009a).

Based on the following considerations

- a groundwater resource sufficient to sustain the projected STP site groundwater use, projected drawdown during normal operation, and the presence of sufficient confining head to maintain a confined aquifer
- production wells designed to minimize the potential for subsidence
- relatively small depletion of discharge to Matagorda Bay and the estuarine environment,

the review team concludes that groundwater use impacts to the groundwater resource from operation of the proposed Units 3 and 4 would be SMALL, and mitigation is not warranted.

5.2.3 Water-Quality Impacts

This section discusses the impacts to the quality of water resources from the operation of proposed Units 3 and 4. Surface-water impacts include thermal, chemical, and radiological wastes, and physical changes in the Colorado River resulting from effluents discharged by the plant.

5.2.3.1 Surface-Water Quality Impacts

The only surface-water discharges during operations of proposed Units 3 and 4 would occur as (1) stormwater runoff to nearby sloughs, the Colorado River, and the West Branch of the Colorado River, (2) MCR discharge to the Colorado River, and (3) seepage from the MCR intercepted by the relief wells and discharged through the site drainage ditches to Little Robbins Slough and the Colorado River upstream of the RMPF.

As stated at the beginning of this section, STPNOC would be required to obtain a multi-sector stormwater permit from the TCEQ. STPNOC would be required to develop and implement an SWPPP to control stormwater runoff to onsite and offsite water bodies as described in the previous paragraph. STPNOCs existing SWPPP would be amended to include activities associated with the proposed new units (STPNOC 2009a). Implementation of best management practices (BMPs) as contained in the SWPPP would minimize stormwater runoff to onsite and offsite water bodies.

During the operation of proposed Units 3 and 4, periodic maintenance dredging near the RMPF may be required on an as-needed basis to remove accumulated sediment (STPNOC 2009a). These activities would be conducted under a Corps permit. The review team determined that the impact to water quality of the Colorado River from these activities would be temporary and minimal because BMPs would be employed.

During the operation of proposed Units 3 and 4, the MCR would receive effluents that consist of the following: (1) UHS cooling tower blowdown, (2) treated sanitary waste, (3) treated liquid radwaste, (4) wastewater retention basin discharge, and (5) startup/flush pond discharge. The last effluent discharge stream, the startup/flush pond discharge, is an intermittent stream, which is treated onsite before it would be discharged to the MCR. Potable and sanitary wastewater would be treated by the sanitary waste system before being discharged to the MCR. The wastewater retention basin would receive effluents from low-volume waste streams.

The only discharges to publicly accessible surface waters during the operations of Units 3 and 4 would occur as the MCR discharge into the Colorado River and from the site drainage ditch, which discharges to Little Robbins Slough, to the Colorado River upstream of the RMPF, and to the West Branch of the Colorado River. The MCR gains water from precipitation and makeup water pumped from the Colorado River. The MCR loses water by natural and induced evaporation, by seepage to groundwater, and by periodic discharge to the Colorado River. The concentration of dissolved materials contained in the water of the MCR would increase as plant effluent discharges to and evaporation from the MCR continues. The water quality in the MCR is managed by diluting it with makeup water from the Colorado River and by discharging to the Colorado River. The makeup flow rate is regulated under the LCRA permit. The flow rate and the concentrations of effluents in the MCR discharge would be regulated by the TPDES permit.

In supplemental information provided to the NRC, STPNOC described the operating policy of the MCR (STPNOC 2009c). STPNOC would discharge when the specific conductivity of the water in the MCR exceeds 3000 µS/cm. Makeup water would be pumped from the Colorado River into the MCR consistent with the rules of the LCRA contract. The MCR discharge would cease when the conductivity of the water in the MCR falls to 2100 µS/cm. Discharge from the MCR could also occur during large rainfall events when the MCR water surface elevation exceeds the spillway crest elevation.

Table 5-3 below shows the summary statistics of water quality parameters obtained from the STPNOC's MCR water budget and water quality model simulations. The MCR water budget and water quality model is described above in Section 5.2.2.1. The review team's independent assessment of STPNOC's water budget and water quality model is also described above in Section 5.2.2.1.

The statistical distribution of water temperature of the MCR discharge showed increases of 5.3°F in the 10^{th} percentile and a decrease of 1.5°F in the 90^{th} percentile for the hypothetical simulations that used historical streamflow; there was only a slight increase in the median. For the hypothetical simulations that used LCRA-SAWS projected streamflow, the temperatures of

MCR discharge increased 6°F for the 10th percentile, 2.1°F for the median, and 0.7°F for the 90th percentile.

Table 5-3. Summary Statistics of Simulated Water Temperature and Total Dissolved Solids of MCR Discharge

Parameter	Statistic	Historical flows		LCRA-SAWS projected flows	
		Existing units operation scenario	Existing and proposed units operation scenario	Existing units operation scenario	Existing and proposed units operation scenario
Water temperature of MCR discharge (°F)	10th percentile	64.1	69.4	64.1	70.1
	50th percentile (median)	75.2	75.6	73.9	76.0
	90th percentile	90.5	88.0	86.9	87.6
Total dissolved solids in MCR discharge (mg/L)	10th percentile	1934	2313	1950	2823
	50th percentile (median)	2048	2844	2186	3548
	90th percentile	2599	3673	2644	4550

Source: STPNOC 2009c

The statistical distribution of simulated total dissolved solids within the MCR showed increases of approximately 20, 39, and 41 percent in the 10th, 50th, and 90th percentiles for hypothetical simulations using historical discharges, respectively. The statistical distribution showed corresponding increases of approximately 44, 62, and 72 percent for the hypothetical simulations that used the LCRA-SAWS projected streamflow.

The maximum duration of continuous discharge from the MCR to the Colorado River for the existing units' operation scenario using historical flows was 88 days. The corresponding duration of continuous discharge for the existing and proposed units' operation scenario was 73 days. The maximum duration of continuous discharge from the MCR to the Colorado River for the existing units' operation scenario using projected flows was 74 days. The corresponding duration of continuous discharge for the existing and proposed units' operation scenario was 37 days.

STPNOC performed a Cornell Mixing Zone Expert System (CORMIX) analysis to estimate the extent of the MCR discharge plume in the Colorado River. The discharge structure consists of seven ports located near the bottom of the river, each of which is capable of a maximum discharge of 44 cfs, for a total maximum MCR discharge of 308 cfs. STPNOC used a bounding approach to estimate the impacts of the MCR discharge on the Colorado River, assuming that all ports would discharge at their maximum capacity. The review team determined that this assumption is conservative because it would result in maximizing the size of the plume. Currently, the TPDES permit disallows any discharge from the MCR to the Colorado River when the flow of the river adjacent to the STP site is less than or equal to 800 cfs, restricts the discharge from the MCR to the Colorado River to less than or equal to 12.5 percent of the flow in the river (see Section 2.3.3.1), and restricts the discharge temperature to less than or equal to 95°F. STPNOC also assumed that during this discharge, the difference in temperatures between the MCR waters and the waters of the Colorado River would be 20.4°F, which was the maximum monthly difference in the long-term hypothetical simulations of MCR water budget and quality. The review team determined that this assumption is also conservative and would maximize the size of the plume. The TPDES permit requirements would allow an MCR discharge of 308 cfs at a minimum Colorado River streamflow of 2464 cfs.

Discharge and salinity data collected by STPNOC during September 2007 to May 2008 indicated that a salinity wedge intrusion occurred near the STP site when the mean monthly flow in the Colorado River was less than 1800 cfs (STPNOC 2008c). The review team determined that the salinity wedge, observed near the RMPF during tidal conditions, would be very small, if at all present, during flows in the Colorado River at 2464 cfs.

STPNOC's CORMIX analysis estimated a plume defined by the 5°F isotherm. The plume was predicted to be attached to the river bottom for approximately 120 ft downstream of the discharge ports, and within this short distance the plume extended less than one quarter of the width of the river. The plume was predicted to quickly rise to the river surface further downstream, occupying the full width of the river cross section approximately 1060 ft downstream of the ports and continuing for an additional 3340 ft. The plume extended approximately 4400 ft downstream from the ports.

Before the plume traveled 300 ft downstream of the discharge ports, the lower boundary of the plume migrated upward, only existing in the upper half of the river cross section. The deeper portion of the river cross section remained close to ambient temperatures.

The review team also independently performed additional CORMIX simulations where (1) the discharges from the ports were reduced to half of their capacity and the streamflow in the Colorado River was increased to 4000 cfs and (2) the discharges from the port were allowed to occur at full capacity and the streamflow in the river was increased to 10,000 cfs. During these simulations the temperature difference between the river and the MCR discharge was kept the same. The results obtained by the review team showed that the MCR discharge plume was very small in the river. The total length and maximum width of the discharge plume were 115 and 26 ft, respectively. The review team determined that the maximum width of the MCR discharge plume in the river would be less than 10 percent of the river width. Therefore, the review team concludes that there is considerable flexibility available in the way the MCR discharge could be operated to minimize the size of the plume in the river.

The review team also performed a simple heat balance calculation to check whether the results of CORMIX simulation are reasonable. Assuming the complete mixing of discharge with ambient water, the temperature excess would be about 2.3°F which is below the mixing zone criteria. In the case of surface floating plume with laterally mixed across the whole river channel, the plume thickness corresponding to the mixing zone criteria (5°F) is approximately estimated less than a half of water depth. These estimations are consistent with the CORMIX model results.

The review team determined, therefore, that the 5°F isotherm plume, resulting from a bounding scenario of MCR discharge, would not completely block the river cross section. The plume resulting from the MCR discharge during the operation of existing and proposed units could last for a relatively extended duration, up to nearly 75 days, and could also occur relatively frequently, once every 11 days. The review team determined, based on a review of the current TPDES permit conditions, that the minimum dilution in the Colorado River would be a factor of 8. Any chemical or radiological contaminants present in the MCR waters would be diluted a minimum of 8 times and would, following the cessation of MCR discharge, be quickly transported downstream to the Matagorda Bay where they would be diluted even further. The review team determined, therefore, that the impact on water quality of the Colorado River from the operation of Units 3 and 4 would be SMALL and no mitigation is warranted.

5.2.3.2 Groundwater-Quality Impacts

Operation of proposed Units 3 and 4 would involve seepage from the MCR into the Upper Shallow Aquifer; however, operation should not involve any other intentional discharges to the aquifer system that underlies the STP site. Spills that might impact the quality of the Shallow Aquifer would be prevented and mitigated by BMPs. Except where excavation removes it, the Shallow Aquifer is protected from spills on the land surface by a 10 to 30-ft thick low conductivity confining zone. Groundwater flow in the Upper Shallow Aquifer away from the proposed units would be to the southeast or the southwest (see Section 4.2.3.2) and toward the STP site property boundary. Representative travel times in the Upper Shallow Aquifer from proposed Unit 3 to the southeast site property line would be approximately 154 years (STPNOC 2009g) and from proposed Unit 4 to the southwest property line would be approximately 330 years. A representative travel time in the Lower Shallow Aquifer from the proposed units to the southeast property line would be approximately 125 years. The review team concludes that these travel times should allow for cleanup and remediation to occur.

A potential offsite impact on the quality of the groundwater resource during operation of the proposed Units 3 and 4 is saltwater intrusion or encroachment resulting from pumping at the annual average normal operation rate allowable under the existing STPNOC groundwater use permit, i.e., 1062 gpm (1713 ac-ft/yr). Production wells at the STP site are completed in the upper portion of the Deep Aquifer with up to 500 ft of screen, well bottom at 700 ft BGS, and pumping capacity of 500 gpm. LCRA (2007b) evaluated the design of wells and their production rate with regard to saltwater intrusion or encroachment (see Section 2.3.3.2), and based on the LCRA study findings the review team concludes the existing and proposed well design parameters of depth, screened interval, and pumping rate at the STP site would minimize the potential for lateral or vertical saltwater intrusion.

Seepage from the MCR enters the Upper Shallow Aquifer. The relief well system, (i.e., 770 wells that surround the MCR), is designed in part to intercept the majority of the seepage from the MCR into the Upper Shallow Aquifer. STPNOC (2009a) has estimated for an MCR at 49 ft above MSL pool elevation that total seepage from the MCR is 3530 gpm (5700 ac-ft/yr), and that approximately 68 percent of this (2400 gpm, 3850 ac-ft/yr) is intercepted by the relief wells and discharged under the TDPES permit (TCEQ 2005).

During January through April of 2003, while the MCR was at elevation 47 ft above MSL, measurements were made of the water level in a series of piezometers located 11 ft landward from the embankment centerline (STPNOC 2008g). These piezometers showed a head drop from MCR to piezometer varying from approximately 17 to 27 ft along the western, northern, and eastern embankments. Along the southern embankment the head drop varied from approximately 22 to 30 ft. The pool elevation change of the MCR from a maximum of 47 ft above MSL to 49 ft above MSL to support proposed Units 3 and 4 is expected to cause an increase in the seepage of MCR water into the Upper Shallow aquifer. Based on the above information, the review team determined that the two foot rise of MCR maximum level would increase the head drop of the hydraulic gradient by no more than 2 ft over the prior condition, and therefore, the increase in seepage from the MCR into the Upper Shallow aquifer is bounded by a range of 12 to 7.5 percent along the western, northern and eastern embankment, and 9 to 6.7 percent along the southern embankment.

Regarding radioactive contaminants in the MCR and impacts related to seepage into the underlying aquifer see Sections 5.9.2.1, 5.9.5.1, and 5.9.6.

Regarding nonradioactive contaminants in the MCR, total dissolved solids (TDS) is an indicator described in Sections 2.3.3.1, 2.3.3.2, and 5.2.3.1. It is anticipated by the review team that seepage from the MCR to the Upper Shallow Aquifer would initially have the same TDS concentration of the MCR. STPNOC's estimate of the median TDS concentration in the MCR for operation of the existing units is approximately 2000 mg/L, and for both existing and proposed units it is approximately 3000 mg/L (see Section 5.2.3.1). The review team concludes that an increase in TDS levels of 1000 mg/L in the MCR could result in a corresponding increase of 1000 mg/L in groundwater concentrations downgradient of the MCR. This is conservative because it does not consider dispersion within the groundwater system, which would likely reduce this concentration increment.

Locally, groundwater from the Shallow Aquifer is described as slightly saline because of TDS concentrations above 1000 mg/L (i.e., slightly saline waters have TDS between 1000 mg/L and

3000 mg/L). Onsite wells completed in the Shallow Aquifer have an average TDS concentration of 1200 mg/L (STPNOC 2009a). Accordingly, the Shallow Aquifer is used locally to water livestock, and it is not a fresh water supply. The review team concludes that with an increase of 1000 mg/L, the groundwater TDS concentration would remain in the range associated with slightly saline waters. If groundwater in the Upper Shallow Aquifer had the TDS concentration of the MCR water, it would be approximately 3000 mg/L and at the upper end of the slightly saline range. The potential future TDS level is consistent with the existing groundwater quality and its use as a source of water for livestock. Any impacts from this groundwater would be local because groundwater plumes originating from the MCR would be local to the STP site and the region immediately downgradient of the site to the Colorado River.

From the information available on TDS concentrations in the MCR and in the Shallow Aquifer, the review team concludes that TDS is an indicator of MCR seepage water quality and that while the concentration of TDS is expected to increase, the incremental increase would minimally change the groundwater resource. Based on the consideration of the potential impact from spills, saltwater intrusion, and seepage from the MCR to the underlying aquifer, the review team concludes that groundwater-quality impacts would be SMALL and mitigation is not warranted.

5.2.4 Water Monitoring

Currently, as part of the operations of existing STP Units 1 and 2, STPNOC conducts surface water monitoring as required by the current TPDES permit. The surface water is monitored at six locations. Flow volume on a daily basis is monitored at five internal outfalls within the MCR (Figure 2-17) and reported to the TCEQ every month.

Outfall 001 is associated with the MCR blowdown discharge pipe. All other monitoring locations are associated with effluent streams that discharge into the MCR. Flow at Outfall 001 is measured continuously and on a daily basis when a discharge is made to the Colorado River. Flow at all other monitoring locations is measured daily.

Under the current water rights permit, STPNOC monitors makeup water diverted from the Colorado River and water consumed on a monthly basis and reports it to TCEQ annually. The annual volume of diverted water is also reported to TWDB.

Currently, STPNOC monitors stormwater at eight locations (Figure 2-18) under its existing SWPPP. The discharge during precipitation events is measured at these locations.

Hydrological monitoring during the operations of proposed Units 3 and 4 would be required by TCEQ in the modified TPDES permit and in the new or amended SWPPP. The requirements for hydrological monitoring for proposed Units 3 and 4 are expected to be similar to the current requirements for existing STP Units 1 and 2.

Currently, STPNOC monitors surface waters for chemicals under the existing TPDES and stormwater permits. Outfall 001 is sampled weekly for total residual chlorine when a discharge occurs from the MCR. Outfall 005 is sampled weekly for iron and copper when metal cleaning waste is discharged into the MCR. Outfalls 101 and 201 are sampled weekly for total suspended solids and for oil and grease. Outfalls 401 and 601 are sampled weekly for biochemical oxygen demand and for total suspended solids. Currently, STPNOC monitors stormwater outfalls A, E, F, and G for iron and total suspended solids during precipitation events.

Chemical monitoring during the operations of proposed Units 3 and 4 at STP would be required by TCEQ in the modified TPDES permit and in the new SWPPP. The requirements for chemical monitoring for the two new proposed units are expected to be similar to the current requirements for existing STP Units 1 and 2.

Currently, STPNOC continuously monitors temperature of the discharge from the MCR at Outfall 001 when blowdown is performed as required by the existing TPDES permit. Monitoring requirements would be addressed by the modified TPDES permit after the addition of Units 3 and 4. These requirements are expected to be similar to those for existing STP Units 1 and 2.

STPNOC anticipates that groundwater monitoring required during operation of Units 3 and 4 would be similar to existing reporting requirements for STP Units 1 and 2 (STPNOC 2009a) and designed and implemented accordingly. However, STPNOC acknowledged that those requirements are changing in response to the Nuclear Energy Institute's program to collect groundwater data at commercial nuclear plants (STPNOC 2009a). Once the project is complete and the sediment profile has been allowed to rewet, STPNOC has committed to conduct an evaluation of groundwater level with the objective of determining whether groundwater level monitoring should continue to ensure that the maximum groundwater level beneath safety-related structures of Units 3 and 4 is below the site characteristic for maximum groundwater level (STPNOC 2008f).

5.3 Ecological Impacts

This section describes the potential impacts to ecological resources from operation of proposed Units 3 and 4 at the STP site, transmission line operation, and transmission line corridor maintenance. The impacts are discussed for terrestrial ecosystems and aquatic ecosystems, including threatened and endangered species. Evaluation of potential impacts to terrestrial and aquatic biota from radiological sources is discussed in Section 5.9

5.3.1 Terrestrial and Wetland Impacts

Impacts on terrestrial communities and species that could result from operation of the proposed units are generally related to cooling system operations or transmission line operations.

Operation of the circulating water cooling system, for which the MCR is the normal heat sink, would have negligible impacts on terrestrial resources and is only discussed in this section relative to shoreline habitat. Operation of the UHS cooling system can result in deposition of dissolved solids; increased local fogging, precipitation, or icing; increased noise levels; and a greater risk of collision mortality to avian species; and shoreline alterations of the source waterbody. Impacts from the operation and maintenance of the transmission system that may affect terrestrial species include collision mortality and electrocution, electromagnetic fields (EMFs), and the maintenance of vegetation within transmission line corridors.

5.3.1.1 Terrestrial Resources – Site and Vicinity

Impacts of operation of Units 3 and 4 on the STP site and vicinity are associated with the increase in the operating level in the MCR and operation of two proposed UHS mechanical draft cooling towers. As described in Chapter 3, the UHS includes a closed-loop system that dissipates gained heat to the atmosphere via mechanical draft cooling towers. In this system, the heat would be transferred to the atmosphere in the form of water vapor and drift. Vapor plumes and drift may affect vegetation such as crops, ornamental vegetation, and native plant communities. In addition, bird collisions and noise-related impacts are possible with mechanical draft cooling towers and other facility structures.

Impacts of Cooling Tower Operations

Two mechanical draft cooling towers are contiguous with the UHS reservoir and structure and would be positioned immediately south of Units 3 and 4 in an industrial area. Makeup water to the UHS cooling towers would be supplied from site groundwater wells, with backup from the MCR. Through the process of evaporation, the total dissolved solid concentration in the cooling water increases, and a small percentage of the water is released into the atmosphere as fine droplets containing elevated levels of TDS that can be deposited on nearby vegetation. Maximum UHS blowdown and make up rates are based on maintaining three cycles of concentration in the cooling tower, which means the TDS in the makeup water would be concentrated approximately three times before being released. Cooling tower water losses from drift are minor in comparison to evaporation and blowdown discharge losses, and the maximum drift rate reported by STPNOC is estimated to be 45 gpm when both units are operating (STPNOC 2009a).

Depending on the make-up source water body, the TDS concentration in the drift can contain high levels of salts that under certain conditions and for certain species can be damaging. Vegetation stress can be caused from drift with high levels of TDS deposition, either directly by deposition onto foliage or indirectly from the accumulation in the soils. Vegetation adjacent to the cooling towers includes relatively open habitats: mowed areas and other areas dominated by mixed grasses, dewberry (*Rubus* spp.), and sea myrtle (*Baccharis halimifolia)*.

A deposition rate of 8.9 pounds per acre per month (lb/ac/mo) during the growing season is considered a threshold value for causing damage to leaves of a variety of species (NRC 2000). The STPNOC analysis indicated that the annual salt deposition rate from cooling tower drift could be as high as 98 lb/ac/mo near the towers, decreasing to less than 8.9 lb/ac/mo at about 0.3 mi, and less than 1 lb/ac/mo beyond about 0.8 mi. The maximum deposition rates occur during the summer. Most of the area with a deposition rate exceeding 8.9 lb/ac/mo is within the protected area to the north of the cooling towers, and between the protected area and the MCR. Regardless of the plume direction, maximum deposition would occur on the STP site. Although the maximum deposition within 0.3 mi of the cooling towers estimated for the proposed Units 3 and 4 is greater than the threshold value for causing damage to leaves, the maximum salt deposition would occur primarily in areas that would be occupied by existing and planned facilities and maintained/mowed vegetation. Thus, the potential impacts to vegetation and surrounding habitat would be limited to a relatively small area within 0.3 mi of the cooling tower, and impacts would be expected to be minimal.

Although STPNOC leases a portion of the site for cattle grazing, these lands are located more than 2000 ft from the cooling towers and would not be expected to receive significant salt deposition from plume drift. The impact of drift on crops, ornamental vegetation, and native plants was evaluated for existing nuclear power plants in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) and was found to be of minor significance (NRC 1996a, 1999). This determination also included existing nuclear power plants with more than one cooling tower.

Due to the local climate and topography, fogging and associated icing are not expected from the operation of the two mechanical draft cooling towers at the STP site and, therefore, would not cause any impacts to habitat or wildlife (STPNOC 2009a). Thus, the potential impact on crops, ornamental vegetation, and native plants from the operation of UHS cooling towers for the proposed new units would be minimal, and mitigation would not be warranted.

Bird Collisions with Cooling Towers and Structures

The potential exists for avian mortality due to collision with proposed nuclear power plant structures and could pose a threat to those species in decline and to threatened or endangered species. The elevation of the tallest structure associated with the new units would be approximately 249 ft above MSL, which is similar to the heights of the existing reactor buildings on the STP site. The two mechanical draft cooling towers would reach a height of approximately 150 ft above MSL—or 119 ft above grade (STPNOC 2009a). Although the STP site lies at the terminus of the Central Migratory Flyway, no bird kills have been reported associated with the existing buildings on the STP site. Data available for communication towers indicate that tall towers greater than1000 ft in height pose the greatest collision risk for birds (Manville 2002). Published accounts of bird strikes and kills at shorter towers are limited but are assumed to occur less frequently.

The NRC has previously concluded that avian collisions are unlikely to pose a biologically significant source of mortality because only a small fraction of total bird mortality has been attributed to collision with nuclear power plant structures (NRC 1996a, 1999). Because the mechanical draft towers are relatively short and bird strikes and kills have not been observed in association with existing buildings of similar height at STP, the potential effects of bird collisions with the buildings and cooling towers associated with proposed Units 3 and 4 are assumed to be negligible.

Noise Impacts of Operation

The noise levels from cooling tower operation and diesel generators are anticipated to be 65 decibels (dBA) at 50 ft (STPNOC 2009a). Noise levels from the combined operation of the two cooling towers are estimated to be approximately 51 dBA at 400 ft. A level of 51 dBA is well below the 60 to 65-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating mechanical draft cooling towers would not be likely to disturb wildlife in habitats away from the existing and planned facilities and would not affect wildlife beyond the STP site boundaries. Thus, the potential impact on wildlife posed by the incremental noise resulting from the operation of the two new mechanical draft cooling towers for Units 3 and 4 and other facilities at the STP site would be minimal, and mitigation would not be warranted.

Shoreline Habitat Along MCR

The normal operating level of the waters of the MCR would be raised approximately 2 ft (from 47 ft above MSL to 49 ft above MSL) to provide additional water supply for cooling (STPNOC 2009a). The banks of the MCR are covered with a soil stabilizer and support little to no vegetation thus providing limited habitat adjacent to the existing water line. Although a number of colonial waterbirds nest on the Y dikes within the reservoir, raising the water level is not expected to affect existing nesting habitat or to significantly decrease the available nesting habitat for these birds. These birds tend to nest on the road bed positioned on the crown of the dike and areas immediately adjacent to this road. An increase in water level of 2 ft would not encroach on these nests. The MCR also is used by wintering waterfowl and other water birds for foraging and resting. As the water level is increased, some species that forage on benthos may temporarily loose the shallowest portion of the reservoir bottom as a forage area until sufficient time passes that mollusks and other invertebrates colonize the newly flooded portions of the shoreline (STPNOC 2009a). Assuming that the fish populations in the reservoir are not affected by the increased water level, piscivorous birds such as eagles, ospreys, pelicans, herons, and gulls that feed on fish near the surface of the reservoir and along its banks are not likely to be affected. Impacts to terrestrial species from raising the water level in the MCR are expected to be negligible.

5.3.1.2 Terrestrial Resources – Transmission Lines

Electric transmission systems have the potential to affect terrestrial ecological resources through right-of-way (ROW) maintenance, bird collisions with transmission lines, and EMFs. Existing 345-kV transmission lines and associated corridors would be used to transmit the power generated from proposed Units 3 and 4. Four different entities are involved in maintaining the transmission corridors associated with existing STP Units 1 and 2. American Electric Power (AEP) Texas Central Company (TCC) maintains the transmission line corridor from STP to Hillje Substation and the corridor to Blessing, and from Hillje to White Point. AEP TCC surveys and controls the woody vegetation in the transmission corridors, as needed, every 3 to 5 years to allow continuous and safe power transmission in accordance with their respective management plans.

Existing management plans include procedures for removing rapidly growing trees and/or trees that might interfere with power transmission, pruning trees near transmission lines, and maintaining travel routes within the transmission line corridor. Manual and mechanical methods as well as herbicide application are used to remove trees encroaching on the power lines. Personnel involved in these maintenance activities are required to be trained and to hold Texas Department of Agriculture Commercial Pesticide Applicators licenses, and all herbicide use follows Federal, State, and local guidelines, and requires a Texas Department of Agriculture pesticide application permit. However, because much of the transmission corridors associated with the transmission of power from STP traverse primarily agricultural lands, the need for corridor maintenance is limited (STPNOC 2009a).

Power generated from the proposed units would be transmitted through existing transmission corridors that are managed and monitored as described. No additional operational impacts associated with maintenance of transmission corridors are expected to occur as a result of operation of the two new units at STP. The impacts of transmission line corridor maintenance on wildlife and habitats, including floodplains and wetlands, were evaluated in the license renewal GEIS (NRC 1996a, 1999), and the impacts were found to be of small significance at operating nuclear power plants with associated transmission line ROWs of variable widths (NRC 1996a, 1999). STPNOC and the transmission service providers have procedures in place that minimize adverse impacts to wildlife and important habitats such as floodplains and wetlands. Therefore, the potential effects on terrestrial species and habitats from transmission line maintenance in existing transmission line ROWs would be negligible and mitigation beyond the use of standard BMPs would not be warranted.

Impacts of EMFs on Flora and Fauna

EMFs are unlike other agents that have an adverse impact (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996a). As discussed in the GEIS for license renewal (NRC 1996a), a careful review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. 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. All transmission lines connected to the proposed reactors would be 345kV and there would be no change in line voltage; thus no increase in EMF would be expected to occur. The EMFs produced by operating transmission lines up to 1100 kV have not been reported to have any biologically or economically significant impact on plants, wildlife, agricultural crops, or livestock (Lee et al. 1989; Miller 1983).

The conclusion presented in the GEIS for license renewal (NRC 1996a) was that the impacts of EMFs on terrestrial flora and fauna were of minimal significance at operating nuclear power plants, including transmission systems with variable numbers of transmission lines. Since 1997, more than a dozen studies have been published that looked at cancer in animals that were exposed to EMFs for all or most of their lives (Moulder 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the review team concludes that the EMF impact posed by the operation of the transmission lines associated with the STP site would be minimal and mitigation would not be warranted.

Avian Collision and Electrocution

Avian interactions with transmission lines and structures are species- and site-specific, and the potential impacts include bird injury or mortality through collision or electrocution. Procedures are in place to document transmission line mortalities of large birds, should they occur, and to deal with bird nests found in hazardous locations along the corridors (STPNOC 2009a), and operates under an Avian Protection Policy (AEP 2009). In addition, American Electric Power (AEP) responds to U.S. Fish and Wildlife (FWS) requests and requirements to install marking devices on some spans to prevent collisions (AEP 2009). Bird electrocutions occur on utility poles and towers where birds use these structures for perching, roosting, and nesting. On structures where bird electrocution issues are identified, AEP applies protective devices to minimize bird electrocutions (AEP 2009).

The NRC’s analysis in the GEIS is that bird collisions with transmission lines are of small significance at operating nuclear power plants, including transmission corridors with variable numbers of transmission lines (NRC 1996a, 1999). Operation of the proposed units would not cause any additional impacts to avian species because there are no additional transmission corridors or additional transmission lines. Thus mitigation would not be warranted.

5.3.1.3 Important Terrestrial Species and Habitats

This section discusses the potential impacts of operation of the proposed Units 3 and 4 to important species and habitats, including Federally and State-listed species, ecologically important habitats (including wetlands), and commercially and recreationally important species.

5.3.1.4 Important Terrestrial Species and Habitats – Site and Vicinity

This section discusses important terrestrial species and habitat in the vicinity of the STP site.

Federally Listed Species

The Federally listed species that potentially occur on the STP site and in the vicinity are described in Chapter 2, Table 2-9 respectively. No designated critical habitat exists in the vicinity of the STP site. Of the four Federally listed species that are known to occur in Matagorda County, only two have been found on or in the vicinity of the site: the American alligator (*Alligator mississippiensis*), and the northern Aplomado falcon (*Falco femoralis septentrionalis*). The American alligator occurs on the STP site and uses the habitats found there (STPNOC 2008a). The Northern Aplomado falcon has been observed within 10 mi of the STP site (NAS 2009), but it is not known to use the habitats on the site. Operation of proposed Units 3 and 4 would not be expected to cause impacts to the Federally listed species that are not found on the site or in the vicinity.

The American alligator commonly occurs in the wetlands and open waters of the STP site. This species is listed as threatened by the FWS due to similarity of appearance to the endangered American crocodile (*Crocodylus acutus*). Alligators currently use aquatic and wetland habitats on the STP site and can be found adjacent to existing buildings where drainages contain water. Increased traffic and new roadways associated with plant operations may provide increased potential for alligators to encounter vehicles and be killed; however, the likelihood of significant mortality to the alligator population as a result of road kills is considered to be low. Because alligators are accustomed to the noise of vehicle traffic and the presence of workers on the STP site, it is unlikely that this species would suffer any significant adverse impacts onsite from operations of proposed Units 3 and 4.

The northern Aplomado falcon has been observed within 10 mi of the STP site, but is not known to nest in the area or to use habitats on the STP site. This species has been reintroduced to the Texas Gulf Coast over the past 15 years on Matagorda Island, which is more than 35 mi from the STP site (TPWD 2003). Operation of proposed Units 3 and 4 is not expected to negatively affect the falcon or to permanently displace this species from critical forage, resting, or nesting areas.

Operational Impacts at the Proposed Site

The American alligator is the only Federally listed species known to occur on the STP site and alligators have not been observed using the habitats at or immediately adjacent to the sites for proposed Units 3 and 4, and they are not expected to be negatively affected or permanently displaced from critical forage, resting, or nesting areas by operations. Thus, impacts of operations to Federally listed species are expected to be minimal.

State-Listed Species

Six bird species listed as threatened or endangered by the State of Texas have been observed recently on the STP site (STPNOC 2009a). The brown pelican (*Pelecanus occidentalis*) has been observed at the MCR and may use water bodies on the site for resting, foraging, and drinking. The bald eagle (*Haliaeetus leucocephalus*) is a resident on the site and nests within the STP site boundary. The white-faced ibis (*Plegadis chihi*), reddish egret (*Egretta rufescens*), peregrine falcon (*Falco peregrinus*), and white-tailed hawk (*Buteo albicaudatus*) have been observed during the annual Christmas Bird Count (NAS 2009).

Brown pelicans nest within Matagorda Bay and the Gulf Intracoastal Waterway (GIWW), which is within 10 mi of the site. Brown pelicans are a relatively recent visitor to the STP site. Brown pelicans would be expected to avoid habitats immediately adjacent to the proposed Units 3 and 4 because of increased noise levels and human and vehicle activities. Brown pelicans appear to be using the water features found on the STP site, including the MCR and Colorado River, which are generally distant (greater than 1000 ft) from the proposed units. Brown pelicans may avoid that region of the MCR that is closest to the proposed mechanical draft cooling towers for proposed Units 3 and 4 because of operational noise and increased activity. However, because the MCR is quite large and other aquatic habitats are readily available, no significant impact is likely to occur to pelican behavior or resting and feeding patterns.

None of the other State-listed species (Chapter 2, Table 2-10) were observed using the habitats immediately adjacent to the proposed Units 3 and 4 during recent ecological surveys (ENSR 2007a). The bald eagle nest is located more than a mile from the power blocks and cooling towers (STPNOC 2009a). The white-faced ibis and reddish egret were observed using wetlands on the STP site and would not be expected to use or forage in the grassland and disturbed habitats that are adjacent to proposed buildings and the cooling towers. White-tailed hawks have been observed on the STP site and potentially use a variety of the habitats found on the STP site for hunting and resting. However, no nest sites are known to occur in the vicinity of the proposed units. Peregrine falcons could fly over the STP site during spring migration from Mexico and might hunt in some habitats onsite. Noise levels associated with operations of cooling towers and human presences and activities would likely cause these birds to avoid the immediate vicinity of the towers and power blocks.

These six bird species are not expected to be negatively affected or permanently displaced from critical forage, resting, or nesting areas by operations of the proposed Units 3 and 4. Thus, impacts of operations to State-listed species are expected to be minimal.

Ecologically Important Habitats—Site and Vicinity

No areas designated as "critical habitat" for threatened or endangered species, State or Federal parks, wildlife refuges, preserves, or wildlife management areas occur on or immediately adjacent to the STP site. A number of palustrine emergent and palustrine scrub – shrub wetlands are located on the STP property around the proposed facilities. All of the wetland areas are more than 1300 ft from the proposed mechanical draft cooling towers for proposed Units 3 and 4 and, thus, would not be likely to be affected by salt deposition above the 8.9 lb/ac/mo threshold. No fogging or icing are estimated to occur, and would not be expected to negatively affect wetland habitats on the site. Operations are not expected to adversely affect any of the three wildlife refuges that are near the STP site. The Clive Runnells Mad Island Marsh Preserve and the Texas Parks and Wildlife Department (TPWD) Mad Island Wildlife Management Area (WMA) are more than 3 mi south of the STP site and would not be affected by noise, traffic, salt drift, fogging, or icing. The Big Boggy National Wildlife Refuge is approximately 9 mi from the site and would not be likely to be affected by operations of the proposed units. In summary, operation of proposed Units 3 and 4 would be expected to have minimal impacts to important habitats on the STP site or in the vicinity.

Commercially and Recreationally Important Species—Site and Vicinity

Game species such as white-tailed deer (*Odocoileus virginianus*), feral pigs (*Sus scrofa*), eastern cottontail (*Silvilagus floridanus*), swamp rabbit (*S. aquaticus*), mourning doves (*Zenaida macroura*), and many different species of waterfowl are common inhabitants of the STP site. Potential impacts of operating proposed Units 3 and 4 include increased noise levels near the cooling towers that may cause these wildlife species to avoid the immediate area and increased activity and traffic that also would cause wildlife to avoid the habitats immediately adjacent to the proposed units. Drift, fogging, and icing are expected to cause negligible or no impacts to habitats and would not be expected to affect important game species. Although animals may avoid habitats adjacent to the new units during operations, the STP property contains large expanses of aquatic and terrestrial habitat where these species would likely relocate. Thus, operational impacts to commercially and recreationally important species would be minimal, and no mitigation would be warranted.

5.3.1.5 Important Terrestrial Species – Transmission Lines

Five existing transmission lines would be required to support the proposed Units 3 and 4. Federally and State-listed species from both Matagorda and Wharton Counties were considered in the review.

Federally Listed Species

In the event that threatened or endangered species are found within the transmission line corridors, established procedures (AEP 2009) would be followed including procedures outlining the process of communicating with Federal agencies. No occurrences of Federally listed species have been reported along any of the transmission corridors (STPNOC 2009a). Because only existing corridors would be used for transmission of power generated by proposed Units 3 and 4, no additional impacts would be expected to occur to any Federally listed species from operation and maintenance of transmission lines and corridors associated with the proposed units.

State-Listed Species

State-listed species that occur within or adjacent to the transmission corridor that would be upgraded to support proposed Units 3 and 4 include the bald eagle and the State species of concern, coastal gay-feather (*Liatris bracteata*). Vegetation management activities along the ROWs are not likely to affect these species. Because only existing corridors would be used for transmission of power generated by proposed Units 3 and 4, no additional impacts would be expected to occur to any State-listed species from operation and maintenance of transmission lines and corridors associated with the proposed units.

Commercially and Recreationally Important Species

Transmission corridors that would transmit power generated from the proposed units travel through a variety of habitats that support large and small game as well as waterfowl species. Because no new transmission corridors are planned to support proposed Units 3 and 4, no additional impacts would be expected to occur to any commercially or recreationally important species as a result of operations of the proposed units.

Important Habitats

No areas designated by the FWS as “critical habitat” for threatened or endangered species occur on or immediately adjacent to existing transmission ROWs associated with existing STP Units 1 and 2 and proposed for use with proposed Units 3 and 4. None of the transmission lines cross State or Federal parks, wildlife refuges, preserves, or wildlife management areas. The impacts of transmission line corridor maintenance on floodplains and wetlands were evaluated in the GEIS for license renewal (NRC 1996a, 1999). The impacts were found to be of small significance at operating nuclear power plants, and these included transmission line corridors of variable widths. Because no new transmission corridors would be required for operation of the proposed new units, the potential impacts of maintaining existing corridors would be minimal.

5.3.1.6 Terrestrial Monitoring

No monitoring of terrestrial ecological resources has been required at the STP site or along its associated transmission ROWs since the MCR was filled, and there is no ongoing ecological monitoring of these resources. Because the potential impacts of operations of STP 3 and 4 on terrestrial resources would be minimal, STPNOC does not propose any additional monitoring during operations (STPNOC 2009a)

5.3.1.7 Summary of Terrestrial Ecosystems Impacts

The potential impacts of operating the proposed new units on vegetation, birds, and shoreline habitat are likely to be minimal. The potential impacts of operation and maintenance of transmission lines and corridors on terrestrial resources are considered minimal, assuming BMPs are followed.

The review team considered the potential terrestrial ecological impacts of operating new generation facilities at the STP site including the associated heat dissipation system, transmission lines, and associated maintenance. Given the information provided by the applicant, interactions with State and Federal agencies, the public scoping process, and NRC's own independent review, the review team concludes the impacts from operation of the new facilities and associated transmission line corridors would be SMALL, and additional mitigation would not be warranted.

5.3.2 Aquatic Impacts

This section discusses the potential impacts of the operation of the proposed Units 3 and 4 on the aquatic ecosystem in the onsite water bodies, the Colorado River and operation and maintenance of the transmission lines. The operation of proposed Units 3 and 4 would directly affect the aquatic resources in the Colorado River and MCR. Indirectly, the operation of proposed Units 3 and 4 would affect the aquatic resources in onsite drainage areas, Little Robbins Slough, and Matagorda Bay.

5.3.2.1 Aquatic Resources – Site and Vicinity

Sloughs, Drainage Areas, Wetlands, and Kelly Lake

Impacts on aquatic resources in the onsite water bodies, (e.g., the sloughs, drainage areas, wetlands, and Kelly Lake) from operation activities associated with proposed Units 3 and 4 would primarily be associated with stormwater drainage. The extensive drainage system already on the STP site would be modified during site preparation and development of the proposed units. The SWPPP that would be approved by TCEQ for implementation during site preparation and development would require reestablishing drainage patterns and other permanent measures to manage stormwater upon completion of proposed new units (STPNOC 2009a).

The other potential impact on aquatic resources during operation is from the release of water from the MCR into drainage areas onsite, including Little Robbins Slough, and to the south of the site. Water from these relief wells is discharged to a surface water ditch that surrounds the MCR and flows away from the reservoir through the site's natural drainage features (STPNOC 2009a). As discussed in Section 5.2.3, water from the MCR is lost through seepage to groundwater and to the 770 pressure-relief wells located in the above-grade dike surrounding the MCR. While the volume of seepage to the onsite areas and the offsite areas is difficult to estimate based on the available water monitoring measurements, water constituents that are from the operation of Units 1 and 2, notably tritium, in the groundwater, relief wells, and Little Robbins Slough confirms the connection of seepage from the MCR (STPNOC 2009a). As STPNOC increases the water level in the MCR from 47 to 49 ft., there would be an incremental increase in water seepage to the onsite waterbodies and to the wetlands south of the site. Sections 2.3.3.1 and 5.2.3.1 discuss the water quality of the MCR. While the MCR water contributes flow to these onsite water bodies, the water quality of the MCR would be monitored and maintained such that the MCR water would not contribute to the degradation of these onsite water bodies. Water quality monitoring during the 2007-2008 aquatic ecology studies in the MCR showed that the salinity (a surrogate for dissolved solids) was on average 1.6 parts per trillion (ppt) (ENSR 2008a). As discussed in Section 2.4.2, the aquatic biota in the onsite drainage system and Little Robbins Slough are generally tolerant of saline waters and would not likely be affected by seepage from the MCR.

The review team concludes that, based on the use of stormwater systems comparable to that currently used for the STP site and water quality conditions in the MCR currently supporting diverse aquatic community, the impacts to onsite water bodies from the operation of the proposed Units 3 and 4 would be minimal.

Colorado River and MCR

<u>Water Intake and Consumption</u>

For aquatic resources, the primary concerns related to water intake and consumption are the impacts related to the relative amount of water drawn from the cooling water source (Colorado River and MCR) and the potential for organisms to be impinged on the intake screens or entrained into the cooling water system. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the RMPF on the Colorado River and the circulating water intake structure (CWIS) on the MCR (69 FR 41576). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (69 FR 41576). Entrainment occurs when organisms are drawn through the RMPF from the Colorado River into the MCR or through the CWIS in the MCR into the proposed Units 3 and 4 cooling system. Organisms that become entrained are normally relatively small benthic, planktonic, and nektonic (organisms in the water column) forms, including early life stages of fish and shellfish, which often serve as prey for larger organisms (69 FR 41576). Due to the use of the MCR at STP, entrained organisms from the Colorado River have survived the stresses of the intake system and colonized the MCR, creating a rather diverse aquatic community that is removed from the rest of the ecosystem in the region. However, as entrained organisms pass through the CWIS into the plant's cooling system, they are subject to mechanical, thermal, and toxic stresses, and survival is unlikely.

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 water body greatly influences the degree to which impingement and entrainment affect the aquatic biota. The 7000-ac MCR is considered a closed-cycle cooling system since the water in the reservoir continues to circulate from the MCR, into the plant, and back again. Water loss from the MCR through evaporation, seepage, and discharge is made up from the Colorado River. Closed-cycle recirculating cooling water systems can, depending on the quality of the makeup water, reduce consumptive water use by 96 to 98 percent of the amount that the facility would use if it employed a once-through cooling system (69 FR 41576). The water withdrawal rate for the MCR to operate Units 1 and 2 has probably been lower compared to other cooling water system designs after the MCR was filled, and the impingement, entrainment, and entrapment of aquatic organisms may also be lower compared to other cooling systems. Typically, organisms entrained by a power plant are assumed to be killed within the plant system. However, the survey of the MCR in 2007 and 2008 indicates that many individuals of numerous species have survived entrainment at the RMPF and are living in the MCR. While these organisms have survived entrainment of the pumps at the RMPF, overall the entrainment has led to a loss of the organisms in the Colorado River and these organisms no longer contribute to the richness of river community.

Location of the intake system is another design factor that can affect impingement and entrainment. The RMPF is located on the Colorado River, which is designated as a tidal stream and includes essential fish habitat (EFH) for Federally managed fish and shellfish species (GMFMC 2004). Locating intake systems in such areas with sensitive biological communities is generally considered a negative factor in protection of aquatic life (69 FR 41576). However, the segment of the river where the RMPF is situated (Segment C) has fewer organisms and less species richness than the downstream segment of the river, closer to the GIWW (Segment A) (ENSR 2008b). During 2007-2008, 18 percent of the total number of individuals collected were from Segment C as compared to 44 percent from Segment A; and 42 species were collected from Segment C as compared to 62 species from Segment A (Figures 2-23 and 2-24 in Chapter 2).

Operational Impacts at the Proposed Site

Operation of the RMPF is based on the need for makeup water in the MCR, and Section 5.2.2.1 discusses the conditions when STPNOC would pump water from the Colorado River into the MCR. One of these conditions is pumping makeup water during periods of high flows in the Colorado River. Pumping at high-flow conditions minimizes impacts to aquatic organisms in the water column because the organisms are likely to remain in the river flow and not likely to be caught in the influence of the water being pumped into the RMPF located on the shoreline (STPNOC 2009a, 2008a, b). During the 2007-2008 aquatic ecology studies in the Colorado River, there was an inverse relationship between high river flow conditions and low densities of fish (as expressed in the catch per unit effort) (ENSR 2008b; STPNOC 2008a, b). Salinity can be an indicator of an influx of estuarine species moving up the river from the GIWW. STPNOC has stated that the salinity of the water being pumped would be monitored, and when the pumped water exceeds 3 ppt, the traveling screens would be monitored for increased impingement. The operation of the fish-return system at the RMPF is a function of river flow and the amount of debris and organisms removed in the screen wash discharge (STPNOC 2008a).

Location of the RMPF and the intake screens on the shoreline of the Colorado River can minimize entrainment and entrapment (as a function of minimized entrainment). The RMPF was designed to position the traveling intake screens in parallel with the flow in the river (69 FR 41576), or “flush” to the river bank with no projecting structures that create eddies and countercurrents that would cause entrapment (NRC 1986; STPNOC 2009a). Most organisms likely to be entrained or entrapped would occur in higher densities in the main river channel and less likely to be removed from the river by an intake facility sited on the shoreline. Entrapment of aquatic organisms in a restricted area (e.g., in the sedimentation basin between the RMPF intake screens and the pumps and in the MCR) can lead to congregation of the organisms, and if environmental conditions change, the organisms may be harmed. Under such conditions, entrapment can increase impingement of aquatic organisms.

Another factor, the intake design through-screen velocity, greatly influences the rate of impingement, entrainment, and entrapment of organisms at a facility. The higher the through-screen velocity, the greater the number of fish impinged, entrained, and entrapped. The Environmental Protection Agency (EPA) defines the through-screen velocity as the water velocity immediately in front of the screen, and the maximum design, through-screen velocity is 0.5 feet per second (fps) or less (69 FR 41576). STPNOC has determined that the RMPF has a maximum design approach velocity at the traveling screens of 0.5 fps based on a maximum pumping rate of approximately 538,000 gpm (STPNOC 2008b, 2009a). As discussed in Section 5.2.2.1, the review team independently calculated that the velocity directly in front of the screens was dependent on the withdrawal rate of the RMPF; for withdrawals of 60 and 1200 cfs, the average velocity in front of the screen would be 0.025 and 0.49 fps. The resulting low through-screen velocity reduces the probability of impingement because most fish can swim against such low flows to avoid or swim off of intake streams.

Other design features at the RMPF would also help to reduce impingement mortality (69 FR 41576). In front of the traveling water screens are coarse trash racks (with 4-in. spacing between bars) and stop log guides that allow fish that approach the RMPF to have free passage, reducing entrapment and impingement. The traveling existing screens have a 3/8-in. mesh, and operate intermittently to coincide with the intermittent withdrawal of river water. STPNOC has not committed to a type of screen for refurbishment or replacement so the review team is assuming that the mesh size of any new or refurbished screens would have a mesh size less than or equal to 3/8-in. Fish collected on the traveling screens can be returned to the river via the sluice and a fish bypass pipe. The discharge point of the fish bypass system is at the downstream end of the intake structure, approximately 2 ft below normal water elevation (STPNOC 2009a). During high-flow conditions, the accumulation of debris on the traveling screens is too high to open the fish bypass system, and screenwash discharge is directed to the sluice trench catch baskets rather than back to the river. Generally, the fish bypass system is closed when river flows are greater than 4000 cfs, and the system is occasionally closed when flows are greater than 2000 cfs (which has occurred from 2001-2006 only 7 percent of the time) (STPNOC 2009a, 2008a, b). Impingement mortality can be reduced based on the procedures for operating the RMPF. Operators at the RMPF are required to monitor for increased impingement rates on the traveling screens, and factors like river flow, salinity, and observations of impingement are used to determine whether pumping should continue (STPNOC 2009a, 2008a, b).

Entrainment and impingement studies were conducted as part of the licensing process for STP Units 1 and 2, and were discussed in the Final Environmental Statement (FES) for operation (NRC 1986). Studies conducted in 1975-1976, prior to construction of the RMPF, estimated entrainment of the larvae of the most common fish and crustacean species during an 8-month period at Station 2 on the Colorado River (Figure 2-21 in Chapter 2): 3.37×10^6 Atlantic croaker (*Micropogonias undulatus*), 1.35×10^6 Gulf menhaden (*Brevoortia patronus*), 1.32×10^6 blue crab (*Callinectes sapidus*), 5.44×10^5 bay anchovy (*Anchoa mitchilli*) and 1.1×10^4 shrimp (undetermined species) larvae. There was a seasonal fluctuation of the species collected monthly during the study. Atlantic croaker larvae were entrained mainly from November through January. From January through April 1976, Gulf menhaden larvae were the predominant species. Anchovy eggs and larvae occurred sporadically throughout the sampling year. Highest numbers of juvenile and megalops of blue crab were collected in October, but there were increased numbers taken in September and April (NRC 1986).

The entrainment studies in 1983-1984 were conducted during the filling of the MCR (NRC 1986). Different species of fish and crustaceans were collected compared to the studies in 1975-1976. The primary fish species collected in the vicinity of the plant intake were bay anchovies, followed by darter goby (*Ctenogobius boleosoma*) and naked goby (*Gobiosoma bosc*). The most common crustacean collected were the zoea larval stage of the Harris mud crab (*Rhithropanopeus harrisii*), followed by the zoeal and postlarval stages of the ghost shrimp

(*Callianassa* spp.). Postlarval stages of the brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*) and the juvenile stages of the blue crab were collected only sporadically in river samples. The variety of species collected illustrates that the lower Colorado River is utilized as a nursery area by estuarine and marine organisms (NRC 1986). The seasonal variations in species and numbers of individuals found in these studies emphasize the complexity of the aquatic environment in the Colorado River and in the vicinity of the RMPF. These variations are a function of the species' reproductive periods, changes in the flow of the river, the mixture of freshwater coming down the river, and tidal influence of the Gulf.

The FES for operation (NRC 1986) concluded that entrainment losses for the species that were collected during the two studies would not constitute a significant impact to their respective populations for several reasons. They estimated that the actual entrainment losses would probably be near a median value of about 10 percent of the organisms passing the RMPF. This value represents the loss of organisms in the influence of the tidal flow in the river and does not represent the entire populations of those species in the Colorado River. The organisms that use the lower Colorado River as a nursery also use many other tidal river systems along the Texas Gulf coast, and the area influenced by the RMPF is not unique. The most common species collected in the entrainment studies were bay anchovy, Gulf menhaden, Atlantic croaker and blue crab; the species are ubiquitous and abundant along the Texas and Gulf coast. The reproductive potential (fecundity) for the species collected during the entrainment studies is high (e.g., one female blue crab can produce over her lifetime at least as many larvae as were projected to be entrained by the studies). And finally, the most makeup water withdrawal would occur during high river flow conditions when tidal flows are low at the RMPF, which is when the concentrations of estuarine and marine organisms would be lowest (NRC 1986).

Impingement studies were conducted in 1983-1984, while river water was being pumped into the MCR. The study reported that the highest numbers of organisms impinged over a 30-minute collection period for two intake screens at the RMPF were 64 organisms in July and 13 organisms in September. The number of organisms that could be impinged for all 24 screens at the RMPF and for two pumping velocities (85 cfs and 260 cfs) was extrapolated to be from 156 to 768 individuals over a 30-min period. Gulf menhaden was the most common species impinged, which relates to their small size (and thus, relatively low swim speed), dense schooling nature and high relative abundance at the site. The report estimated that Gulf menhaden could constitute about 65 percent of the total number of all individuals impinged at the RMPF. The other major species that could be impinged include: Atlantic croaker (16 percent), bay anchovy (10 percent) and mullet (8 percent, undetermined species). The remaining species that were collected during the impingement study were expected to make up less than 1 percent of all the individuals impinged. This impingement study has been the only study conducted to date in the Colorado River to report collection of the commercially important pink shrimp (*Farfantepenaeus duorarum*), and during that study, less than 10 individuals were collected over six months (NRC 1986).

The FES for operation concluded that impingement losses would have only a minor effect of the biota of the Colorado River. The reasons cited for the minor impacts due to impingement included those mentioned above for perspective on entrainment losses (e.g., the species are ubiquitous and the number of similar habitat areas along the Texas Gulf coast). Additional reasons cited included design elements of the RMPF that should reduce impingement losses. For example, the mounting of the intake screens on the RMPF flush with the shoreline and without protruding sidewalls into the flow of the river would reduce entrapment and concentration of organisms ahead of the screens. Also, the location of the screens would decrease eddy currents downstream and allow free passage of the organisms into the main channel. Trash racks and the fish handling and bypass system were other features cited that would reduce impingement losses. Finally, the location of the intake structure was designed to use the upper stratum of the river water that is primarily freshwater flowing downstream in the river and not the lower portion of the river in the salt wedge where the estuarine organisms are most common (NRC 1986).

Since the impingement and entrainment studies for the RMPF were conducted, the Corps completed the Mouth of the Colorado River Project, diverting the Colorado River flow from the Gulf into Matagorda Bay (Wilber and Bass 1998; Corps 2005). As discussed in Section 2.4.2.1, the diversity of aquatic species has increased since the diversion of the river. Of the most common species impinged during the 1983-1984 studies (NRC 1986), Gulf menhaden, striped mullet (*Mugil cephalus*) and Atlantic croaker continue to be the most common species of fish collected around the RMPF, and probably are the most common species impinged today for the same reasons speculated above. The lack of studies over time in the lower Colorado River makes it difficult to conclude if the aquatic communities are stable based on the changes in the river system and the relationship of the species distributed in the region to the flow of freshwater and tidal changes. However, the results and conclusions of the earlier impingement and entrainment studies mentioned above are still applicable because the design features of the RMPF that would minimize losses of organisms would not change with the addition of Units 3 and 4.

The survey of fish and shellfish in the Colorado River in 2007-2008 (ENSR 2008a) indicates that the river has a large population of fresh- and saltwater species, with high species richness and a strong dynamic ecosystem. Impingement, entrainment, and entrapment from current operations of the RMPF have removed individuals from the river environment. A survey of only one year provides limited information about the robustness of the populations of aquatic organisms in the river. However, based on the limited information from the latest survey and what is known about the design of the RMPF, the operation of the RMPF does not appear to have changed the populations of the species currently found in the river.

Based on the use of the MCR as closed-cycle cooling, frequency of pumping water, location of the RMPF, pumping with low through-screen velocity, and the presence of trash racks, traveling screens and fish return system, the review team concludes that impacts from impingement, entrainment, and entrapment for proposed Units 3 and 4 would be minor.

Cooling Water Discharge System

The potential impacts to the Colorado River from the operation of the proposed Units 3 and 4 would include effects of heated effluents on aquatic resources, chemical impacts and physical impacts from discharge of the MCR.

Thermal Impacts. The discharge from the MCR would be directly into the Colorado River. Sections 3.2.2.2 and 5.2.3.1 discuss the location, design, and operational parameters for the discharge structure. Thermal impacts to aquatic organisms include heat stress, cold shock, and the potential for creating preferred conditions for some invasive nuisance species.

Heat Stress. Thermal conditions influence all aspects of aquatic ecology, which includes an array of processes: feeding, metabolic processes, growth, reproduction, development, distribution, and survival (Coutant 1976). In a general sense, biota are often able to persist (e.g., grow, reproduce, survive) under a range of thermal conditions. While many species exhibit similar tolerance for temperature regimes, growth and survival are linked to optimal thermal conditions that are driven by species-specific requirements (Kellog and Gift 1983). The thermal tolerance for aquatic organisms is defined in different ways. Some definitions relate to the temperature that causes fish to avoid the thermal plume, other definitions relate to the temperature that fish prefer for spawning, and others relate to the temperatures (upper and lower) that may cause mortality. The effects of thermal conditions on aquatic biota can occur at multiple scales. Spatially, thermal pollution may exist at the site level, or may perpetuate to include larger extents (i.e., reach scale, watershed). Temporally, conditions resulting in water temperatures that exceed ambient levels may be more pronounced during certain time periods (i.e., winter). Finally, the consequences of thermal pollution within aquatic ecosystems may be confined to individual species, and depending on ecosystem conditions, may encompass a population-level response (Coutant 1976).

In the operating policy for the MCR, STPNOC stated that they would discharge water from the MCR into the Colorado River when they are pumping water at the RMPF (SPTNOC 2009f). STPNOC would discharge water from the MCR when the specific conductivity of the water in the MCR exceeds 3000 μS/cm. They would pump makeup water from the Colorado River under conditions specified by the LCRA contract. The conditions that STPNOC would consider when planning to discharge from the MCR include: when the MCR water level is between 40 and 49 ft MSL, when the river water conductivity is less than 2100 μS/cm, and when the river flow at the discharge facility is greater than or equal to 2500 cfs. STPNOC revised these conditions and indicated that they might discharge MCR water when the river flow is as low as 800 cfs, as permitted by their TPDES permit (TCEQ 2005; STPNOC 2009g). If all these conditions are met, STPNOC would then only discharge when the MCR water had a conductivity greater than or equal to 3000 μS/cm. In addition to the river flow conditions, the TPDES permit limits the amount of discharge from the MCR to 12.5 percent of the flow in the river, limits the daily average discharge temperature to less than or equal to 95°F, and requires whole effluent toxicity testing (biomonitoring) of the MCR water being discharged (TCEQ 2005).

Discharge of the MCR water into the Colorado River would create a thermal plume that could create stressful conditions for the aquatic organisms in the vicinity of the plume. Highly mobile aquatic species can detect changes in the water column and avoid the area all together or search for a passage around the temperature change. Section 5.2.3.1 discusses the characteristics of the thermal plume in the river during discharge of the MCR water, including the likely water temperature increases with the addition of two new units, the likely duration and frequency of discharge, and the dimensions of the thermal plume. STPNOC has only discharged into the Colorado River once during operation of Units 1 and 2. The information describing the thermal plume during four-unit operation is based on modeling bounding conditions to support the water quality in the MCR. No information was provided on the most likely time of year for discharging water (STPNOC 2009a). STPNOC and the review team used a conservative approach in using CORMIX to analyze the thermal plume that could be created during discharge of MCR water into the Colorado River using known conditions of the river environment as well as water and air temperatures in the vicinity of the discharge. The maximum thermal plume dimensions would be during the greatest difference in temperatures between the MCR water and the water in the river (20.4°F), highest MCR discharge rate through seven ports (44 cfs per port, for a total of 308 cfs discharge rate), and the minimal flow in the Colorado River where the discharge would be equal to 12.5 percent of the total flow in the river (2464 cfs). Under these conditions, there is always a portion of the river that remains at ambient water temperature allowing for passage of aquatic organisms on the bottom of the river and throughout much of the water column.

During the maximum expected thermal plume dimensions, the thermal plume that is 5°F above ambient conditions is attached to the bottom of the river from the last port of the discharge pipe to 120 ft downstream, and the plume extends approximately 25 percent across the width of the river. In that part of the river the benthic invertebrate species (e.g., grass [*Palaemonetes pugio*], white, and brown shrimp) would be able to pass along the bottom of the river on the far side of the discharge structure without passing through the elevated temperature plume. Approximately 120 ft downstream of the last port of the discharge pipe, the plume becomes buoyant and rises to the surface of the river. The surface of the river is predicted to have an elevated temperature across the entire width from approximately 1060 ft from the last port of the discharge pipe to about 4400 ft downstream from the ports. As the plume rises to the surface and extends from bank to bank, there would be a portion of the water column that would remain at ambient river temperatures that would allow foraging fish (e.g., Gulf menhaden, black drum [*Pogonias cromis*], spotted seatrout [*Cynoscion nebulosus*], striped mullet) to move up and downstream.

As discussed in Section 2.4.2.1, the region of the river that would be affected by the thermal plume corresponds with Segment B of the 2007-2008 aquatic ecology survey (Figures 2-23 and 2-24). More than a third of all the organisms collected in the 2007-2008 study were collected in this portion of the river, and represented 83 percent of the total number of species collected. Thus, the thermal conditions of the discharge plume would create conditions that the highly mobile aquatic organisms could detect and would likely avoid, remaining above or below the discharge plume. Less mobile organisms, such as eggs, larvae, and mollusks, would be adversely affected by the thermal discharge in localized areas. The review team also performed additional CORMIX simulations and demonstrated that the size of the thermal plume would be smaller than that discussed above if the discharges from the ports were reduced to half their capacity and river flow increased, as well as if the discharges from the ports were at full capacity and the river flow was increased.

The review team evaluated the possibility that the thermal plume generated by discharging the MCR water into the Colorado River could coincide with poor water quality for aquatic organisms in the river at the discharge structure. ENSR (2008b) measured water quality, e.g., salinity and dissolved oxygen, at various levels in the water column while collecting fish and shellfish. As discussed in Section 2.4.2, there are times of the year that ENSR reported the water at the bottom of the river was anoxic or low in dissolved oxygen (hypoxic, or dissolved oxygen less than 2 mg/L) when the salinity was high. The conditions were most often observed at or below the mid-point of the water column. The combination of the maximal thermal plume and poor river water conditions (e.g., high salinity and low dissolved oxygen) would force aquatic species to avoid the area completely. STPNOC compared the results reported by ENSR (2008b) and the flow in the river at the nearest gauging station at the time of the water sampling, and determined that during river flows greater than 800 cfs the salinity at the bottom of the river ranged from 0 to 18.7 ppt (STPNOC 2008c). The review team found that there was only one occurrence during 2007-2008 when the dissolved oxygen was less than or equal to 2 mg/L during river flows greater than 800 cfs. The salinity at this sampling time was 17.5 ppt (ENSR 2008b). Although there is limited information available on river flow and water quality, the STPNOC discharge operating policy complies with requirements in their TPDES permit and the LCRA contract, and would likely result in infrequent opportunities for discharging from the MCR when the combined effect of the thermal plume with river conditions would harm the aquatic community.

STPNOC estimated that the need for discharging would likely be as frequent as once every 11 days, and could be continuous for as much as 75 days. The most common juvenile and adult species collected in Segment B were Gulf menhaden, grass shrimp, black drum, white shrimp, and striped mullet. The juveniles and adults of these species would likely pass around or below the thermal plume as they move through the affected area while foraging. However, the thermal plume could affect the viability of eggs and larvae that occur in the warmer waters. Entrainment studies conducted in 1975-1976 indicated that these species were present as eggs and larvae in the vicinity of the RMPF, and that the numbers of early life stages changed over the seasons corresponding to the reproductive cycle of these species (from January through April for Gulf menhaden). However, the overall impact to these species from the effects of the thermal plume would likely be minor because these organisms have a high fecundity, and the number of organisms lost would be insignificant compared to their population in the lower Colorado River.

The review team concludes that the effects of the thermal plume on the aquatic community would often be minor. If STPNOC were to discharge MCR water creating a thermal plume in the river when water quality in the river was poor for aquatic organisms, there could be a detectable avoidance by aquatic organisms and loss of viability in the non-motile life stages of organisms in the affected region of the river. However, the foraging behavior and high fecundity of the aquatic organisms that have been reported in the area would indicate that the effects from the thermal plume and ambient river conditions is not expected to noticeably alter or destabilize important attributes at the population or ecosystem levels in the lower Colorado River.

Cold Shock. Another factor related to thermal discharges that may affect aquatic biota is cold shock. 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. This can occur when a power plant shuts down suddenly in the winter. Cold shock mortalities at U.S. nuclear power plants located in southern regions (where temperatures rarely decrease below freezing) are "relatively rare" and typically affect small numbers of fish (NRC 1996a, 1999). In the MCR, cold shock is not likely to occur because the temperature decrease from shutting down one unit is moderated by the heated discharge from the units that continue to operate. In the case that all units would be shut down at once, the potential for cold shock would exist although highly unlikely considering climate for the region (Section 2.9.1). Discharge from the MCR into the Colorado River would likely be as frequent as once every 11 days, and could be continuous for as nearly 75 days. These conditions would not be frequent enough to attract aquatic organisms to the thermal plume. Based on this analysis, the review team concludes the thermal impacts on the fish populations in the Colorado River due to cold shock would be negligible.

Invasive Nuisance Organisms. Thermal discharges may create an environment that is favorable to invasive nuisance organisms. Taxa such as *Corbicula*, giant salvinia (*Savinia moesta*), and *Hydrilla* have not been found in high densities in the Colorado River in the vicinity of STP (STPNOC 2009a). In 2008, the review team observed *Corbicula* shells on the shoreline of the river above the site but did not see any nuisance organisms at the RMPF in the screen racks or in the fish bypass system. The 2007-2008 survey of the MCR did not report any nuisance organisms in the reservoir or during impingement and entrainment studies at the CWS for existing Units 1 and 2 (ENSR 2008a). It is unlikely that the MCR discharge would become a contributor of nuisance organisms in the Colorado River because these species have not been reported in surveys of the MCR (ENSR 2008a), and the MCR discharge is likely to be infrequent.

Chemical Impacts. Other discharge-related impacts include chemical treatment of the cooling water. Discharges to the Colorado River would only occur from the MCR. Inputs to the MCR include makeup water from the river, precipitation, radioactive and nonradioactive effluents from the operation of the condenser and UHS for all units, and permitted chemical discharges from other operations (e.g., treated sanitary sewage and other effluents discussed in Section 3.4). In addition, stormwater and groundwater from building activities would also be discharged to the MCR. As discussed in Section 5.2.2.1, the most significant chemical changes in the MCR would be the concentration of total dissolved solids from the operation of the condenser and UHS.

STPNOC has an existing TPDES permit for the discharge of water from the MCR for outfall 001 (TCEQ 2005). The same permit would be used during operation of proposed Units 3 and 4 (STPNOC 2009a). STPNOC does not currently evaluate the water quality of the MCR in relation to permit conditions for chemical standards for the protection of aquatic life because they are not currently discharging to the Colorado River. The permit conditions also require evaluating acute and chronic effects on aquatic organisms from the MCR discharge prior to commencing discharge into the river.

The review team has determined that the impacts from chemical discharges to the Colorado River would be minimal if STPNOC performs the tests for protection of aquatic life required in its TPDES permit and meets all other conditions of the permit (TCEQ 2005). TCEQ could require additional monitoring based on these tests and with further modification of the discharge permit.

Physical Impacts. Physical effects from the operation of the blowdown discharge facility in the Colorado River could affect aquatic resources, particularly through scouring of aquatic habitat. The structure consists of seven 36-in. pipes, spaced 250 ft apart, and the pipes are directed 45 degrees from the downstream western shore of the Colorado River.

In the FES for construction, discharged-induced scouring of the seven-port diffuser was evaluated. Discharge rates through two to seven ports at a rate of 0 to 308 cfs were considered. NRC concluded that scouring would be limited to a few feet downstream of each port and would have no adverse impacts on the aquatic biota in the vicinity (NRC 1975). Since the discharge pipes have not been operated except for a test in 1997 (STPNOC 2009a) and the Colorado River in the vicinity of the pipes has not been dredged recently, the initial discharge of water would disturb the sediments in the area. The water would remain turbid for a period of time, and the suspended sediments would be dispersed downstream temporarily. Aquatic organisms in the scour area would be displaced, but the overall area of the river that would be physically affected by the discharge flow would be relatively small.

The review team has determined that physical impacts to the aquatic ecosystem from discharges to the Colorado River would be minimal. No further mitigation beyond permit requirements would be warranted.

Maintenance Dredging

STPNOC has stated that periodic dredging in the future would be conducted in front of the RMPF and barge slip. These activities are currently covered by existing permits with the Corps for the operation of Units 1 and 2. Dredging would remove benthic habitat and the organisms that are not highly mobile (e.g., mollusks). Organisms that can readily swim would likely avoid the area during dredging activities. After dredging activities, these areas would be recolonized by the aquatic community. Impacts from dredging on aquatic organisms would be minor.

5.3.2.2 Aquatic Resources – Transmission Lines

There are approximately 480 mi of existing, 345-kV transmission lines and associated corridors that would be used to transmit the power generated from proposed Units 3 and 4. The transmission corridors primarily pass through agricultural and rangeland regions with limited water features.

Operation and maintenance of the transmission lines for proposed Units 3 and 4 at STP would continue to be performed by the four transmission service providers currently providing those services (CenterPoint Energy, AEP, Austin Energy, and CPS Energy). Potential for impacts to aquatic resources in the transmission corridors is limited to maintenance activities and management of vegetation under the lines. Maintenance activities can lead to minor erosion and sedimentation associated with the vehicles traveling on access roads and use of equipment for maintaining the transmission system. Managing the vegetation under the lines can involve manual and mechanical methods for removal of growth. The transmission service providers also use chemicals along the transmission corridors, primarily herbicides for vegetation management. All service providers require chemical applicators to be trained in the safe use of herbicides and require supervisory personnel to hold Texas Department of Agriculture Commercial Pesticide Applicators licenses (STPNOC 2009a).

Minimal impacts to aquatic biota from operation and maintenance activities along the transmission corridors are expected. Effects from erosion and sedimentation in water bodies along the transmission corridors are likely to be temporary and negligible. Application of chemicals along the transmission corridors are expected to have minimal impacts to aquatic biota if application of the chemicals does not occur in or over water bodies and herbicides that are approved for use around aquatic biota are used. Access to lines and towers might result in temporary impacts to wetlands resulting from the placement of board roads for use with heavy equipment.

The review team concludes that the impacts of transmission line corridor maintenance activities on aquatic resources would not adversely affect aquatic ecosystems and that additional mitigation beyond that described above would not be warranted.

5.3.2.3 Important Aquatic Species and Habitats

This section describes the important aquatic species and habitats for the proposed Units 3 and 4 and associated transmission corridors (to the first substations). Commercially and recreationally important species are found onsite and in the vicinity of STP. In addition, there are important habitats in the vicinity of STP.

Commercial and Recreational Species

Activities associated with the operation of proposed Units 3 and 4 are primarily onsite and along the Colorado River at the STP site. Commercially and recreationally important species were discussed in Section 2.4.2.3. Those species that are found onsite (e.g., black drum and red drum [*Sciaenops ocellatus*]) are in water bodies that are not open to the public, e.g., in the MCR, and have limited ability to contribute to the populations found offsite. Impacts to those species would primarily be associated with stormwater drainage. As mentioned above, onsite water bodies would experience minimal impacts from stormwater drainage based on the implementation of BMPs as part of the site's SWPPP.

The top five most common species (Gulf menhaden, striped mullet, blue catfish (*Ictalurus furcatus*), Atlantic croaker, and white shrimp) collected in Segment C of the river are commercially and recreationally important species, and some of those individuals would likely be affected during pumping operations. All of these species have been collected in the MCR, indicating that the organisms were entrained by RMPF operations. However, all of these species have a high fecundity and are common to the Texas Gulf coast, and thus, the impacts of operating the RMPF would likely have negligible impacts on the populations of these species in the lower Colorado River.

Species with Designated Essential Fish Habitat

Section 2.4.2.3 and the EFH assessment in Appendix F describe the fish species with designated EFH in the vicinity of the STP site (Table 2-15): king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculates*), gray snapper (*Lutjanus griseus*), red drum, brown shrimp, pink shrimp, white shrimp, and Gulf stone crab (*Menippe adina*). Of the eight species, only red drum, brown shrimp, white shrimp, and pink shrimp have been collected during surveys of the river in the areas of the RMPF and MCR discharge structure (NRC 1975, 1986; ENSR 2008a, b). Gray snapper was collected in the Colorado River in the area closest to the confluence with the GIWW (ENSR 2008b). All of these eight species, except for the mackerel species and the stone crab, have been collected in the MCR (ENSR 2008a), indicating that the organisms have survived entrainment by RMPF operations.

STP Units 3 and 4 could affect species with designated EFH through operation of the RMPF and the discharge structure on the Colorado River as well as through maintenance dredging in front of the RMPF and at the barge slip. As described in the EFH assessment in Appendix F, operation of the proposed Units 3 and 4 could affect EFH for juvenile king mackerel; all life stages of Spanish mackerel, gray snapper, red drum, and Gulf stone crab; and larvae and juveniles of brown, pink, and white shrimp. Operation of the RMPF and discharge structure could create conditions in the river that juvenile king mackerel or their prey would have to avoid. However, since STPNOC does not plan on operating these facilities continuously, the adverse effects would be relatively short in duration. In addition, maintenance dredging would be infrequent and limited in area (no more than 3 ac), and juvenile king mackerel could avoid the area easily. Therefore, operation of Units 3 and 4 would have minimal adverse effect on EFH for juvenile king mackerel.

Operation of Units 3 and 4 would likely affect Spanish mackerel, gray snapper, and red drum similarly. The eggs and larvae of Spanish mackerel, gray snapper, and red drum could be entrained during pumping at the RMPF, and the organisms would be lost from the river environment. Discharge of MCR water could create thermal and chemical characteristics of the river water and affect the viability of the eggs and larvae of these species. However, operations of the RMPF and discharge system are not continuous, and their effects would be relatively short in duration. Maintenance dredging at the RMPF could remove or damage some eggs and larvae of these species. The juvenile and adult Spanish mackerel, gray snapper, and red drum and their prey could avoid the affected areas of the Colorado River during operation of the RMPF and discharge structure as well as during maintenance dredging. Overall, operation of Units 3 and 4 would have minimal adverse effect on EFH for all life stages of Spanish mackerel, gray snapper, and red drum.

Avoiding operation of facilities on the Colorado River associated with Units 3 and 4 could be difficult for larvae and juveniles of brown, pink, and white shrimp. Larvae and juveniles could be entrained during pumping at the RMPF. While juveniles and adults could avoid discharge of MCR water, thermal and chemical characteristics of the plume could affect the viability of larvae. Maintenance dredging would also remove larvae, juveniles, adults, and their habitat in the dredged areas, turbidity and sedimentation could also temporarily remove habitat. Therefore, construction and operation of the proposed Units 3 and 4 at the STP site could affect shrimp in the area and are likely to have a greater than minimal but less than substantial adverse effect on EFH for the brown, pink, and white shrimp larvae and juveniles.

Juvenile and adult stone crabs would be affected similarly to those life stages of the shrimp by operation activities in the Colorado River. While eggs are maintained by the female beneath her abdomen until hatching, once the zoea larvae and other larval stages of the stone crab are pelagic, they could be entrained by pumping at the RMPF and could be affected by thermal and chemical changes in the river water through discharge of MCR water. However, stone crabs of any life stage have not been reported in any of the surveys of the Colorado River in the vicinity of the STP site (NRC 1975, 1986; ENSR 2008b). Therefore, operation of Units 3 and 4 would have minimal adverse effect on EFH for all life stages of stone crab.

Federally and State-Listed Species

All the Federally listed aquatic species in Matagorda County are those listed by National Marine Fisheries Service (NMFS) (Table 2-14). The most likely species to be in the area are loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles. None of these turtle species have been observed to travel beyond Matagorda Bay into the Colorado River. Operations of the RMPF, discharge structure and any maintenance dredging around the RMPF and the barge slip are not likely to affect these species.

There are three State-listed species in Matagorda County that are listed as threatened: blue sucker (*Cycleptus elongates*), smooth pimpleback (*Quadrula houstonensis*), and Texas fawnsfoot (*Truncilla macrodon*). The blue sucker would be located in the Colorado River and not likely be in the onsite water bodies. This species was not collected during the aquatic surveys of the river in the 1970s, 1980s, and 2007-2008. Blue suckers move upstream in the spring to areas with riffles for spawning. Since spawning habitat is not within the vicinity of the STP site, operations of proposed Units 3 and 4 would not likely affect eggs and larvae of the species. Impingement of juvenile or adult blue suckers is unlikely because they prefer to forage in the deeper channels of the river and would not likely be drawn to the intake screens because they are strong enough to swim out of the current created by the RMPF when it is operating (TPWD 2009). They would also be able to avoid the thermal plume from the MCR discharge.

The two State-listed threatened freshwater mussels in Matagorda County are likely to be found in different water bodies at STP. The smooth pimpleback could be found in the MCR and the Colorado River in the vicinity of STP since the species prefers small to moderate rivers as well as reservoirs, tolerates the flow regimes of the MCR and river, and prefers the type of substrate found in the MCR and river. However, since the species does not tolerate dramatic water level fluctuations, it is not likely to be found in the onsite water bodies. The smooth pimpleback has not been reported in the surveys of aquatic organisms at the STP site (NRC 1975, 1986; ENSR 2007b, 2008a, b). Operation of the RMPF would likely not affect the adult lifestage of the mussel. There is no information on the reproduction of the smooth pimpleback (e.g., glochidia are unreported). Mussels are tolerant of temperature changes and thus the thermal plume from discharging the MCR is not likely to affect the species (Howells et al. 1996; TPWD 2009).

Texas fawnsfoot has not been reported in the surveys of aquatic organisms at STP (NRC 1975, 1986; ENSR 2007b, 2008a, b). What little is known about the species is that it has been found in river systems similar to the Colorado River and in flowing rice irrigation canals, but the Texas fawnsfoot has not been found in impoundments. Thus, Little Robbins Slough and the Colorado River might be suitable habitat for the species. In addition, the ponds and drainage areas that are located along the transmission corridor could be appropriate habitat for the Texas fawnsfoot. Operation of the RMPF would likely not affect the adult lifestage of the mussel. There is no information on the reproduction of the Texas fawnsfoot (e.g., glochidia are unreported). Mussels are tolerant of temperature changes and thus the thermal plume from discharging the MCR is not likely to affect the species. Operation and maintenance of the transmission lines may include vehicular traffic that could temporarily cause erosion into the ponds and drainage areas. If mussels are present in these water bodies, they are not likely to be affected by turbidity from erosion (Howells et al. 1996; TPWD 2009).

Important Habitats

The Mad Island WMA and Clive Runnells Family Mad Island Marsh Preserve are to the southwest of the STP site, and the flow from Little Robbins Slough in the vicinity of STP provides freshwater into these wetlands. Operations of proposed Units 3 and 4 would include stormwater discharge from the site into the slough during precipitation events. Impacts to the slough would be minimized by STPNOC's compliance with its SWPPP. In addition, there would be a minimal, incremental increase in flow from MCR seepage into the groundwater and relief-well collection system as the water level in the MCR is increased from 47 to 49 ft. The additional water flow to the wildlife management area and preserve would likely be minimal.

EFH is present for the region of the Colorado River that extends along the STP site up to the FM 521 bridge. The Colorado River and Matagorda Bay are within Ecoregion 5 of the Gulf of Mexico, as designated by the Gulf of Mexico Fishery Management Council in accordance with the Magnuson-Stevens Fishery Conservation and Management Act. Operation of the RMPF and the discharge structure would adversely affect EFH. Further discussion on the impacts to EFH and Federally managed fish and shellfish species is included in Appendix F.

5.3.2.4 Aquatic Monitoring

STPNOC plans to perform operation-related monitoring for water quality in accordance with Federal and State permitting requirements as specified by the Corps and TCEQ. The Corps may require monitoring as part of the Department of the Army permit associated with periodic dredging in front of the RMPF forebay and dredging of the barge slip during the operation of proposed Units 3 and 4 at STP. The TPDES permit from TCEQ would also require monitoring as part of the water-quality-based effluent limitations. STPNOC would have to evaluate the effluent from the MCR against criteria for the protection of aquatic life once discharging of the MCR commences (TCEQ 2005).

5.3.2.5 Summary of Impacts to Aquatic Resources

With regard to aquatic ecosystems, operational impacts associated with proposed Units 3 and 4 are centered on the intake and discharge structures, but also include stormwater management, seepage from the MCR, maintenance dredging of the RMPF and barge slip, as well as maintenance and operation of the transmission corridors. The aquatic community in the vicinity of the STP site consists of a diversity of biota with a range of life-history requirements. Biota most vulnerable to entrainment and impingement include planktonic and nektonic life forms, respectively. As reviewed above, the low through-screen intake velocity (less than or equal to 0.5 fps), the use of closed-cycle cooling, the population status, and reproductive potential of fish most vulnerable to impingement, entrainment, and entrapment result in minimal adverse impacts to the aquatic ecosystem in the Colorado River. The discharge structure would deliver effluent with thermal, chemical, and physical inputs to the Colorado River, which would be regulated by TCEQ. The size and configuration of the thermal plume in combination with poor water quality could affect the passage of the aquatic organisms in the Colorado River under certain flow conditions and during certain times of the year. Affected aquatic species would include Federally managed species with designated EFH in the Colorado River. However, the review team determined that STPNOC's discharge operating policy would rarely result in discharges from the MCR that would create a thermal plume during times when river water quality is poor. Also, because of the foraging behavior and high fecundity of the aquatic species, population level impacts from the effects of the discharge plume are unlikely. Based on the foregoing, the review team concludes that the impacts on the aquatic resources on- and offsite from the operation of Units 3 and 4, and from maintenance and operation of the transmission lines and corridors would be SMALL.

5.4 Socioeconomic Impacts

Operations activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of operations-related activities and of the operations workforce on the region. Unless otherwise specified, the primary source of information for this section is the ER (STPNOC 2009a).

Although the review team considered the entire region within a 50-mi radius of the STP site when assessing socioeconomic impacts, the primary socioeconomic impact area is Brazoria and Matagorda Counties in Texas. Based on commuter patterns and the distribution of residential communities in the area, the review team found minimal impacts on other counties within the 50-mi radius. The socioeconomic impact area for operations differs from the socioeconomic impact area for building due to the smaller size of the workforce and the nature of operations jobs. While the building phase required a four county economic area to assess impact, operations workers tend to be long term, permanent employees and therefore, tend to gravitate to areas with shorter commutes and more services and amenities. Approximately

83 percent of the current operations workforce for existing Units 1 and 2 lives in Matagorda and Brazoria Counties, and STPNOC along with the review team expect the proposed Units 3 and 4 operations workforce to in-migrate in a similar distribution. The small percentage of workers (See Table 2-14) that are likely to move into other counties would be absorbed by the communities they move into with minimal socioeconomic impact.

5.4.1 Physical Impacts

This section identifies and assesses the direct physical impacts of operations-related activities on the community, including the disturbances from noise, odors, vehicle exhaust, dust, vibration, and shock from blasting. It includes consideration of impacts resulting from plant operations, transmission corridors and access roads, other offsite facilities, and project-related transportation of goods and materials in sufficient detail to predict and assess potential impacts and to show how these impacts should be treated in the licensing process.

Potential physical impacts include noise, odors, exhausts, thermal emissions, and visual intrusions. The review team believes these impacts would be mitigated through operations of the facility in accordance with all applicable Federal, State, and local environmental regulations and therefore would not significantly affect the region surrounding STP. The following sections assess the potential operations-related physical impacts of two new units on specific segments of the population, the plant, and nearby communities.

5.4.1.1 Workers and the Local Public

There are no residential areas located within the site boundary. The nearest resident is located 1.5 mi west southwest of the Exclusion Area Boundary (EAB) (STPNOC 2009a). The area within 10 mi of the STP site is predominately rural and characterized by agricultural and forested land, with 5170 residents (see Section 2.5.1). There are three other industrial facilities within 10 mi of the STP site.

Once the two new reactors have begun operation, they would not produce any known air pollutant, except for: (1) the periodic testing and operation of STP standby diesel generators and auxiliary power systems, (2) commuter vehicle dust and exhaust, (3) odors from operations, and (4) operations-based noise. Certificates to operate the diesel generators require that air emissions comply with all applicable regulations and the review team expects the impact air quality would be minimal. Access road maintenance and speed limit enforcement would reduce the amount of dust generated by the commuting workforce (STPNOC 2009a). During normal plant operation, the new units would not use chemicals in amounts that would generate odors exceeding Federal and State limits. STPNOC plans to use BMPs to control the odors emitted by chemicals and other sources during routine outages and therefore does believes the addition of two new reactors to the site would have only a minor impact. Air quality impacts of plant operation are discussed in more detail in Section 5.7.

Operational Impacts at the Proposed Site

The proposed units would produce noise from the operation of pumps, transformers, turbines, generators, and switch yard equipment. The noise levels would be controlled in accordance with local regulations. Most equipment would be located inside structures, reducing the outdoor noise level. STPNOC used noise levels from existing STP Units 1 and 2, which are less than background noise, in evaluating noise levels for proposed Units 3 and 4. Background noise (ambient sound) is between 44 to 52 dBA for STP (STPNOC 2009a). Noise levels below 60 to 65 dBA are not considered to be significant because these levels are not sufficient to cause hearing loss (NRC 1996a, 1999). Therefore, the review team determined the noise related effect on workers, residents, and recreational users of nearby areas would be minor.

5.4.1.2 Buildings

Operations activities would not affect offsite buildings. Onsite safety-related buildings have been constructed to safely withstand any possible impact, including shock and vibration, from operations activities associated with the proposed activity (10 CFR Part 50, Appendix A). Except for STP site structures, no other industrial, commercial, or residential structures would be affected. Consequently, the review team determined there would be no operations impacts to onsite and offsite buildings.

5.4.1.3 Roads

Roads within the vicinity of STP would experience an increase in traffic at the beginning and the end of each operations shift and the beginning and end of each outage support shift. Commuter traffic would be controlled by speed limits. The access roads to the STP site would be paved. Maintaining good road conditions and enforcing appropriate speed limits would reduce the impacts generated by the workforce commuting to and from STP (STPNOC 2009a). Therefore, the review team determined the road-related impacts from noise and dust to workers, residents, and other users of the roads within the vicinity of the proposed site would be minimal.

5.4.1.4 Aesthetics

The nearest residence is about 1.5 mi from the EAB of the proposed new units. There are 10 residences within a 5-mi radius and the LCRA Park is 6 mi east of the STP site. The containment buildings and the two mechanical draft cooling from proposed Units 3 and 4 are visible from these distances. The MCR is the only current plant structure visible from the Lower Colorado River. The visual impacts from the new cooling towers would be from the towers themselves and their plumes, which would resemble cumulus clouds. The plumes would be rarely visible to nearby residences and not significant in size (Section 5.7). Given that the site has already been affected by the presence of two reactors, the visual aesthetic aspect of the STP site would not be significantly changed by the proposed units.

5.4.1.5 Summary of Physical Impacts

Based on information provided by STPNOC, review team interviews with local public officials, and NRC's own independent review, the review team concludes that the physical impacts of operation of the proposed new units would be SMALL and adverse.

5.4.2 Demography

STPNOC anticipates employing 959 operations workers at the new units. In addition, STPNOC plans on reducing the operations workforce for Units 1 and 2 from its current workforce of 1365 to 1062, a decrease of 303 jobs, this would result in a net increase of 656 new operations jobs. Some employees would already reside within a reasonable commuting distance to the plant, for several reasons. First, most operations employees would have resided in the area since about the peak of building for training purposes and plant start-up. Second, some local people already have the skills necessary to take new operations jobs after the plants are built. Finally, local training efforts to increase the available local workforce have been established (Scott and Niemeyer 2008). However, maximum demographic impacts from operations would be derived from the net 656 workers and not just those that in-migrate for the operations phase. The review team assumed all the new operations employees and their families would migrate into the region from other locations. The average household size in Texas of 2.74 was used to determine the increase in population in the 50-mi region of approximately 1797 people.

The review team assumed the distribution of new operations workers and their families would resemble the residential distribution of employees operating existing STP Units 1 and 2. Therefore, 60.7 percent would likely reside in Matagorda County (1091 people) and 22.4 percent in Brazoria County (403 people) (see Table 2-14 in Chapter 2 and Table 5-4 on the following page). The proposed Units 3 and 4 related population increase represents a 3 percent increase in the 2015 estimated populations for Matagorda County and less a than 1 percent in Brazoria County. The review team assumes the remaining 17 percent of operations employees and their families would be scattered throughout the other counties within the 50-mi region in the same distribution as the current workforce and would represent a negligible fraction of each community's population. Table 5-4 displays the assumed distribution of new workers in tabular form.

Based on the information provided by STPNOC, review team interviews with local public officials, and NRC's own independent review, the review team concludes that the demographic impacts of operation of the new unit or units at the STP site would be SMALL.

Table 5-4. Potential Increase in Resident Population Resulting from Operating Units 3 and 4

County	Percent of Current STP Site Workforce by Location	Proposed Units 3 and 4 -Related Increase in Population	2015 Projected Population	Percentage Increase in Resident Population
Matagorda	60.7%	1091	43,195	2.5%
Brazoria	22.4%	403	311,763	0.1%
All Other	16.9%	303	N/A	N/A
Total	**100.00%**	**1797**		

Source: STPNOC 2009a and Texas State Data Center 2007

5.4.3 Economic Impacts to the Community

The impacts of station operation on the local and regional economy are dependent on the region's current and projected economy and population. Although future impacts cannot be predicted with certainty, some insight can be obtained for the projected economy and population by consulting with county planners and population data. The economic impacts over a 40-year period of station operation are qualitatively discussed. The primary economic impacts from employing 656 net new workers to operate all units at the STP site would be related to taxes, housing, and increased demand for goods and services, with the largest impact associated with plant property tax revenues (discussed in Section 5.4.3.2).

5.4.3.1 Economy

The review team estimated the potential social and economic impacts on the surrounding region as a result of operating the proposed two new reactors at the STP site, assuming a 40-year operating license. Social and economic impacts would occur from additional operation workforce jobs, tax revenue impacts, and increased population because of in-migrating workers and their families.

The in-migration of approximately 656 workers and their families would create new indirect jobs in the area through a process called the spending/income "multiplier effect." Each dollar spent on goods and services by one person becomes income to another, who saves some money but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves a portion and re-spends the rest, and so on. The percentage by which the sum of all spending exceeds the initial dollar spent is called the "multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings (STPNOC 2008e). The BEA earnings multiplier for the two county socioeconomic impact area is 1.56. Applying the multiplier to the review team's estimated average operations salary of $72,000 would create a total dollar impact of about $47 million per year in the region.

BEA also estimated a jobs multiplier of 2.47. In other words, for every operations worker, an additional 1.47 jobs would be created in the socioeconomic impact area near the STP site. Therefore, the net 656 workers would create 964 indirect jobs ($26 million annual earnings) for a total of 1620 jobs equating to $73 million per year in total earnings. These jobs are usually in the retail and service industries and not highly specialized. The review team expects these indirect jobs to be filled by unemployed individuals living in the socioeconomic impact area.

The operation of two new units at the STP site would also increase the number of planned outages, periodically bringing an additional 1500 to 2000 outage workers into the area. Current units undergo a scheduled refueling outage every 18 months. Once the proposed units are operational at least one outage would occur every year, with some years requiring two planned outages at different units. Most of the outage workers would stay in local hotels, rent rooms in local homes, or bring travel trailers so they can stay as close as possible to the STP site. In Bay City, the closest town to the STP site, the hotels fill up during outages for existing STP Units 1 and 2 (Scott and Niemeyer 2008). Outside of Matagorda County, the impacts become more diffuse because of more available hotel rooms and temporary housing.

The overall impact on the economy of the region from operating two new units at the STP site would be positive. The most pronounced economic impacts would occur in Matagorda County, where impacts could be noticeable and beneficial, while minimal and beneficial economic impacts may occur in Brazoria County.

5.4.3.2 Taxes

Sales, Use, Income, and Corporate Taxes

To the extent the operations employees move into the socioeconomic area surrounding the STP site the two counties would experience an increase in sales and use taxes. Matagorda County has limited shopping and entertainment choices. Houston serves as the regional retail center, and Lake Jackson in Brazoria County is considered part of the greater Houston area and has extensive shopping and services. Also, during outages, Matagorda County would see an increase in hotel occupancy tax revenues.

STPNOC estimates that the annual expenditures for goods and services during operation of Units 3 and 4 would be $60 million and that approximately 20 percent ($12 million) of those expenditures would be spent locally. The tax revenues from these expenditures are dependent on several unknowns such as the percent of private ownership of the purchaser and the location of the purchase. Only private entities are subject to sales taxes. Therefore, because it is a municipal utility, CPS Energy’s purchases are not taxable. Under the proposed settlement discussed in Section 4.4.3.2, the private ownership share of proposed Units 3 and 4 would be 92.375 percent. CPS Energy would own the remaining 7.625 percent interest of Units 3 and 4

(NINA 2010, CPS 2010). Any purchases made by private owners in Bay City would be subject to a two percent local sales tax on top of the 6.25 State sales taxes (STPNOC 2008b).

Texas has no personal income tax. Recently, Texas has changed its laws on franchise taxes (gross margin tax). NRG South Texas LP (STPNOC's only current taxable entity) has not had to pay franchise taxes on existing STP Units 1 and 2 because the State has not yet completed implementing regulations for the new law. The franchise tax, as discussed in Section 2.5.2.2, is calculated as total revenue minus allowable operating costs. Because Units 3 and 4 are unregulated merchant plants, their future revenues and costs are not fully predictable. Therefore, NRG has estimated a range for annual franchise tax payments for proposed Units 3 and 4. NRG estimated that if the units were 100 percent taxable, Unit 3 franchise tax payments would be $4.7 to $5.4 million and Unit 4 would have payments of $3.9 to $4.7 million. Texas is projected to receive approximately $2.9 billion in franchise taxes for 2009 (STPNOC 2009a). Even if proposed Units 3 and 4 were subject to 100 percent taxation, it would represent less than 1 percent of Texas's 2009 franchise taxes revenues.

Property Taxes

One of the primary sources of local economic impact related to the operation of new units would be property taxes assessed on the facility. Currently, the STP owners' tax payments represent 75 percent of the total property taxes received by Matagorda County (See Table 2-23). The current STP owners also make payments to several special districts (See Table 2-24). Property taxes that would be paid by the owners for the new units during operations depend on many factors, most of which are unknown at this time, including future millage rates, the percent ownership of each co-owner, and the co-owner's taxable status. STPNOC made simplifying assumptions to develop an estimate of tax payments based on current millage rates, an assessed value similar to existing STP Units 1 and 2, and a range of ownership percentages (44, 60, 80, and 100 percent private ownership). The review team has reviewed these estimates and finds them not unreasonable. Table 5-5 provides an estimate range of the tax payments for the proposed units throughout the life of the plant.

In addition to the property taxes paid on the value of the plant itself, Matagorda and Brazoria counties could experience an increase in property tax revenues on new homes if the influx of workers results in any new residential construction and/or increases in existing home prices. This overall impact would likely be minor and beneficial since the operations workforce and their families would only make up a small percentage of the existing population in the region.

Table 5-5. Estimated Operations Impacts to Property Taxes for Matagorda County and Special Districts (Total Levies and Payments in Millions of Dollars)

Tax Rates and STP Payments by Entity, 2006, Based on 44% Private Ownership

Entity	***Tax Rates per 100 Dollars of Assessed Valuation***	***Total STP Payments***	***Entity's Total Levy***	***STP as Percent of Total Levy***
Matagorda County	*$0.26829*	*$6.10*	*$9.04*	*67.5%*
Matagorda County Hospital District	*0.17214*	*$2.57*	*$5.75*	*44.6%*
Navigation District #1	*0.03758*	*$0.34*	*$0.49*	*70.3%*
Drainage District #3	*0.022*	*$0.20*	*$0.24*	*82.7%*
Palacios Seawall	*0.02528*	*$0.23*	*$0.33*	*70.2%*
Coastal Plains Groundwater District	*0.00433*	*$0.04*	*$0.15*	*25.6%*
Total	***0.52962***	***$9.48***	***$16.00***	***59.2%***

Hypothetical Impact Scenarios: STP 3 and 4 Property Tax Assessment, 2015
(Assumption: STP 3 and 4 are valued similarly to STP 1 and 2)

Scenarios:	**44% Private Ownership**		**60% Private Ownership**		**80% Private Ownership**		**100% Private Ownership**	
Tax Entity	***Estimated Payment***	***% Increase over 2006 Total***	***Estimated Payment***	***% Increase over 2006 Total***	***Estimated Payment***	***% Increase over 2006 Total***	***Estimated Payment***	***% Increase over 2006 Total***
Matagorda County	$6.10	67.5%	$8.32	92.0%	$11.09	122.7%	$13.86	153.4%
Matagorda County Hospital District	$2.57	44.6%	$3.50	60.8%	$4.67	81.1%	$5.83	101.4%
Navigation District #1	$0.34	70.3%	$0.47	95.9%	$0.62	127.8%	$0.78	159.8%
Drainage District #3	$0.20	82.7%	$0.27	112.8%	$0.36	150.4%	$0.46	188.0%
Palacios Seawall	$0.23	70.2%	$0.31	95.7%	$0.42	127.7%	$0.52	159.6%
Coastal Plains Groundwater District	$0.04	25.6%	$0.05	34.9%	$0.07	46.6%	$0.09	58.2%
Total	***$9.48***	***59.2%***	***$12.93***	***80.8%***	***$17.24***	***107.7%***	***$21.54***	***134.6%***

Source: STPNOC 2008b

The owners of STP Units 1 and 2 are Palacios Independent School District's (ISD's) largest tax payer, representing approximately 71 percent to 99 percent their revenues between 2000 and 2005 (Table 2-23). An increased appraised value would increase the tax payments made to the ISD, however Palacios ISD is a Texas Education Code, Chapter 41 ("property rich") school district and would keep only a small part of any increase in property tax revenues. The amount that the district would get to keep under the State's wealth equalization laws is dependent on factors such as how many new students were to enroll into the district. The remainder of the property tax revenues collected by Palacios ISD would go to the State. As discussed in Section 4.4.3.2, new legislation allows school districts to negotiate a reduction in the taxable value of Units 3 and 4 (abatement). The plants' owners would be allowed to defer the effective date of the abatement for up to 7 years after the date of the agreement. The agreement would also allow the district and the proposed Units 3 and 4 owners to share in the tax savings. The money the district may receive would not be subject to the State's equalization laws and would not have to be sent back to the State. Negotiations between Palacios ISD and the STP Units 3 and 4 owners have begun. Tax payments to the Palacios school district during operations of proposed Units 3 and 4 would likely be minimal and beneficial because the district would have to send the money back to the State, however if they enter into an agreement with the STP Units 3 and 4 owners, impacts could be noticeable and beneficial for the Palacios ISD.

5.4.3.3 Summary of Economic Impacts

Based on review team interviews with local public officials, and its own independent review of data on the regional economy, the review team concludes that the impacts on the regional economy of operating proposed Units 3 and 4 at the STP site would be SMALL and beneficial for Brazoria County and most of the rest of the region while Matagorda County would experience a MODERATE and beneficial economic impact. The impact on Matagorda County tax revenues is likely to be LARGE and beneficial while impacts on Brazoria County and the rest of the region would be SMALL and beneficial. Depending on the terms of the tax abatement agreement between Palacios ISD and the Units 3 and 4 owners, the impact to Palacios ISD would be MODERATE and beneficial. Based on the information in the ER (STPNOC 2009a) and the review team's independent review, the review team concludes that the overall economic impacts of the operation of STP Units 3 and 4 on Matagorda County would be LARGE and beneficial, impacts on Brazoria County and the rest of the region would be SMALL and beneficial, and Palacios ISD would experience a MODERATE and beneficial impact.

5.4.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education. The operation of two new units at the STP site would impact the transportation network as additional workforce use the local roads to commute to and from work and possibly additional truck deliveries are made to support operation of the new units. These same commuters could also potentially impact recreation in the area. As the workforce migrates and settles in the region, there may be impacts on housing, education, and public sector services.

5.4.4.1 Transportation

Similar to the impacts discussed in Section 4.4.4.1, the impacts of the two new units' operations on transportation would be greatest on the roads of Matagorda County, particularly FM 521. FM 521 is a two-lane FM road that provides the only access to the STP site. Beyond FM 521 traffic is disbursed onto State highways.

As presented in Section 2.5.2.3, the hourly capacity of FM 521 is 2300 cars per hour and the current use is 170 cars per hour. STPNOC estimates that the operations workforce for proposed Units 3 and 4 is expected to follow a similar 35-day work rotation to that used by the existing Units 1 and 2 operations workers, with STP Units 1 and 2 employment reduced from the current level of 1365 to 1062 (net loss of 303 jobs), and proposed Units 3 and 4 operations employment at 959 jobs. Approximately 58 percent of total operations workers would be on the day shift, 23 percent on the night shift, while 19 percent would be off duty (STPNOC 2008b). Traffic congestion would be most noticeable during the day-to-night shift change when approximately 1172 day shift workers leave and 465 night shift workers arrive over a 1.5-hourperiod (STPNOC 2008b). The total shift change vehicles of 1832 (1637 plant workers combined with 195 non-plant-related traffic), which is within the maximum capacity of 2300 vehicles per hour. During outages as many as 2000 additional vehicles could be on the road within a 24-hour period in two 12.5-hour shifts, but outage workers start times would be staggered so that they would not be on the road at the same time as the operations workers. STPNOC would schedule outages so only one unit would be down at a time (STPNOC 2009a). The review team concludes that the additional operations workers would have a minor impact on the local road network and FM 521. Any mitigation measures (i.e., widening lanes) would have likely been implemented during the building phase.

5.4.4.2 Recreation

A detailed description of local tourism and recreation is provided in Section 2.5. The primary impacts on recreation would be similar to, but smaller than, those impacts described for the development of the two new units in Section 4.4.4.2. Recreationists are not expected to be on the road at the same time as proposed Units 3 and 4 commuters (STPNOC 2009a) or otherwise significantly compete for recreation resources. The impacts on recreation in the vicinity of the STP site due to operation of proposed Units 3 and 4 are expected to be minimal.

5.4.4.3 Housing

Section 2.5.2.5 states there were 685 vacant rental units and 244 vacant housing units for sale in Matagorda County in 2000 while Brazoria County had 3168 vacant rental units and 984 for sale. Based on the 2000 data there would be enough available housing to support the maximum influx of workers and their families (1797 total people) into the region, but there is no way to know the availability of housing when operations commence. In addition, although the number of units may be sufficient to house the expected number of operations workers, the available units may not be the type of housing that the workers would desire. Matagorda County, which would likely receive the highest percentage of in-migrating workers relative to the available housing stock, may experience a noticeable increase in housing demand. Matagorda County may also experience a shift in demand toward relatively higher-value houses to match the relatively high wages of operations workers.

With all four units operational, the STP site would have annual and sometimes semiannual outages for 17 to 35 days (STPNOC 2009a). The maximum outage workforce would be 1500 to 2000 workers. The temporary outage workers for the existing STP Units 1 and 2 typically stay in area hotels or recreational vehicles. In Bay City, however, all available hotel rooms are filled to capacity during the current outages and once the proposed Units 3 and 4 become operational, this would occur twice as often. This influx of temporary workers would not be expected to impact the permanent housing stock or housing market in the region.

The overall impact on housing demand and prices from plant operations over the expected 40-year operation of the plant in the region would likely be minimal for both Brazoria and Matagorda Counties.

5.4.4.4 Public Services

Water Supply Facilities

The STP site does not use water from a municipal system. Instead, the STP site relies upon five groundwater wells. The STP site has permits to extract an average of 2.7 million gallons per day (MGD) from these wells, but has typically drawn an average of 1.1 MGD. STPNOC expects those wells to provide the additional potable water demanded for operation of the two proposed units, as well (STPNOC 2009a). Section 5.2 provides more detail on plant water usage.

The average per capita water usage in the United States is 90 gpd per person (EPA 2003). Therefore, the new operations workforce and their families would require an additional 161,730 gpd of potable water. Section 2.5 describes the public water supply systems in the analytical area, their permitted capacities, and current demands. Municipal water suppliers in the region have excess capacity (see Table 2-29). Regional water planning boards are predicting water supply shortages for the socioeconomic impact area and have implemented mitigation strategies. Therefore the impact on water supply would be minor.

Waste Water Treatment Facilities

The STP site has a private wastewater treatment facility for the existing units. As part of the new units' development project, the facility would be expanded to support the increased capacity of the additional units (STPNOC 2009a). Therefore, operations would not impact the exiting wastewater treatment facility.

Section 2.5 describes the public wastewater treatment systems in the socioeconomic impact area, their permitted capacities, and current demands. Assuming 100 percent of the water consumed would be disposed of through the wastewater treatment facilities, the proposed units' plant operations-related population increase of 1797 people would require 161,730 gallons of additional wastewater treatment capacity in the socioeconomic impact area. Wastewater treatment facilities in the three counties have excess capacity (see Table 2-30) to handle the influx of construction workers. Therefore, the review team determined the impact on wastewater treatment from the in-migration of operations workers and their families would be minor.

Police, Fire and Medical Services

As discussed in Section 4.4.4.4 the citizen to police officer ratios for Matagorda and Brazoria Counties were 420:1 and 643:1, respectively. Assuming these same staffing levels, the assumed population increases in Matagorda and Brazoria Counties would raise the ratios to 432:1 in Matagorda County and 643:1 in Brazoria County which would approximately a three percent in Matagorda County and less than one percent in Brazoria County increase in the citizen-to-police officer ratio. The in-migration of operations workers would raise the citizen to firefighter ratios in Matagorda and Brazoria Counties from 228:1 to 235:1 and 539:1 to 540:1, respectively, representing an approximately three percent increase in Matagorda County and less than one percent increase in Brazoria County. Therefore, the in-migration of operations workers would have a minimal impact on police and fire services.

Section 4.4.4.4 describes the level of medical and human services within the socioeconomic impact area, which the review team determined is sufficient to absorb the much larger project-related influx of workers. The expected four percent increase in population for Matagorda County and the less than one percent expected increase in Brazoria County would not impact medical facilities in those counties.

Social Services

New jobs created to operate and maintain the proposed new reactors would benefit the disadvantaged population served by the State health and human resources offices by adding some additional jobs to the region which may go to people who are currently under-employed or unemployed, removing them from 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 believes the net effect of the new permanent operations workforce on local and State welfare and social services would minimal and beneficial.

5.4.4.5 Education

Section 5.4.2 discusses the review team's underlying assumptions about the distribution of workers' families within the 50-mi radius area around the proposed site. These assumptions indicate the expected increase in population related to operations would be 1797 people and 0.8 percent would be school-aged children. The future increase of 436 children would correspond to a 318 increase in the student population in Matagorda County (less than 4.0 percent from current levels) and an increase of 118 from current levels in Brazoria County (less than 0.2 percent from current levels). These increases would be spread over K-12 grades, and across several communities within each county. Therefore, the operations-related increase in class size would likely not have a noticeable effect on either county and the review team determined the increase in students would have a minor impact in Brazoria and Matagorda Counties.

5.4.4.6 Summary of Infrastructure and Community Services

Based on information supplied by applicant, review team interviews conducted with and information solicited from public officials in Matagorda and Brazoria Counties, and review team review of data concerning the current availability of services and current State and community planning efforts, the review team concludes that the operation impacts on the regional infrastructure and community services would be SMALL and adverse.

5.4.5 Summary of Socioeconomic Impacts

Based on information supplied by STPNOC, review team interviews conducted with public officials in the socioeconomic impact area concerning the current availability of services, and additional taxes that would likely compensate the need for additional services, the review team concludes physical impacts and impacts on demographics, impacts on infrastructure and community services (transportation, recreation, housing, public services and education) for Matagorda and Brazoria Counties would be SMALL and adverse. However, in Matagorda County the impacts on the economy would be beneficial and MODERATE, while tax impacts for Matagorda County would be beneficial and LARGE and impacts to the Palacios school district would be SMALL to MODERATE and beneficial. The impacts on the economy and taxes in Brazoria County would be SMALL and beneficial. All impacts would be SMALL in the remainder of the 50-mi region.

5.5 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.6 discusses the locations of minority and low-income populations around the STP site and within the 50-mi radius.

The review team evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.6 could be disproportionately affected by the potential impacts of operating two new reactors at the proposed site. To perform this assessment, the review team used the same process employed in Section 4.5.

5.5.1 Health Impacts

For all three health-related considerations, the review team determined through literature searches and consultations with NRC staff health physics experts that the expected operations-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations, and therefore cannot impose a disproportionately high and adverse radiological health effect on minority or low-income populations.

The results of the normal operation dose assessments (see Section 5.9) indicate that the maximum individual dose for the pathways identified in Section 5.9 was found to be insignificant, that is, well below the NRC and EPA's regulatory guidelines. Because there would be no significant adverse health impacts on the most exposed members of the public, there would be no disproportionate and adverse health impacts on any minority and low-income populations. Therefore the environmental justice impacts from operations would be minimal.

The operational staff and the public would receive radiation doses from operation of the proposed Unites 3 and 4. Section 5.9 assesses these doses and concludes that the doses would be within NRC and EPA dose standards. Section 5.9 further concludes that radiological health impacts to the operational staff and the public for the proposed Units 3 and 4 would be SMALL.

As discussed in Section 5.8.5, nonradiological health impacts from emissions during the operation period to the public and onsite workers would be minimal. The review team has not found any environmental pathway that would lead to offsite nonradiological health effects that would disproportionately impact to any minority or low-income populations. For example, any increase in traffic accidents due to heavier traffic is unlikely to have a disproportionate impact on any particular population subgroup. Section 5.2.3 states the effects of Unit 3 and 4 discharges to the lower Colorado would have a minimal effect on water quality in the Lower Colorado River and on groundwater in the vicinity of the STP site. In addition, Section 5.8 found that health impacts to the public and workers from etiological agents, noise generated by plant operations, and acute impacts of EMF from power lines would be minimal. The review team reviewed available scientific literature on 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. Furthermore, as discussed in Section 2.6.3, 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 (STPNOC 2009a; Scott and Niemeyer 2008). Therefore, the potential impacts of nonradiological effects resulting from the operation of the proposed two additional units would be minimal and there would be no disproportionate and adverse impacts felt by minority or low-income populations within the analytical area.

5.5.2 Physical and Environmental Impacts

For the three environmental and physical considerations the review team determined that the physical impacts from operations at the proposed STP Units 3 and 4 would attenuate rapidly with distance. In addition, the review team did not find any evidence of unique characteristics or practices among any minority or low-income populations of interest and expect there would be no disproportionately high and adverse physical or environmental impact that would be felt by any minority or low-income population. The following four subsections discuss each of the primary physical-environmental pathways in greater detail.

5.5.2.1 Soil

Land-use impacts to transmission line rights-of-way from operation of new units would be identical to existing units. Therefore, there is no additional effect on any population from new transmission lines (Section 5.1). There would be very limited offsite deposition of salt from reactor operations and no impact to offsite populations (Section 5.7). Therefore, there is no disproportionate adverse exposure to minority or low-income populations from this pathway. No other environmental pathways to soil were identified by the review team. Additionally, as discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority or low-income populations that may result in different soil-related impacts as compared to the general population (STPNOC 2009a, Scott and Niemeyer 2008). Consequently, the review team determined the marginal impact to soils from the proposed new units would be minimal.

5.5.2.2 Water

As discussed in Section 5.2, the review team determined the proposed units at the STP site would generate a small and infrequent thermal plume in the Lower Colorado River. In Section 5.3 the review team determined that this plume would not significantly affect the aquatic resources of the river. Therefore, there would be no disproportionate adverse impact on minority and low-income populations engaged in subsistence activities from this source. In addition, in Section 5.2 the review team found that water withdrawals from groundwater by the plant would not significantly affect offsite wells. Water quality effects from nonradiological emissions also would be minimal (Section 5.10.2). Consequently the review team determined that the marginal impacts to the water from the proposed new units would be minimal. As discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority or low-income populations that may result in different water-related impacts as compared to the general population (STPNOC 2009a, Scott and Niemeyer 2008). Therefore, there would be no disproportionate adverse impact on minority and low-income populations who might be reliant on well water near the site.

5.5.2.3 Air

The primary air emissions from a nuclear power plant such as STP are water vapor and salt, which do not pose any health dangers to members of the offsite population. Because there is no danger to the members of the offsite public, the review team determined that there could not be a disproportionately large and adverse impact on minority or low-income populations, either. The total liquid and gaseous effluent doses from all four units (the existing units plus the new units) 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. As described in Sections 5.7.1 and 5.10.3, the review team concludes that the potential impacts from all potential air sources would be minimal. As discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority or low-income populations that may result in different air-related impacts as compared to the general population (STPNOC 2009a; Scott and Niemeyer 2008). Therefore, there would be no disproportionate adverse impact on any offsite minority and low-income populations from the air pathway.

5.5.2.4 Summary of Physical and Environmental Impacts

Based on the review team's analysis presented in the preceding sections, no disproportionate and adverse physical impacts on minority and low-income populations would be expected from operations. Therefore, the review team concludes the physical impacts of operations on minority and low-income populations would be minimal.

5.5.3 Socioeconomic Impacts

The review team determined that once the proposed new units are operational at the STP site, any building-related adverse socioeconomic impacts felt by any group within the 50-mi region would either stop or significantly diminish. While the addition of a net 656 new operations employees (most of whom would actually arrive during the construction period) would place pressure on local infrastructures (roads, housing, schools, hospitals, etc.), as discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority or low-income populations that may result in greater impacts than those experienced by the general population (STPNOC 2009; Scott and Niemeyer 2008). The review team believes any adverse impact would not be disproportionately felt by any demographic sub-group. The review team's interviews of surrounding communities revealed a high level of preparedness with regard to any potential influx of temporary construction or permanent operations workers. Consequently the review team determined that the marginal socioeconomic impacts from operating the proposed new units would be minimal.

5.5.4 Subsistence and Special Conditions

Both STPNOC and the review team interviewed public officials and community leaders of the minority populations with the socioeconomic impact area in relation to subsistence practices. No subsistence practices were found. The review team determined there were no operations-related disproportionate and adverse impacts on minority or low-income populations related to subsistence.

The Hispanic and Vietnamese communities in the Palacios area are engaged in fishing, but as commercial fishermen, not as subsistence fishermen (STPNOC 2008c, 2009a; Scott and Niemeyer 2008). Any subsistence fishing activity by the riverfront community, identified in Section 2.6, would not have either a radiological or nonradiological adverse health effect (Sections 5.9.2.1 and 5.8.1). The review team also has determined that the impacts from chemical discharges to the Lower Colorado River would be minimal, and no additional monitoring would be required (Section 5.3.2.1). Impacts on aquatic species would also be minimal, as suggested in Section 5.9.5.1. Therefore, low income or minority individuals who may be engaged in subsistence fishing would not experience disproportionate adverse impacts.

5.5.5 Summary of Environmental Justice Impacts

Based on the underlying assumptions of the analysis discussed in Section 2.6, the impacts of plant operations on minority and low-income populations would be SMALL because no environmental pathways or conditions were found that would result in a disproportionate and adverse impact on minority or low-income populations.

5.6 Historic and Cultural Resource Impacts

The National Environmental Policy Act of 1969, as amended (NEPA) requires that Federal agencies 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), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as “Historic Properties” in NHPA). As outlined in 36 CFR 800.8(c), “Coordination with the National Environmental Policy Act of 1969,” the NRC is coordinating compliance with Section 106 of the NHPA in fulfilling its responsibilities under NEPA.

Operating new nuclear power plants can affect either known or potential historic properties that may be located at the site. In accordance with the provisions of NHPA and NEPA, the NRC and the Corps are required to make a reasonable and good faith effort to identify historic properties in the areas of potential effect and, if such properties are present, determine whether or not significant impacts are likely to occur. Identification of historic properties is to occur in consultation with the State Historic Preservation Officer (SHPO), Native American Tribes, interested parties, and the public. If significant impacts are possible, then efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, then the NRC and the Corps are still required to notify the SHPO before proceeding. If historic properties are present, then the NRC and the Corps are required to assess and resolve adverse effects of the undertaking.

For a description of the historic and cultural information on the STP site, see Section 2.7. The applicant concluded that any sites that may have existed onsite would no longer retain their integrity because the area was heavily disturbed (STPNOC 2009a). During the site visit in February 2008, the review team reviewed the documentation used by the applicant to prepare the cultural resource section of the ER. The review team did not identify any cultural resources that would be affected because resources that may have existed prior to the construction of STP Units 1 and 2 would have been destroyed during land clearing and construction activities. Further, no historic buildings were identified that could be affected by the visual impacts of the proposed units.

For the purposes of NHPA 106 consultation, the review team does not expect any significant impacts on cultural and historic resources during the operation of proposed Units 3 and 4. Therefore, the review team concludes a finding of no historic properties affected (36 CFR Section 800.4(d)(1)).

For the purposes of the review team's NEPA analysis, the review team does not expect any significant impacts on historic and cultural resources during COL unit operation. Therefore, the review team concludes that the impacts from operations would be SMALL. Mitigative actions may be warranted only in the event of an unanticipated discovery during any ground-disturbing activities associated with maintenance of the operating facility; these actions would be determined by STPNOC in consultation with the Texas SHPO. STPNOC has agreed to follow procedures if historic or cultural resources are discovered. These procedures are detailed in STPNOC's Addendum #5 to procedure No. OPGP03-ZO-0025 Rev. 12 (Unanticipated Discovery of Cultural Resources) (STPNOC 2008d); the procedure includes notification of the Texas Historical Commission.

5.7 Meteorological and Air Quality Impacts

The primary impacts of operation of proposed Units 3 and 4 at the STP site on local meteorological conditions and air quality would be associated with emissions from the routine operation of auxiliary equipment and cooling systems and from emissions from worker's vehicles. The potential impacts on air quality are addressed in Section 5.7.1, and the potential impacts of operation of the cooling system are addressed in Section 5.7.2.

5.7.1 Air Quality Impacts

Proposed Units 3 and 4 at the STP site would each have three standby diesel generators and a single combustion turbine generator. These generators, each of which would be operated about 4 hours per month, and the UHS cooling towers would be the largest stationary sources of emission that could affect air quality. Table 5-6 lists the expected annual emissions from these sources. There would be other minor emission sources onsite such as diesel-driven fire water pumps, but their impact on air quality would be negligible because of infrequent use. There would also be auxiliary boilers onsite. These boilers would not impact air quality because they would be electric. STPNOC has stated that "[a]ir emissions sources would be managed in accordance with Federal, Texas, and local air quality control laws and regulations." (STPNOC 2009a)

In its ER, STPNOC briefly addresses fugitive dust during plant operations. STPNOC states that fugitive dust generated by the commuting work force would be minimized by properly maintaining hard-surfaced access roads and setting appropriate speed limits (STPNOC 2009a).

As noted in Section 2.9, the STP site is in Matagorda County which is in attainment for all criteria pollutants defined in the National Ambient Air Quality Standards. Further, the closest Class I Federal Area is more than 100 mi from the STP site.

Table 5-6. Anticipated Atmospheric Emissions Associated With Operation of Proposed Units 3 and 4

	Diesel Generators (lb/yr)[a]	Combustion Turbine (lb/yr)[a]	UHS Cooling Towers (lb/yr)[b][c]
Particulates	2500	44	44,700
Sulfur Oxides	5200	3800	---
Carbon Monoxide	5200	1800	---
Hydrocarbons	6100	120	---
Nitrogen Oxides	57,900	2000	---

(a) STPNOC 2009a
(b) Review team estimate based on cooling tower flow and drift rate assuming that drift is salt particles.
(c) Approximately 90 percent would be deposited within ½ mi of the cooling towers.

Impacts of existing transmission lines on air quality are addressed in NUREG-1437 (NRC 1996a). Small amounts of ozone and 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 1200-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. The components needed to complete an interface between proposed Units 3 and 4 and STP Units 1 and 2 and ties to the regional power grid would be well within the range of transmission lines provided in NUREG-1437, and the review team therefore concludes that air quality impacts from transmission lines would not be noticeable.

Finally, the operation of a nuclear power plant involves the emission of some greenhouse gases, primarily carbon dioxide (CO_2). The review team has estimated that the total carbon footprint for actual plant operations of Units 3 and 4 for 40 years is on the order of 280,000 metric tons of CO_2 equivalent, as compared to a total United States annual CO_2 emissions rate of 6,000,000,000 metric tons (EPA 2009). Workforce transportation accounts for about 90 percent of the total. Periodic testing of diesel generators accounts for most of the rest. These estimates are based on carbon footprint estimates in Appendix I and emissions data contained in the ER (STPNOC 2009a). Based on its assessment of the relatively small plant operations carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable and additional mitigation would not be warranted.

The review team has considered the timing and magnitude of atmospheric releases related to operation of proposed Units 3 and 4, the existing air quality at the STP site and the distance to the closest Class I Federal Area, and the STPNOC commitment to manage and mitigate emissions in accordance with applicable regulations. On these bases, the review team concludes that the air quality impacts of operation of proposed Units 3 and 4 would not be noticeable. Based on its assessment of the carbon footprint of plant operations, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable.

5.7.2 Cooling System Impacts

The operation of the cooling system is described in Section 3.4 of the ER (STPNOC 2009a). Proposed Units 3 and 4 would share use of the MCR with STP Units 1 and 2. In addition, proposed Units 3 and 4 at the STP site would each have a six-cell mechanical draft cooling tower that serves as the UHS and as a helper cooling tower for cooling during normal operations. Half of the cells in each tower are used during normal operation; all cells are used when heat loads are increased such as during cool down and shutdown.

Potential atmospheric impacts from cooling system operation include fogging and subsequent icing downwind of the MCR, and potential impacts from the plume and drift from the cooling towers. In response to review team RAIs, STPNOC updated the information in the ER based on additional analyses using onsite meteorological data supplemented with data from the Palacios Municipal Airport (STPNOC 2009i). The results of the study indicate that MCR operation with existing Units 1 and 2 does not significantly increase fog in the vicinity. In the additional analyses requested by the review team, STPNOC provided information on the expected changes in MCR temperatures and an analysis evaluating the potential impacts of the addition of proposed Units 3 and 4 on fog.

Table 5-7 summarizes the results of the STPNOC analyses for two locations along FM 521. Fog hours are hours when fog of any density would be visible, while hours with visibility less than 0.3 mi are those hours when the fog would be considered to significantly restrict visibility. The fog hours for the Palacios Municipal Airport are included to provide context relative to naturally occurring fog.

Table 5-7. MCR Fog Impact Analysis

Location	Units 1 and 2		Units 1, 2, 3, and 4	
	Fog (hr)	Visibility < 0.3 mi (hr)	Fog (hr)	Visibility < 0.3 mi (hr)
0.31 mi N	130	20	230	36
1.1 mi N	33	5	77	12
Palacios	276	43	276	43

Source: STPNOC 2009a

On the basis of this analysis, comparison of the fogging predictions for existing Units 1 and 2 with the results of the previous study, STPNOC concludes that the impacts of the MCR on fogging would be minimal and not warrant mitigation. It further concludes that because the temperatures in the area are generally above freezing the impacts on icing would also be minimal and not warrant mitigation.

The review team has reviewed the fogging study related to operation of existing STP Units 1 and 2 and the information and analysis provided by STPNOC in response to the review team's RAIs, and the team finds the information and analysis acceptable. Based on the results of the fogging study for existing Units 1 and 2, the analysis conducted by STPNOC for the addition of proposed Units 3 and 4, and comparison of the analysis predictions with data from the Palacios Municipal Airport, the review team concludes that the impacts of the MCR on fogging with the addition of proposed Units 3 and 4 would not be noticeable.

STPNOC (STPNOC 2009i) has conducted an evaluation of the potential impacts of the UHS cooling towers using the SACTI computer code (Policastro et al. 1984). The SACTI computer code estimates the plume characteristics and salt deposition from the operation of cooling towers. The results of the STPNOC analysis suggest that the average length of the plume from the cooling towers would range from about 0.2 mi in the summer to 0.4 mi in the winter. However, because these numbers are strongly affected by a relatively few occurrences of long plumes, they do not adequately represent the visible impact of the plume. The median length of plumes from the cooling towers is about 0.1 mi in each season. When plumes are calculated to extend beyond the site boundary they most frequently extend to the north northwest or north.

Annually, the maximum number of hours that plumes extend beyond the site boundary in a specific direction is 43 hours to the north northwest. During the spring and summer, plumes extend beyond the site boundary fewer than 10 hours in any single direction. In the STPNOC analysis, the visible plume did not intersect the ground, therefore STPNOC concluded that there would be neither fogging nor icing.

The STPNOC analysis indicated that the annual salt deposition rate from cooling tower drift could be as high as 98 lb/ac/mo near the towers, decreasing to less than 8.9 lb/ac/mo at about 0.3 mi, and less than 1 lb/ac/mo beyond about 0.8 mi. The maximum deposition rates occur during the summer. Most of the area with a deposition rate exceeding 8.9 lb/ac/mo is within the protected area to the north of the cooling towers, and most of the remaining area with a deposition rate exceeding 8.9 lb/ac/mo is between the protected area and the MCR. Based on experience with cooling towers reported in the license renewal GEIS (NRC 1996a, 1999), STPNOC concluded that the impacts of salt deposition from cooling towers would be minimal and would not require mitigation.

On the basis of the analysis presented by STPNOC in the ER and the review team's independent evaluation of that analysis, the review team concludes that atmospheric impacts of UHS cooling tower operation would be minimal.

5.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating proposed Units 3 and 4. 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 proposed Units 3 and 4 on air quality from emissions of criteria pollutants, CO_2 emissions, and cooling system emissions are SMALL and that no further mitigation is warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological human health impacts to the public and workers from operating the proposed new nuclear Units 3 and 4 at the STP site. Nonradiological public health impacts are considered from operation of the cooling system, from noise generated by operations, from EMF, and from transporting materials and personnel to the site. Nonradiological health impacts from the same sources are also evaluated for workers during the operation of proposed Units 3 and 4. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the STP site. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological Agents

Operation of proposed Units 3 and 4 would result in a thermal discharge to the MCR, and occasionally water from the MCR would be discharged to the Colorado River. Thermal discharges have the potential to increase the growth of thermophilic microorganisms (including those that can cause diseases, i.e., etiological agents), in the MCR and the Colorado River. The types of organisms of concern include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels. Section 2.10.1.3 discusses the incidence of water-borne diseases in Texas. Incidence of diseases such as Legionellosis, Salmonellosis, or Shigellosis, is possible through exposure to water vapor resulting from operation of proposed Units 3 and 4. However, public access to the STP site is limited, and there are no residences in the vicinity of the site where water vapor from operation of the proposed Units 3 and 4 would be likely to accumulate.

Naegleria fowleria (*N. fowleria*) is an etiological agent of concern because the amoeba lives in warm freshwaters and can cause a disease, called primary amebic meningoencephalitis (PAM), in people that swim in and have water containing the organisms pushed up their nasal passages. While the conditions for exposure to *N. fowleri* in Texas are favorable, the incidence of contracting PAM is low considering the number of people in the State that recreate in the water (Yoder et al. 2009; CDC 2009; TDSHS 2010). The Centers for Disease Control and Prevention (CDC) and the Texas Department of State Health Services (TDSHS) have stated that it is not practical to monitor all swimming areas for the presence of the amoeba, and that postings of warning signs is unlikely to be effective in preventing infections (CDC 2008a; TDSHS 1995, 1997). However, CDC, TDSHS, and the LCRA have all published preventative actions that the public could take to minimize infections. These include avoiding swimming and jumping into freshwater during periods of high temperature and low water volume, minimizing forceful entry of water up the nasal passages during jumping or diving activities (i.e., by holding one's nose or wearing nose plugs), and avoiding digging in or stirring up the sediment while swimming in shallow areas (CDC 2008b; LCRA 2007c; TDSHS 1995, 1997).

As described in NUREG-1555, *Environmental Standard Review Plan* (NRC 2000), nuclear power plants that use cooling ponds, lakes, or canals and those that discharge to "small rivers" have a greater chance of affecting the public from increases in thermophilic microbial populations. A small river is defined as one with an average flow rate of less than 100,000 cfs. Based on the historical data for the years 1948 to 2004, the maximum annual average stream flow for the Colorado River at the Bay City streamflow gauging station above the STP site is 14,270 cfs, the minimum annual average flow is 375 cfs, and the mean annual average flow is approximately 2629 cfs (STPNOC 2009a). These flow rates meet the criterion in NUREG-1555 for a small river.

At Selkirk Island, above the MCR discharge point, water temperature in the Colorado River ranges from 43.5 to 92.1°F, with an average of 72.5°F (Section 2.3.3.1). While the average river water temperature is lower than the optimum temperature for growth of etiological agents (e.g., *N. fowleri*), the water temperature is warm enough to support the microorganisms (Wellings et al. 1977; TDSHS 1997; Ettinger et al. 2003). Section 5.2.3.1 discusses the analysis by STPNOC and the review team of the thermal plume created by discharge from the MCR into the Colorado River. The maximum plume size evaluated was based on the greatest difference in temperatures between the MCR water and the river water (20.4°F). The conditions that create the maximum size of a thermal plume where the surface water would be elevated by 5°F above the ambient river water would cover the entire width of the river for a distance of about 4400 ft. However, under these conditions, the ambient river water temperature would be 55°F, which is too low for the optimum temperature for growth of the organisms that cause diseases in people. In addition, the water temperature is likely too cold for people in the region to swim and immerse themselves in the water.

Recreational activities in the Colorado River within the vicinity of the STP site could expose people to etiological agents even during times when there is no discharge from the MCR because this segment of the river has been classified by TCEQ as impaired by presence of bacteria (TCEQ 2010b). However, the incidence of exposure leading to infection is low. For *N. fowleri*, the incidence of exposure is estimated at less than one in 100 million that a person exposed to water inhabited by *N. fowleri* would become infected (TDSHS 1995). As discussed in Section 2.10.1.3, outbreaks of other water-borne diseases in Texas are within the range of national trends in terms of cases per 100,000 population or total cases per year (TDSHS 2009).

In the vicinity of the existing and proposed discharge structure, the Colorado River is used primarily by fisherman and boaters. Some boaters and owners of riverside houses use the river for swimming, water skiing, and other water sports (STPNOC 2008b). Opportunities for infection would be reduced if swimmers followed Federal and State recommendations for prevention of water-borne diseases (CDC 2008b; LCRA 2007c; TDSHS 1995, 1997).

Furthermore, as discussed in Section 5.2, STPNOC evaluated the frequency of discharge from the MCR into the Colorado River based on operation of four units. The results of the simulations indicate that most of the discharge would take place during the first six months of any year, with the greatest frequency of discharge occurring in January and February. Since most recreational swimming takes place in the warmer months of the year, and incidences of PAM infections mostly occur in June through August, the likelihood that swimmers would become infected with *N. fowleri* from discharge water is diminished.

Based on the relatively low incidence of waterborne diseases from recreational activities in Texas (CDC 2009; TDSHS 2010), the infrequent discharge from the MCR into the Colorado River, and the small temperature increase expected as a result of discharging into the river, the review team concludes that potential impacts from etiological agents on human health would be minor and mitigation would not be warranted.

5.8.2 Noise

In NUREG-1437 (NRC 1996a), the NRC discusses the environmental impacts of noise from operations 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 such as diesel generators. In addition, while there may be corona discharge noise associated with high-voltage transmission lines, the occurrences are infrequent and weather-related, when the public is likely to be indoors. The common sources of noise are discussed in this section.

The landscape in the vicinity of the STP site is rural and flat. Approximately 67 percent of the land within the 6-mi vicinity of the STP site is agricultural land; 15 percent is forest land; 11 percent is water; 1 percent is wetlands; 4 percent is rangeland, grassland, or bottomland; 2 percent is urban; and less than 1 percent is barren land. Two recreation areas are in the vicinity: the 7200-ac Mad Island WMA is located approximately 3 mi south of the STP site and the LCRA park approximately 3 mi east of the STP site (Section 2.2.2). Areas that are subject to farming are prone to seasonal noise-related events such as planting and harvesting. Wooded areas provide natural noise abatement control that reduces noise propagation.

According to the STPNOC ER (2009a), noise from the operation of each cooling tower would be approximately 71 dBA at about 3 ft from the tower and 57 dBA at 200 ft from the tower. Noise from the RMPF for four units is expected to be within the levels of the existing Units STP 1 and 2, which have generated no noise complaints (STPNOC 2009a). The nearest full-time residence is 1.5 mi west-southwest of the STP site. Relative to the location of the nearest full-time residence, proposed Units 3 and 4 cooling towers would be located 0.6 mi (approximately 3200 ft) from the site boundary. Distance and vegetation would significantly attenuate any noise. Noise levels at the site boundary are expected to be below the 60-65 dBA level that NRC considers significant (NRC 1996a, 1999).

STPNOC assumes that the noise from existing STP Units 1 and 2 is not greater than the normal operations noise occurring at other nuclear power plants and could be used as the basis for evaluating impacts for proposed Units 3 and 4 (STPNOC 2009a). With the exceptions of the public address system and when the emergency sirens are tested, which are both relatively short-lived occurrences, the noise level at the STP site boundary is likely to be less than background. Intermittently operated equipment (e.g., emergency diesel generators, combustion turbine generators) are equipped with mufflers to reduce exhaust noise. As discussed above, no public roads, public buildings, or residences are located within the EAB. Planned re-vegetation of areas previously disturbed while building Units 3 and 4 at STP would provide an additional buffer for operations-related noise (STPNOC 2009a). Background or ambient sound levels at the STP site, considering the local environment, are comparable to the ambient sound level of a farm, which is approximately 44 dBA, or to that of a small town or quiet suburban area, around 46 to 52 dBA. To put these noise levels in context, normal conversation is 50 to 60 dBA (EPA 1974).

According to NUREG-1437 (NRC 1996a), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NUREG-0586, Supplement 1) (NRC 2002). 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, 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.

Based on the relatively low levels of noise associated with the operation of the proposed Units 3 and 4 and the significant attenuation of that noise, the review team concludes that potential noise impacts associated with the operation of the new units on the public would be minor and would not require mitigation.

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from either direct access to energized conductors or induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1999). 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 Public Utility Commission of Texas (PUCT).

As discussed in Section 3.2.2.3, the transmission system activities specifically for operation of Units 3 and 4 primarily would principally involve installation activities on the STP site. Other activities include upgrades to existing offsite systems that are owned and operated by other companies.

In the ER, STPNOC evaluated the proposed Units 3 and 4 transmission systems acute effects of EMF (STPNOC 2009a). AEP and CenterPoint Energy, which are transmission server providers and owners of the affected transmission lines, would be responsible for any upgrades to the transmission lines. AEP planned to replace some of the towers and conductors along the STP-to-Hillje ROW by addressing line sag clearances to conform to NESC standards, and consequently, to prevent electrical shock. STPNOC states that all existing 345-kV transmission lines use steel towers designed to provide clearances consistent with the NESC. The ER further states that STPNOC anticipates that transmission service providers would construct lines in the future with clearances consistent with the NESC. Clearances for new above grade high-voltage conductors would be expected to be equal to or exceed existing clearances.

Based on the PUCT regulations related to the design and installation of new transmission lines, and that transmission lines constructed and upgraded to serve proposed Units 3 and 4 would meet NESC standards in effect at the time of installation, the review team concludes that the potential impact to the public from acute effects of EMF would be minor and further mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce EMF of nonionizing radiation at 60 Hz, which is considered to be an ELF EMF. Research on the potential for chronic effects of EMF from energized transmission lines was reviewed and addressed by the NRC in NUREG-1437 (NRC 1996a). 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; AGNIR 2006) 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 on chronic effects to human health from ELF-EMF published since the NIEHS report, and found that several other organizations reached the same conclusions (AGNIR 2006; WHO 2007). Additional work under the auspices of the World Health Organization (WHO) updated the assessments of a number of scientific groups reflecting the potential for transmission line EMF to cause adverse health impacts in humans. The monograph 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 WHO (2007) found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive.

The review team reviewed available scientific literature on 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

As discussed in Section 2.10, human health risks for personnel engaged in activities such as maintenance, testing, and plant modifications for Units 3 and 4 are expected to be dominated by occupational accidents (e.g., falls, electric shock, burns) or occupational illnesses due to noise exposure, exposure to toxic or oxygen-replacing gases, and other hazards. The 2007 annual incidence rates (the number of injuries and illnesses per 100 full-time workers) for the State of Texas and the United States for electric power generation, transmission and distribution workers are 3.1 and 3.6, respectively (BLS 2008a, b). The 2007 annual incidence rate (the number of injuries and illnesses per 100 full-time workers) in the United States for nuclear electric power generation workers is 0.9 (BLS 2008b). Historically, actual injury and fatality rates at STPNOC facilities have been lower than the average U.S. industrial rates, with a 2002 through 2006 average incidence rate of 0.6 per hundred workers (STPNOC 2009a).

In its ER, STPNOC addresses management of occupational injury and fatality risks through safety and health programs, and personnel to promote safe work practices and respond to occupational injuries and illnesses (STPNOC 2009a). Procedures have been developed and implemented for the existing units that would be applied to the proposed new units that have the objective of providing personnel who work at STP with an effective means of preventing accidents due to unsafe conditions and unsafe acts. These safe work practices address a number of occupational health issues (e.g., hearing protection, confined space entry, personal protective equipment, heat stress, electrical safety, the safe use of ladders, chemical handling, storage, and use, and other industrial hazards). These procedures ensure that STPNOC adheres to NRC and Occupational Safety and Health Administration (OSHA) safety standards (29 CFR Part 1910), practices, and procedures. Furthermore, health impacts to workers from nonradiological emissions during operations at the proposed Units 3 and 4 would be monitored and controlled in accordance with the applicable OSHA regulations. Appropriate State and local statutes would also be considered when assessing the occupational hazards and health risks for new nuclear unit operation.

Based on mitigation measures identified by STPNOC in its ER, strict adherence to NRC and OSHA safety standards, practices, and procedures, and the review team's independent evaluation, the review team concludes that occupational health impacts to STP onsite personnel would be minimal and no further mitigation would be warranted.

5.8.6 Impacts of Transporting Operations Personnel to the Proposed Site

This EIS assesses the impact of transporting workers to and from the STP site from the perspective of three areas of impact: the socioeconomic impacts, the air quality impacts of fugitive dust and particulate matter emitted by vehicle traffic, and the potential health impacts due to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 5.4.1.3, and air quality impacts are addressed in Section 5.7.2.

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the proposed STP site and alternative sites (see Section 4.8.3). However, preliminary estimates are the only data available to estimate these impacts. The impacts evaluated in this section for two new nuclear generating units at the STP site are appropriate to characterize the alternative sites discussed in Section 9.3. Alternative sites evaluated in this EIS include the existing STP site (proposed), and alternative sites at Allens Creek, Red 2, and Trinity 2. There is no meaningful differentiation among the proposed and the alternative sites regarding the nonradiological environmental impacts from transporting operations and outage personnel to the STP site and alternative sites and are not discussed further in Chapter 9.

The assumptions made by the review team to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are listed below.

- In its ER, STPNOC stated that 959 workers would be needed for operation of proposed Units 3 and 4 (STPNOC 2009a). The review team assumed that one-half of the operations workers would be assigned to each unit so the operations work force used in the calculations was 480 workers per unit. An additional 1500 to 2000 temporary workers are estimated to be needed for refueling outages (STPNOC 2009a). The review team assumed that outages for the two units would not occur simultaneously.

- The average commuting distance for operations and outage workers was assumed by the review team to be 20 mi one-way. This assumption is based on the U.S. Department of Transportation (DOT) data that estimates the typical commute is approximately 16 mi. one way (DOT 2003).

- To develop representative commuter traffic impacts, data from the U.S. Department of Transportation provide a Texas-specific fatality rate for all traffic for the years from 2003 to 2007 (DOT 2009a). The average fatality rate for the period from 2003 to 2007 in Texas was used as the basis for estimating Texas-specific injury and accident rates. Adjustment factors were developed using national traffic accident statistics in the DOT publication *National Transportation Statistics 2007* (DOT 2007). The 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 Texas-specific fatality rate to approximate the injury and accident rates for commuters in the State of Texas.

The estimated impacts of transporting operations and outage workers to and from the proposed STP site and alternative sites are listed in Table 5-8. The total annual traffic fatalities during operations, including both operations and outage personnel, represent about a 1.4 percent increase above the average 7.4 traffic fatalities per year that occurred in Matagorda County, Texas, from 2004 to 2008 (DOT 2009b). The impacts of transporting operations workers to and from the alternative sites were about a 0.9 percent increase for the Trinity 2 site and 1 percent increases for the Allens Creek and Red 2 sites. These percentages represent small increases relative to the current traffic fatality risks in the areas surrounding the proposed STP site and alternative sites.

Table 5-8. Nonradiological Estimated Impacts of Transporting Operations Workers to and from the STP Site

	Accidents Per Year Per Unit	Injuries Per Year Per Unit	Fatalities Per Year Per Unit
Permanent Workers	9.4×10^{0}	4.3×10^{0}	6.4×10^{-2}
Outage Workers	4.7×10^{0}	2.2×10^{0}	3.2×10^{-2}

Based on the information provided by STPNOC, the review team's independent evaluation, and considering that this increase would be small relative to the current traffic fatalities (that is, before the proposed units are constructed) in the affected counties, the review team concludes that the nonradiological impacts of transporting construction materials and personnel to the proposed STP site would be minimal, and mitigation would not be warranted.

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts to the public and workers from the proposed cooling system, noise generated by plant operations, acute and chronic impacts of EMFs, and transporting operations and outage workers to and from the proposed Units 3 and 4. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from etiological agents, noise generated by plant operations, and acute impacts of EMF would be minimal. The review team reviewed available scientific literature on 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. Based on the information provided by STPNOC and the review team's own independent evaluation, the review team concludes that the potential impacts to nonradiological health resulting from the operation of the proposed two additional units at the STP site would be SMALL and mitigation would not be warranted.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed two new units on the STP site, including a discussion of the estimated radiological doses to a member of the public and to biota inhabiting the area around the STP site. Estimated doses to workers at the proposed units are also discussed. Radiological impacts were determined using the Advanced Boiling Water Reactor (ABWR) design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation.

5.9.1 Exposure Pathways

The public and biota would receive radiation dose from a nuclear unit via the liquid effluent, gaseous effluent and direct radiation pathways. STPNOC estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the STP site. STPNOC considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (STPNOC 2009a). For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, STP considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., fish and invertebrates), direct radiation exposure from shoreline activities, and swimming and boating exposure. The analysis for population dose considered the following exposure pathways: ingestion of aquatic food and direct radiation exposure from shoreline activities, swimming and boating. The water downstream of proposed Units 3 and 4 is neither used for irrigation nor as a source of drinking water. Liquid effluents are released to the MCR. Seepage from the MCR (described in Section 2.3.3.2) would result in releases of radiological materials to groundwater and surface water pathways. For the gaseous effluent release pathway, STPNOC considered the following pathways in evaluating the dose to the MEI: immersion in the radiological plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, and ingestion of beef. Milk consumption was not considered because no milk animals are located within 5 mi of the site.

STPNOC (STPNOC 2009a) stated that direct radiation from the Units 3 and 4 reactor buildings and planned Onsite Staging Facility likely would be the primary source of exposure to the public from the STP site. STPNOC (2009a) stated the primary objective of radiation shielding is to protect operating personnel and the general public from radiation emanating from the reactor, power conversion systems, radwaste process systems, and auxiliary systems. However, STPNOC assumes that the direct radiation from normal operation of proposed Units 3 and 4 would result in 2.5 mrem/yr per unit at the EAB, based on the plant shielding design acceptance criteria for the ABWR due to direct and scattered radiation.

STPNOC (2009a) calculated population doses using the same exposure pathways as used for the individual dose assessment, but included ingestion of invertebrates caught in Matagorda Bay (see Figure 5-1).

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-2 and included:

- Ingestion of aquatic foods
- Ingestion of water
- External exposure from water immersion or surface effect
- Inhalation of airborne radionuclides
- External exposure to immersion in gaseous effluent plumes
- Surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977).

The NRC staff reviewed the exposure pathways for the public and biota identified by STPNOC and found them to be appropriate, based on a documentation review, a tour of the environs, and interviews with STPNOC staff and contractors during the site visit in February 2008.

5.9.2 Radiation Doses to Members of the Public

STPNOC calculated the dose to the MEI and the population living within a 50-mi radius of the site from the direct radiation, liquid, and gaseous effluent release pathways (STPNOC 2009a). STPNOC stated that it conservatively estimated the direct radiation exposure to the MEI from sources of radiation at the proposed Units 3 and 4 would be 2.5 mrem per year per unit.

5.9.2.1 Liquid Effluent Pathway

Liquid effluents are released into the MCR. The highest concentration of the radiological material would be in the MCR. Water seeps out of the MCR into the groundwater underlying the MCR. As this water moves away from the MCR the concentration of radiological material diminishes due to dispersion and radiological decay. A series of 770 pressure relief wells drain water from the Upper Shallow Aquifer underlying the MCR into drainage ditches. The drainage ditches on the west side of the MCR flow into the Little Robbins Slough, which empties into the Colorado River. The drainage ditches on the east side of the MCR flow into the Colorado River. The remainder of water not collected by the relief wells follows the groundwater gradient and discharges into the Colorado River. The Colorado River flows into Matagorda Bay. There are private wells that pump non-potable water from the Upper Shallow Aquifer between the MCR

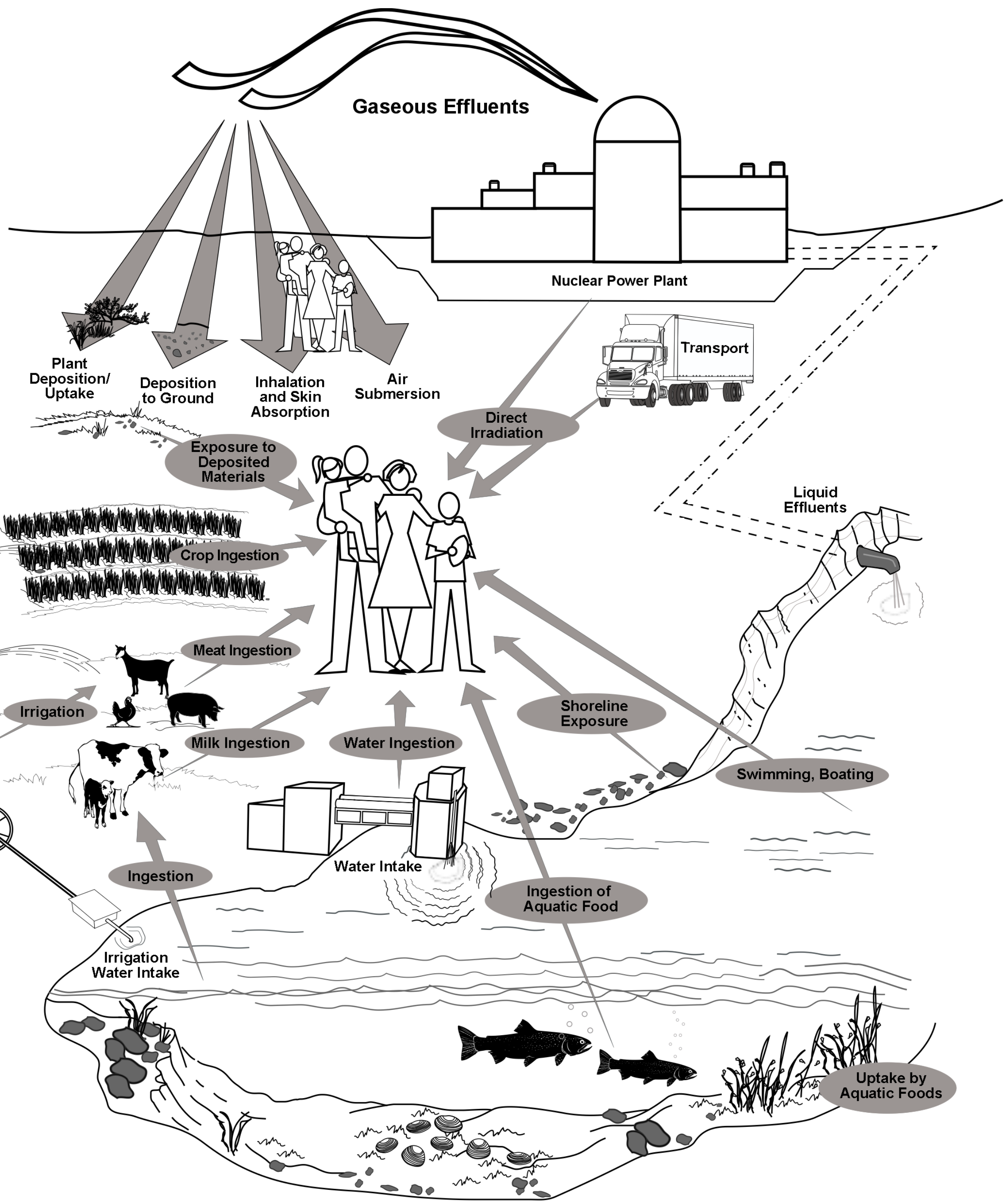
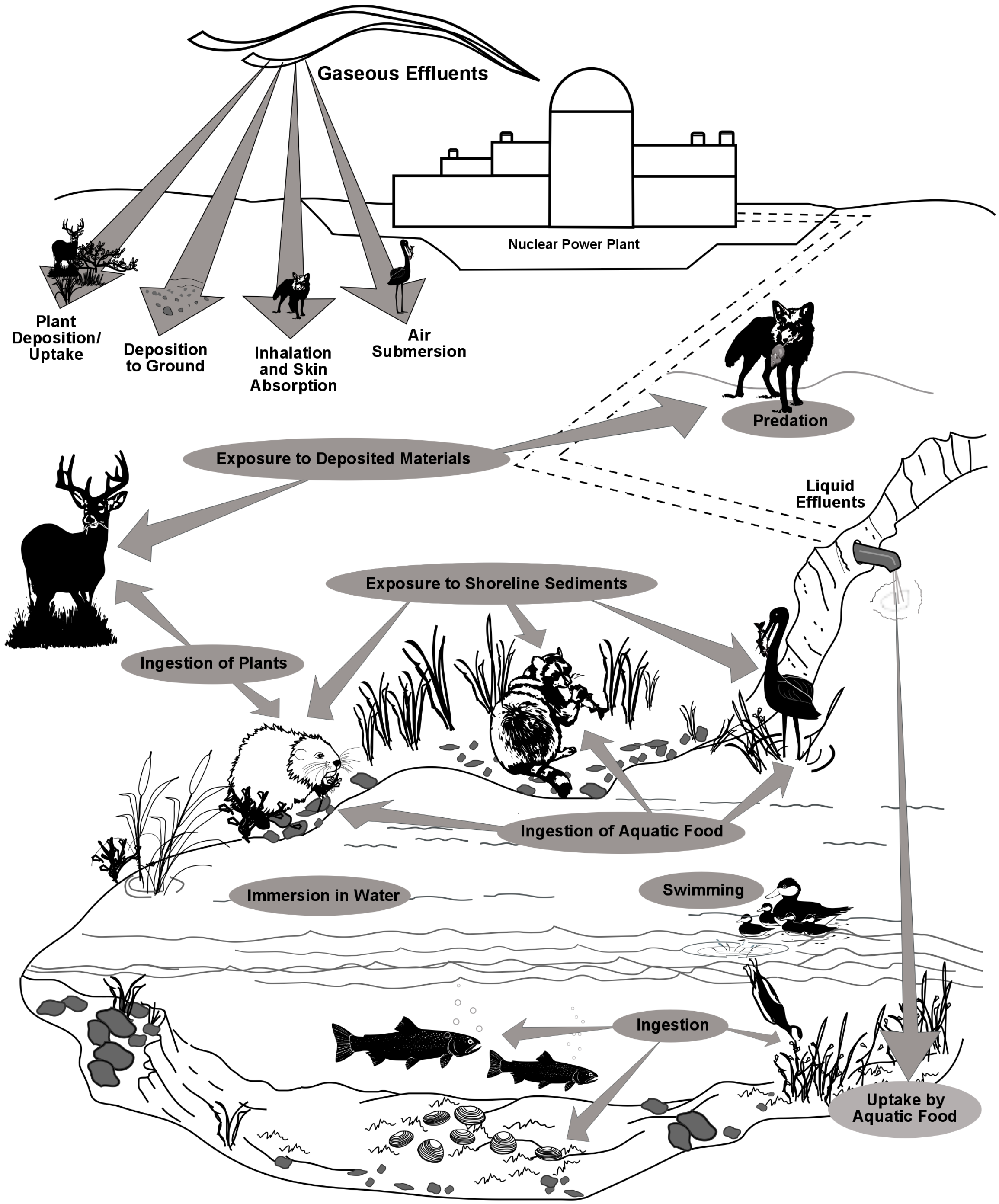


Figure 5-1. Exposure Pathways to Man (adapted from Soldat et al. 1974)



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2 **Figure 5-2**. Exposure Pathways to Biota Other Than Man (adapted from Soldat et al. 1974)

and the Colorado River. The owners of these wells use the groundwater to provide water for livestock (STPNOC 2009h). Liquid pathway doses to the MEI were calculated by STPNOC using the LADTAP II computer program (Strenge et al. 1986). The following activities were considered in the STPNOC dose calculations: fish and invertebrate consumption, and swimming, boating and shoreline exposure (STPNOC 2009a). NRC staff added the meat cow pathway from livestock drinking water from groundwater wells.

The liquid effluent releases used in the estimates of dose are found in Table 3.5-1 of the ER (STPNOC 2009a). 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., fish consumption). For the meat cow pathway, NRC staff used the beef consumption parameters reported in Appendix G and calculated an estimate of tritium in a beef cow drinking well water.

STPNOC calculated liquid pathway doses to the MEI as shown in ER Table 5.4-4 and LADTAP II Output files. Table 5-11 is derived from those output files. The representative MEI was a teenager ingesting fresh water sport fish, and receiving shoreline exposure from Little Robbins Slough for total body and all other organs except bone. For dose to bone, the MEI was a child at the same location (STPNOC 2009a). Table 5-9 also includes doses for the meat cow pathway as calculated by NRC staff.

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 concluded that all the input parameters used in the STPNOC calculations were appropriate. The NRC staff performed an independent evaluation of the liquid pathway doses using input parameters from the ER and found similar results. Results of the NRC staff's independent review are found in Appendix G.

Table 5-9. Annual Doses to the MEI for Liquid Effluent Releases from a New Unit

Pathway	Age Group	Total Body (mrem/yr)	Maximum Organ (GI-LLI)[(a)] (mrem/yr)	Thyroid (mrem/yr)
Fish and Other Organisms	Adult	0.0001	0.0004	0.00003
	Teen	0.0001	0.0003	0.00003
	Child	0.0001	0.0001	0.00002
Meat Cow	Adult	0.00002	0.00002	0.00002
	Teen	0.00001	0.00001	0.00001
	Child	0.00002	0.00002	0.00002
Direct Radiation	Adult	0.00003	0.00003	0.00003
	Teen	0.0002	0.0002	0.0002
	Child	0.00004	0.00004	0.00004

(a) GI-LLI is the gastrointestinal tract – lower large intestine

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the MEI were calculated by STPNOC using the GASPAR II computer program (Strenge et al. 1987) at the nearest residence, the EAB, the nearest garden and meat cow. 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 contaminated grass; and (4) ingestion of garden vegetables contaminated by gases and particulates. STPNOC (2009a) states that no milk cows or milk goats are located within 5 mi of the proposed site; therefore, milk ingestion was not considered as a dose pathway for the MEI. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 3.5-2 of the ER (STPNOC 2009a). 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 5.4-2, 5.4-3 and 5.4-4 of the ER (STPNOC 2009a). Gaseous pathway doses to the MEI calculated by STPNOC are found in Table 5.4-6 of the ER (STPNOC 2009a). STPNOC assumed the MEI was a child located 2.18 mi WSW from the proposed units except for the thyroid doses; the MEI for thyroid doses was a child located 3.03 mi NNW from the proposed units. Gaseous pathway doses for a single unit are shown in Table 5-10 on the following page.

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 STPNOC and concluded that the parameters used by STPNOC were appropriate. The NRC staff performed an independent evaluation of the gaseous pathway doses and obtained similar results for the MEI. Results of the NRC staff's independent review are found in Appendix G.

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 of the proposed two new units at the STP site. The evaluation addresses dose from operations to the MEI located at the STP site and the population dose (collective dose to the population within 50 mi) around the STP site.

Table 5-10. Annual Doses to MEI for Gaseous Effluent Releases from a New Unit

Pathway	Age Group	Total Body Dose (mrem/yr)	Max Organ (Bone) (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose[(a)] (mrem/yr)
Plume (2.18 mi WSW)	All	0.167	0.167	0.462	0.087
Ground (2.18 mi WSW)	All	0.0236	0.0236	0.0277	0.0283
Inhalation (2.18 mi WSW)	Adult	0.00162	0.000815	0.00103	0.0745
	Teen	0.00175	0.00113	0.00104	0.0975
	Child	0.00167	0.00151	0.00092	0.121
	Infant	0.00104	0.00113	0.00053	0.110
Vegetable (2.18 mi WSW)	Adult	0.0409	0.176	0.00335	0.83
	Teen	0.0615	0.284	0.054	1.055
	Child	0.138	0.68	0.129	1.99
Meat (2.18 mi WSW)	Adult	0.0133	0.0615	0.0123	0.0399
	Teen	0.0109	0.052	0.0135	0.0297
	Child	0.0200	0.098	0.0194	0.0467

(a) MEI was located 2.18 mi WSW of new units except for thyroid; MEI for thyroid was located 3.03 mi NNW of new units.

5.9.3.1 Maximally Exposed Individual

STPNOC (2009a) stated that total body and organ dose estimates to the MEI from liquid and gaseous effluents for each new unit would be within the dose design objectives of 10 CFR Part 50, Appendix I. STPNOC determined the total body and maximum organ doses at the Little Robbins Slough from liquid effluents were well within the respective 3 mrem/yr and 10 mrem/yr Appendix I dose design objectives. Doses at the site boundary from gaseous effluents were well within the Appendix I dose 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 dose design objective. A comparison of dose estimates for each new unit to the Appendix I dose design objectives is found in Table 5-11 on the following page.

Table 5-11. Comparison of Annual MEI Dose Rates for a Single Unit with 10 CFR 50, Appendix I Criteria

Pathway / Type of Dose	STPNOC (2009a)	Appendix I Design Objectives
Liquid Effluents		
Total Body	0.00026[(a)]	3 mrem/yr
Maximum Organ Dose (Bone)	0.0012[(b)]	10 mrem/yr
Gaseous Effluent[(c)] (Noble Gases Only)		
Gamma Air Dose	3.3	10 mrad/yr
Beta Air Dose	4.3	20 mrad/yr
Total Body Dose	3.2	5 mrem/yr
Skin Dose	7.3	15 mrem/yr
Gaseous Effluents (Radioiodines and Particulates)		
Maximum Organ Dose (Thyroid)	2.2[(d)]	15 mrem/yr

Source: STPNOC 2009a
(a) Teenager using Little Robbins Slough
(b) Child using Little Robbins Slough
(c) North-northwest Site Boundary.
(d) Child eating home grown meat and vegetables.

Table 5-12 on the following page compares the combined dose estimates from direct radiation, gaseous and liquid effluents from existing Units 1 and 2 and the proposed Units 3 and 4 against the 40 CFR Part 190 standards (STPNOC 2009a). The table shows that the total doses to the MEI from liquid and gaseous effluent as well as direct radiation at the STP site are well below the 40 CFR Part 190 standards. The total body and organ dose estimates to the MEI from liquid and gaseous effluents for STP Units 1 and 2 would be less than the estimates from Units 3 and 4, which are well within the design objectives of 10 CFR Part 50, Appendix I. Section 4.9 states that the direct radiation doses from the existing STP site do not vary significantly from background radiation levels at the site boundary; therefore, direct radiation from the existing units is not included in Table 5-12. The NRC staff completed an independent evaluation of compliance with 40 CFR 190 standards and found similar results. The results of staff's evaluation are presented in Appendix G.

5.9.3.2 Population Dose

STPNOC estimates the collective total body dose within a 50-mi radius of the STP site to be 0.58 person-rem/yr from the proposed Units 3 and 4 from gaseous and liquid effluent pathways (STPNOC 2009a). The estimated collective dose to the same population from background radiation is estimated to be 160,000 person-rem/yr. The dose from natural background radiation was calculated by multiplying the 50-mi population estimate for 2060 of approximately

514,000 people (STPNOC 2009a) by the annual background dose rate of 311 mrem/yr (NCRP 2009).

Table 5-12. Comparison of MEI Dose Rates with 40 CFR Part 190 Criteria – (mrem/yr)

	STP 1 and 2 (Existing) [(a)]				STP 3 and 4 (ABWR)				
	Liquid	**Gaseous**	**Total**	**Direct Radiation**	**Liquid[(b)]**	**Gaseous**	**Total**	**Site Total**	**Regulatory Limit**
Total Body	0.0042	0.0080	0.012	5.0	0.00025	0.70[(c)]	5.70	5.71	25
Thyroid	0.0041	0.0097	0.014	NA[(e)]	0.00011	4.54[(d)]	4.54	4.55	75
Other Organ - bone	0.00077	0.0011	0.0019	NA	0.0023	1.94[(c)]	1.94	1.94	25

Source: STPNOC 2009a
(a) Same receptors as proposed Units 3 and 4 at STP.
(b) Child using Little Robbins Slough for shoreline activities and fishing.
(c) Residence with meat animal and vegetable garden, dose to child, 2.18 mi WSW of new units (MEI).
(d) Residence with meat animal and vegetable garden, dose to child, 3.03 mi NNW of new units (MEI).
(e) NA = Not Applicable

Collective population doses from gaseous and liquid effluent pathways were estimated by STPNOC using GASPAR II and LADTAP 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), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by 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-Sieverts), equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection (ICRP) Publication 103 (ICRP 2007). The estimated collective whole body dose to the population living within 50 mi of the proposed two new units at the STP site is 0.583 person-rem/yr (STPNOC 2009a), which is less than the 1754 person-rem/yr value that ICRP and National Council on Radiological Protection and Measurements (NCRP) suggest would most likely result in zero excess health effects (NCRP 1995; ICRP 2007).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). 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" (NCI 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The health impacts from routine gaseous and liquid radiological effluent releases from the two proposed units have been calculated by both STPNOC and NRC staff. Based on information provided by STPNOC, and the NRC's evaluation, the NRC staff concludes there would be no observable health impacts to the public from normal operations of the proposed units; the health impact would be SMALL and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

STPNOC (2009a) reported annual occupational dose estimates of about 248 person-rem for existing STP Units 1 and 2 during 2005. Based on available data for the ABWR design, the projected annual occupational dose, including outages, is estimated to be 91 person-rem for each unit or 182 person-rem for both units (STPNOC 2009b). The estimated occupational doses for ABWR designs are estimated to be less than the annual occupational doses for current light-water reactors.

The licensee of a new plant would need to maintain individual doses to workers within 5 rem annually as specified in 10 CFR 20.1201 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 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 Doses to Biota Other than Humans

STPNOC estimated doses to biota in the site environs; in many cases using surrogate species. Surrogate species used in the ER are well defined and provide an acceptable method for evaluating doses to biota (Soldat, Robinson and Baker, 1974). Surrogate species analysis was performed for aquatic species such as fish, invertebrates, and algae; and for terrestrial species such as muskrats, raccoons, herons, and ducks. Important biota species for the STP site and the corresponding surrogate species are as follows: (1) grass shrimp, crayfish and blue crab – invertebrates; (2) darter, shiner, largemouth bass, - fish; (3) white-tailed deer, gray and fox squirrels, - raccoon and muskrat; (4) wood storks, coots, teal, and shovellers – duck; and

(5) whooping crane - heron. Exposure pathways considered in evaluating dose to the biota were discussed in Section 5.9.1 and shown in Figure 5-2.

5.9.5.1 Liquid Effluent Pathway

Liquid effluents are released into the MCR. The highest concentration of the radiological material would be in the MCR. Water seeps out of the MCR into the groundwater underlying the MCR. As this water moves away from the MCR the concentration of radiological material diminishes due to dispersion and radiological decay. A series of 770 pressure relief wells drain water from the Upper Shallow Aquifer underlying the MCR into drainage ditches. The drainage ditches on the west side of the MCR flow into the Little Robbins Slough, which empties into the Colorado River. The drainage ditches on the east side of the MCR flow into the Colorado River. The remainder of water not collected by the relief wells follows the groundwater gradient and discharges into the Colorado River. The Colorado River flows into Matagorda Bay (STPNOC 2009a).

STPNOC (2009a) used the LADTAP II computer program to calculate doses to the biota from the liquid effluent pathway. Liquid pathway doses were higher for biota compared to humans because of considerations for 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 biota dose are found in Table 3.5-1 of the ER (STPNOC 2009a). STPNOC evaluated biota doses in Little Robbins Slough (STPNOC 2009a) and in the MCR (STPNOC 2009i). Table 5-13 presents STPNOC's estimates of the doses to biota from the liquid and gaseous pathways from proposed Units 3 and 4. Doses from liquid effluents at other locations such as Little Robbins Slough would be lower. As discussed in Appendix G, the NRC staff obtained similar results in confirmatory calculations for the liquid pathway.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). 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 (Figure 5-2). The dose calculated to the MEI from gaseous effluent releases in Table 5-13 would also be applicable to terrestrial surrogate species with two modifications. One modification defined in STPNOC's ER (2009a) was increasing the ground deposition factors by a factor of two as terrestrial animals would be closer to the ground than the MEI. The second modification was to assume no vegetation intake pathway for muskrat and heron because they are not known to consume vegetation. The gaseous effluent releases used in estimating dose are found in Table 3.5-2 of the ER (STPNOC 2009a). The ER used doses at the site area boundary in estimating terrestrial species doses. STPNOC's dose estimates to the surrogate species from the liquid and gaseous pathways are shown in Table 5-13. As discussed in Appendix G, the NRC staff obtained slightly higher results in confirmatory calculations.

Table 5-13. Biota Doses for Proposed Units 3 and 4

Biota	STPNOC Biota Dose Estimates		
	Liquid Pathway[(a)] (mrad/yr)	**Gaseous Pathway[(b)] (mrad/yr)**	**Total (mrad/yr)**
Fish	2.50	0	2.50
Invertebrate	5.30	0	5.85
Algae	0.54	0	0.68
Muskrat	2.44	8.45	10.89
Raccoon	1.38	9.96	11.34
Heron	2.46	8.45	10.91
Duck	3.15	9.96	13.11

(a) Using MCR water
(b) Maximum site boundary

5.9.5.3 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 biota dose estimates of the new units are conservative because they do not consider dilution or decay of liquid effluents during transit. Actual doses to the biota are likely to be less than estimated.

The ICRP (ICRP 1977; ICRP 1991, ICRP 2007) 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) and the NCRP (NCRP 1991) reported that a chronic dose rate of no greater than 1000 mrad/d to the MEI in a population of aquatic organisms would ensure protection of the population. IAEA (1992) also concluded that chronic dose rates of 100 mrad/d or less do not appear to cause observable changes in terrestrial animal populations. Table 5-14 compares STPNOC's estimated total body dose to the biota from the proposed Units 3 and 4 to the IAEA chronic dose rate values for aquatic and terrestrial biota. Even considering the slightly higher doses to biota calculated by the NRC staff (see Appendix G) from the gaseous effluent pathway, the dose rates would be far less than the NCRP and IAEA guidelines.

Based on the information provided by STPNOC and NRC's review, the NRC staff concludes that the radiological impact on biota from the routine operation of the proposed Units 3 and 4 at the STP site would be SMALL, and additional mitigation would not be warranted.

Table 5-14. Comparison of Biota Doses from the Proposed Units 3 and 4 at the STP Site to Relevant Guidelines for Biota Protection

Biota	STPNOC Estimate of Dose to Biota (mrad/d)	IAEA / NCRP Guidelines for Protection of Biota Populations (mrad/d) [(a)]
Fish	6.8×10^{-4}	1000
Invertebrate	1.6×10^{-2}	1000
Algae	1.9×10^{-4}	1000
Muskrat	3.0×10^{-2}	100
Raccoon	3.1×10^{-2}	100
Heron	3.0×10^{-2}	100
Duck	3.1×10^{-2}	100

(a) Published guidelines reported in mGy/d (1 mGy equals 100 mrad).

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) has been in place for the STP site since 1986, when preoperational sample collection activities began before the construction and operation of existing STP Units 1 and 2 (STPNOC 2009a). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway from the Colorado River, and the ingestion exposure pathway in a 5-mi radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi. Milk is not currently sampled because there is no known production within 5 mi of the site. 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 occurrence of milk production. 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 unit began operation. The pre-operational 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 STP Unit 1 began in 1988, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. Radiological releases and the results of the REMP are summarized in two annual reports: the Annual Radiological Environmental Operating Report (e.g., STPNOC 2008h) and Annual Radiological Effluent Release Report (e.g., STPEGS 2008). No additional monitoring program has yet been established for the two new units. To the greatest extent practical, the REMP for the COL program would use the procedures and sampling locations used by the existing STP site. The NRC staff reviewed the documentation for the existing REMP, the Offsite Dose Calculation Manual, and recent monitoring reports from STPNOC, and 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 units at the STP site.

STPNOC now performs additional groundwater sampling around the STP site in support of the NEI Ground Water Protection Initiative. These results are summarized in the 2007 Annual Environmental Operating Report (STPEGS 2008). Drinking water in the area is obtained from deep aquifer wells, which are monitored quarterly, and no tritium has been detected in this water. However, tritium is released to the MCR. Monitoring shows that levels of tritium in the shallow aquifer around the MCR originating from the liquids discharged to the MCR are below the EPA drinking water standards (DWS) (40 CFR Part 141).

Historical monitoring data for the MCR water show a peak tritium concentration of 17,410 picocuries per liter (pCi/L) in 1996 and values less than 14,000 pCi/L since (STPNOC 2009a). A relief well monitored since 1995 showed a peak tritium concentration value of 7672 pCi/L in 1998 and values less than 7000 pCi/L since. Tritium activity in an onsite well completed in the Shallow Aquifer shows a peak in the year 2000 of less than 8000 pCi/L, and lower values before and since (STPEGS 2008). During 2005, the REMP sampled six onsite wells and found one above tritium detection limits (260 pCi/L). A tritium concentration of 1200 pCi/L was observed (STPNOC 2009a). During 2006, 16 shallow aquifer STPNOC-controlled wells surrounding the MCR and located outside the Protected Area of existing STP Units 1 and 2 were sampled (STPNOC 2009a; STPEGS 2007). Review of the Annual Radiological Environmental Operating Report showed a highest observed mean tritium concentration of 1600 pCi/L (STPEGS 2007). A higher result was obtained in 2007 when the highest observation mean was 5300 pCi/L (STPEGS 2008).

The relief well system, (i.e., 770 wells that surround the MCR), is designed in part to intercept the majority of the seepage from the MCR into the Upper Shallow Aquifer. STPNOC (2009a) has estimated that total seepage from the MCR is 3530 gpm (5700 ac-ft/yr), and that approximately 68 percent of this or 2390 gpm (3850 ac-ft/yr) is intercepted by the relief wells and discharged under the TDPES permit (TCEQ 2005). During operation of existing STP Units 1 and 2 the annual release of tritium into the MCR has varied from less than 500 Ci/yr to approximately 3700 Ci/L with the release in 2006 between 2000 and 2500 Ci, and in 2007 less than 1500 Ci (STPEGS 2007; 2008). Reported concentrations of tritium in the MCR are below the EPA DWS (i.e., 20,000 pCi/L) (65 FR 76707) and those in groundwater are well below the DWS. Reported concentrations are well below the NRC reporting level of 30,000 pCi/kg. Of the radionuclides measured in the laboratory, only tritium was detected above its detection limits in the shallow aquifer test wells and piezometers (STPEGS 2007, 2008).

5.10 Nonradioactive Waste Impacts

This section describes the potential impacts to the environment that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during the operation of proposed Units 3 and 4 at the STP site.

Section 3.4.4 describes the nonradioactive waste systems for STP Units 3 and 4. Types of nonradioactive waste that would be generated, handled, and disposed of during operational activities at proposed Units 3 and 4 include solid wastes, liquid effluents, and air emissions. Solid wastes include municipal waste, dredge spoils, sewage treatment sludge, and industrial wastes. Liquid waste includes TPDES-permitted discharges such as effluents containing chemicals or biocides, wastewater effluents, site stormwater runoff, and other liquid wastes such as used oils, paints, and solvents that require offsite disposal. Air emissions would primarily be generated by vehicles, diesel generators, and combustion 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 to Land

Operation of proposed Units 3 and 4 would generate solid and liquid wastes similar to those already generated by current operation of STP Units 1 and 2. Total volume of solid and liquid wastes would increase, however no new solid or liquid waste types are expected to result from the operation of the new Units 3 and 4. Process wastes such as waste oils, solvents, paints, and hydraulic fluids are transported offsite for either fuel blending and thermal recovery, or recycling. STPNOC has indicated it would continue to use recycling and waste minimization practices to reduce offsite disposal of non-sanitary solid and liquid waste. Current recycling and waste minimization practices at the STP site reflect a recycling rate of 70 percent for all nonradioactive solid waste, including paper, scrap metal, used oil, antifreeze, and non-lead batteries. Solid waste that cannot be recycled is transported to an offsite landfill (STPNOC 2009a).

Debris from trash racks on the RMPF is routinely collected and disposed of according to TECQ regulations at an offsite landfill. Spoils from maintenance dredging of the barge slip and in front of the RMPF would be stockpiled and/or disposed at an approved onsite or offsite location according to new or revised Corps Section 404 and Section 10 permits for the STP site. Both of these wastes generated during the operation of Units 3 and 4 would follow current disposal management plans for existing STP Units 1 and 2 (STPNOC 2009a).

Two onsite wastewater treatment facilities collect and treat sanitary waste. Activated sludge from these facilities is currently disposed of at both onsite and offsite locations. The increased sludge that would be generated by the operation of two additional units would be disposed of in a similar manner through a revised or new permit from TCEQ (STPNOC 2009a).

Based on the effective practices for recycling and minimizing waste already in place for STP Units 1 and 2, and the plans to manage solid and liquid wastes in a similar manner in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts to land from nonradioactive wastes generated during the operation of proposed Units 3 and 4 would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts to Water

Effluents containing chemicals or biocides would be discharged from proposed Units 3 and 4 to the MCR and the Colorado River. Effluents include discharges from the wastewater treatment system, the circulating water treatment system, nonradioactive floor drains, site stormwater runoff, and cooling system discharge. As stated above, two wastewater treatment facilities currently receive, treat, and discharge treated wastewater to the MCR through TCEQ permitted outfalls. The existing facilities would be replaced with two new wastewater treatment plants that would serve all four units. To properly manage stormwater flow, STPNOC would update its existing SWPPP to reflect the increase in impervious surfaces and changes in onsite drainage patterns (STPNOC 2009a).

Section 5.2.3 discusses impacts to surface- and groundwater quality from operation of Units 3 and 4. Nonradioactive liquid effluents that would be discharged to the MCR and the Colorado River would be regulated by TCEQ and subject to limitations contained in the site's TPDES permit (TCEQ 2005). STPNOC anticipates that it would be necessary to revise or apply for a new TPDES permit to accommodate increased discharges to the MCR and the Colorado River resulting from operation of STP Units 3 and 4 (STPNOC 2009a); in either case, discharges would be subject to limitations contained in the site's TPDES permit.

Based on the regulated practices for managing liquid discharges containing chemicals or biocide, and other wastewater, and the plans for managing stormwater, the review team expects that impacts to water from nonradioactive effluents during the operation of Units 3 and 4 would be minimal and no further mitigation would be warranted.

5.10.3 Impacts to Air

Operation of proposed Units 3 and 4 would result in gaseous emissions from the intermittent operation of emergency diesel generators and combustion generators. In addition, increased vehicular traffic associated with personnel necessary to operate Units 3 and 4 would increase vehicle emissions in the area. Impacts to air quality are discussed in detail in Section 5.7. Increases in air emissions from operation of Units 3 and 4 would be in accordance with permits issued by TCEQ that would ensure compliance with the Federal Clean Air Act.

Based on the regulated practices for managing air emissions from stationary sources, the review team expects that impacts to air from nonradioactive emissions during the operation of proposed Units 3 and 4 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 Atomic Energy Act of 1954, the Solid Waste Disposal Act of 1965, as amended by the Resource, Conservation, and Recovery Act (RCRA) in 1976, and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). Each reactor at the STP site can be expected to produce on the order of 0.5 m^3 per year of mixed waste. However, no mixed waste has been generated at STP Units 1 and 2 in the past five years, in part, due to waste minimization practices (STPNOC 2009a). Mixed waste can be reduced through decay, stabilization, neutralization, or filtration. STPNOC stated that mixed waste that cannot be treated onsite would be temporarily stored until shipment for offsite disposal at an approved facility; existing STPNOC procedures for storage of mixed wastes would be used to limit occupational exposure or accidental spill (STPNOC 2009a).

Based on the effective practices for minimizing waste already in place for STP Units 1 and 2, and the plans to manage mixed wastes in a similar manner in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts from the generation of mixed waste at STP Units 3 and 4 would be minimal, and no further mitigation would be warranted.

5.10.5 Summary of Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of proposed Units 3 and 4 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste, and Corps permits for disposal of dredged spoils, would be obtained and implemented. A revised SWPPP for surface water runoff and TCEQ permits for permitted releases of cooling and auxiliary system effluents would ensure compliance with the Federal Water Pollution Control Act (Clean Water Act) and TCEQ water quality standards. Wastewater discharge would be compliant with TPDES limitations. Air emissions from Units 3 and 4 operations would be compliant with air quality standards as permitted by TCEQ. Mixed waste generation, storage, and disposal impacts during operation of proposed Units 3 and 4 would be compliant with requirements and standards.

Based on the information provided by STPNOC, the effective practices for recycling, minimizing, managing, and disposing of wastes already in use at the STP site, the review team's expectation that regulatory approvals would be obtained to regulate the additional waste that would be generated from proposed Units 3 and 4, and the review team's independent evaluation, the review team concludes that the potential impacts from nonradioactive waste resulting from the operation of the proposed two additional units at the STP site would be SMALL, and mitigation would not be warranted.

Cumulative impacts to water and air from nonradioactive emissions and effluents are discussed in Sections 7.2.2.1 and 7.5, respectively. For the purposes of Chapter 9, the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for the STP site and the three alternative sites and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at the proposed new units at the STP site. Consequence estimates are based on the ABWR certified design as set forth in 10 CFR Part 52, Appendix A. 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 in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous 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 the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as reasonable achievable are specified in 10 CFR Part 50, Appendix I. There are additional measures that are designed to mitigate the consequences of failures in the first line of defense. These measures include the NRC’s reactor siting criteria in 10 CFR Part 100, 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, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants* (NRC 1980). 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.

This section discusses (1) the types of radioactive materials that may be released, (2) the potential paths for their release 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, after operation, a significant fraction of the 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, have lower tendencies to escape from the fuel than the noble gases and isotopes of iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. 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 recent report by the National Research Council (2006), the BEIR 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.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rem over a short period (hours) (IAEA 2001). Untreated doses of about 250 to 500 rem received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

STPNOC evaluated the potential consequences of postulated accidents to demonstrate that an ABWR could be constructed and operated at the STP site without undue risk to the health and safety of the public (STPNOC 2009a). These evaluations used a set of DBAs that are representative for the reactor design being considered for the STP site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on the certified ABWR at the STP 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 (10 CFR Part 52, Subpart B). Potential consequences of DBAs are evaluated 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 ABWR for evaluating potential accidents are based on guidance in Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors" (NRC 1974).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, also referred to as relative concentration (χ/Q), which has units of s/m^3. Small χ/Q values are associated with greater dilution capability. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants" (NRC 1983).

Table 5-15 repeats χ/Q values pertinent to the environmental review of DBAs for the STP site that were presented earlier in Table 2-39. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the EAB, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term, i.e., 2 hours, and for the Low Population Zone (LPZ), they are calculated for the course of the accident, i.e., 30 days (720 hours) composed of four time periods. The NRC staff reviewed the χ/Q values presented by STPNOC and concluded that they were overly conservative. Therefore, the NRC staff calculated 50th percentile χ/Q values using the STP site meteorological information discussed in ER Sections 2.7.4 and 6.4. The staff used these χ/Qs to estimate the environmental consequences of DBAs. The second column in Table 5-15 lists the χ/Q values calculated by the NRC staff assuming ground-level releases located on a line enclosing all potential release points.

Table 5-16 lists the set of DBAs considered by STPNOC and presents the NRC staff's estimates of the potential environmental consequences of each accident in terms of thyroid dose from inhalation and the whole body dose from external exposure. The staff reviewed the STPNOC selection of DBAs by comparing the accidents listed in the application with the DBAs considered in the ABWR design control document (General Electric 1994; NRC 1994, 1997a). The DBAs in the ER are an appropriate subset of those considered in the design certification. The doses in Table 5-16 were calculated by the NRC staff from the DBA doses in the design control document using the ratio of the staff's site-specific atmospheric dispersion factors in Table 5-16 to the atmospheric dispersion factors assumed for the design certification.

Table 5-15. Atmospheric Dispersion Factors for STP Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, Exclusion Area Boundary	3.64×10^{-5}
0 to 8 hr, Low Population Zone	2.53×10^{-6}
8 to 24 hr, Low Population Zone	2.23×10^{-6}
1 to 4 d, Low Population Zone	1.70×10^{-6}
4 to 30 d, Low Population Zone	1.15×10^{-6}

Table 5-16. Design Basis Accident Doses for an ABWR

		Doses in rem[(a)]					
		EAB		LPZ		Review Criterion	
Accident	SRP Section[(b)]	Whole Body	Thyroid	Whole Body	Thyroid	Whole Body	Thyroid
Main Steamline Break	15.6.4						
Pre-existing Iodine Spike		0.035	1.4	0.0024	0.094	25[(c)]	300[(c)]
Accident-Initiated Spike		0.0017	0.069	0.00011	0.0048	2.5[(d)]	30[(d)]
Loss-of-Coolant Accident	15.6.5	0.11	51	0.23	22	25[(c)]	300[(c)]
Failure of Small Line Carrying Primary Coolant Outside Containment	15.6.2	0.0025	0.013	0.00017	0.0089	2.5[(d)]	30[(d)]
Fuel Handling	15.7.4	0.032	2.0	0.0022	0.14	6[(d)]	75[(d)]
Cleanup Water Line Break Outside Containment		0.00035	0.037	0.000031	0.0033	25[(c)]	300[(c)]

(a) To convert rem to Sv divide by 100.
(b) NUREG-0800 (NRC 2007)
(c) 10 CFR 100.11 and 10 CFR 50.34(a)(1) criterion
(d) Standard Review Plan criterion

There are no environmental criteria related to the potential consequences of DBAs. Consequently, the review criteria used in the NRC staff's safety review of DBA doses are included in Table 5-16 to illustrate the magnitude of the calculated environmental consequences (whole body and thyroid doses). In all cases, the calculated environmental consequences (doses) are considerably smaller than the doses used as safety review criteria.

Summary of DBA Impacts. The NRC staff reviewed the STPNOC DBA analysis, which is based on analyses performed for the design certification of the ABWR design with adjustment for STP site-specific characteristics. The results of the STPNOC analyses presented in its ER indicate that the environmental risks associated with DBAs, if an ABWR was to be located at the STP site, would be small. The NRC staff performed an independent assessment of the environmental consequences of DBAs at the STP site and concludes that the environmental consequences of DBAs would be SMALL.

5.11.2 Severe Accidents

In its ER, STPNOC considers the potential consequences of severe accidents for an ABWR at the STP 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.

The STPNOC evaluation of the potential environmental consequences for the atmospheric pathway incorporates the results of the MELCOR Accident Consequence Code System (MACCS2) computer code (Chanin et al. 1990; Jow et al. 1990) run using ABWR reactor source term information and site-specific meteorological, population, and land-use data. The NRC staff has reviewed STPNOC input and output files, has run confirmatory calculations, and finds the STPNOC results reasonable.

The MACCS2 computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants: Final Summary Report* (NRC 1990). The MACCS2 code evaluates the consequences of atmospheric releases of radioactive material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to radioactive material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of radioactively contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS2 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. MACCS2 estimates both early cancer fatalities and latent 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).

Latent 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 to15) 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 radioactive contamination following a severe accident. Farmland 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 calculated 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 an ABWR reactor at the STP site is estimated to be 1.34×10^{-7} per reactor year (Ryr^{-1}), and the cumulative population dose associated with a severe accident without loss of containment at the STP site is calculated to be 19,600 person-rem. The population dose risk for this class of accidents is the product of 1.34×10^{-7} Ryr^{-1} and 19,600 person-rem, or 2.63×10^{-3} person-rem Ryr^{-1}.

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. STPNOC has submitted an application to construct and operate two ABWRs at the STP site. The consequences of a severe accident would be the same regardless of whether one or two reactors were built at the site. However, if two reactors were built, the risks would apply to each reactor, and the total risk for new reactors at the site would be twice the risk for a single reactor.

5.11.2.1 Air Pathway

The MACCS2 code directly estimates consequences associated with releases to the air pathway. STPNOC used the MACCS2 code to estimate consequences to the population in 2060 based on meteorological data for 1997, 1999 and 2000. The results of the MACCS2 calculations presented in the following tables are the averages of the estimates for the 3 years. The core damage frequencies (CDFs) given in these tables are for internally initiated accident sequences 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. Estimates of the core damage frequencies for externally initiated events and during shutdown are discussed later.

Table 5-17 presents the probability-weighted consequences, i.e., risks, of severe accidents for an ABWR reactor located on the STP site that contribute 1 percent or more to at least one risk category. Risks are small for all risk categories considered. For perspective, Table 5-18 and Table 5-19 compare the health risks from severe accidents for an ABWR reactor at the STP site with the risks for current-generation reactors at various sites and with an ABWR reactor at the North Anna, Clinton, and Grand Gulf Early Site Permit (ESP) sites.

In Table 5-18, the health risks estimated for an ABWR at the STP site are compared to health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach

Table 5-17. Mean Environmental Risks from ABWR Reactor Severe Accidents at the STP Site

	Release Category Description (Accident Class)	Core Damage Frequency(a) (Ryr^{-1})	Environmental Risk: Population Dose(b) (person-rem Ryr^{-1})	Fatalities (Ry^{-1}): Early(c)	Fatalities (Ry^{-1}): Latent(d)	Cost(e) (\$ Ryr^{-1})	Land Requiring Decontamination(f) (ac Ryr^{-1})	Population Dose from Water Ingestion(b) (person-rem Ryr^{-1})
0	No loss of containment	1.34×10^{-7}	2.63×10^{-3}	0.0	1.57×10^{-6}	0.01	5.79×10^{-7}	4.22×10^{-6}
1	Transients followed by failure of high-pressure coolant makeup water and failure to depressurize in timely fashion	2.08×10^{-8}	2.29×10^{-4}	0.0	1.37×10^{-7}	0.00	9.82×10^{-9}	3.71×10^{-7}
3	Station blackout with Reactor Core Isolation Cooling (RCIC) available for about 8 hr	1.00×10^{-10}	3.57×10^{-5}	0.0	2.14×10^{-8}	0.00	1.14×10^{-6}	2.28×10^{-7}
6	Transient, loss-of-coolant accident (LOCA), and anticipated transient without scram (ATWS) events with successful coolant makeup water, but potential prior failure of containment	1.00×10^{-10}	5.91×10^{-5}	0.0	5.41×10^{-8}	0.15	1.27×10^{-5}	1.05×10^{-5}
7	Small/medium LOCA followed by failure of high-pressure coolant makeup water and failure to depressurize	3.91×10^{-10}	2.52×10^{-4}	6.63×10^{-16}	2.31×10^{-7}	0.58	5.80×10^{-5}	5.29×10^{-5}
8	LOCA followed by failure of high-pressure coolant makeup water	4.05×10^{-10}	5.74×10^{-4}	2.12×10^{-13}	3.46×10^{-7}	0.96	6.75×10^{-5}	1.46×10^{-4}
9	ATWS followed by boron injection failure and successful high-pressure coolant makeup water	1.70×10^{-10}	2.64×10^{-4}	2.16×10^{-13}	1.60×10^{-7}	0.52	2.48×10^{-5}	8.38×10^{-5}
Total		1.56×10^{-7}	4.08×10^{-3}	4.29×10^{-13}	2.54×10^{-6}	2.23	1.66×10^{-4}	2.98×10^{-4}

(a) Source: GE 1997
(b) To convert to person-Sv, divide by 100.
(c) 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).
(d) Latent fatalities are fatalities related to low doses or dose rates that could occur after a latent period of several (2 to 15) years.
(e) 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).
(f) Land risk is farmland requiring decontamination prior to resumption of agricultural usage.

Table 5-18. Comparison of Environmental Risks for an ABWR Reactor at the STP Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150[(a)]

	Core Damage Frequency (Ryr^{-1})	50-mi Population Dose Risk (person-rem Ryr^{-1})[(b)]	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent	Early	Latent Cancer
Grand Gulf[(c)]	4.0×10^{-6}	$5 \times 10^{+1}$	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[(c)]	4.5×10^{-6}	$7 \times 10^{+2}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[(c)]	5.7×10^{-5}	$1 \times 10^{+3}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[(c)]	4.0×10^{-5}	$5 \times 10^{+2}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[(c)]	3.4×10^{-4}	$5 \times 10^{+3}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
ABWR[(d)] Reactor at the STP_site	1.6×10^{-7}	4.1×10^{-3}	4.3×10^{-13}	2.5×10^{-6}	5.8×10^{-14}	3.1×10^{-12}
ABWR[(e)] Reactor at North Anna	1.6×10^{-7}	5.9×10^{-3}	2.4×10^{-11}	2.7×10^{-6}	4.6×10^{-14}	4.4×10^{-12}
ABWR[(f)] Reactor at Clinton	1.6×10^{-7}	2.4×10^{-3}	7.9×10^{-10}	1.0×10^{-6}	3.8×10^{-14}	3.9×10^{-12}
ABWR[(g)] Reactor at Grand Gulf	1.6×10^{-7}	2.1×10^{-3}	1×10^{-12}	9×10^{-7}	2×10^{-14}	3×10^{-12}

(a) NRC 1990
(b) To convert to person-Sv, divide by 100.
(c) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(d) Calculated with MACCS2code using STP site-specific input.
(e) NUREG-1811 (NRC 2006a)
(f) NUREG-1815 (NRC 2006b)
(g) NUREG-1817 (NRC 2006c)

Table 5-19. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an ABWR Reactor at the STP Site with Risks Initiated by Internal Events for Current Plants Undergoing Operating License Renewal Review and Environmental Risks of the ABWR Reactor at Other Sites

	Core Damage Frequency (yr^{-1})	**80-km (50-mi) Population Dose Risk (person-rem Ryr^{-1})[(a)]**
Current Reactor Maximum[(b)]	2.4×10^{-4}	$6.9 \times 10^{+1}$
Current Reactor Mean[(b)]	2.7×10^{-5}	$1.6 \times 10^{+1}$
Current Reactor Median[(b)]	1.6×10^{-5}	$1.3 \times 10^{+1}$
Current Reactor Minimum[(b)]	1.9×10^{-6}	3.4×10^{-1}
ABWR[(c)] Reactor at the STP Site	1.6×10^{-7}	4.1×10^{-3}
ABWR[(d)] Reactor at North Anna	1.6×10^{-7}	5.9×10^{-3}
ABWR[(e)] Reactor at Clinton	1.6×10^{-7}	2.4×10^{-3}
ABWR[(f)] Reactor at Grand Gulf	1.6×10^{-7}	2.1×10^{-3}

(a) To convert to person-Sv, divide by 100.
(b) Based on MACCS and MACCS2 calculations for 76 current plants at 44 sites.
(c) Calculated with MACCS2 code using STP site-specific input.
(d) NUREG-1811 (NRC 2006a)
(e) NUREG-1815 (NRC 2006b)
(f) NUREG-1817 (NRC 2006c)

Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-18. The health risks shown for ABWR at the STP site are significantly lower than the risks associated with current-generation reactors presented in NUREG-1150. Table 5-18 also compares health risks of an ABWR at the STP site with health risks for an ABWR at three ESP sites (NRC 2006a, b, c).

The last two columns of Table 5-18 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the staff compares these estimates to the 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). 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 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 plant 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 plant 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 two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," is about 4.0×10^{-4} per year, including a 1.6×10^{-4} per year risk associated with transportation accidents (NSC 2006). One-tenth of one 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^{-1}.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the United States which is about 1 in 500 or 2×10^{-3} per year (Reed 2007). One-tenth of one 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} per Ryr^{-1}.

The MACCS2 computer code 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, these risks were well below the Commission's safety goals. Risks calculated by STPNOC for the ABWR design at the STP site are lower than the risks associated with the current-generation reactors considered in NUREG-1150 and are well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for an ABWR at the STP site with statistics summarizing the results of contemporary severe accident analyses performed for 76 reactors at 44 sites. The results of these analyses are included in the final site-specific Supplements 1 through 37 to the GEIS for License Renewal, NUREG-1437 (NRC 1996a), and in the ERs included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990), and the analyses for 72 of the reactors used MACCS2, which was released in 1997. Table 5-19 shows that the CDFs estimated for the ABWR are significantly lower than the core damage frequencies of current-generation reactors. Similarly, the population doses estimated for an ABWR at the STP 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 an ABWR reactor at the STP site (4.1×10^{-3} person-rem/Ryr) may be compared to the dose risk for normal operation of a single ABWR reactor at the STP site (2.9×10^{-1} person-rem/Ryr) (see Section 5.9.3.2). The risk associated with a severe accident is two orders of magnitude lower than the risk associated with normal operations. Comparatively, the population dose risk associated with a severe accident is small.

In developing a probabilistic risk assessment for a nuclear power plant, criteria are included to "screen out" information that is insignificant. Regulatory Guide 1.200 (NRC 2009a) discusses methods and criteria for determining if the contribution to risk from an initiating event is insignificant. For example, the risk potential of a severe accident at a co-located nuclear unit as an initiating event is insignificant compared to other initiating events because the event frequency is very low. First, the frequency of a severe accident that results in an early large release of radioactive material to the environment is on the order of 1×10^{-6} per Ryr for current operating nuclear power plants such as STP Units 1 and 2 (even lower for new reactors such as STP Units 3 and 4). Then that accident or the radioactive release from that accident has to create a problem that leads to the initiation of a severe accident at a co-located nuclear power plant. The radioactive release from the accident does not initiate an accident at the co-located reactor; however, it may set up conditions that could eventually lead to a severe accident at the co-located reactor. The wind direction must move the accident release toward the co-located units; the release must overwhelm the habitability systems such that operators on the co-located units have to be evacuated because of high dose rates; and the lack of continuous operator attention and action must eventually result in multiple system failures that lead to a loss of reactor cooling and containment failure. There is no detailed estimate of the combined probability of this sequence of events; however, the overall probability of a severe accident initiating a severe accident at a co-located reactor would be at least three orders of magnitude lower (10^{-9} per Ryr or less). This probability is insignificant compared to the overall probability of accident initiators, and consideration of this scenario as an initiating event is "screened out".

Based on this explanation, the NRC staff concludes the potential environmental impact of this accident scenario does not need to be evaluated because it is remote and speculative.

Even though this accident scenario is remote and speculative, STPNOC made a bounding estimate of the population dose risk by postulating that a severe accident at one STP unit could cause a severe accident at the remaining units. STPNOC estimated the population dose risk for one ABWR at the STP site to be about 4 x 10^{-3} person-rem per Reactor-year (Ryr) (STP 2009a), and further indicated that the large early release frequency for Units 1 and 2 is about 30 times higher than the large release frequency for Unit 3 and 4 (STPNOC 2009j). The resulting population risk for all four units would be less than one person-rem per reactor-yr. The NRC staff reviewed the applicant's bounding analysis and concludes that the corresponding environmental risks would still be small based on comparisons with the environmental risks shown in Table 5-17.

The ER does not address potential consequences from externally initiated events or events at low power and shutdown. The following paragraphs discuss risks from low power and shutdown events, tornado, internal floods and fires, external floods, and seismic events.

For design certification, the ABWR vendor evaluated qualitatively features that minimize shutdown risk discussed in NUREG-1449, *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States* (NRC 1993), which include internal floods and internal fire protection. The ABWR vendor also performed a detailed reliability study of the decay heat removal system which evaluated the conditional probability of core damage given loss of the operating residual heat removal system. Chapter 19 of the staff's safety evaluation report (SER) (NRC 1994; 1997a) concluded that the ABWR vendor appropriately addressed concerns in NUREG-1449 related to the capability to provide alternate core cooling in the case of a loss of the residual heat removal system.

With respect to tornado-initiated events, the Design Control Document (GE 1997) states that the total CDF is "extremely small" and is small compared to the internal events result. In the SER, the NRC staff noted that the ABWR is designed to withstand tornadoes with a 1×10^{-7} yr^{-1} frequency of occurrence and that the internal events evaluation includes loss-of-offsite power events, which are the most likely way in which a tornado would impact an ABWR. As a result, the NRC staff did not consider it necessary to assess tornado-initiated events probabilistically.

With respect to internal floods and fires, the design certification analyses were based on conservative simplifying assumptions. In its SER, the staff estimated that the internal flooding events considered the most challenging and having the worst consequences had CDFs that were less than 1×10^{-8} yr^{-1}, and that the CDF associated with internal fires was about 1×10^{-6} yr^{-1}. In addition, the staff noted "Because of conservatism in the analyses, the staff does not believe that the fire and internal flood core damage frequency estimates should be compared to those of internal events." (NRC 1994)

STPNOC's Final Safety Analysis Report (FSAR) (STPNOC 2009b) reviews the DCD fire analysis and concludes that the fire analysis in the DCD bounds the risks at the STP site. The STPNOC FSAR repeats the DCD analyses of internal flooding of the turbine and control buildings. In each case, the FSAR concludes that the CDF is extremely small. The FSAR then presents an STP site-specific flooding analysis for the Reactor Service Water pump house and concludes that "This conservative bounding analysis shows that the CDF for internal flooding is very small..." (STPNOC 2009b)

The applicant requested a design departure from the ABWR DCD site parameter (STP DEP T1-5.0-1) for the maximum flood level to 183 cm above grade (STPNOC 2009b). The plant design will be modified to account for the change in the level of the maximum flood at STP by including watertight doors for the external entrances to the control and reactor buildings; this will ensure that there is adequate protection for equipment in rooms containing critical equipment in the reactor and control buildings. STPNOC conducted an external event flooding analysis for the STP site that considered river flooding, tsunamis, dam failures, and storm surges from hurricanes; the one external initiating event related to flooding that was not excluded by the screening analysis was the breach of the MCR embankment. STPNOC also committed to develop procedures to ensure the watertight doors will be closed and controlled when necessary to prevent flooding in the reactor and control buildings, such as during a hurricane (STPNOC 2010).

Seismic events are considered in the DCD and SER using a "seismic margins analysis" approach that does not yield a CDF. The ABWR has a design basis safe shutdown earthquake of 0.3g; the STP site-specific value is lower than 0.3g. The result of the seismic margin analysis is that there is a high confidence with low probability of failure that an ABWR would withstand a 0.6g earthquake without core damage.

5.11.2.2 Surface-Water Pathways

Surface-water pathways are an extension of the air pathway. These pathways consider the effects of radioactive material deposited on open bodies of water. The surface-water pathways of interest include external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the MACCS2 code evaluates only the ingestion of contaminated water. The risks associated with this surface-water pathway calculated for the STP site are included in the last columns of Table 5-17. Environmental consequences of potential surface-water pathways related to immersion and ingestion (e.g., swimming and fishing) are not evaluated by MACCS2. STPNOC relied on generic analyses in the GEIS, NUREG-1437 (NRC 1996a) for the immersion pathway. NUREG-1437 reiterates conclusions set forth in the *Final Environmental Impact Statement*

Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2, NUREG-0769 (NRC 1981) that indicate that doses from shoreline activities and swimming are smaller than either water ingestion doses or aquatic food ingestion doses. In Table 5-17 the water ingestion dose risk is less than 10 percent of the air pathway dose risk. STPNOC also relied on the GEIS analysis to estimate that the dose risk from uninterdicted ingestion of aquatic foods would be between 0.4 and 270 person-Ryr^{-1}.

NUREG-1437 (NRC 1996) classifies the STP site as being a coastal or estuarine site. Table 5.16 in the GEIS lists aquatic food harvest and uninterdicted aquatic food ingestion risks for several plants at coastal and estuarine sites. For this table, the population dose was related to aquatic food harvest assuming a linear relationship with a transfer factor (coefficient) of about 2.4 person-rem per kg of harvest. Using this value and the average Matagorda Bay aquatic harvest for the 2005 through 2007 seasons (PNNL 2009), the NRC staff estimates that the upper bound for the uninterdicted aquatic food pathway population dose risk is about 0.1 person-rem per reactor year.

Should a severe accident occur at a reactor located at the STP site, it is likely that Federal, State, and local officials would take various measures including limiting access to contaminated areas and interdiction to reduce exposures. In addition, the distance between the STP site and Matagorda Bay would reduce the aquatic food pathway dose risk below the risk estimated above. Considering the likelihood of interdiction and the distance from the STP site to Matagorda Bay, the NRC staff concludes that the population dose risk from the surface water pathways at the STP site is likely to be a small fraction of the air pathway risk.

5.11.2.3 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris reaches the groundwater where soluble radionuclides are transported with the groundwater. The MACCS2 code does not evaluate the environmental risks associated with severe accident releases of radioactive material to groundwater. In the GEIS (NUREG-1437) (NRC 1996), the NRC staff assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination, and concludes that groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway.

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 plants. New designs include features to reduce the probability of basemat melt-through in the event of a core melt accident. The probability of core melt with basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-17 presents a total CDF estimate of 1.56×10^{-7} Ryr^{-1} for the ABWR reactor. NUREG-1150 indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. Further, the ABWR severe accident release sequences that might be expected to involve core-concrete interactions have frequencies of less than 1 x 10^{-8} Ryr^{-1}. On this basis, the NRC staff believes that a basemat melt-through probability of 1 x 10^{-7} Ryr^{-1} is reasonable and still conservative.

The groundwater pathway is 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 determination of suitability of the STP site.

5.11.2.4 Summary

The NRC staff reviewed the risk analyses in the ER, FSAR, and DCD for the purpose of determining the potential environmental impacts of severe accidents. Based on this review, the NRC staff concludes that the overall severe accident risk for proposed STP Units 3 and 4 is low. The NRC staff is currently reviewing the risk analyses presented in the FSAR to confirm this conclusion and determine compliance with the NRC's safety regulations (10 CFR 52.79) and the Commission's safety goals. The results of that review will be presented in the Safety Evaluation Report prepared by the staff regarding the COL application. The NRC staff also conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for proposed STP Units 3 and 4 using the MACCS2 code. The results of both the STPNOC analysis and the NRC staff analysis indicate that the environmental risks associated with severe accidents if two ABWR reactors were to be located at the STP site would be small compared to risks associated with operation of the current-generation reactors at the STP and other sites. On these bases, the NRC staff concludes that the environmental impact of the probability-weighted consequences of severe accidents at the STP site would be SMALL for the proposed ABWRs.

5.11.3 Severe Accident Mitigation Alternatives

STPNOC has applied for a license to construct and operate two ABWRs at the STP site. The ABWR design (see Appendix A to Part 52–Design Certification Rule for the U.S. Advanced Boiling Water Reactor) incorporates many features intended to reduce severe accident CDFs and the risks associated with severe accidents. The effectiveness of the ABWR design features is evident in Table 5-18 and Table 5-19, which compare CDFs and severe accident risks for the ABWR with CDFs and risks for current-generation reactors including existing STP Units 1 and 2. CDFs and risks have generally been reduced by a factor of 100 or more when compared to the existing units.

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 2000b). Consistent with the direction from the Commission to consider the SAMDAs at the time of certification, the ABWR vendor (GE 1994) and the NRC staff, in its environmental assessment (EA) accompanying the rule (NRC 1996b), have considered a design alternatives for a ABWR at a generic site. The NRC staff incorporates that EA into this EIS by reference.

On these bases, the NRC staff concluded (NRC 1996b):

> Because the ABWR design already includes numerous plant features designed to reduce core-damage frequency and risk, additional plant improvements would be unable to significantly reduce the risk of either internally or externally initiated events…. Moreover, with the features already incorporated in the ABWR design, the ability to estimate core-damage frequency and risk approaches the limitations of probabilistic techniques. … Although improvements in these areas may introduce additional contributors to core-damage frequency and risk estimates, the NRC staff does not expect that they would be significant in absolute terms.

Further, 10 CFR Part 52 Appendix A Section VI(B)(7) provides resolution for:

> All environmental issues concerning severe accident mitigation design alternatives associated with the information in the NRC's final environmental assessment for the ABWR design and Revision 1 of the technical support document for the ABWR, dated December 1994, for plants referencing this appendix whose site parameters are within those specified in the technical support document.

In its ER, STPNOC reasserted the reactor vendor’s claim that there were no SAMDAs that would be cost beneficial. STPNOC did not do a STP site-specific evaluation of design alternatives. STPNOC did assess the maximum benefit that would accrue if a single procedural or training alternative could eliminate all remaining risk associated with the ABWR design by updating the analysis submitted for design certification (GE 1994) with STP site specific information and procedures set forth in NUREG/BR-0184 (NRC 1997b). STPNOC determined that the maximum benefit at the STP site would be less than $20,000. A more realistic assessment would show that the potential benefit would be substantially less than the maximum because no alternative can reduce the remaining risk to zero.

The NRC staff has limited its review to determination of whether or not the STP site characteristics are within the site parameters specified in the ABWR technical support document (GE 1994). The technical support document does not contain a specific list of site parameters. However, the population dose risk is given as 4.5×10^{-3} person-rem per year. The population dose risk is based on release characteristics including amount and probability, meteorological conditions, and population distribution and is, therefore, the appropriate site parameter for purposes of comparison.

STPNOC evaluated the population dose risk for the STP site using the MACCS2 code with site specific meteorological and population distribution. The population dose risk derived from the site-specific analysis discussed in the ER and shown in Table 5-18 is 4.1 $\times 10^{-3}$ person-rem per year. Independent review by the NRC staff confirmed this value. On this basis, the NRC staff concludes that the STP site characteristics are bounded by the site parameters considered during the ABWR design certification, and that the environmental issues related to the SAMDAs have been resolved by rule.

SAMDAs are a subset of SAMAs. SAMAs also include procedural and training alternatives. STPNOC did not develop procedural and training alternatives. In its ER, STPNOC (2009a) states that "[e]valuation of specific administrative controls would occur when the proposed Units 3 and 4 design is finalized and plant administrative processes and procedures are being developed." Pursuant to regulatory requirements, procedures must be in place and training must be completed prior to loading fuel.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for an ABWR at the STP site. Based on the information provided by STPNOC and NRC's own independent review, the staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed Units 3 and 4 would be SMALL and additional mitigation would not be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of proposed Units 3 and 4, the review team relied on STPNOC'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., Corps' Section 404 Permit, NPDES),
- Compliance with existing STP Unit 1 and 2 processes and/or procedures applicable to proposed Unit 3 and 4 environmental compliance activities for the STP site,
- Compliance with STPNOC procedures applicable to environmental control and management, and
- Implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-20, which is the review team's adaptation from sections of STPNOC's ER Table 5.10-1 (STPNOC 2009a), lists a summary of measures and controls to limit adverse impacts during operation proposed by STPNOC.

Table 5-20. Summary of Proposed Measures and Controls to Limit Adverse Impacts During Operation

Resource Category	Specific Measures and Controls
Land-Use	
	There are no practical measures of mitigation for the approximately 300 ac of land that would be permanently dedicated to the plant until decommissioning.
	Salt deposition could affect land use in the immediate vicinity of the cooling towers. The cooling towers would operate under rules and regulations governing these systems.
	STPNOC would maintain communication with local and regional government agencies to disseminate project information so they have the opportunity to plan accordingly for land-use impacts from operations workforce population growth and development for commercial and residential purposes.
	All Federal, Texas, and local requirements and standards would be met regarding handling, transportation, and offsite land disposal of the solid waste at licensed facilities.
Water-Related	
Water-Use Impacts	No mitigation would be required for pumping water from the Colorado River to the MCR. STPNOC would apply every three years to the Coastal Plains Groundwater Conservation District to extend the site's current groundwater use permit for 9000 acre-ft of groundwater over an approximate 3-year period. STPNOC would also apply for permits to drill and complete new wells, but they would fall under the existing permit limit. Groundwater withdrawal would be from the deep confined Chicot Aquifer, and impacts from withdrawals to local wells in the Deep Aquifer would be achieved by following CPGCD requirements. Groundwater monitoring would be conducted as required by groundwater use permit.
Water Quality Impacts	STPNOC would obtain a TPDES permit and comply with its discharge limits and monitoring requirements for discharges to the Colorado River.
	STPNOC would obtain TPDES permit and comply with its discharge limits and monitoring requirements for blowdown from the MCR to the Colorado River. The MCR would be operated such that discharges would not be made when the river flow is less than 800 cubic ft per second (cfs) and the volume would not exceed 12.5percent of river flow, allowing a dilution of the already diluted Units 3 and 4 cooling system effluent of at least 8.
	Nonradioactive wastewater discharges would be in accordance with applicable TCEQ water quality standards. STPNOC would revise the existing SWPPP. The impacts due to the new impervious surfaces would be negligible due to BMPs.

Table 5-20. (contd)

Resource Category	Specific Measures and Controls
Ecology	
Terrestrial Ecosystems	Personnel performing transmission maintenance activities such as herbicide application must be trained in and hold Texas Department of Agriculture Commercial Pesticide Applicators Licenses, and all herbicide use follows Federal, State, and local guidelines, and requires a Texas Department of Agriculture pesticide application permit
Aquatic Ecosystems	Closed-cycle cooling, intake screens parallel with river flow, and low approach velocity of traveling screens minimize impingement, entrainment, and entrapment.
	Discharges from MCR to the Colorado River are expected to meet all permits (TPDES permit WQ0001908000). Chemical discharges would be monitored and concentrations are expected to be below criteria that are protective of aquatic life. Physical impacts, e.g., scouring, would be minimized by flow rate and direction of diffusers in the discharge facility.
	Aquatic resources in transmission corridors are protected during maintenance by training chemical applicators to use appropriate chemicals and procedures for protection of aquatic life, as required by Texas Department of Agriculture Commercial Pesticide Applicators Licenses (Note: Maintenance is performed by the transmission system owners, not STPNOC).
Socioeconomic Impacts	
Physical Impacts	STPNOC would obtain air permits and operate systems within permit limits and monitor emissions as required.
Community Impacts	STPNOC would maintain communication with local and regional governmental and non-government organizations in a timely manner so that they are aware of number of workers coming, and the timing of arrivals and departures to allow for community planning concerning potential change in housing, education, and other community services due to the influx of operations workers.
	STPNOC would stagger outage schedules to prevent traffic congestion due to operations and outage worker commuting so only one unit would be down at a time. STPNOC would stagger arrival and departure times.
Historic and Cultural Resources	The Texas Historical Commission has indicated that ongoing operations and maintenance activities of STP Units 1 and 2 would have no effect on historic properties. Therefore it is anticipated that operations and maintenance activities associated with the proposed Units 3 and 4 should also have no effect on historic properties.
Air Quality	STPNOC would obtain air permits and operate systems within permit limits and monitor emissions as required.

Table 5-20. (contd)

Resource Category	Specific Measures and Controls
	Operation of the proposed Units 3 and 4 cooling towers would result in water vapor plumes that would occur in each direction of the compass and would be spread over a wide area, reducing the time that the plume would be visible from any particular location. The average plume lengths would be short and would not be long enough to reach the site boundary in most directions. No mitigation would be required.
	Operation of the cooling towers could lead to minor shadowing, very small increase in precipitation, increases in ground-level humidity in the immediate vicinity, and salt deposition that is a fraction of the level needed to have visible effects on vegetation outside the site boundaries (greater than 1300 ft). No mitigation would be required.
Radiological Impacts of Normal Operation	
Radiation Doses to Members of the Public	Calculated radiation doses to members of the public within NRC and EPA standards (10 CFR Part 20, Appendix I of 10 CFR Part 50, and 40 CFR Part 190).
	Radiological effluent and environmental monitoring programs would be implemented.
Occupational Radiation Doses	Estimated occupation doses are within NRC standards (10 CFR Part 20).
	Program would be implemented to maintain occupational doses ALARA (10 CFR Part 20).
Radiation Doses to Biota Other Than Humans	Calculated doses for biota are well within NCRP and IAEA guidelines.
	Radiological environmental monitoring program would be implemented.
Nonradioactive Waste	
Nonradioactive Waste System Impacts	Reuse, recycle and reclaim solid waste and liquids as appropriate; otherwise use approved transporters and offsite disposal facilities. STPNOC has recycling and waste minimization programs currently in place for the increase in total volume of solid waste that would be generated at the STP site.
	Comply with applicable State and Federal hazardous waste and air quality regulations. Comply with NPDES permit, including implementing an SWPPP.
	Disposal area(s) for nonradioactive waste would be at a permitted waste disposal facility with a land use designated for such activities. Disposal area would be operated under appropriate regulations and guidelines until such time an NRC-licensed high-level waste disposal facility is constructed. At that time, the storage area could be restored for other uses.

Table 5-20. (contd)

Resource Category	Specific Measures and Controls
Mixed Waste Impacts	STPNOC would update existing STP waste minimization plan for operation of proposed Units 3 and 4.
	STPNOC would implement materials handling and safety procedures as well as storage, shipment and emergency response procedures.
	STPNOC would revise Integrated Spill Contingency Plan as necessary to address handling and transport of mixed waste generated at Units 3 and 4.
Accidents	
Design Basis Accidents	Calculated dose consequences of design basis accidents for the ABWR at the STP site were found to be within regulatory limits.
Severe Accidents	Calculated probability-weighted consequences of severe accidents for the ABWR at the STP site were found to be lower than the probability- weighted consequences for current operating reactors.
	The STP site parameters are within the site parameters considered in the design certification review of severe accident mitigation design alternatives. Therefore, issues related to severe accident mitigation design alternatives are resolved. Procedural and training alternatives would be considered when procedures are developed.
Nonradiological Health Impacts	STPNOC would implement the existing STP industrial safety program at proposed Units 3 and 4 to mitigate impacts to worker health due to occupational injuries and illnesses.

Source: STPNOC 2009a

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations of proposed Units 3 and 4 is summarized in Table 5-21. 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 5-21. Summary of Operational Impacts at the Proposed Units 3 and 4 Site

Resource Category	Comments	Impact Level
Land-Use Impacts		
Site	No adverse impacts projected.	SMALL
Transmission Lines and Offsite Areas	No new offsite transmission corridors. Some new offsite housing and retail development expected.	SMALL
Water-Related Impacts		
Water Use - Surface Water	The addition of Units 3 and 4 would result in only slight decreases in Colorado River streamflow below the RMPF.	SMALL
Water Use - Groundwater	Groundwater use would remain bounded by the existing groundwater use permit for existing STP Units 1 and 2. Groundwater use during operation would require the drilling and completion of at least one new well to obtain the capacity necessary to meet peak demands. Short-term maximum peak demands would be met, if necessary, by drawing from stored groundwater reserves, the MCR, or the Colorado River.	SMALL
Water Quality - Surface Water	Stormwater runoff to onsite and offsite water bodies would be minimal because of implementation of a stormwater pollution prevention plan and use of BMPs. The 5°F isotherm plume, resulting from a bounding scenario of MCR discharge, would not completely block the Colorado River cross section. The minimum dilution in the Colorado River would be a factor of 8 and chemical or radiological contaminants present in the MCR discharge would be quickly transported downstream to the Matagorda Bay where they would be diluted even further. Water quality in the Colorado River would be minimally and temporarily affected by maintenance dredging of the RMPF.	SMALL
Water Quality - Groundwater	Groundwater quality would remain substantially unchanged as a result of (1) the use of BMPs to contain and remove spills, (2) the negligible change in contamination levels in the MCR that seep into the Upper Shallow Aquifer, and (3) the increased spatial distribution of pumping impacts by adding a well to the existing Deep Aquifer well network.	SMALL

Table 5-21. (contd)

Resource Category	Comments	Impact Level
Ecological Impacts		
Terrestrial Ecosystems	Impacts from operations of two new nuclear units, including the associated heat dissipation system, transmission lines, and right-of-way maintenance would be negligible.	SMALL
Aquatic Ecosystems	Impacts to onsite aquatic ecosystems would be negligible. Impacts to aquatic ecosystems from operation of the RMPF and dredging would be minor. Impacts to aquatic organisms from operations of the MCR discharge would be detectable but would not noticeably alter important attributes of populations or communities.	SMALL
Socioeconomic Impacts		
Physical	Roads within the vicinity of STP would experience an increase in traffic at the beginning and the end of each operations shift and the beginning and end of each outage support shift.	SMALL
Demography	The population of Matagorda County would grow by between 3 and 4% over a few years.	SMALL
Economic Impacts to Community	Employment would be about 2400 higher in the region than without Units 3 and 4. Much of this activity could occur in Matagorda County. Impacts would be less noticeable in other counties.	SMALL to LARGE beneficial
Infrastructure and Community Services	Additional operations workers would have a minor impact on the local road network and FM 521. The overall impact on housing demand and prices from plant operations over the expected 40-year operation of the plant in the region would likely be minimal for both Brazoria and Matagorda Counties.	SMALL
Environmental Justice	No environmental pathways or health and other preconditions of the minority and low-income population were found that would lead to adverse and disproportionate impacts.	SMALL
Historic and Cultural Resources	There are no known historic or cultural impacts at this site. STPNOC has agreed to follow procedures if historic or cultural resources are discovered during ground-disturbing activities.	SMALL
Meteorology and Air Quality Impacts	Operation of the UHS cooling tower and intermittent operation of various diesel generators would be the primary emissions sources for air pollutants.	SMALL

Table 5-21. (contd)

Resource Category	Comments	Impact Level
Nonradiological Health Impacts	There would be no observable nonradiological health impacts to the public from normal operation of the new units. Traffic accident impacts during operations would increase local traffic impacts by about 1%.	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, Appendix I to 10 CFR Part 50, 40 CFR Part 190).	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	Current STPNOC practices and procedures would help minimize waste generation at Units 3 and 4.	SMALL
Impacts of Postulated Accidents		
Design Basis Accidents	Impacts of design basis accidents would be well below regulatory limits.	SMALL
Severe Accidents	Probability-weighted consequences of severe accidents would be lower than the probability-weighted consequences for currently operating reactors.	SMALL

5.14 References

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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 proposed Units 3 and 4 at the South Texas Project Electric Generating Station (STP) site.

In its evaluation of uranium fuel cycle impacts from proposed Units 3 and 4 at the STP site, STP Nuclear Operating Company (STPNOC) used the U.S. Advanced Boiling Water Reactor (ABWR) advanced light water reactor (LWR) design. The capacity factor reported by STPNOC (2009) for the ABWR design is 95 percent. The results reported here assume two units with a capacity factor of 95 percent.

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 ABWR design. The environmental impacts of this design are evaluated against specific criteria for LWR designs in Title 10 of the Code of Federal Regulations (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state that

> Under §51.10, 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 ABWRs proposed for the STP site are light water reactors that would use uranium dioxide fuel; therefore, Table S–3 (10 CFR 51.51(b)) can be used to assess environmental impacts of the uranium fuel cycle. Table S–3 values are normalized for a reference 1000 megawatt electrical (MW(e)) LWR at an 80-percent capacity factor. The Table S–3 values are reproduced in Table 6-1. The power rating for the proposed Units 3 and 4 at the STP site is 2560 MW(e), assuming that two ABWRs would be located on the STP site (STPNOC 2009a), with a capacity factor of 95 percent.

Table 6-1. Table S–3 from 10 CFR 51.51(b), 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 110-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% of model 1000-MW(e) LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4% of model 1000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5% of model 1000 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% of model 1000 MW(e) energy output.
Effluents--Chemical (MT)		
Gases (including entrainment):[c]		
SO_x	4400	
NO_x[d]	1190	Equivalent to emissions from 45 MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
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	
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: 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	

1 **Table 6-1**. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
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 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)	4063	<5% of model1000-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, other areas 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); the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976); 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 1977b); 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 Sec. 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 or not the plant services one reactor for one year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2% 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 and low-level wastes, and radiation doses from transportation and occupational exposures. In developing Table S–3, the U.S. Nuclear Regulatory Commission (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 to the system. 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, utilization, and ultimate disposition of fuel for nuclear power reactors.

In 1978, the Nuclear Non-Proliferation Act of 1978 (22 USC 3201, et seq.) was enacted. This law significantly impacted 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. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 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 DOE efforts would be required 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 either open-pit or underground mines or by an *in situ* leach solution mining process. *In situ* leach mining, presently the primary form of 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 uranium oxide (UO_2) 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 five percent uranium-235, is then converted to UO_2. The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are destined to be placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reaction has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After being stored onsite 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.

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, 1999),[(a)] 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; the NRC staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and provided here.

The fuel cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). In the following

(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

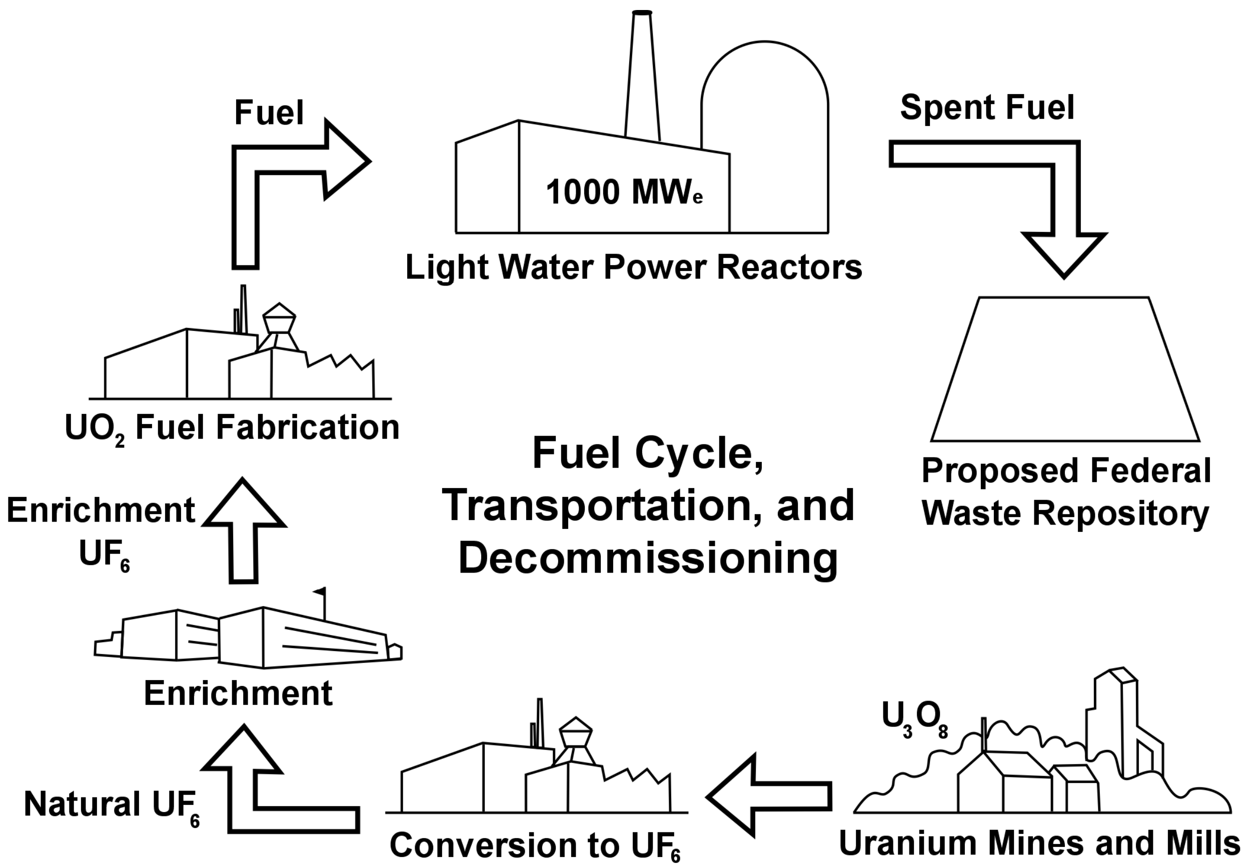

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1999)

review and evaluation of the environmental impacts of the fuel cycle, the NRC staff considered the capacity factor of 95 percent with a total net electric output of 1280 MW(e) for each of the proposed Units 3 and 4 at the STP site for a total of 2560 MW(e) (STPNOC 2009a) this is about 3.2 times (i.e., 2560 MW(e) divided by 800 MW(e) yields 3.2) the impact values in Table S–3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1000-MW(e) LWR-scaled model, 2560 MW(e) for the site.

Recent changes in the 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 fuel cycle trends in the United States:

- Increasing use of in-situ leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifuge. The latter centrifuge process uses only a small fraction of the electrical energy

per separation unit than does gaseous diffusion. (U.S. gaseous diffusion plants relied on electricity derived mainly from the burning of 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.

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 NRC staff used an approach of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to ensure 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. Many subtle fuel cycle parameters and interactions were recognized by the NRC staff as being less precise than the estimates and were not considered or were considered but had no effect 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 1000-MW(e) LWR reactor operating at 80-percent capacity with a 12-month fuel reloading cycle and an average fuel burn-up of 33,000 MWd/MTU. This is a "reactor reference year" or "reference reactor year" depending on the source (either Table S–3 or NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all the reloads for the lifetime of the reactor can be divided by the now more likely 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This was done in NUREG-1437 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 NUREG-1437 (NRC 1996, 1999) as the basis for the reference reactor year. 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 Table S–3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change 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. These market conditions resulted in the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, more recently the spot price of uranium has increased from $24 per pound in April 2005 to $135 per pound in July 2007 and has decreased to near $44 per pound as of April 2009 (UxC 2009). As a result, there is some renewed interest in uranium mining and milling in the United States and the NRC anticipates receiving multiple license applications for uranium mining and milling in the next several years. The majority of these applications are expected to be for *in situ* leach solution mining that does not produce tailings. 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 have not been reduced for these analyses.

Section 6.2 of NUREG-1437 discusses the sensitivity to recent changes in the fuel cycle on the environmental impacts in greater detail.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model would be about 366 ac. Of this land requirement, approximately 42 ac are permanently committed and 324 ac are temporarily committed. 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, for release of that area for unrestricted use. Of the 324 ac of temporarily committed land, 254 are undisturbed, and 70 ac are disturbed. In comparison, a coal-fired power plant using the same MW(e) output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 640 ac per year for fuel alone. The NRC staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting the 1000-MW(e) LWR-scaled model would be 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 3.65×10^{10} gallons, about 3.56×10^{10} gallons are required for the removal of waste heat, assuming that the proposed Units 3 and 4 use once through cooling. Also scaling from Table S-3, other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 5.13×10^8 gallons per year and water discharged to the ground (e.g., mine drainage) of about 4.07×10^8 gallons per year. 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

Electric energy and process heat are required during various phases of the fuel cycle process. Electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant.

The largest source of carbon dioxide (CO_2) emissions associated with nuclear power is from the fuel cycle, not the operation of the plant, as indicated above and in Table S–3. The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent fossil fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas centrifuge (GC) technology is likely to eventually replace gaseous diffusion (GD) technology for uranium enrichment in the United States. The same amount of enrichment from a GC facility uses less electricity and therefore results in lower amounts of air emissions such as carbon dioxide than a GD facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S-3 continue to be appropriately bounding values.

In Appendix I, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000 MW(e) LWR for a 40-year plant life is on the order of 1.4×10^7 metric tons of CO_2 including a small contribution from other greenhouse gases. Scaling this footprint to the power level and capacity factor of STP Units 3 and 4, the NRC staff estimates the carbon footprint for 40 years of fuel cycle emissions to be 4.5×10^7 metric tons of CO_2.

On this basis, the NRC staff concludes that the fossil fuel impacts, including greenhouse gas 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 gaseous and particulate chemical effluents produced in fuel-cycle processes are given in Table S–3 (Table 6-1) for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), 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 1000-MW(e) LWR requires 323,000 MW-hr of electricity. The fuel cycle for the 1000-MW(e) LWR scaled model would therefore require 1,033,600MW-hr of electricity, or 0.025 percent of the 4.1 billion MW-hr of electricity generated in the United States in 2008 (DOE 2009). Therefore, the gaseous and particulate chemical effluents would add about 0.025 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 S–3 (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.

Based on the above analysis, the NRC staff concludes that the impacts of these gaseous, particulate, and liquid chemical effluents 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). Using these effluents in NUREG-1437 (NRC 1996, 1999), the NRC staff calculated the 100-year environmental dose commitment to the U.S. population from the fuel cycle of one year of operation of the model 1000-MW(e) LWR. The total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle (excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99) were calculated to be approximately 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 3.2 for the 1000-MW(e) LWR-scaled model reactor would result in whole body dose commitment estimates of 1280 person-rem for gaseous releases and 640 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1920 person-rem for the 1000-MW(e) LWR-scaled model reactor.

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. STPNOC provided an assessment of radon-222 and technetium-99 in its environmental report (ER) (STPNOC 2009a). STPNOC's evaluation relied on the information discussed in NUREG-1437 (NRC 1996, 1999).

In Section 6.2 of NUREG-1437 (NRC 1996, 1999), 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 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1000-MW(e) LWR-scaled model reactor, or for the total electric power rating for the site for a year, are approximately 16,600 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 NRC staff assumed that the LWR-scaled model reactor would result in an emission of 3.19 Ci per site year, (i.e., about 3.2 times the NUREG-1437 [NRC 1996, 1999] 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 20 Subpart C 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 1000-MW(e) LWR-scaled model) would be approximately 1900 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, 1999).

Also, as discussed in NUREG-1437, the NRC staff considered the potential doses associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor year for the 1000-MW(e) LWR-scaled model reactor are 0.011 Ci from chemical processing of recycled uranium hexafluoride before it enters the isotope enrichment cascade and 0.008 Ci 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 20 Subpart C 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 320 person-rem for the 1000-MW(e) LWR-scaled model reactor.

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 assumption is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold 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. The nominal probability coefficient for total detriment is a factor for the incidence of cancer and other health effects. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem, equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection's (ICRP) Publication 103 (ICRP 2007).

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 4300 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 2.5 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 0.6 mi in some cases) (NRC 1996). The public dose limit in the Environmental Protection Agency's regulation, 40 CFR 190.10, 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).

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 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants and several other nuclear fuel cycle facilities in operation in the United States in 1981; the report found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities". 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 National Council on Radiation Protection and Measurements (NCRP) (NCRP 2009) 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 (about 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.

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S–3 (Table 6-1).

For low-level waste disposal at land burial facilities, the Commission notes in Table S–3 that there would be no significant radioactive releases to the environment. STP Units 1 and 2 can no longer dispose of Class B and C low-level waste (LLW) at the Energy Solutions site in Barnwell, South Carolina. Proposed Units 3 and 4, if in operation, would also not be able to

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 & 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**	

Source: NCRP 2009. Report 160, *Ionizing Radiation Exposure of the Population of the United States*
(a) 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 US population of 300 million.

dispose of these wastes at Barnwell. However, Class A LLW can be shipped to the Energy Solutions site in Clive, Utah. Other disposal sites may be available by the time the two new units would become operational. For example, on September 10, 2009, the Texas Commission on Environmental Quality (TCEQ) (TCEQ 2004) issued a Radioactive Material License R04100 to Waste Control Specialists, LLC (WCS) for the construction of a low-level waste facility in Andrews County, Texas. The facility will be capable of disposal of Class A, B, and C LLW. Construction will begin after WCS demonstrates that it has adequately addressed the conditions identified in its license. Once WCS completes construction and satisfies any operational-related conditions imposed by the TCEQ, the facility may begin to receive and dispose of LLW (TCEQ 2009). Disposal activities are estimated to begin in late 2010 (Valhi 2010). Thus, it is likely that this facility would be available to the STP for disposal of LLW. In addition, the industry is investigating alternate disposal pathways for Class B and C LLW to include (1) compaction and storage at offsite vendor locations until disposal is secured, and (2) blending of waste types with subsequent disposal at available disposal sites.

The NRC staff anticipates that licensees would temporarily store Class B and C LLW onsite until offsite storage locations are available. Several operating nuclear power plants have successfully increased onsite storage capacity in the past in accordance with existing NRC regulations. This extended waste storage onsite resulted in no significant increase in dose to the public. In addition, the NRC issued considerations for extended onsite interim storage of LLW in Regulatory Issue Summary 2008-12 (NRC 2008). Examples of considerations included storing waste in a manner that minimizes potential exposure to workers which may require adding shielding and storing waste in packaging compatible with the waste composition (e.g., chemical and thermal properties).

The NRC staff concluded in NUREG-1437 (NRC 1996, 1999) that the radiological impacts from LLW storage would be small and fall within current regulatory requirements. Although NUREG-1437 is for license renewal activities, the staff concludes the evaluation can be applied to new reactors because radwaste technology and operations will be similar to existing operating reactors. In NUREG-1437 (Section 6.4.4.2), 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. STPNOC's resolution of LLW disposal issues for the existing STP Units 1 and 2 could also be implemented for the proposed Units 3 and 4.

The Commission notes that high-level and transuranic wastes are to be buried at a repository, such as the candidate repository at Yucca Mountain, Nevada. The Commission also notes that no release to the environment is expected to be associated with such disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the high-level and transuranic Table S–3 values established by the Commission, the NRC staff indicates that these high-level and transuranic wastes will be buried and will not be released to the environment.

As a 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 NRC reached an overall generic determination that fuel cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC's position that the zero release assumption was reasonable in the context of the Table S–3 rulemaking to address generically the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas & Electric *v.* Natural Resources Defense Council).

Furthermore, in the Commission's Waste Confidence Decision, 10 CFR 51.23, the Commission has made the generic determination that "if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation … of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations." That regulation also states that "the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time." The regulation provides that, accordingly, no discussion of any environmental impact of spent fuel storage for the period following the term of a reactor combined license is required in any EIS prepared in connections with the issuance of that combined license.

In October 2008, the Commission proposed a rulemaking to update and revise the Waste Confidence Decision (73 FR 59551). Public comments were received on the rulemaking and the public comment period for the rule was extended through February 2009 (73 FR 72370). At this time, however, the Commission has not approved publication of the final rule. If a revised rule concerning the waste confidence determination is ultimately issued by the Commission, the staff will be required to follow that determination. Absent further developments with respect to the Waste Confidence rulemaking, Table S–3 and the existing Waste Confidence Decision indicate that any environmental impacts associated with the high-level waste that would be generated by Units 3 and 4 would be small.

In the context of operating license renewal, Sections 6.2 and 6.4 of NUREG-1437 (NRC 1996) provide additional description of the generation, storage, and ultimate disposal of LLW, mixed waste, and spent fuel from power reactors, concluding that environmental impacts from these activities are small. For the reasons stated above, the NRC staff concludes that the environmental impacts of radioactive waste storage and disposal associated with Units 3 and 3 are SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 1920 person-rem. This is based on a 600 person-rem occupational dose estimate attributable to all phases of the fuel cycle for the model 1000 MW(e) LWR (NRC 1996, 1999). The environmental impact from this occupational dose is considered SMALL because the dose to any individual worker would be maintained within the limits of 10 CFR 20, Subpart C, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public totals about 2.5 person-rem annually for the reference 1000-MW(e) LWR per Table S–3 (Table 6-1). This corresponds to a dose of 8 person-rem for the 1000-MW(e) LWR-scaled model. For comparative purposes, the estimated collective dose from natural background radiation to the current population within 50 mi of the STP site is about 75,000 person-rem/yr (STPNOC 2009a). Based on this comparison, the NRC staff concludes that environmental impacts of transportation would be SMALL.

6.1.9 Conclusion

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 1000-MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of greenhouse gas emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on these evaluations, the NRC staff concludes that the impacts of the uranium fuel cycle 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 STP site and the alternative sites, (2) shipment of irradiated (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, Nevada, site as a surrogate destination for a permanent repository. The impacts evaluated in this section for two new nuclear generating units at the STP site are appropriate to characterize the alternative sites discussed in Section 9.3 of this environmental impact statement (EIS). Alternative sites evaluated in this EIS include the existing STP site (proposed), and alternative sites at Allens Creek, Red 2, and Trinity 2. There is no meaningful differentiation among the proposed and the alternative sites regarding the radiological and nonradiological environmental impacts from normal operating and accident conditions and are not discussed further in Chapter 9.

The NRC performed a generic analysis of the environmental effects of transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC 1975) and found the impact to be SMALL. These documents provided the basis for Table S–4 in 10 CFR 51.52 that summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR.[a] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per

(a) The transportation impacts associated with the STP site were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparisons to Table S–4. Note that the basis for Table S–4 is an 1100 MW(e) LWR at an 80% capacity factor (AEC 1972, NRC 1975). The basis for Table S–3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is a 1000 MW(e) LWR with an 80% capacity factor (NRC 1976). However, since fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

reference reactor year. The combined dose to the public along the route and dose to onlookers were 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, are SMALL. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reactor years and one nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and NUREG/CR-6672 (Sprung et al. 2000) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 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 zircalloy-clad fuel rods.
- 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 it is discharged 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.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) are to be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

In its application, STPNOC requested combined licenses (COLs) for two additional reactors at its STP site in Matagorda County, Texas. The proposed ABWR has a design thermal power rating of 4005 MW(t), with a net electrical output of approximately 1300 MW(e). The thermal power rating exceeds the 3800 MW(t) condition given in 10 CFR 51.52(a). The ABWR is expected to operate with a 95 percent capacity factor (STPNOC 2009a), resulting in a net electrical output (annualized) of about 1235 MW(e). Fuel for the plants would be enriched up to about 2.2 weight percent uranium-235 (U-235) for the initial core and 3.2 weight percent U-235 for core reloads, both of which are less than the 10 CFR 51.52(a) condition. In addition, the average irradiation level of about 32,300 MWd/MTU (STPNOC 2009a) is also less than the 10 CFR 51.52(a) condition. However, since the thermal power rating exceeds the 10 CFR 51.52(a) condition, a full description and detailed analysis of transportation impacts is required.

In its ER (STPNOC 2009a), STPNOC 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 STP site and alternative sites were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008). RADTRAN 5.6 was used in this EIS and is the most commonly used transportation impact analysis software in the nuclear industry.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent evaluation of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the STP 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 to populations and maximally exposed individuals (MEIs) are presented. Because the specific fuel fabrication plant for STP unirradiated fuel is not known at this time, the NRC staff's analysis assumes a "representative" route between the fuel fabrication facility and STP site and alternative sites. This means that there are no substantive differences between the impacts calculated, for the purposes of Chapter 9, for the STP site and the three alternative sites. The site-specific differences are minor because the radiation doses from unirradiated fuel transport are minute and the differences in shipping distances between potential fuel fabrication plants and the STP site and alternative sites are small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities during 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 at some level would occur to the following individuals: (1) persons residing along the transportation corridors between the fuel fabrication facility and the STP site; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides an estimate of the number of truck shipments of unirradiated fuel for the ABWR compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80-percent capacity (880 MW(e)). After normalization, the NRC staff found that the number of truck shipments of unirradiated fuel to the proposed STP site is slightly greater (about 5 percent) than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238.

Table 6-3. Numbers of Truck Shipments of Unirradiated Fuel for the Reference LWR and the ABWR

Reactor Type	Number of Shipments per Reactor	Unit Electric Generation, MW(e)[(b)]	Capacity Factor[(b)]	Normalized, Shipments per 1100 MW(e)[(c)]
	Total[(a)]			
Reference LWR (WASH-1238)	252	1100	0.8	252
STP ABWR	372	1300	0.95	265

(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).
(b) Unit capacities and capacity factors were taken from WASH-1238 for the reference LWR and the ER (STPNOC 2009a) for the ABWR.
(c) Normalized to net electric output for WASH-1238 reference LWR (i.e.,1100-MW(e) plant at 80 percent or net electrical output of 880 MW(e)).

Shipping Mode and Weight Limits

In 10 CFR 51.52, a condition is identified that states all unirradiated fuel is shipped to the reactor by truck. STPNOC specifies that unirradiated fuel would be shipped to the proposed reactor site by truck. Section 10 CFR 51.52, Table S–4, includes a condition that the truck shipments not exceed 73,000 lbs as governed by Federal or State gross vehicle weight restrictions. STPNOC states in its ER that the unirradiated fuel shipments to the proposed STP site would comply with applicable weight restrictions (STPNOC 2009a).

Radiological Doses to Transport Workers and the Public

Section 10 CFR 51.52, Table S–4, 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 number of shipments to which the individuals are exposed. For this EIS, the radiological dose impacts of the transportation of unirradiated fuel were calculated by the NRC staff for the worker and the public using the RADTRAN 5.6 computer code (Weiner et al. 2008).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 3.3 ft from the transport vehicle is about 0.1 mrem/hr. This assumption was also used in the NRC staff's analysis of the ABWR unirradiated fuel shipments. This assumption is reasonable because the ABWR fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to that described in WASH-1238 (i.e., inside a metal 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 (listed in metric units) used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

Table 6-4. RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3200	AEC (1972)[(a)]
Travel Fraction – Rural	0.90	NRC (1977a)
Travel Fraction – Suburban	0.05	
Travel Fraction – Urban	0.05	
Population Density – Rural, persons/km^2	10	DOE (2002a)
Population Density – Suburban, persons/km^2	349	
Population Density – Urban, persons/km^2	2260	
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 (2002a)
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC (1972)
Shipment length, m	8.94	Approximate length of two ABWR fuel assemblies placed end to end (INEEL 2003)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a)
Stop time, hr/trip	4	Based on 1 30-minute stop per 4 hr driving time (Johnson and Michelhaugh 2003)
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) AEC (1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for unirradiated fuel shipments. A 3200-km (2000-mi) "representative" shipping distance was assumed here.

The RADTRAN 5.6 results for this "generic" unirradiated fuel shipment are as follows:

- Worker dose: 1.71×10^{-3} person-rem/shipment
- General public dose (onlookers/persons at stops and sharing the highway): 3.56×10^{-3} person-rem/shipment
- General public dose (along route/persons living near a highway or truck stop): 5.04×10^{-5} person-rem/shipment.

These values were combined with the average annual shipments of unirradiated fuel for the ABWR to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts 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 STP site. The cumulative annual dose estimates in Table 6-5 were normalized to 1100 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 STP Site or Alternative Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-rem/yr per 1100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public - Onlookers	Public - Along Route
Reference LWR (WASH-1238)	6.3	0.011	0.022	0.00032
STP and Alternative Sites ABWR	6.6	0.011	0.024	0.00033
10 CFR 51.52, 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.

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), the BEIR 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's Publication 103 (ICRP 2007).

Both the NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the STP site and alternative sites was 2.4×10^{-2} person-rem, which is less than the 1754 person-rem value that 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 about 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). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be about 2.2×10^5 person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the STP 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

A scenario-based analysis was conducted by the NRC staff to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the STP site and alternative sites. The following discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive waste shipments from, any of the alternative sites. The analysis is based on data in DOE (2002b) 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 2 m (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 (49 CFR 173.441). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972; DOE 2002a). An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the STP site and alternative sites. The analysis is described below.

Truck crew member. 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. The analysis assumed that crew member doses are limited to 2 rem per year, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005). The NRC staff anticipates this limit will apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. There will be more shipments of spent nuclear fuel from the STP site (or alternative sites) than there will be shipments of unirradiated fuel to, and radioactive waste other than spent fuel from, these sites. This is because the capacities of spent fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002a). 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 (see DOE 2005) is less than the NRC limit for occupational exposures of 5 rem/yr (see 10 CFR Part 20).

The U.S. DOT does not regulate annual occupational exposures. It does recognize that air crews are exposed to elevated cosmic radiation levels and recommends dose limits to air crew members from cosmic radiation (DOT 2003). Air passengers are less of a concern because 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 (DOT 2003). As a result of this recommendation, a 2 rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the STP site and alternative sites.

Inspectors. Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. The Yucca Mountain Final EIS DOE (2002b) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. Assuming conservatively that the external dose rate at 2 m (6.6 ft) is at the maximum allowed by regulations (10 mrem/hr), the dose rate at 1 m (3.3 ft) is about 14 mrem/hr (Weiner et al. 2008). Therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative external dose rate and the assumption that the same person inspects all shipments of fuel and waste to and from the STP site and alternative sites, the annual doses to vehicle inspectors were calculated to be about 1.4 rem/yr, based on a combined total of 98 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is less than the DOE administrative control level (DOE 2005) on individual doses and is also less than 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 obtained from the NRC staff'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. The potential radiation dose to the maximally exposed resident is about 0.06 mrem/yr for shipments of fuel and waste to and from the STP site and alternative sites.

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for one hour at a distance of 4 ft. The NRC staff's 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 2 m (6.6 ft) from the shipment, so the dose rate will be higher at the assumed exposure distance of 4 ft. The dose to the MEI was calculated to be 16 mrem in DOE's Yucca Mountain Final EIS (DOE 2002b).

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments to and from the STP 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 2002b). The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of about 0.34 mrem/shipment and an annual dose of about 33 mrem/yr for the STP site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the STP site and alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the STP site and alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security, and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference in consequences of transportation accidents severe enough to result in a release of unirradiated fuel particles to the environment between the ABWR 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), the impacts of accidents during transport of unirradiated fuel for the ABWR at the STP site and alternative sites are expected to be negligible.

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 STP site and alternative sites (that is, 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-km 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-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in ANL/ESD/TM-150 *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nation-wide 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 STP site and alternative sites. In addition, the U.S. Department of Transportation Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) 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) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), 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, to account for the under-reporting.

The nonradiological accident impacts for transporting unirradiated fuel to (and empty shipping containers from) the STP site and alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR are also shown for comparison purposes. Note that there are only small differences between the impacts calculated for an ABWR at the STP site and alternative sites and the reference LWR in WASH-1238 due entirely to the estimated annual number of shipments. Overall, the impacts are minimal and there are no substantive differences among the alternative sites.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the STP Site and Alternative Sites, Normalized to Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Round-trip Distance, km per Year	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	6.3	3200	4.0×10^4	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
STP and Alternative Sites ABWR	6.6	3200	4.2×10^4	2.0×10^{-2}	9.8×10^{-3}	6.1×10^{-4}

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 STP site and alternative sites to a spent fuel disposal repository. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain, Nevada, site as a surrogate destination. Currently, NRC has not made a decision on the proposed geologic repository at Yucca Mountain. However, the NRC staff considers that 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 to 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.

This NRC staff's 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). Due to 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). Because the alternative transportation methods involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999), thereby reducing impacts, these assumptions are conservative. Also, 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 (greater 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.

Radiological impacts of transportation of spent fuel were calculated by the NRC staff using the RADTRAN 5.6 computer code (Weiner et al. 2008). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2003). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS (Johnson and Michelhaugh 2003). Traffic accident rates input to RADTRAN 5.6 and nonradiological impact calculations were adjusted to account for under-reporting, as discussed in Sections 4.8.3 and 6.2.1.3.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" conditions, are transportation activities in which shipments reach their destination without an accident occurring enroute. 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 populations: (1) persons residing along the transportation corridors between the STP site and 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, rest, and vehicle inspections; and (4) transportation crew workers (drivers). For the purposes of this analysis, it was assumed that the destination for the spent fuel shipments is the proposed Yucca Mountain disposal facility in Nevada. This assumption is conservative because it tends to maximize the shipping distance from the STP site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the ABWR. Information in *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) 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 ABWR spent fuel shipments. The NRC staff assumed that the capacity of a truck shipment of ABWR spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972). In its ER (STPNOC 2009a), STPNOC assumed a shipping cask capacity of 0.5 MTU/shipment.

Input to RADTRAN 5.6 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 (Johnson and Michelhaugh 2003) for highway routes from the proposed STP site and alternative sites to 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 utilized in RADTRAN 5.6 on a state-by-state basis. This increases precision and could allow the results to be presented for each state along the route between the STP site and alternative sites and Yucca Mountain.

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 listing of the values for these and other parameters and the sources of the information is provided in Table 6-8.

Table 6-7. Transportation Route Information for Shipments from the STP Site and Alternative Sites to the Proposed Geologic Repository at Yucca Mountain, Nevada[(a)]

Advanced Reactor Site	One-way Shipping Distance, km				Population Density, persons/km^2			Stop time per trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
STP Site	2922	2425	414	83	7.7	362.3	2437	3.5
Allens Creek	2848	2356	409	83	7.7	358.2	2436	3.5
Red 2	2604	2331	233	40	6.7	359.5	2272	3.0
Trinity 2	2828	2435	319	73	7.2	372.3	2435	3.0

Source: Johnson and Michelhaugh 2003

(a) This table presents aggregated route characteristics provided by TRAGIS (Johnson and Michelhaugh 2003), including estimated distances from the alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

For purposes of 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 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 rest were assumed to occur at the rate of 30 minutes per 4 hours driving time. TRAGIS outputs were used to estimate the number of stops. Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5.6 analyses. For this analysis, doses to the public at refueling and rest stops ("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 in Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

The results of these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed STP 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).

1 **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 (2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	State-specific	Weiner et al. (2008)
Traffic count – Suburban, vehicles/hr		
Traffic count – Urban, vehicles/hr		
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, b) – approximate dose rate at 1 m that is equivalent to 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 (2002b)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a, b)
Stop time, hr/trip	Route-specific	See Table 6-5
Population Density at Stops, persons/km^2	30,000	Sprung et al. (2000). Equivalent to 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)
Shielding Factor Applied to Annular Area Surrounding Vehicle at Stops, dimensionless	1 (no shielding)	Sprung et al. (2000)
Population Density Surrounding Truck Stops, persons/km^2	340	Sprung et al. (2000)
Min/Max Radius of Annular Area Surrounding Truck Stop, m	10 to 800	Sprung et al. (2000)
Shielding Factor Applied to Annular Area Surrounding Truck Stop, dimensionless	0.2	Sprung et al. (2000)

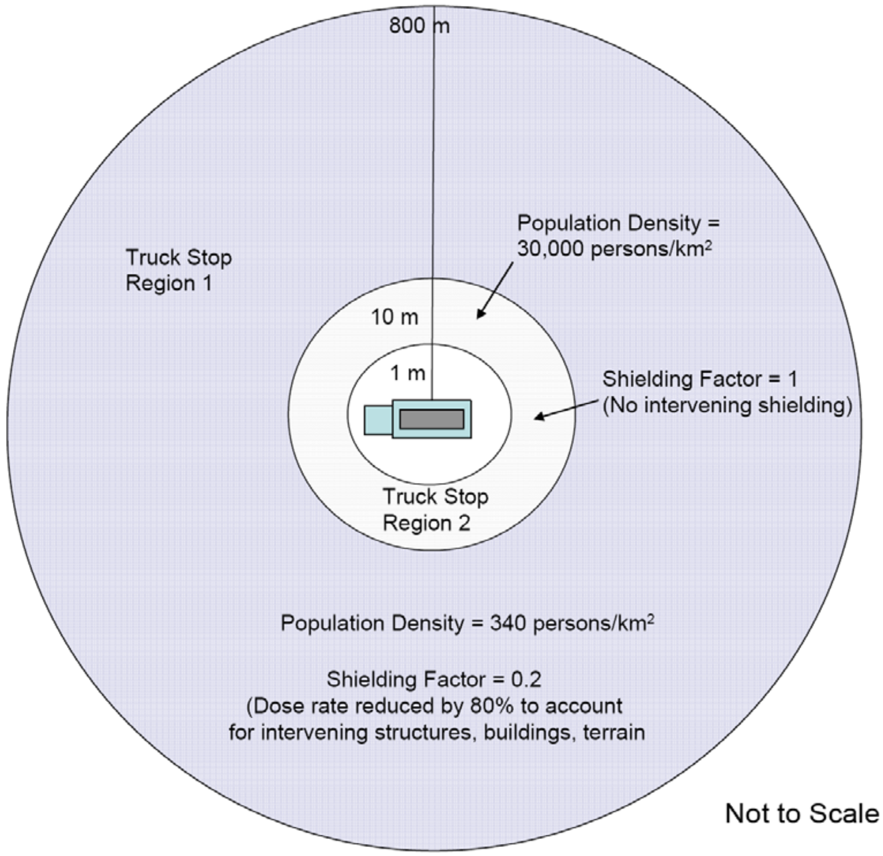

Figure 6-2. Illustration of Truck Stop Model

Shipping schedules for spent fuel generated by the proposed new unit have not been determined. It was determined by the NRC staff to be reasonable to calculate annual doses assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW[e]). This corresponds to an 1100-MW(e) LWR operating at 80-percent capacity.

The small differences in transportation impacts among the four alternative sites evaluated are not substantive. In general, the STP site has slightly higher impacts than the alternative sites, primarily because of the longer shipping distance to Yucca Mountain. However, the differences among sites are relatively 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.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the STP Site and Alternative Sites to the Proposed High-Level Waste Repository at Yucca Mountain

	Worker (Crew)	Along Route	Onlookers
Reference LWR (WASH-1238), person-rem/yr[(a)]	8.0×10^{0}	3.7×10^{-1}	$1.7 \times 10^{+1}$
ABWR at STP Site, person-rem/yr	8.0×10^{0}	3.7×10^{-1}	$1.7 \times 10^{+1}$
Allens Creek, person-rem/yr	7.8×10^{0}	3.6×10^{-1}	$1.7 \times 10^{+1}$
Red 2, person-rem/yr	7.1×10^{0}	2.3×10^{-1}	$1.4 \times 10^{+1}$
Trinity 2, person-rem/yr	7.7×10^{0}	3.0×10^{-1}	$1.4 \times 10^{+1}$
Table S–4 Condition, person-rem/yr	4×10^{0}	3×10^{0}	3×10^{0}

(a) To convert person-rem to person-Sv, divide by 100.

The calculated population doses to the crew and onlookers for the reference LWR and the STP site and alternative site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 is the longer shipping distances assumed for this COL analysis (i.e., to a proposed repository in Nevada) than the distances used in WASH-1238. WASH-1238 assumed that each spent fuel shipment would travel a distance of 1000 mi, whereas the shipping distances used in this assessment were about 1600 to 1800 mi. If the shorter distance were used to calculate the impacts for the STP spent fuel shipments, the doses could be reduced by about 40 percent. Other important differences are the stop model described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities on highways (vehicles per hour).

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:

- <u>Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations</u>. 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 2002b) would transport spent fuel that has cooled for a minimum of 5 years (see 10 CFR 961, Subpart B). Most spent fuel would have cooled for much longer than 5years before it is shipped to a possible geologic repository. Based on this, shipments from the STP site and alternative sites are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 would be further reduced if more realistic dose rate projections and shipping cask capacities are used.
- <u>Use of 30 minutes as the average time at a truck stop in the calculations</u>. 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) indicate that a 30-minute

duration is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996) 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 by the NRC staff to demonstrate the effects of using more realistic dose rates and stop times on 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) 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 2.8 person-rem/yr or about 36 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 4.8 person-rem/yr (26 percent) and the annual doses to persons along the route were reduced to 0.13 person-rem/yr (37 percent).

In its ER (STPNOC 2009a), STPNOC described the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to Yucca Mountain. Although the overall approaches are the same (e.g., use of TRAGIS and RADTRAN 5.6), there are some differences in the modeling details. For example, the NRC staff's analysis used state-by-state route characteristics whereas STPNOC elected to use aggregated route information. The NRC staff concluded that the results produced by STPNOC are similar to those calculated by the NRC staff in this EIS.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual public dose impacts for transporting spent fuel from the STP or alternative sites to Yucca Mountain are about 20 person-rem, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in no excess health effects. This dose is very small compared to the estimated 1.8×10^5 person-rem that the same population along the route from the proposed STP site to Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose along the STP-to-Yucca-Mountain route from natural background radiation is different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route was used in Section 6.2.1.1 for unirradiated fuel shipments and actual highway routes were 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 Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5.6 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 exposed 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 the applicant’s ER (STPNOC 2009a). 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 of the radionuclides that were included in the analysis conducted by Sprung et al. (2000). The 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 ABWR spent fuel are not available at this time. This uncertainty will be reduced over time as operating experience with advanced reactors increases; however, at the present time, only projections can be made using operating experience with the current generation of LWRs. For this EIS, the STP ABWR spent fuel transportation accident impacts were calculated by the NRC staff assuming the cobalt-60 inventory in the form of crud is 169 Ci/MTU, based on information in Sprung et al. (2000).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. 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), 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 ABWR 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 were taken from Saricks and Tompkins (1999) and used in the RADTRAN calculations. The State-specific accident rates were then adjusted to account for under-reporting, as described in Section 6.2.1.3. 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).

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for an ABWR[(a)]

Radionuclide	Ci/MTU	Physical-Chemical Group
Am-241	1440	Particulate
Am-242m	33	Particulate
Am-243	60	Particulate
Ce-144	13,200	Particulate
Cm-242	62	Particulate
Cm-243	62	Particulate
Cm-244	13,500	Particulate
Cm-245	2	Particulate
Co-60 (crud)[(b)]	169	Crud
Co-60 (activation)[(b)]	3630	Particulate
Cs-134	77,600	Cesium
Cs-137	158,000	Cesium
Eu-154	15,600	Particulate
Eu-155	8270	Particulate
Kr-85	8900	Gas
Pm-147	31,300	Particulate
Pu-238	10,900	Particulate
Pu-239	427	Particulate
Pu-240	852	Particulate
Pu-241	135,000	Particulate
Pu-242	3	Particulate
Ru-106	22,900	Ruthenium
Sb-125	7170	Particulate
Sr-90	106,000	Particulate
Y-90	106,000	Particulate

(a) The source of the spent fuel inventories is STPNOC (2009a), Table 7.4-3, except as noted in footnote (b).

(b) Co-60 exists both as an activation product in spent fuel and is the primary radioactive constituent in fuel assembly crud, or radioactive material deposited on the external surfaces of fuel assemblies. The Co-60 inventory in crud was calculated using information in NUREG/CR-6672 (Sprung et al. 2000).

The RADTRAN 5.6 accident risk calculations were performed 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 STP site and alternative sites to the proposed repository at Yucca Mountain in Nevada. As was done for routine exposures, the NRC staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts from the ABWR 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.

The NRC staff used RADTRAN 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways.[(a)] These pathways are:

- External dose from exposure to the passing cloud of radioactive material (cloudshine).
- External dose from the 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 NRC staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

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 STP and alternative sites to Yucca Mountain are on the order of 1×10^{-4} person-rem, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most

Table 6-11 presents the environmental consequences of transportation accidents when shipping spent fuel from the STP site and alternative sites to the proposed Yucca Mountain repository. 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 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80-percent capacity) to provide a common basis for comparison to the impacts listed in Table S–4. Although there are slight differences in impacts among the alternative sites, none of the alternative sites would be clearly favored over the STP site.

(a) 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.

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 STP and alternative sites to Yucca Mountain are on the order of 1 × 10^{-4} person-rem, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an ABWR at the STP Site and Alternative Sites, Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, Person-rem/RRY[(a)]
Reference LWR (WASH-1238)	1.5 × 10^{-4}
ABWR at STP Site	1.5 × 10^{-4}
Allens Creek	1.5 × 10^{-4}
Red 2	5.8 × 10^{-5}
Trinity 2	1.7 × 10^{-4}

(a) Multiply person-Sv/yr times 100 to obtain person-rem/yr.

likely result in zero excess health effects. This risk is very minute compared to the estimated 130 fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually along the route from the proposed STP site to Yucca Mountain 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. The main difference is that the spent fuel shipping route characteristics are better-defined so the State-level accident statistics in Saricks and Tompkins (1999) may be used. State-by-State shipping distances were obtained from the TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by State from Saricks and Tompkins (1999) to calculate nonradiological impacts. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted to account for under-reporting (see Section 6.2.1.3). The results are shown in Table 6-12. Overall, the impacts are minimal and there are no substantive differences among the alternative sites.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the STP Site and Alternative Sites to Yucca Mountain, Normalized to Reference LWR

Site	One-Way Shipping Distance, km	Nonradiological Impacts, per Year		
		Accidents/yr	Injuries/yr	Fatalities/yr
STP (proposed site)	2922	2.0×10^{-1}	1.3×10^{-1}	6.2×10^{-3}
Allens Creek	2848	1.9×10^{-1}	1.2×10^{-1}	5.7×10^{-3}
Red 2	2604	1.2×10^{-1}	7.9×10^{-2}	5.5×10^{-3}
Trinity 2	2828	1.5×10^{-1}	9.6×10^{-2}	6.2×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 60 shipments/yr after normalizing to the reference LWR.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste other than spent fuel from the STP site and alternative sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- 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 tons per cask per railcar would be met.
- Traffic density would be less than the one truck shipment per day or three railcars per month condition.

Radioactive waste other than spent fuel from the STP ABWR is expected to be capable of being shipped in compliance with Federal and/or State weight restrictions. Table 6-13 presents estimates of annual waste volumes and annual waste shipment numbers for an ABWR normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual waste volumes for the ABWR are estimated at 3500 ft^3/yr, and the annual number of waste shipments was estimated at 31 shipments per year after normalization to the reference LWR in WASH-1238. The annual waste volume and annual number of shipments are less than those for the 1100-MW(e) reference reactor that was the basis for Table S–4. The annual shipment estimates could also be reduced if more efficient packagings are used to transport waste from STP than were assumed in WASH-1238.

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste for an ABWR located at the STP site and alternative sites is less than the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S–4.

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). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). These rates were adjusted to account for under-reporting, as described in Section 6.2.1.3. The results are presented in Table 6-14. As shown, the calculated nonradiological impacts for transportation of radioactive waste other than spent fuel from the STP site and alternative sites to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238.

Table 6-13. Summary of Radioactive Waste Shipments from the STP Site and Alternative Sites

Reactor Type	Waste Generation Information	Annual Waste Volume, m^3/yr per Unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/1100 MW(e) Unit (880 MW(e) Net)[(a)]	Shipments/ 1100 MW(e) (880 MW(e) Net) Electrical Output[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46
STP ABWR (ER volume)	3500 ft^3/yr per unit[(c)]	99[(c)]	1300[(c)]	71	31

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(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) and 95 percent for the STP ABWR (STPNOC 2009a). Waste generation for the ABWR is normalized to 880 MW(e) net electrical output (1100-MW(e) unit with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated by dividing the normalized rate by the assumed shipment capacity used in WASH-1238 (2.34 m^3/shipment).

(c) This value was taken from the ER (STPNOC 2009a).

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the STP Site

	Normalized Shipments per Year	One-Way Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	46	800	3.4×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
STP ABWR	31	800	2.3×10^{-2}	1.1×10^{-2}	7.2×10^{-4}

Note: The shipments and impacts have been normalized to the reference LWR.

6.2.4 Conclusions

The NRC staff conducted independent confirmatory analyses of potential impacts under normal operating and accident conditions of transportation of fuel and wastes to and from an ABWR to be located at the proposed STP site and alternative sites. To make comparisons to Table S–4, the environmental impacts were adjusted (that is, normalized) to the environmental impacts associated with the reference LWR in WASH-1238 (AEC 1972) by multiplying the ABWR impact estimates by the ratio of the total electric output for the reference reactor to the electric output of the proposed reactor.

Because of the conservative approaches and data used to calculate impacts, the NRC staff does not expect that actual environmental effects will exceed those calculated in this EIS. Thus, the NRC staff concludes that the environmental impacts of transportation of fuel and radioactive wastes to and from the STP site and alternative sites site would be SMALL, and would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes to and from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

The NRC staff notes that on March 3, 2010, DOE (DOE 2010) submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, Nevada. 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 Texas to Nevada. The distance from the STP site or any of the alternate sites to any new planned repository in the contiguous United States would be no more than double the distance from the STP site 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 for NEPA purposes. The NRC staff concludes that the environmental impacts of these doubled estimates 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. Decommissioning is 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.

An applicant for a COL is required to certify that sufficient funds will be available to assure radiological decommissioning at the end of power operations. As part of its COL application for the proposed Units 3 and 4 on the STP site, STPNOC included a Decommissioning Funding Assurance Report (STPNOC 2009b). STPNOC would establish an external sinking funds account to accumulate funds for 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 I, Regarding the Decommissioning of Nuclear Power Reactors* (GEIS-DECOM), NUREG-0586 Supplement 1 (NRC 2002). 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 ABWR 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 ABWR.

The GEIS-DECOM does not specifically address the carbon 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 CO_2 footprint of decommissioning to be of the order of 6.3×10^4 metric tons without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix I. A 40-yr SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

The NRC staff relies upon the bases established in the 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 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. Ecological impacts of decommissioning are expected to be negligible.
7. Socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air quality impacts from greenhouse gas 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.

6.4 References

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10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, “Domestic Licensing of Production and Utilization Facilities.”

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, “Packaging and Transportation of Radioactive Material.”

10 CFR Part 961. Code of Federal Regulations, Title 10, *Energy*. Part 961, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Waste.”

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

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7.0 Cumulative Impacts

The National Environmental Policy Act of 1969, as amended (NEPA), requires Federal agencies to consider the cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. When evaluating the potential impacts of construction and operation of two new nuclear units at the South Texas Project Electric Generating Station (STP) site proposed by STP Nuclear Operating Company (STPNOC) in its application for combined licenses (COLs) which included an Environmental Report (ER)(STPNOC 2009a), the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Army Corps of Engineers (Corps) review team considered potential cumulative impacts to resources that could be affected by the construction, preconstruction, and operation of two U.S. Advanced Boiling Water Reactors (ABWRs) at the STP site. Cumulative impacts result when the effects of an action are added to or interact with other past, present, and reasonably foreseeable future effects on the same resources. For purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable through building and operating the proposed Units 3 and 4, including decommissioning. The geographic area over which past, present, and reasonably foreseeable future actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area. The review team considered, among other things, cumulative effects of the proposed Units 3 and 4 with current operations at existing STP Units 1 and 2.

The approach for this environmental impact statement (EIS) is outlined in the following discussion. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on guidance developed by the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1508.27). The three significance levels established by the NRC – SMALL, MODERATE, or LARGE – are defined as follows:

> 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.

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 STP site that would affect the same resources impacted by the proposed new units, 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 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 actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a)) 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 and components 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 units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning impacts 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 actions.

The review team visited the STP site in February 2008. The team then used the information provided in the ER, and in responses to Requests for Additional Information, information from other Federal and State agencies, and information gathered at the STP site visit to evaluate the cumulative impacts of building and operating two new nuclear power plants at the site. To inform the cumulative analysis, the review team researched Environmental Protection Agency (EPA) databases for recent EISs within Texas, used an EPA database for permits for water discharges in the area to identify water use projects, and 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). 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.

Table 7-1. Past, Present, and Reasonably Foreseeable Future Projects and Other Actions Considered in the STP Cumulative Analysis.

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and Decommissioning of South Texas Project Units 1 and 2	Two 1265 MW(e) Westinghouse pressurized water reactors	About 1500 ft south and 2150 ft east of proposed center of Units 3 and 4	Operational.[a] STP plans to submit an application for renewal of the operating licenses for Units 1 and 2 in late 2010. If granted, the operating licenses would be extended for 20 years, or until 2047 for Unit 1 and 2048 for Unit 2.[b]
White Stallion Energy Center (WSEC)	Proposed 1320 MW baseload power plant fueled by a petroleum coke/bituminous combination	About 5 mi northwest	Proposed.[c] Four to five year project; construction is planned to begin in early 2010.
Victoria County Nuclear Station	One or more large-scale nuclear power reactors	About 55 mi west-southwest	Proposed. Exelon Generation intends to submit an application to NRC for an Early Site Permit in March 2010.[d]
Calhoun Liquefied Natural Gas (LNG) Terminal (Port Lavaca)	LNG terminal on Port Lavaca-Point Comfort	About 25 mi west-southwest	Proposed.[e]
E.S. Joslin Power Plant Project (Port Lavaca)	Proposed upgrade from 261 MW to 303 MW power plant fueled by petroleum coke	About 25 mi west-southwest	The E.S. Joslin Power Plant operated from 1971 until 2004. Currently not operating; however, NuCoastal Power Corp plans to repower the plant. Air permits have been issued. Scheduled to be online by late 2012.[f]
Transmission Lines	New transmission lines are not required for STP, but various transmission lines currently exist throughout region and installation of additional lines would occur if new nuclear plants such as the Victoria County Nuclear Station or other large energy projects such as the WSEC are built. New transmission lines could require the following: widening of existing corridors, building new corridors, moving facilities within corridors, building new facilities within corridors.	Throughout region	Currently existing as well as the potential for additional transmission lines to be built

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Water Resources			
Lower Colorado River Authority-San Antonio Water System (LCRA-SAWS) project	Water sharing proposal to develop alternative water supplies that could help meet long-term needs in the lower Colorado River basin and the San Antonio area. Delivery of water would occur from LCRA to SAWS.	Entire Lower Colorado River basin	Proposed. Delivery of water from LCRA to SAWS could begin in 2025.[g]
Mouth of the Colorado River Project	Construct a channel to divert all Colorado River flow from the Gulf of Mexico into the Matagorda Bay	Mouth of the Colorado River (approx 4-5 mi south-southeast)	Constructed 1989-1992 by the Corps.[h]
Gulf Intracoastal Waterway (GIWW) Reroute	Reroute of the GIWW across Matagorda Bay	Matagorda Bay	Completed[i]
Municipal diversions from the Colorado River	Diversion for city water supplies	Various locations along the Colorado River such as Bay City and Selkirk	Operational
Municipal wastewater treatment facilities	Matagorda, Beach Road Municipal Utility District, Wadsworth, Markham Municipal Utility District, Matagorda County, Bay City, Midfield	Within 10 mi of STP	Operational
East Jetty construction and pipeline dredging	Sediment removal and channel excavation and repairs	Colorado River and Tributaries, Texas mouth of Colorado River in Matagorda County	To be completed in December 2010[j]
Port of Bay City Authority Barge Terminal	Barge terminal with a liquid cargo dock, a concrete dock, a low level heavy duty dock and a turning basin	About 5 mi north	Operational[k]
Parks			
Brazos Bend State Park	Camping, picnicking, hiking, and fishing	About 35 mi northeast	Development unlikely in this park[l]

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Clive Runnels Family Mad Island Marsh Preserve	Natural preserve	About 4 mi southwest	Development unlikely in this preserve[m]
Mad Island Wildlife Management Area	Wildlife management area	About 3 mi south	Development unlikely in this area[n]
Other Actions/Projects			
Formosa Plastics Corporation	Manufactures plastic resins and petrochemicals	About 25 mi west-southwest	Operational[o]
Alcoa Aluminum Plant	Aluminum manufacturing	About 25 mi west-southwest	Operational[p]
Equistar Chemicals Matagorda Facility	Manufactures plastics, synthetic resins, and nonvulcanized elastomers	About 4 mi east	Operational[q]
Celanese Ltd., Bay City Plant	Manufactures organic chemicals, including cellulosic organic fiber and petrochemicals	About 3 mi north-northeast	Operational[r]
Oxea Corp., Bay City Plant	Manufactures organic chemicals	About 3 mi north-northeast	Operational[s]
Texas Liquid Fertilizer Co. Point Comfort	Manufactures nitrogenous fertilizer	About 25 mi west-southwest	Operational[t]
Various hospitals and industrial facilities that use radioactive materials	Medical and other isotopes	Within 50 mi	Operational in nearby cities and towns
Future Urbanization	Construction of housing units and associated commercial buildings; roads (such as the I-69 Trans-Texas Corridor project), bridges, and rail; construction of water- and/or wastewater- treatment and distribution facilities and associated pipelines, as described in local land-use planning documents. There is a low potential for increased urbanization within Matagorda and Brazoria counties as population growth is expected to be less than 2 percent per year (see Table 2-17).	Throughout region	Construction would occur in the future, as described in state and local land use planning documents[u]

Table 7-1. (contd)

(a) Source: NRC 2009a
(b) Source: NRC 2009b
(c) Source: WSEC 2009c
(d) Source: Exelon 2009
(e) Source: FERC 2009
(f) Source: O'Grady 2008
(g) Source: LCRA 2009e
(h) Source: Corps 2009
(i) Source: TxDOT 2000
(j) Source: Onvia Inc. 2009
(k) Source: Port of Bay City Authority 2010
(l) Source: TPWD 2009a
(m) Source: The Nature Conservancy 2009
(n) Source: TPWD 2009b
(o) Source: EPA 2009a
(p) Source: EPA 2009b
(q) Source: EPA 2009c
(r) Source: EPA 2009d
(s) Source: EPA 2009e
(t) Source: EPA 2009f
(u) Source: TxDOT 2009

7.1 Land Use

The description of the affected environment in Section 2.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.1, the review team 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 impacts of operations on land use would also be SMALL and no further mitigation would be warranted.

The combined impacts from construction and preconstruction are described in Section 4.1 and determined to be SMALL. In addition to land-use impacts from construction, preconstruction, and operation, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to land use. For this cumulative analysis, the geographic area of interest is the area within a 15-mi radius of the proposed STP site. The review team determined that a 15-mi radius would represent the smallest area that would be directly affected because it includes the primary communities (the largest being Bay City) that would be affected by the proposed project. A radius larger than 15 mi would include land areas that would not be directly affected by the proposed project.

Historically, the STP site and vicinity was a relatively flat coastal plain with farmland and pasture land predominating. Residential development in Matagorda County began in the 1800s and accelerated when construction of Units 1 and 2 began in the 1970s. Much of the STP site was affected by building Units 1 and 2. The general trend in the 15-mi geographic area of interest over the past few decades has been a gradual increase in residential areas, roads, utilities, and businesses and a small decrease in wetlands and agricultural lands.

As described in Section 4.1, there would be a loss of undeveloped land and habitat (see Table 4-2 for the types of affected acreage) at the STP site from development related to the proposed project. No new offsite transmission corridors or expansion of existing corridors are planned for proposed Units 3 and 4. Although there would be upgrades and maintenance to existing transmission lines, these activities would not result in any land use changes. STPNOC plans to apply for renewal of its operating licenses for STP Units 1 and 2 for an additional 20 years (NRC 2009). It is not anticipated that any new areas on the STP site would be converted to industrial use if the license renewals are granted.

Within the 15-mi geographic area of interest, the reasonably foreseeable project with the greatest potential to affect land use would be the proposed White Stallion Energy Center (WSEC) project. If constructed, the WSEC would be located on a 1200-ac tract of land approximately 5 mi northwest of the STP site (WSEC 2009b). The workers, especially construction workers, would likely be drawn from a wide area, dispersing any potential land-use impacts from workers. The WSEC project would require at least one new transmission line corridor within the 15-mi review area. If the WSEC were to be constructed, the review team concludes that the land-use impacts of the project within the 15-mi review area would be sufficient to alter noticeably, but not destabilize, important attributes of land use.

Future urbanization in the review area and global climate change (GCC)—two trends that are difficult to predict—could contribute to additional decreases in open areas, forests, and wetlands. Urbanization in the vicinity of STP would alter important attributes of land use. Urbanization would reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. GCC could reduce crop yields and livestock productivity (Karl et al. 2009), which may change portions of agricultural and ranching land uses in the area of interest. In addition, GCC could increase sea level and storm surges in the area of interest (Karl et al. 2009), thus changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Future urbanization trends and direct changes resulting from GCC could noticeably alter land uses in the geographic area of interest.

Based on its evaluation, the review team concludes that the cumulative land-use impacts associated with proposed Units 3 and 4 and other projects in the 15-mi geographic area of interest, including the proposed WSEC project, would be MODERATE. The land-use impacts would be sufficient to alter noticeably, but not destabilize, important attributes of land use. The incremental land-use impacts associated with the proposed WSEC project and the associated transmission corridor(s) for the project and the changes resulting from future urbanization and GCC are the principal contributors to the MODERATE characterization of cumulative land-use impacts. The NRC staff concludes that the incremental impacts of NRC-authorized activities would be SMALL, and would not contribute significantly to the MODERATE impact characterization.

7.2 Water Use and Quality

This section analyzes the cumulative impacts of the proposed new units, the existing STP Units 1 and 2, and other past, present, and reasonably foreseeable projects on water use and water quality.

7.2.1 Water Use Impacts

As stated in Section 2.3.2, water use in Texas is regulated by the Texas Water Code. As established by Texas Water Code, surface water belongs to the State of Texas (Texas Water Code, Chapter 11, Section 11.021). The right to use surface waters of the State of Texas can be acquired in accordance with the provisions of the Texas Water Code, Chapter 11. In Texas, surface water is a commodity. Since the Colorado River Basin is currently heavily appropriated, future water users in this basin would likely obtain surface water by purchasing or leasing existing appropriations. Regarding groundwater, Texas law has allowed landowners to pump the water beneath their property without consideration of impacts to adjacent property owners (NRC 2009c). However, Chapter 36 of Texas Water Code authorized groundwater conservation districts to help conserve groundwater supplies. Chapter 36, Section 36.002, Ownership of Groundwater, states that ownership rights are recognized and that nothing in the code shall deprive or divest the landowners of their groundwater ownership rights, except as those rights may be limited or altered by rules promulgated by a district. Thus, groundwater conservation districts with their local constituency offer groundwater management options (NRC 2009c). Existing projects in Texas have appropriations to use water for their requirements. STPNOC has stated that proposed Units 3 and 4 would operate within the limits of these existing surface water and groundwater appropriations (STPNOC 2009a). The review team expects that future projects would do so, as well.

Climate Change

On a larger spatial and longer time scale, GCC is a subject of national and international interest. The recent compilation of the state of knowledge by the U.S. Global Change Research Program (GCRP), a Federal Advisory Committee, has been considered in preparation of this EIS (Karl et al. 2009). Within the Colorado River Basin, changes in temperature and precipitation are projected by 2080-2099. In Section 2.9.1, the review team discussed changes to temperature and precipitation resulting from global climate change forecasted by U.S. GCRP for the vicinity of the site. The review team determined that the forecasted changes could affect water supply and water quality in the Colorado River Basin during operation of the proposed STP Units 3 and 4.

For the water use and water quality assessments discussed below, the review team considered forecasted changes to temperature and precipitation for the entire Colorado River watershed. The projected change in temperature from ‘present day’ (1993-2008) to the period encompassing the licensing action (i.e., the period of 2040 to 2059 in the GCRP report) for the Colorado River watershed is an increase of between 0 to 5°F. While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation from the ‘recent past’ (1961-1979) to the period 2080 to 2099 is a decrease of between 10 to 30 percent (Karl et al. 2009). The GCRP assessment also identified this region as likely to experience water conflicts by 2025 based on a combination of factors including population trends and potential endangered species’ needs. Declines in aquifer water levels are likely to continue throughout Texas, as the aquifers, such as the Ogallala, are increasingly relied on in response to drought in Texas and the larger Great Plains region (Karl et al. 2009). Such changes in climate could result in adaptations to both surface water and groundwater management practices and policies that are unknown at this time.

7.2.1.1 Surface Water-Use Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on surface water use would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on surface water use would also be SMALL, and no further mitigation would be warranted.

The combined surface water-use impacts from construction and preconstruction are described in Section 4.2.2 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that would affect surface water use, including potential effects of GCC, as discussed above. For the cumulative analysis of impacts on surface water, the geographic area of interest is the drainage basin of the Colorado River and Matagorda Bay in Region K because the effects on other actions within this region could interact with the effects of the proposed project and result in a cumulative impact. The Lower Colorado Regional Water Planning Area, or Region K, includes all or part of 14 counties that extend from Mills and San Saba Counties in the northwest to Matagorda County in the southeast. The Region K boundaries do not completely coincide with county boundaries or the Colorado River Basin watershed boundary. The current water planning time period for the Region is through 2060.

The Colorado River has provided water for agricultural, industrial, and municipal use since this region was settled. Dams have been installed on the river to provide flood control, increase the reliability of water supply to the region, and to provide power. Key past and present actions that have potential impacts on surface-water supply in the Colorado River Basin include construction and operation of upstream water supply dams, construction and operation of STP Units 1 and 2, and diversion of water from the river for current surface water use.

Other existing and reasonably foreseeable future actions in the geographic area of interest include the operation of STP Units 1 and 2, the LCRA-SAWS project, the proposed WSEC project, current surface withdrawals for municipal, industrial, and irrigation use, potential impacts from GCC, and the additional water demand created by population growth in the region. The impacts of other projects listed in Table 7-1 would have little or no impact on surface-water use.

As discussed in Section 4.2.2, STPNOC has proposed no surface water use during site development. The expected consumptive surface-water use of proposed Units 3 and 4 would be 37,373 ac-ft per year (23,170 gallons per minute [gpm]) during normal operations and 37,788 ac-ft per year (23,427 gpm) during maximum demand conditions. The existing STP Units 1 and 2 diverted an average of 37,083 ac-ft per year (22,990 gpm) from the Colorado River from 2001 through 2006 (STPNOC 2009a). Together, all four STP units would consume approximately 68,714 ac-ft per year (42,600 gpm) under normal operations and 69,004 ac-ft per year (42,780 gpm) under maximum demand conditions. The average water diverted for existing STP Units 1 and 2 and the expected water use for all four STP units are estimated to be 2 and 4 percent, respectively, of the annual mean daily discharge in the Colorado River at the Bay City U.S. Geological Survey (USGS) gauge based on 1949-2008 streamflow data (discussed in Section 5.2). If no water management strategies are implemented in Region K, the combined water use of existing and proposed units at the STP site would be 6 percent of the current estimated water supply and 8 percent of the available 2060 water supply. Water management strategies are used to conserve, reuse, or develop water supplies. Development of water supplies includes building new water supply reservoirs, and developing unused aquifers underlying the region (TWDB 2006b). Implementation of water management strategies results in increased available water within a region. The review team concludes that the surface water use impact of operating all four units at the STP site would be minimal if all water management strategies are implemented, and would be noticeable if no water management strategies are implemented.

A water-sharing project between the LCRA and the SAWS, in Water Planning Regions K and L, respectively, is currently undergoing a feasibility study (LCRA 2009a) and would impact water resources in the geographic area of interest. A set of conservation and storage strategies would conserve and develop surface and groundwater resources in the lower Colorado River Basin to provide water for both Regions—although no groundwater would be sent from Region K to Region L. An off-channel holding basin in Wharton County (LCRA 2009b) would be used to store water for the LCRA-SAWS project. The planned project would provide 377,000 ac-ft per year of water to users in the two Regions (TWDB 2006a); Region L would receive 150,000 ac-ft per year from Region K starting in the 2020 decade (TWDB 2006b). The Region L diversion of 150,000 ac-ft per year would be approximately 9 and 17 percent of the 2060 water supply in Region K with and without implementation of water management strategies, respectively. If the LCRA and SAWS boards determine that the project is technically feasible, the permitting process is planned for 2010-2015, followed by construction during 2015-2025, with water delivery to SAWS to start in 2025. The LCRA-SAWS diversion would have a noticeable impact on surface water resources of Region K.

A 1320-MW power plant, the WSEC, listed in Table 7-1, is proposed in Matagorda County near Farm-to-Market (FM) 2668 approximately 1 mi south of Port of Bay City and approximately 5 mi northeast of the STP site (WSEC 2009b). On October 13, 2008, the WSEC applied to LCRA for a new firm water supply of 22,000 ac-ft per year (LCRA 2009c). The total diversion from the Colorado River would be 29,750 ac-ft per year accounting for delivery losses. At this time, no other details regarding WSEC diversion are available. The WSEC water use of 22,000 ac-ft per year would be 2 percent of the current estimated water supply and 2.5 percent of the 2060 water supply in Region K without implementation of water management strategies, and 1 percent of the 2060 Region K water supply with implementation of all water management strategies. The review team concludes that the surface water use impact of the WSEC project would be minimal.

Downstream of the STP site, there are no users of Colorado River waters except for freshwater inflow needs for the Matagorda Bay. The LCRA, Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), and the Texas Water Development Board (TWDB) (LCRA 2006) updated an earlier 1997 freshwater inflow needs study for the Matagorda Bay. The study used two measures for freshwater inflow to the bay: (1) the target freshwater inflow need that would optimize the productivity of selected estuarine species and (2) the critical freshwater inflow need that would promote the repopulation of finfish and shellfish species following a dry period. The average monthly target freshwater inflow was estimated to be 118,975 ac-ft per month (1972 cubic feet per second [cfs]) from the Colorado River into the Bay. The critical freshwater inflow was estimated to be 36,000 ac-ft per month (597 cfs). This situation continues to be evaluated. For example, a habitat assessment study for the Matagorda Bay by LCRA-SAWS is currently ongoing (LCRA-SAWS 2006) and is expected to evaluate the effects of the alteration to freshwater inflow into Matagorda Bay as part of the LCRA-SAWS project and to aid in the development of freshwater inflow criteria. As of February 2010, no recommendations regarding freshwater inflow needs have been made so far. A freshwater inflow need, when established, could make that amount of surface water unavailable for other use.

The operation of existing and proposed units at the STP site, the WSEC project, and the LCRA-SAWS project together would use 21 percent of the estimated 2010 water supply in Region K.

With the anticipated implementation of the proposed water management strategies (TWDB 2006b), the combined water used by the projects listed above would be 17 percent of the Region K 2060 water supplies. The combined water used by the projects listed above would be 28 percent of the Region K 2060 water supply without implementation of any new water management strategies. The review team concludes that the combined water use of the proposed units at the STP site, the WSEC project, and the LCRA-SAWS project would result in a noticeable but not destabilizing impact on the surface water resources of Region K. As stated above, implementation of water management strategies results in additional water available for use.

In addition to the specific projects listed in Table 7-1, continued population growth is anticipated in the geographic area of interest. In the 2007 State Water Plan, the TWDB stated that the population of the State of Texas is expected to grow to 46 million by 2060 and the demand for water is expected to increase to 21.6 million ac-ft in 2060 (TWDB 2006b). The existing surface and groundwater supplies are estimated to be 17.9 million ac-ft in 2010 and would decrease to 14.6 million ac-ft in 2060 because of sediment accumulation in reservoirs and depletion of aquifers (TWDB 2006b). There is a low potential for increased urbanization within Matagorda and Brazoria counties, as population growth is expected to be less than 2 percent per year (see Table 2-17), which would have a minimal impact on water use in the region.

The 2060 estimated shortfall in water supply from growth in demand and reduction in water supply due to sedimentation of reservoirs and expiration of water contracts is 413,710 ac-ft per year. However, the TWDB plans to develop, conserve, and share water supplies that would yield an additional water supply of 550,658 ac-ft per year in Region K by 2060. TWDB (2007) concluded that the water demand in 2060 can be met by implementing the proposed strategies.

The diversion of surface water to Region L from Region K as part of the LCRA-SAWS project is already accounted for in the 2007 State Water Plan (TWDB 2007). The current STPNOC water right of 102,000 ac-ft per year for existing and proposed units is also accounted for in Region K planning (TWDB 2006b). The proposed water use by WSEC is not included in the 2007 State Plan. Therefore, the planned water management strategies would need to account for the additional 22,000 ac-ft per year of water use proposed by the WSEC project. Without the WSEC water use accounted for, the estimated excess water supply with the implementation of water management strategies in 2060 is estimated to be 136,948 ac-ft per year. The review team concludes that with implementation of water management strategies, the impact of future projects on the surface water resources of Region K would be noticeable, but not destabilizing.

Historically, the waters of the Colorado River Basin have been used extensively. Therefore, as discussed above, the region has surface water planning, allocation, and development systems in place to manage the use of its limited surface water resources. These efforts are described in the Regional and State Water Plans (TWDB 2006a, b). The review team has reviewed the regional and State plans and other publicly available information. The cumulative impact on surface water use in the Colorado River and Matagorda Bay drainages in Region K to the unaltered conditions prior to these uses, from past and present diversions and reasonably foreseeable projects, would noticeably alter but not destabilize the surface water resource, and therefore would be MODERATE. The incremental impacts from the proposed action and NRC-authorized activities would be SMALL and would not noticeably alter water use in the Region. No further mitigation beyond that described in Chapters 4 and 5 would be warranted.

As stated above, GCC could result in decreased precipitation and increased temperatures in the lower Colorado River basin. These forecasted changes have the potential to reduce surface runoff and increase evapotranspiration. The changes may result in reduction in the surface water resource in the region. While these changes from GCC may not be insignificant, the review team has not identified anything that would alter the conclusions presented above.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater use would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-use impacts from construction and preconstruction are described in Section 4.2.2 and determined to be SMALL. 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 groundwater use, including potential effects of GCC, as discussed above. For this analysis, two geographic areas of interest have been identified. For the Shallow Aquifer, which would be impacted by dewatering, the area of interest for construction and preconstruction is limited to the STP site. For the Deep Aquifer, which would be impacted by water withdrawn for construction, preconstruction, and operation of proposed Units 3 and 4, the geographic area of interest extends from recharge areas in Wharton County to Matagorda Bay.

Groundwater use from the Gulf Coast Aquifer system increased between 1940 and the mid-1980s, primarily from the increase in water withdrawals for rice irrigation, and Matagorda County was among the counties where this occurred (CPGCD 2009a). Impacts of overpumping the groundwater resource included land subsidence, saltwater intrusion, stream base-flow depletion, and increased pumping lift. Groundwater use from the Gulf Coast Aquifer system has since declined because of these issues and the TWDB forecasts a continued decline in groundwater use in the Gulf Coast Aquifer through 2030. The USGS in 2002 projected a net decrease of 48 percent in groundwater pumping from 1985 levels (Ryder and Ardis 2002).

Cumulative Impacts

As discussed in Section 4.2.2, STPNOC currently holds a groundwater use or operating permit to withdraw from the Deep Aquifer. The Deep Aquifer would be the sole source of groundwater used during Units 3 and 4 building activities and, as discussed in Section 5.2.2.2, would be used as the source of makeup water for the proposed Units 3 and 4 Ultimate Heat Sink (UHS), service water for the power plants, fire protection systems, and water for potable and sanitary systems. Projects listed in Table 7-1 that are in the geographic area of interest that could contribute to cumulative impacts on the Deep Aquifer include operation of STP Units 1 and 2, Equistar Chemicals LP, the Oxea Corporation Bay City Plant and municipal water supplies for Bay City and the nearby community of Selkirk.

Aside from STP Units 1 and 2, the closest of these are 3 to 4 mi from the proposed location of Units 3 and 4. The closest community having groundwater production wells is Selkirk, which is located immediately east of the STP site's eastern boundary, and the closest STP groundwater production well is located about 1 mi from this community. Each of the above-listed users of the groundwater resource does so under the rules of the Coastal Plains Groundwater Conservation District (CPGCD) (CPGCD 2009b). The purpose of the CPGCD (2009b) is to provide for the conserving, preserving, protecting, and recharging of the groundwater to control subsidence and prevent the waste and pollution of the groundwater resource. While potential impacts from groundwater use include excessive drawdown, saltwater intrusion, or land subsidence, groundwater use under the rules of the CPGCD is designed to minimize the potential for these impacts to arise and affect neighboring groundwater users (CPGCD 2009b). Accordingly, no projects listed in Table 7-1, other than STP Units 1 and 2, would contribute substantially to cumulative impacts on the Deep Aquifer in the vicinity of the STP site. Because the Deep Aquifer wells providing groundwater to STP Units 1 and 2 would also be used to provide groundwater to STP Units 3 and 4, their impacts are cumulative. Groundwater impacts at wells located 2500 ft from the STP site are included in Chapters 4 and 5. Because the closest off-site water supply wells are farther than 2500 ft from the site, impacts from wells servicing the Selkirk community have a smaller effect on the STP site, and STP site wells have a smaller effect on Selkirk community wells, than as previously described in Chapters 4 and 5.

Given that the geographic area of interest for the Shallow Aquifer is limited to the STP site (i.e., the on-site dewatering activities), no projects listed in Table 7-1, other than Units 1 and 2, would contribute to cumulative impacts on the Shallow Aquifer.

The USGS has forecast a decline in groundwater use in Matagorda County based on historical record and changes in groundwater resource use (Ryder and Ardis 2002). Recent groundwater use, however, reflects current drought conditions and exhibits an increase in groundwater use over that seen in the late 1990s, but not a return to the previously seen high usage rates of the 1980s. With the exception of STP Units 1 and 2, other groundwater users are sufficiently distant from the site so that groundwater withdrawals supporting proposed Units 3 and 4 would have minimal impact on the groundwater resources for these users. The affected environment described in Chapter 2 and the review team's assessments in Section 4.2.2 and Section 5.2.2.2 reflected the groundwater used by current users including operation of STP Units 1 and 2 (i.e., baseline groundwater levels include the influence of existing groundwater use).

The potential offsite impact on the groundwater resource during the operation of four STP units would be represented by an annual average normal operation groundwater requirement of 1860 gpm (3000 ac-ft/yr), which is the maximum usage allowed under the groundwater use permit held by STP (CPGCD 2008). This current permit limit would also be used during operation of existing STP Units 1 and 2 and construction, preconstruction, and operation of proposed Units 3 and 4 at STP. Based on estimates of the current groundwater use and the available groundwater resource (Section 2.3.2.2), future STP groundwater use totaling 1860 gpm for the four units represents approximately 10 percent of current usage in Matagorda County and 6 percent of the available groundwater resource within the CPGCD. Because the managed available groundwater resource is not exceeded in the CPGCD, these levels of groundwater use have minimal impact on the groundwater resource within the district. An evaluation of drawdown resulting from the operation of proposed Units 3 and 4 is presented in Section 5.2.2.2. A similar analysis of the drawdown resulting from groundwater withdrawal to support all four STP units provides similar results and demonstrates that the drawdown would be substantially less than the confining pressure in the aquifer prior to operations of all four units at the STP site, resulting in minimal impact to the regional groundwater resource.

Groundwater use is declining regionally and therefore subsidence is expected to be less of an issue regionally over the life of the operation of the proposed plants. The Updated Final Safety Analysis Report (UFSAR) for Units 1 and 2 projected regional subsidence from 1973 through 2020 to be between 2.5 to 3 ft based on a projected regional groundwater decline of 87 ft and subsidence coefficients derived from regional observations (UFSAR Section 2.5.1.2.9.6.3) (STPNOC 2007b). In the Final Safety Analysis Report (FSAR) Section 2.5S.1.2.6.5 (STPNOC 2009b) STPNOC estimated the maximum subsidence at the STP site because of excavation dewatering is between 0.04 and 0.05 ft. In FSAR Section 2.4S.12.4 (STPNOC 2009b) STPNOC commits to expanding the ongoing plant subsidence monitoring program to include the proposed Units 3 and 4.

The review team is also aware of the potential climate changes that could affect groundwater use. A recent compilation of the state of knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed Units 3 and 4 include an increase in average temperature and a decrease in precipitation. This may result in less groundwater recharge. While the changes that are attributed to climate change in these studies are not insignificant, the review team did not identify anything that would alter its conclusion regarding groundwater use below.

The impacts associated with other groundwater users in the region and the projections that groundwater use by others in the region could decrease in the future were considered in the analysis performed in Chapters 4 and 5. Based on the presence of sufficient confining head to maintain a confined aquifer and a groundwater resource sufficient to sustain the projected site groundwater use, the review team concludes that the cumulative effects to the groundwater resource from preconstruction, construction, and operation of STP Units 3 and 4, and other past, present, and reasonably foreseeable projects would be minimal, including the potential of decreased precipitation and increased temperatures due to GCC. Therefore, the review team concludes that cumulative impacts of groundwater use would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts from construction, preconstruction, and operations of proposed Units 3 and 4, and 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 of this document serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on surface water quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on surface water quality would also be SMALL, and no further mitigation would be warranted.

The combined surface water-quality impacts from construction and preconstruction are described in Section 4.2.3.1 and determined to be SMALL. 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 surface water quality, including the potential effects of GCC. For the cumulative analysis of impacts on surface water, the geographic area of interest is the drainage basin of the Colorado River upstream and downstream of the STP site because other actions within this region could result in a cumulative impact.

Historically, point and nonpoint pollution sources have impaired the quality of the Colorado River. Water quality in the Colorado River has been affected by nonpoint source effluents in the river basin such as agricultural runoff. TCEQ has a Total Maximum Daily Load program in place to restore waters to their designated use, pursuant to Section 303 of the Clean Water Act (TCEQ 2010a). The segment of the river near the STP site is impaired and is listed on the State's 303(d) list, a list that identifies water bodies in or bordering Texas for which effluent limitations are not stringent enough to implement water quality standards, and for which the associated pollutants are suitable for measurement by maximum daily load (TCEQ 2010b). As such, restoration of the Colorado River is the focus of several current and planned Federal, State, and local efforts.

Other present and reasonably foreseeable future actions in the geographic area of interest of the proposed Units 3 and 4 site include the operation of STP Units 1 and 2, the LCRA-SAWS project, the proposed WSEC project, current waste water treatment plant discharges (Matagorda, Beach Road, Wadsworth, Markham, Matagorda County, Bay City, Midfield), additional water demand created by population growth in the region, and potential decreases in precipitation and increased temperatures due to GCC. The impacts of other projects listed in Table 7-1 would have little or no impact on surface-water use.

The impact on surface water quality from construction and preconstruction activities would be minimal because impacts would be localized and temporary, as described in Section 4.2.3. Impacts during operations would also be minimal because any chemicals or radiological contaminants would be diluted, as described in Section 5.2.3. In addition to discharges from proposed Units 3 and 4, STP Units 1 and 2 would also have future discharges from the Main Cooling Reservoir (MCR) to the Colorado River. The bounding scenario of discharge thermal plume formation described in Section 5.2.3.1 includes the potential effects of the operation of existing and proposed units at the STP site on the water quality of the Colorado River. The review team determined that the thermal plume caused by a bounding discharge scenario would not completely block the river cross section and the chemical or radiological constituents of the discharge would be diluted at least eight times, as such, the thermal and chemical effects of the discharge plume during operation of all four units would not be significant. The review team also determined that following the cessation of the discharge, which could last for a relatively extended duration, the plume constituents would be quickly transported downstream to Matagorda Bay where they would undergo further dilution. The review team concluded, therefore, that the impact on surface water quality, from operation of existing and proposed units at the STP site would not be noticeable.

Water quality in the Colorado River could also be affected by projects that discharge effluents upstream or downstream of the STP site such as municipal wastewater treatment plants. In such cases, if the additional discharges from other projects were to occur sufficiently close to the point of discharge used by the STP units, the water quality alterations within the Colorado River could be amplified by combination of the individual discharges. The WSEC project site is located approximately 5 mi northeast of the STP site. The WSEC project has requested a water use permit for 22,000 ac-ft per year from TCEQ. The project would likely use water withdrawn from the Colorado River. There are no other details available regarding the cooling system that the WSEC would employ and the amount of cooling water and other effluent discharge to the Colorado River. The review team conservatively assumed that the WSEC project would discharge to the Colorado River approximately 6 mi upstream of the location of the MCR discharge ports. The power generation capacity of the WSEC (1320 MW) is smaller than that of the existing and proposed units at the STP site (5130 MW). Therefore, the review team assumed that the discharge plume from a cooling system similar to the one employed by the STP units would also be smaller. The WSEC project would also need to obtain a Texas Pollutant Discharge Elimination System (TPDES) permit to discharge effluent to the Colorado River and therefore would be subject to conditions similar to those placed on the STP discharge by the State. The effects of the WSEC effluent discharge would be transported approximately 6 mi downstream to the STP MCR discharge ports where their effects may combine with the effects of a concurrent MCR discharge. The review team determined that there is sufficient separation between the two projects' discharge locations for the WSEC plume to dissipate before reaching the STP discharge ports and therefore only slight increases in constituent concentration or water temperature would be anticipated during a concurrent discharge from both projects, and the cumulative impact to Colorado River water quality would be minimal.

As stated in Section 2.3.1.1, it is reasonably foreseeable that sea level rise may exceed 3 ft by the end of the century due to GCC (Karl et al. 2009). Actual changes in shorelines would also be influenced by geological changes in shoreline regions (such as sinking due to subsidence). The increase in sea level relative to the Colorado River bed, coupled with reduced streamflow (also due to GCC), could result in the salt water front in the Colorado River moving up towards the Reservoir Makeup Pumping Facility (RMPF).

As stated above, GCC could result in decreased precipitation and increased temperatures in the Lower Colorado River Basin. These forecasted changes have the potential to reduce surface runoff, increase evapotranspiration, change cropping patterns, and alter nutrient loadings to runoff. The changes may result in alteration to the surface water quality in the region. While these changes from GCC may not be insignificant, the review team has not identified anything that would alter the conclusions presented above.

Historically, point and nonpoint pollution sources have impaired the quality of the Colorado River, and as such, the segment of the river near the STP site is impaired and is listed on the State's 303(d) list. Because water quality in the Colorado River in the vicinity of the STP site is already impaired from past and current actions, the review team concludes that the cumulative impact on surface water quality from construction, preconstruction, and operation of Units 3 and 4, and from other past, present, and reasonably foreseeable projects, and potential effects of GCC, would be MODERATE. Other point and nonpoint pollution sources in the Colorado River Basin are the principal contributors to this cumulative impact characterization. The incremental impacts from the proposed action, and NRC-authorized activities, would be SMALL and would not noticeably alter water quality of the Colorado River. No further mitigation beyond that described in Chapters 4 and 5 would be warranted.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater quality would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-quality impacts from construction and preconstruction of the proposed Units 3 and 4 are described in Section 4.2.3.2 and determined to be SMALL. 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 groundwater quality, including potential effects of GCC. For this analysis, two geographic areas of interest have been identified. For the Shallow Aquifer, which would be impacted by MCR seepage and potential spills, the geographic area of interest extends from recharge areas in Matagorda County to downgradient discharge areas along the Colorado River. For the Deep Aquifer the geographic area of interest extends from recharge areas in Wharton County to Matagorda Bay.

Historically, the naturally occurring salinity of the Shallow Aquifer has limited its use. The primary groundwater quality concern in the Deep Aquifer has been the intrusion or encroachment of saltwater into the aquifer due to the withdrawal of groundwater for rice irrigation and other uses.

As described in Sections 2.3.3.2 and 5.2.3.2, the MCR is connected hydraulically to the underlying Upper Shallow Aquifer and water from the MCR seeps into the aquifer. Groundwater plumes with the MCR as their source would be local to the STP site and the region immediately downgradient of the site to the Colorado River. Impacts from radioactive contaminants in the MCR and seepage from the MCR would be minimal as described in Sections 5.9.2.1 and 5.9.6. Total dissolved solids (TDS) are an indicator for nonradioactive contaminants, as described in Sections 2.3.3.2 and 5.2.3.2, and it is anticipated that the impacts from MCR seepage into the Upper Shallow Aquifer from Units 3 and 4 would be minimal. STP's estimate of the median TDS for operation of the existing units is approximately 2000 mg/L, and the estimate for operations of the existing and proposed units is approximately 3000 mg/L (Section 5.2.3.1). Groundwater from the Shallow Aquifer is currently described as slightly saline (i.e., having TDS between 1000 and 3000 mg/L) (STPNOC 2009b) and is used locally to water livestock. It is not considered a source of fresh drinking water. While the operation of four units is projected to result in a higher concentration of TDS in MCR waters than current levels in the Upper Shallow Aquifer, the groundwater should still be within the range of slightly saline waters. Furthermore, the potential for dispersion would reduce the TDS concentration in the aquifer. The review team concludes that the impact to groundwater quality from MCR seepage into the Shallow Aquifer would be minimal.

Potential offsite impact from saltwater intrusion or encroachment in the Deep Aquifer was assessed by the review team based on prior evaluation by the USGS (Ryder and Ardis 2002) and the design of production wells proposed by STP compared to groundwater well designs evaluated by the LCRA (2007b). Ryder and Ardis (2002) described saltwater intrusion or encroachment as a potential threat to the rice-irrigation region, including Matagorda County. Because of the reduction of hydraulic head from long-term pumping of the aquifer system for rice irrigation, saltwater encroachment could occur by either lateral migration in coastal areas or vertical migration where freshwater sands overlie saline groundwater. However, Ryder and Ardis (2002) conclude that "(s)altwater encroachment is not currently a serious threat to the quality of groundwater used in the coastal rice-irrigation area" that includes portions of Wharton and Matagorda Counties.

Production wells at the STP site are completed in the upper portion of the Deep Aquifer with up to 500 ft of screen and well bottom at 700 ft below ground surface (BGS). These wells are designed to be pumped at 500 gpm. At the STP site, thickness of the fresh water aquifer is defined by the water quality, and it is believed to be somewhat greater than 1000-ft thick. Thus, a well completed in the Deep Aquifer to 700 ft BGS is more than 300 ft above the interface between fresh and saline groundwater. Based on its review of the LCRA study of pumping in a variable density aquifer system (LCRA 2007b) (also see Section 2.3.3.2), and the design parameters and pumping rates evaluated therein, the review team concludes that the planned STP well design and pumping rate is appropriate and would minimize the potential for lateral or vertical saltwater intrusion. Furthermore, the LCRA study provides guidance to ensure that groundwater withdrawals do not result in significant degradation of the groundwater quality in the regional aquifer system (LCRA 2007b). As such, the production wells at the STP site would not significantly impact the Deep Aquifer.

Based on the regional evaluation by the USGS (Ryder and Ardis 2002) that analyzes current and future impacts to groundwater flow and related saltwater intrusion issues, the comparison of the well design used and proposed for future use at the STP site against the LCRA study results for the Deep Aquifer (LCRA 2007b), and efforts by regional agencies including the LCRA to ensure groundwater quality in the future, the review team concludes the cumulative pumping rate to be used to support the operation of all four STP units does not pose a substantial risk of salt water intrusion or encroachment for Matagorda County. As listed in Section 7.2.1.2, projects in the geographic area of interest that use the Deep Aquifer groundwater resource in the vicinity of the proposed new units are 3 to 4 miles from the STP site. These groundwater users utilize the groundwater resource, as does STPNOC, under the rules of the CPGCD (2009b). Because the purpose of the CPGCD rules is to provide for the conserving, preserving, protecting, and recharging of the groundwater resource to control subsidence and prevent the waste and pollution of the groundwater resource, the review team concludes that potential impacts on the quality (e.g., saltwater intrusion or encroachment) of the Deep Aquifer from other users would be minimal, and are relatively distant from the STP site. Effects on Deep Aquifer groundwater quality from STP actions, as described above, would be local to the site and minimal. Regarding the Shallow Aquifer, the review team also concludes that seepage from the MCR from operation of all four STP units to groundwater would not result in a change in the characterization of the Upper Shallow Aquifer from its current characterization as a slightly saline water resource. Therefore, after reviewing other past, present, and reasonably foreseeable projects in the vicinity of the STP site, the review team concludes that cumulative impacts to groundwater quality would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted.

Projected changes in the climate for the region during the life of the proposed Units 3 and 4 include an increase in average temperature and a decrease in precipitation. These changes are likely to result in changes to agriculture including crops, pests, and the associated changes in application of nutrients, pesticides and herbicides that may reach groundwater. As a result, groundwater quality may be altered by the infiltration of different chemicals. While the groundwater quality changes that are indirectly attributable to climate change may not be insignificant, the review team did not identify anything that would alter its conclusion regarding groundwater quality above.

7.3 Ecology

This section addresses the cumulative impacts on terrestrial, wetlands and aquatic ecological resources as a result of activities associated with the proposed new units at the STP site and other past, present, and reasonably foreseeable future activities within the geographic area of interest for each resource.

7.3.1 Terrestrial and Wetland Ecosystem Impacts

The description of the affected environment in Section 2.4.1 t provides the baseline for the cumulative impacts assessments for terrestrial and wetlands ecological resources. As described in Section 4.3.1, the review team concludes that the impacts from NRC-authorized construction on terrestrial and wetlands ecology would be SMALL, and no further mitigation would be warranted. The combined impacts of construction and preconstruction were described in Section 4.3.1 and determined to be SMALL. As described in Section 5.3.1, the review team concludes that the impacts of operations on terrestrial and wetlands ecology would also be SMALL, and no further mitigation would be warranted.

In addition to impacts from construction, preconstruction, and operation, the cumulative analysis also considers other past, present, and reasonably foreseeable projects that could affect terrestrial ecological resources. For the cumulative analysis of potential impacts to terrestrial and wetland resources, the geographic area of interest includes the intersection of the Western Gulf Coast Plains ecoregion with the Matagorda Bay Watershed and the Lower Colorado River watershed (Figure 7-1 on the following page). This area is expected to encompass the ecologically relevant landscape features and species. The geographic area of interest currently consists of primarily agricultural croplands with some rangelands. It also includes two wildlife refuges: the Clive Runnells Family Mad Island Marsh Preserve, and the Mad Island Wildlife Management Area, which is managed by the Texas Parks and Wildlife Department (TPWD).

7.3.1.1 Wildlife and Plant Communities

The STP site is located within coastal prairies of the Western Gulf Coast Plains ecoregion (Griffith et al. 2004). Coastal prairies of the Western Gulf Coast Plains are tallgrass prairies similar to the tallgrass prairie of the Midwestern United States (Allain et al. 1999), with vegetation consisting mostly of grasses overlain by a diverse variety of wildflowers and other plants. These prairies are estimated to have historically covered about 6.5 million ac of Texas. During the past century, the Texas coast has experienced considerable urban, industrial, and agricultural growth that fragmented lands, converted prairies, changed river flows, decreased water quality, and increased sediment loads and pollutants on marshes and estuaries. Projections indicate continued high growth and increasing fragmentation in most parts of this ecoregion (TPWD 2009c). Less than 1 percent of the original native grasslands of the entire coastal prairie in Texas are estimated to remain in a relatively pristine state (Diamond and Smeins 1984). In the late 1800s, large numbers of cattle were introduced onto Southwest grasslands and livestock numbers remained high through the 1920s. Livestock grazing and ranching continue to be large components of land use in the region, but the majority of the land has been altered for growing rice, sugarcane, forage, and grain crops.

The Texas Gulf Coast historically contained abundant and diverse wetlands, but thousands of acres of wetlands have been lost during the past century to agricultural land use and development. Approximately 30 percent of the coastal prairies along the Texas Gulf coast were once wetlands (TPWD 2010). Human activities, including landscape alteration for agricultural, industrial or urban uses, continue to significantly threaten remaining wetland habitats (TPWD 2005). Of the estimated 4,105,343 ac of coastal Texas wetlands existing in 1955, only 3,894,753 ac of wetlands were estimated to remain in 1992 (Moulton et al. 1997). Suburban and industrial development are reducing wetland habitat at a faster rate than anywhere else along the coast. In addition, decreased precipitation, sea-level rise, more frequent storm surges, increased intensity of coastal storms, and increased temperatures resulting from GCC could potential also contribute to wetland losses and exacerbate the ongoing trend (Karl et al. 2009). Rice fields, prairie wetlands, and coastal marshes associated with the coastal prairie provide important habitat for waterfowl and thousands of other forms of wildlife. TPWD

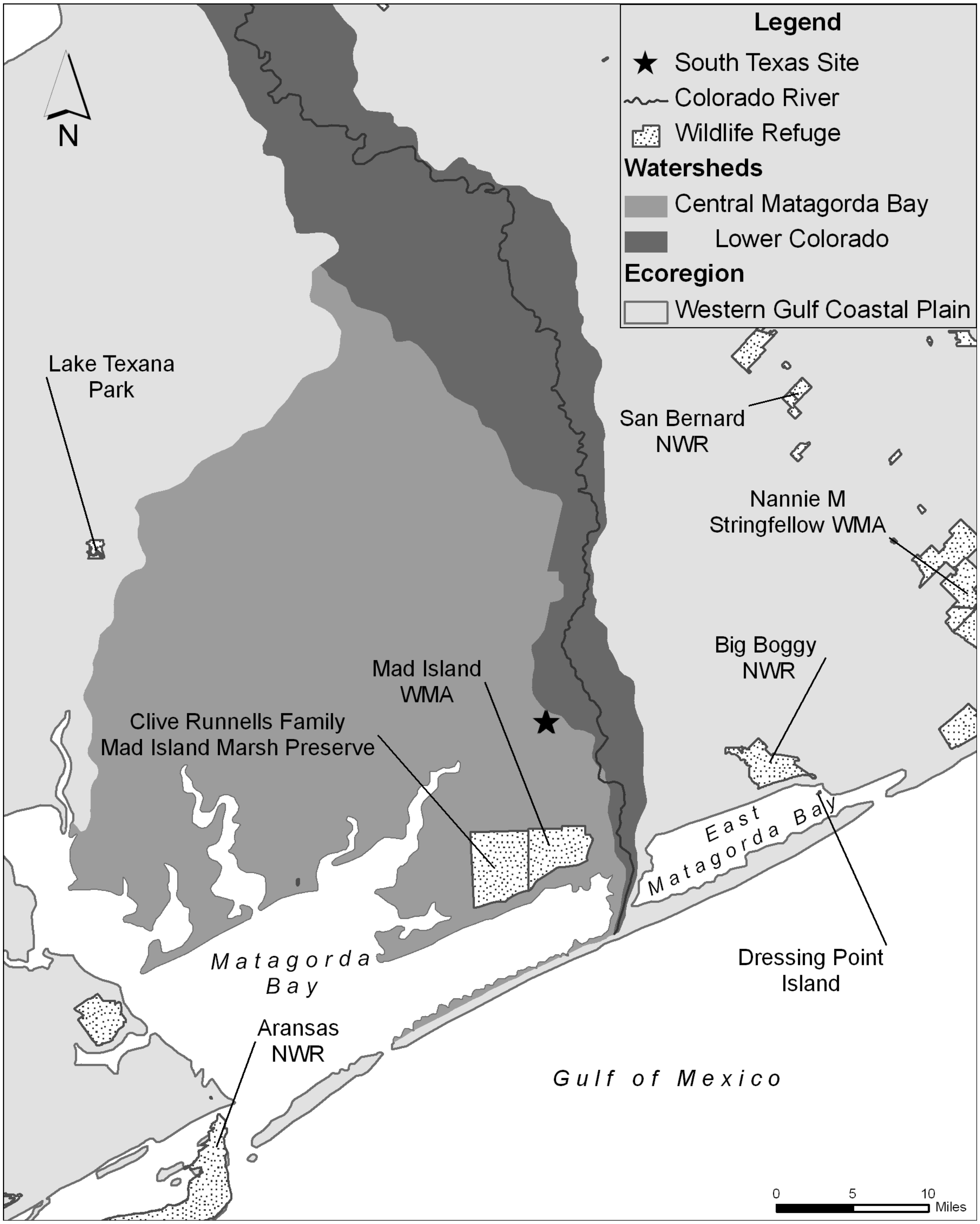

Figure 7-1. Geographic Area of Interest Evaluated to Assess Cumulative Impacts to Terrestrial Ecological Resources

identifies the Gulf coast and associated grassland prairies, wetlands, marshes, and agriculture as one of the most important wintering areas for North America's waterfowl populations (TPWD 2005).

Past actions in the geographic area of interest include the development of STP Units 1 and 2, which required building and filling the 7000-ac MCR, and building the existing facilities associated with STP Units 1 and 2 that comprise about 300 acres. Other past projects in the geographic area of interest that have contributed to loss of available habitat include the building and operation of various industrial facilities and wastewater treatment plants (Table 7-1). These include the Formosa Plastics Corporation plant, the Texas Liquid Fertilizer Company, and the Alcoa aluminum plant near Point Comfort, Texas; the Equistar Chemicals facility, the Celanese Ltd. chemical plant, and Oxea Corp chemical plant near Bay City, Texas. Building and development of these industrial areas likely contributed to loss of agricultural lands and rangelands that would have provided habitat for generalist species including game species. Development of industrial plants near the Gulf coast contributed to loss of wetland habitats.

Building the proposed Units 3 and 4 at STP would affect limited areas of several habitat types including the permanent loss of approximately 300 ac, consisting mostly of maintained and mowed grasslands, shrub-scrub habitat, and existing industrial areas. Overall, 540 ac would be disturbed during preconstruction and construction, which represent about 4 percent of the total site. No native coastal prairie habitat or wetland habitats would be affected by construction and preconstruction activities for the proposed new reactors at the STP site. Proposed future actions within the geographic area of interest that would adversely affect terrestrial resources in a similar way to development at the STP site include the proposed development and building of energy projects including the WSEC (located on a 1200-ac tract of land approximately 5 mi northeast of the STP site), Calhoun LNG Terminal on Matagorda Bay, Victoria County Nuclear Station, and upgrades to the E.S. Joslin Power Plant Project (Table 7-1). Other future actions or conditions that would contribute to cumulative effects on terrestrial resources would include creation and/or upgrading transmission lines, new road development and expansion, continued industrial and urban development throughout the geographic area of interest, increased outdoor recreation, nonpoint source runoff from activities such as agriculture and ranching, and GCC.

Development of the WSEC would potentially result in the loss of wildlife habitat. Activities associated with this facility that could cumulatively affect terrestrial ecological resources include land clearing and grading (temporary and permanent), filling and/or draining of wetlands, population growth due to building and operation, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. The main site for the Victoria County Nuclear Station lies outside the area of analysis for cumulative effects to terrestrial resources, but infrastructure planned to support the proposed units would include new rights-of-way and corridors for water pipelines and transmission lines that would potentially have portions in the area of interest. Upgrading the E.S. Joslin power plant would likely also contribute to cumulative effects to terrestrial resources by increasing noise levels and increased traffic, but would be expected to affect a smaller area. Site preparation and building activities for these proposed projects would likely displace or destroy wildlife that inhabit areas where activities take place. Some wildlife, including important species, would perish or be displaced during land clearing for any of the above projects as a consequence of direct mortality, habitat loss, habitat fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to areas of activity could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Such land-disturbing activities are not expected to destabilize any terrestrial resources; however site preparation and building activities for other projects could noticeably alter important attributes of terrestrial resources. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured or suffer mortality through collisions with tall structures or equipment. The impact on wildlife from each noise-generating activity is expected to be temporary and minor.

Because only existing transmission line corridors would be used to support power transmission from proposed Units 3 and 4 at STP, there would be no additional habitat loss associated with building new transmission corridors. Development of the WSEC and the Victoria County Nuclear Station nuclear facility would potentially require new transmission lines and require new corridors to be created. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer *(Odocoileus virginianus)*, or bobwhite quail (*Colinus virginianus*). However, in general, new transmission lines and corridors would also present increased risks for avian collision and electrocution, and would contribute to habitat fragmentation. The maintenance of transmission-line corridors could also be beneficial for some species, including those that inhabit early successional habitat or use edge environments. Vegetation maintenance and control along the corridors would not be anticipated to cause any increases in bird collisions and electrocutions, and thus, would not be expected to increase and contribute to cumulative effects. Much of the land in the geographic area of interest consists of agricultural cropland and rangelands, and the relative amounts of forested habitat crossed by new corridors would likely be small.

The review team estimates that maximum salt deposition from cooling tower drift under normal operations for STP would occur on the site; however, damage to vegetation and habitats would be minimal and would not contribute to a cumulative salt drift outside the STP boundaries (Table 5.7-3 in STPNOC 2009a). There are no cooling towers associated with STP Units 1 and 2. Cooling towers for other proposed energy projects in the geographic area of interest are sufficiently distant from the proposed site such that the effects on terrestrial resources would not be additive or synergistic. Cooling tower plumes are not expected to overlap or result in cumulative salt deposition, and potential fogging and icing would not noticeably affect terrestrial resources.

The geographic area of interest lies within the Central Flyway migration route which is a major migratory corridor for neotropical migrants and other birds. Mechanical draft cooling towers planned for the proposed units at STP are approximately of similar height (119 ft above grade) as existing buildings at the site and would not be expected to present a significant collision hazard for migratory birds. Cooling towers or tall structures associated with other proposed energy projects or with the Calhoun LNG terminal may present increased risks of collision and increased mortality. Although bird mortality from collisions with tall structures has been documented, it would not be expected to be a significant source of mortality and would have a minimal effect on populations.

The habitats that would be disturbed at the STP site are common on the 12,220-ac property, and no habitats that would be lost to building the proposed new units are considered to be critical or important habitat for the survival of important species or common wildlife. Major portions of the STP site were previously used for agricultural and grazing purposes and the site consists of primarily of successional habitats. Development of proposed projects such as transmission lines for the Victoria County Nuclear Station and the WSEC would most likely affect rangeland and agricultural habitats but would not likely affect substantial amounts of prairies or bottomland forest habitats. Because the majority of the Gulf coast prairies and forests have been subject to agricultural development and livestock grazing, future development, and proposed actions would likely further reduce these types of habitats and may also affect wetlands within the region, noticeably altering these terrestrial resources.

7.3.1.2 Important Species

Future urban and industrial development, new transmission corridors, and the effects of GCC may potentially affect important species in the geographic area of interest primarily by decreasing or degrading the available habitat for these species. Habitat loss may occur through proposed projects that cause permanent loss of upland and wetland habitats, sea level rise, increasing salinity of estuarine areas, and inundation or filling of wetland habitats. Sea level rise resulting from climate change along the Gulf coast of Texas would accelerate loss of wetlands and estuaries, thus eliminating breeding and foraging habitat for commercial, game, and threatened and endangered species (Ning et al. 2003; Karl et al. 2009). GCC could also cause shifts in species ranges and migratory corridors as well as changes in ecological processes (Karl et al. 2009). Impacts from development, new transmission corridors, and potential effects of GCC would noticeably alter, but not destabilize, important species in the geographic area of interest.

Populations of three species of birds listed under the Endangered Species Act (ESA) occur along the Gulf Coast adjacent to the geographic area of interest for cumulative effects. The Federally endangered whooping crane (*Grus americana)* and the Federally threatened piping plover (*Charadrius melodus*) overwinter along the Gulf coast. The major threats to these two species would be decreased or degraded foraging habitat as a result of sea level rise and increased salinity caused by climate change that may change prey availability for the whooping crane. The Federally endangered northern Aplomado falcon (*Falco femoralis septentrionalis)* also occurs within the geographic area of interest and nests on Matagorda Island. The major threat to this species would be the loss of hunting and foraging habitat to development. In addition, building new transmission lines and corridors would also present increased risks for avian collision and electrocution for all of these species and would contribute to habitat fragmentation. Structures and transmission lines associated with future projects could also present increased threats of collision and electrocution within the migratory path for trans-Gulf migratory birds.

The American alligator (*Alligator mississippiensis*)*,* listed as threatened under the ESA (due to similarity of appearance to the American crocodile [*Crocodylus acutus*]) is found in the geographic area of interest, but is considered to have fully recovered (52 FR 21059). Although trends and conditions, such as urbanization, industrialization, and GCC, could affect the American alligator's habitat and local distribution, none of the identified present or future projects are expected to affect the recovered species.

Eight species of birds are listed as threatened or endangered by the State of Texas in Matagorda County. Three species listed as threatened are raptors: the bald eagle (*Haliaeetus leucocephalus*); the peregrine falcon (*Falco peregrinus*); and the white-tailed hawk *(Buteo albicaudatus*). Proposed projects that reduce available hunting/foraging habitat or involve construction of new transmission lines and corridors would potentially cause adverse effects to these species. Three of the state-listed species are wading birds, the white-faced ibis (*Plegadis chihi*), reddish egret (*Egretta rufescens*), and the woodstork, (*Mycteria americana*). Activities that alter or destroy wetland and marsh habitats where birds forage would adversely affect these species. These birds would also be subject to increased risk of mortality through collision and electrocution from transmission lines or collision with tall structures. The brown pelican (*Pelecanus occidentalis*) is listed as endangered in Texas and occurs within the analysis area. This species would also suffer increased risk of mortality from collision or electrocution with transmission lines or collision with tall structures. Nesting habitat for the brown pelican along the Gulf coast might be altered or inundated by sea level rise due to changing climate. The sooty tern (*Sterna fuscata*) is a pelagic species that is found across tropical oceans and is unlikely to use habitats within the area of interest.

State-listed reptile species including the smooth green snake (*Liochlorophis vernalis*), the Texas scarlet snake (*Cemophora coccinea lineri*), the Texas tortoise (*Gopherus berlandieri*), Texas horned lizard (*Phrynosoma cornutum*), and timber rattlesnake (*Crotalus horridus*) would be affected by projects involving land clearing, habitat fragmentation or loss, and increased vehicle traffic on roads and right-of-ways. These species would be displaced and would likely suffer increased mortality.

The creation and maintenance of transmission-line corridors could be beneficial for some important species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer *(Odocoileus virginianus)*, or bobwhite quail (*Colinus virginianus*). Local populations of game species may be temporarily affected by regional development activities. Because many game species are generalists, they potentially occur across a variety of habitats within the area of interest. During land-clearing activities, habitat for game species may be lost, and wildlife would be displaced during the site preparation and building activities.

Summary

Cumulative impacts to terrestrial ecology resources are estimated based on the information provided by STPNOC and the review team's independent evaluation. Past, present, and reasonably foreseeable future activities exist in the geographic area of interest that could affect terrestrial ecological resources. Development of new transmission corridors and infrastructure to support the proposed future projects would likely affect wildlife and may be detrimental to wetland and bottomland habitats. Loss of wildlife habitat, increased fragmentation, and increased loss of wetlands from continued development and climate change are unavoidable and would continue to occur. The extents of habitats for most important species are relatively limited, and limited native coastal prairie and wetland habitats remain in the area of interest. Detectable alteration of habitat, loss of habitat, increased habitat fragmentation, and increased risk of collision and electrocution within the Central Migratory Corridor would contribute to the cumulative impacts. Based on this analysis, the review team concludes that cumulative impacts from past, present, and reasonably foreseeable future actions on important species and habitat loss in the Western Gulf Coast Plains near the STP site would noticeably alter, but would not likely destabilize, the terrestrial ecological resources. The review team concludes that the cumulative impacts from construction, preconstruction, and operations of Units 3 and 4 and from past, present, and reasonably foreseeable future actions to terrestrial resources in the region of interest would be MODERATE; however, the incremental contribution of impacts to terrestrial resources from NRC-authorized activities at the STP site would be SMALL.

7.3.2 Aquatic Ecosystem Impacts

The description of the affected environment in Section 2.4.2 provides the baseline for the cumulative impacts assessment for aquatic ecological resources. As described in Section 4.3.2, the NRC staff concludes that the impacts of NRC-authorized construction activities on aquatic biota would be SMALL. The combined impacts from construction and preconstruction, including the upgrades to the Hillje transmission corridor, were also described in Section 4.3.2 and were determined to be SMALL by the review team. As described in Section 5.3.2, the review team concludes that the impacts on the aquatic resources in onsite water bodies from the operation of proposed Units 3 and 4, in the Colorado River from operation of the RMPF and the discharge structure, and in offsite water bodies from maintenance and operation of transmission lines and corridors would be SMALL.

In addition to the impacts from construction, preconstruction, and operation of the proposed STP Units 3 and 4 and associated transmission lines and corridors, this cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could affect aquatic ecology. For this cumulative analysis, the geographic area of interest is based on the extent of the aquatic community within the influence of the STP site. The area encompasses the lower Colorado River basin and Matagorda Bay, including the GIWW between Matagorda Bay and the northeastern Colorado River lock (Figures 2-8 and 2-22 in Chapter 2).

The aquatic resources of the lower Colorado River basin have been affected by development and changes to the mouth of the river and its confluence with the Gulf of Mexico since the 1920s. As discussed in Section 2.4.2.1, the course of the river has been redirected by various construction projects into the Gulf of Mexico, and the most recent change diverted the river into Matagorda Bay in 1992. These alterations have affected the aquatic resources by changing the inputs of freshwater and estuarine waters into the lower Colorado River and the area available for aquatic organisms to navigate through the river, bay, and Gulf. The increase in freshwater to the bay has resulted in a slight decrease in salinity and increased marsh areas that could become nursery areas for numerous commercially and recreationally important fish and shellfish. There has not been a significant change in Eastern oyster (*Crassostrea virginica*) and finfish catch per unit effort (CPUE) since the diversion channel opened into Matagorda Bay. However, white shrimp (*Litopenaeus setiferus*) CPUE has decreased, and brown shrimp (*Farfantepenaeus aztecus*) and blue crab (*Callinectes sapidus*) CPUEs have increased in the Bay (Wilber and Bass 1998; Corps 2007). Species richness and diversity have increased in the lower Colorado River (from the GIWW to navigation mile marker 8) based on surveys in 2007-2008 compared to similar surveys in 1983-1884 (NRC 1986; STPNOC 2009a; ENSR 2008). The apparent change in the aquatic community of the Colorado River in the vicinity of the site could be due to a number of reasons (e.g., differences in sampling protocol over time, variance in weather conditions during the two sampling efforts, a river diversion project, and sea level rise). However, the shift in the aquatic community is not likely to be associated with the construction and operation of the RMPF, barge slip, or discharge structure for existing Units 1 and 2 because those activities were primarily on the shoreline of the river and used erosion and turbidity controls (e.g., sheet pile walls). While slow-moving benthic organisms (e.g., mollusks and polychaetes) were lost during construction, these organisms likely recolonized the area. Other aquatic organisms likely avoided the area during construction and returned after sheet pile walls and other in-stream activities were completed.

In addition, during the construction of the MCR for STP Units 1 and 2, the onsite water body, Little Robbins Slough, was diverted around the reservoir. The diversion temporarily changed the flow of freshwater into wetlands to the south of the site as well as flows into the Clive Runnells Family Mad Island Marsh Preserve and the Mad Island Wildlife Management Area. However, studies conducted in the 1980s showed that the changes in freshwater input to the preserve and management areas were minimal (NRC 1986).

The construction and filling of the MCR created a new water resource onsite. The first aquatic surveys of the MCR were completed in 2007 through 2008, and the results were discussed in Section 2.4.2.1. The results demonstrated that a diverse aquatic community had developed as fish and invertebrates were entrained in water pumped from the Colorado River. The MCR is not considered waters of the U.S. or the State, access to the MCR by the public is prohibited and the aquatic resources are not harvested.

Construction of STP Units 1 and 2 caused minor, temporary changes in the aquatic community adjacent to facilities on the Colorado River (NRC 1986). Cofferdams were used to minimize the impacts from erosion and turbidity in the river during installation of the RMPF and barge slip. Upon the cessation of construction activities for Units 1 and 2 in the Colorado River, aquatic habitat recolonized that area as demonstrated by the diverse aquatic community in the vicinity that was evaluated during the 1983, 1984, and 2007-2008 surveys (NRC 1986; ENSR 2008; STPNOC 2009a). Installation of the discharge pipes and stabilization of the river bank created temporary changes to the aquatic community, similar to the construction of the RMPF.

Additionally, the review team considered the potential cumulative impacts of operating four units of operating four units at the STP site, and the additional requirement of makeup water to be pumped from the RMPF. Past studies on aquatic organisms in the Colorado River that are likely to be impinged or entrained at the RMPF concluded that impacts to the important species would be insignificant and minor, primarily because the density of organisms in the vicinity is rather low and the species are ubiquitous in the region (NRC 1986; STPNOC 2009a). The increase in species richness and diversity in the Colorado River from 1983-1984 to 2007-2008 indicates that the operation of the RMPF has had negligible impact on the aquatic community in the vicinity of the site although impingement, entrainment, and entrapment at the RMPF have not been evaluated since 1984 (NRC 1986; STPNOC 2009a; ENSR 2008). The types of aquatic organisms currently within the vicinity of the site are common species, and no threatened or endangered species have been found. Additionally, the structure and operation of the RMPF are designed to minimize impacts on aquatic biota. Therefore, impacts from operation of the RMPF (impingement, entrainment, and entrapment) for four units are likely to remain minimal.

STPNOC plans on increasing the water level in the MCR and that would result in additional seepage to groundwater and the relief well system that could contribute flow to Little Robbins Slough and the wetlands to the south of the site. The increase in facilities and structures like parking lots would change the flow of stormwater into the drainages onsite. STPNOC plans on moving and constructing additional drainages and culverts to manage the flows after precipitation events, which could increase due to GCC. A site-specific stormwater pollution prevention plan would include practices for minimizing impacts to the aquatic communities in these onsite drainages. Operation of the four units would affect the aquatic community in the MCR. The two operating circulating water intake structures (CWISs) would increase entrainment and impingement of the aquatic community. The two discharges from the four units would increase the water temperature in the MCR that the aquatic species would either avoid or acclimate to the new conditions. However, since the aquatic community in the MCR is isolated from the onsite waterbodies and the Colorado River, these impacts are negligible to the overall aquatic resources of the geographic area of interest.

The review team also considered the potential cumulative impacts related to thermal and chemical discharges. There have been no past impacts from discharges into the Colorado River because STPNOC has not released water from the MCR into the river except for one test of the discharge facility in 1997. As discussed in Sections 5.2.3.1 and 5.3.2.1, the frequency and duration of discharge from the MCR into the Colorado River would be managed by STPNOC based on water quality in the MCR and TPDES permit conditions. The operation of four units would change the water quality in the MCR similar to the changes that were evaluated for operation of Units 3 and 4 (Table 5-3). Chemical releases from discharging the MCR into the Colorado River are expected to be below the criteria for protection of aquatic life (TCEQ 2005). Physical impacts (e.g., scouring of aquatic habitat) is likely to be minimal due to the flow and frequency of discharge. In general, these impacts would not noticeably alter the resource. However, under certain conditions, the size and configuration of the thermal plume from the discharge of MCR water into the river from the operation of four units in combination with poor river water quality could create detectable changes to the passage of the aquatic organisms in the Colorado River, including species that are of commercial and recreational importance and species that are Federally managed and have designated essential fish habitat. However, the foraging behavior and high fecundity of the aquatic organisms indicate that the effects from the thermal plume would not noticeably alter or destabilize the populations or aquatic community in the lower Colorado River.

Several activities associated with maintenance of the shoreline as well as dredging to maintain the RMPF and barge slip are planned for Units 1 and 2 and would continue for all four units. The revetment along 1600 ft of shoreline on the west bank of the Colorado River, beginning at the MCR spillway and extending down the river to the STP site property line, has become damaged due to bank erosion during and following high river flows. Flooding has eroded and undercut the revetment and damaged the associated rigid matting. STPNOC has requested approval from the Corps to conduct restoration work as part of the existing permit with the Corps or under the Nationwide Permit No. 13 for bank stabilization activities (STPNOC 2009a).

Aquatic organisms inhabiting the shoreline habitat would be disturbed during restoration activities, but these impacts would be temporary and the organisms would likely recolonize the area.

In addition to the maintenance dredging in the Colorado River described in Chapter 5, the Corps continue dredging operations in the Colorado River to maintain the navigation channel. Dredging would remove benthic habitat and the organisms that are not highly mobile (e.g., mollusks). Organisms that can readily swim would likely avoid the area during dredging activities. After dredging activities, these areas would be recolonized by the aquatic community. Impacts from dredging on aquatic organisms would be minor.

Future projects in the vicinity of the STP site would use significant quantities of Colorado River flow, which could affect aquatic habitat and migratory behavior. These projects include the proposed LCRA-SAWS project and WSEC (TWDB 2006a). The LCRA-SAWS project is projected to generate 150,000 ac-ft of new water supplies by 2060 through conjunctive use of groundwater from the Gulf Coast Aquifer and surface water supplies from the Colorado River (TWDB 2006a). A habitat assessment program is underway to collect baseline information and evaluate effects of freshwater inflow alterations to Matagorda Bay as part of the LCRA-SAWS project (LCRA-SAWS 2006). LCRA has evaluated WSEC in its Water Supply Resource Plan for Region K, Matagorda County. The increases in water demand from 2010 to 2020 is approximately 22,000 ac-ft per year, which would be attributed to the needs for WSEC (LCRA 2008b). Details on these projects and their potential impacts on aquatic resources have not been completed; however, these projects have the potential to change the freshwater contribution in the river within the vicinity of STP. Changes in saltwater intrusion or flow of salt water into the river could change the habitat, movement and composition of the aquatic community in the vicinity. These types of changes are likely to have influenced the shift in aquatic communities as demonstrated by the differences observed in earlier studies with varying flow conditions in the river (NRC 1975, 1986), as well as in the shifts observed by comparing the results of the studies before and after the completion of the diversion of the river into Matagorda Bay in 1992 (ENSR 2008).

Proposed future power generation facilities, including WESC and the Victoria County Nuclear Station, may require the development of new transmission systems (lines as well as corridors) in the geographic area of interest. The WSEC may be required to add additional transmission capabilities within the vicinity for its power transmission, but that information is currently not available to evaluate. If new transmission corridors are built, they would likely have a minor effect on aquatic species assuming transmission line routing considers aquatic resources and best management practices (BMPs) are employed during construction and during transmission line maintenance activities once the lines are completed and energized. Because only existing transmission corridors would be used to support power transmission from proposed Units 3 and 4, there would be no additional impacts to aquatic resources associated with construction of new transmission corridors for the proposed new STP units. Vegetation maintenance and control along existing and future corridors would not be expected to increase and contribute to cumulative effects (STPNOC 2009a).

Anthropogenic (derived from human activities) stressors such as residential or industrial development in the vicinity of STP site can affect aquatic resources. Increased urbanization and population growth, while projected to be low in comparison to other locations in Texas (Table 2-17), would still lead to increased development along the shores of the Colorado River that can contribute to cumulative impacts in the lower Colorado River Basin through habitat loss and nonpoint source pollution. Future activities could lead to increased water needs, nonpoint and point source water pollution, vessel traffic on the waterways, maintenance dredging, and fishing pressures.

Commercial and recreational fishing in the Colorado River and Matagorda Bay would likely continue to increase in the future. The region is recognized for recreational fishing of a number of species, and fishing would likely increase with increased urbanization in the vicinity. Matagorda Bay is one of the recognized regions in Texas for commercial fishing, primarily associated with the shrimp industry (TPWD 2002), although these fisheries are not significant contributors to employment in the region (Section 2.5.2). In efforts to improve the fisheries in the area, TPWD has designated the "most eastern half of the eastern arm of Matagorda Bay" as a finfish and shellfish nursery, closing the area to commercial fishing and commercial harvesting of oysters (LCRA 2006). A freshwater inflow needs study for Matagorda Bay has identified several alternatives associated with water management strategies designed to improve commercial fishing opportunities (LCRA 2006). If management strategies do not improve sustainability of fisheries, then increased fishing pressures could result in overall decreased biological productivity for the Colorado River and Matagorda Bay.

In addition to direct anthropogenic activities, GCC could impose additional stressors on aquatic communities. The presence of natural environmental stressors (e.g., short- or long-term changes in precipitation or temperature) would contribute to the cumulative environmental impacts to the Colorado River and Matagorda Bay. GCC could lead to decreased precipitation, increased sea levels, varying freshwater inflow, increased temperatures, increased storm surges, greater intensity of coastal storms, and increased nonpoint source pollution from runoff during these storms, in the water bodies in the geographic area of interest (Nielsen-Gammon 1995; Montagna et al. 1995; Karl et al. 2009). Such changes could alter salinity, change freshwater inflow, and reduce dissolved oxygen, which could directly affect aquatic habitat. Rising sea water due to global climate change could affect water levels in the lower Colorado River and Matagorda Bay and subsequently change the water quality associated with the mixing of freshwater and estuarine waters (Montagna et al. 1995; Karl et al. 2009). These kinds of changes have been experienced in the vicinity of STP associated with the diversion of the Colorado River into the Gulf and Matagorda Bay since the 1920s. As discussed in Section

2.4.2, the aquatic communities in the vicinity have shifted along with these water quality changes with time. Most recent studies on Matagorda Bay since the opening of the diversion channel from the Colorado River have shown slower than expected development of wetlands, oyster reefs, and other aquatic habitat (Wilber and Bass 1998; LCRA 2006; Corps 2007). LCRA has indicated that more freshwater inflow into the Bay is needed to increase biological productivity in the bay (LCRA 2006). The effects of rising sea level would likely be counterproductive to the current efforts to increase freshwater flows into the Bay. Changes in water quality in Matagorda Bay and the lower Colorado River could create areas that are hypoxic (low in dissolved oxygen) and lead to further stress on aquatic communities (Montagna et al. 1995). These stressors would result in shifts in species ranges, habitats, and migratory behaviors and also alter ecosystem processes (Karl et al. 2009).

Summary

Cumulative impacts to aquatic ecology resources are estimated based on the information provided by STPNOC and the review team’s independent evaluation. Past, present and future activities exist in the geographic area of interest that could contribute to cumulative effects to aquatic ecological resources. Future development of industries that compete for water in the Colorado River as well as management of water budgets across the State of Texas through diversion projects like LCRA-SAWS project would likely affect aquatic resources in the lower Colorado River. Under certain conditions, the thermal plume from the discharge of MCR water into the river could affect passage and potentially survival of aquatic organisms in the river. The alterations to the transmission corridors for Units 3 and 4 would have negligible effects on aquatic species in the area, and the cumulative impacts associated with transmission system upgrades on the aquatic community for other projects in the geographic area of interest would likely be minor. Direct and indirect anthropogenic and natural environmental stressors, including other energy projects, in the geographic area of interest would cumulatively lead to effects on the aquatic communities that would noticeably alter important attributes, such as species range, habitat availability, ecosystem processes, migratory corridors and behavior, species diversity, and species abundance. The review team concludes that cumulative impacts from past, present, and reasonably foreseeable actions to aquatic resources in the geographic area of interest would be MODERATE. The incremental contribution of NRC-authorized construction and the operation of the proposed Units 3 and 4 to cumulative impacts on aquatic resources in onsite water bodies, the Colorado River, and Matagorda Bay would be SMALL.

7.4 Socioeconomics and Environmental Justice

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 impacts assessment in this resource area. As described in Section 4.4, any negative impacts of the NRC-authorized construction activities on socioeconomics would be SMALL and adverse, with the following exceptions. First, NRC-authorized construction would result in MODERATE beneficial economic and tax revenue impacts to Matagorda County, and SMALL beneficial economic and tax revenue impacts elsewhere in the region. Second, NRC-authorized construction (75 percent of the total project on a labor-hours basis) generally would result in MODERATE and adverse demographic impact and MODERATE adverse impacts in Matagorda County on roads, housing, and education and fire services. As described in Section 5.4, the adverse socioeconomic impacts of operations would be SMALL. Operations of proposed Units 3 and 4 would result in LARGE beneficial tax revenue impacts on Matagorda County, and SMALL beneficial economic and tax revenue impacts elsewhere in the region.

The combined impacts from construction and preconstruction were described in Section 4.5 and were determined to be the same as described above for NRC-authorized construction. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable projects that could affect socioeconomics. For this analysis, the primary geographic area of interest is Matagorda and Brazoria Counties because these counties are the principle areas where STP workers would live, where the economy, tax base and infrastructure would most likely be affected, and therefore where socioeconomic impacts would occur. However, the geographic area of interest was modified as appropriate for specific impact analyses; for example, specific taxation jurisdictions were considered when appropriate, and Calhoun and Jackson Counties were considered for impacts of the Victoria County Nuclear Station, Calhoun LNG, and E.S. Joslin Power Plant projects.

Matagorda County historically had an agricultural based economy initially centered on cattle, corn, and cotton, and later on rice. By the 1970s the county was a leading cattle producing area. Significant amounts of cotton, grain sorghums, soy beans, and corn were grown there, while rice remained a very important crop. Oil and gas fields were found early in the 20th Century in Matagorda County and oil production grew until the mid-1960s, then began to decline. The County also has had several chemical and gas-processing and oil-refining facilities. STP was constructed during the 1970s and 1980s and began operations in 1988.

Matagorda County population grew from about 18,000 people in 1930 to about 37,000 in 1980, but remained roughly constant at 37,000 throughout the 1980s and 1990s.

Agriculture was the foundation of the Brazoria County's early economy, and some of the State's largest and most prosperous sugar and cotton plantations were located there in the 19th century. Rice became the center of the agricultural economy after World War II. In the 1990s, there were about 41,000 acres used for rice production. Oil production began in 1902, sulfur was first mined in 1912, and oil and mining remain important. The Dow Chemical Company, drawn to natural resources at Freeport, came in 1939 and gave rise to the Brazosport industrial and port community, which subsequently included several chemical processing plants. By the 1980s the county had 186 manufacturing establishments that employed almost 18,000 workers. The population boomed and became more urbanized, with Brazoria County population rising from 23,000 in 1930 to nearly 242,000 in the year 2000 (TSHA 2009a,b).

The socioeconomic impact analyses in Chapters 4 and 5 are cumulative by nature and depend largely on the rate of change from existing conditions, for example, the increase in the rate of population growth. Past and current economic impacts associated with activities listed in Table 7-1 already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the Regional Input-Output Model 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. State and county plans along with modeled demographic projections like those used in Sections 2.5, 4.4 and 5.4 include forecasts of future development and population increases. Thus, cumulative impacts associated with general growth in Matagorda and Brazoria Counties and construction, preconstruction, and operation of proposed Units 3 and 4 are evaluated in Chapters 4 and 5.

Regarding specific reasonably foreseeable future projects that are not part of general growth in the region, the proposed 1320-MW WSEC listed in Table 7-1 is large enough that if its construction period coincided with that for proposed Units 3 and 4, some of the impacts of STP construction on schools, housing, and public services in Matagorda County might be more significant than if only Units 3 and 4 were built. However, the review team determined the construction periods for WSEC and Units 3 and 4 are not likely to overlap. WSEC is projected to begin construction in 2010, at least 2 years before construction of the STP units likely would commence; as a result, even if the WSEC project employed 1500 construction workers and 150 operations workers, a likely outcome is that WSEC construction would be declining just as construction of the first new STP unit would be increasing (WSEC 2009a). WSEC is in the vicinity of STP and would further alter the current viewshed. This would have a noticeable effect on the viewshed, but it would not be destabilizing.

In September 2008, Exelon Generation submitted a COL application to the NRC for two nuclear power units at a site in Victoria County, Texas, about 55 mi southeast of the STP site (Exelon 2008). However, the application was subsequently withdrawn and Exelon has since stated its intent to submit an Early Site Permit application in March 2010 (Exelon 2009). Cumulative impacts might occur from construction, preconstruction, and operation of new nuclear units at the previously proposed Victoria County Nuclear Station site if Exelon followed the construction schedule provided in its COL application. This schedule calls for peak construction activity in 2013 with 6526 workers onsite. However, even if the construction periods overlap to some extent, Victoria County Nuclear Station is not likely to significantly exacerbate the impacts of STP on Matagorda and Brazoria Counties. Because of lengthy commuting distances involved, it is unlikely that large numbers of Victoria County Nuclear Station workers would in-migrate to Matagorda or Brazoria Counties. Workers would likely prefer Victoria County with smaller numbers relocating to Calhoun and Jackson Counties, due to their more limited services. Construction workers already resident in Victoria County, however, could commute to the STP projects, reducing the need to import construction labor specifically for STP. Moreover, the property tax base represented by the WSEC (investment is projected at $2.5 billion) could be available when needed to pay for any public infrastructure improvements that would be required to support STP-related population growth. The Victoria County Nuclear Station would not add to physical or aesthetic and recreational impacts in Matagorda County because of its distance from STP.

The other major future energy projects shown in Table 7-1 are the Calhoun LNG terminal and the E.S. Joslin Power Plant Project, NuCoastal Power Holdings' proposed repowering project for a closed power plant. Both are about 25 mi west-southwest from the STP site near Port Lavaca. The LNG project would employ about 645 workers at peak activity, of whom an estimated 416 would be non-residents (FERC 2007). No employment information appears to be available on the repowering project. Taken together, these two projects likely would have noticeable but not destabilizing impacts on Calhoun County. The LNG project, if it overlapped with STP, could add population and socioeconomic impact on Matagorda County in addition to that of proposed Units 3 and 4. The NuCoastal project is expected to be completed by 2012 and is unlikely to exacerbate socioeconomic impacts of STP construction. Neither Calhoun County project would add to physical or aesthetic and recreational impacts because of their distance from STP.

During the preconstruction and prior to the construction phases of proposed Units 3 and 4, the existing barge slip would need to be rehabilitated through dredging and construction of bulk heading. The existing navigation channel in the Colorado River, which is approximately 200-ft wide and 12-ft deep, is dredged as-needed by the Corps. STPNOC has not included dredging of the navigation channel of the Colorado River for barge access as part of the proposed action. However, alterations to traffic patterns within the Colorado River during rehabilitation and dredging of the existing barge slip at the STP site may occur. In addition, a slight increase in barge traffic associated with the barging of heavy equipment may occur during the construction phase. This increase in barge traffic during construction would be temporary; no additional barge traffic is expected in association with the operation of proposed Units 3 and 4. Additional past and present actions within the geographic area of interest that contribute to barge traffic include the active Port of Bay City located approximately 8 mi upstream of STP. The Port of Bay City is a small barge terminal with a liquid cargo dock, a concrete dock, a low level heavy duty dock and a turning basin. Reasonably foreseeable future actions that may contribute to barge traffic on the Colorado River includes the construction of WSEC and the decommissioning of proposed Units 3 and 4. Based on its evaluation, the review team has concluded that the incremental impact of the proposed Units 3 and 4 on marine or recreational navigation when added to other past, present and reasonably foreseeable future actions within the geographic area of interest would be minor.

The remaining projects in the socioeconomic impact area (Table 7-1) are either already operational or part of general growth in the region. In either case they are included in the socioeconomic baseline discussed in Section 2.5 and are already included in the impacts assessments in Sections 4.5 and 5.4. Because the projects within the socioeconomic impact area identified in Table 7-1 would be consistent with applicable county plans and policies, the review team considers the cumulative socioeconomic impacts from the projects to be manageable, particularly over time.

The review team has considered the cumulative impacts of construction, preconstruction, and operation of Units 3 and 4 plus other past, present, and reasonably foreseeable future activities over the life of the two new units. Based on the above considerations, information provided by STPNOC, and the review team's independent review, the review team concludes that NRC-authorized construction of proposed Units 3 and 4 could make a temporary detectable adverse contribution to the cumulative effects associated with some socioeconomic issues under certain circumstances, and adverse socioeconomic impacts would be mostly confined to Matagorda County. Cumulative impacts on demography, traffic, housing availability, schools, and possibly emergency services such as police and fire protection staffing during construction would likely be MODERATE and adverse. It is unlikely that peak construction of the WSEC, Victoria County Nuclear Station and the two Port Lavaca projects would coincide. If the local community would have to absorb more than one of these projects at once, significant adverse cumulative impacts on schools, housing, and traffic in Matagorda County could occur. Mitigation may be warranted for these impacts, especially for schools in the county and traffic congestion near STP. Even with the cumulative population increases and additional facilities, there would not be significant changes in the character of offsite noise, offsite dust or offsite recreation opportunities in Matagorda County and these impacts would be SMALL.

Housing and schools may experience noticeable adverse cumulative impacts due to mismatches between demand and capacity early in the operations period if the identified projects coincide. In general, however, because even the combined population increases would be slight during the operations period, adverse socioeconomic cumulative impacts during operations would be SMALL, with no mitigation required. During operations, Matagorda County would experience LARGE beneficial increases in tax revenue as a result of STP Units 3 and 4, and this impact would be increased further by an operating WSEC. WSEC would noticeably change the viewshed in the vicinity of STP. The incremental contribution would be minimal from proposed Units 3 and 4 because the offsite view of the STP site would not change significantly given that existing Units 1 and 2 are currently within the viewshed. This results in a MODERATE and adverse cumulative aesthetic impact, and the incremental contribution from NRC-authorized construction would be SMALL and adverse. Because the cumulative project workforces living in Calhoun and Jackson and other nearby counties are likely to be relatively unnoticed and Brazoria County's population is large relative to projected population increases associated with all of the projects taken together, the cumulative impact on the regional economies and tax revenues would be beneficially SMALL to MODERATE in Calhoun County (the site of the two Port Lavaca plants), and beneficially SMALL in Jackson County, Brazoria County, and the remainder of the 50-mi region. The incremental contribution from NRC-authorized construction would be SMALL in Calhoun, Jackson, and Brazoria County.

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, there would be no disproportionate adverse impacts to minority or low-income populations from NRC-authorized construction, and therefore the environmental justice impacts from NRC-authorized construction would be SMALL. Similarly, as described in Section 5.5, there would be no disproportionate adverse impacts to minority or low-income populations from operations, and therefore the environmental justice impacts from operations would be SMALL.

The combined impacts from construction and preconstruction were described in Section 4.5 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable projects that could cause environmental justice impacts on minority and low-income populations. For this cumulative analysis, the general geographic area of interest is the 50-mi region described in Section 2.5.1, which is the area most likely to experience health effects (if any) and provide the workforce for proposed Units 3 and 4. This is the region for which census block groups were assessed. However, subsets of the area were considered based on the area likely to be both influenced by the particular impact of proposed Units 3 and 4. For example, the areas for which socioeconomic impacts were considered was limited to the four-county area expected to experience noticeable socioeconomic impacts from Units 3 and 4.

From an environmental justice perspective, there is a potential for minority and low-income populations to be disproportionately affected by environmental impacts. In Matagorda County, the review team found low-income, Black, Asian-Pacific Islander, Hispanic and aggregated minority populations that exceed the percentage criteria established in Section 2.6.1 for environmental justice analyses. Further, one of the Asian census block groups is within 10 mi of STP near Palacios.

The impact analyses in Chapters 4 and 5 are cumulative by nature. Past or current environmental justice impacts associated with activities listed in Table 7-1 already have been considered as part of the environmental justice baseline presented in Section 2.6 and there were no subsistence and cultural practices noted for any of the minority populations in the region that would make them vulnerable to environmental impacts of STP. Also, there were no offsite environmental impacts identified in Sections 4.5.1 and 5.5.1 that would affect any minority or low-income population, so STP would not have any offsite environmental impacts on minority and low-income populations, even if there were environmental impacts on these populations from the WSEC and the two energy projects identified at Port Lavaca. The review team considers the proposed Victoria County Nuclear Station is too far away from Matagorda County in particular to have any socioeconomic or health impacts in Matagorda County. Thus, there are no cumulative environmental impacts associated with building and operating of STP Units 3 and 4 beyond those already evaluated in Chapters 4 and 5 and no disproportionate environmental impacts on minority and low income populations.

Other reasonably foreseeable projects in the socioeconomic impact area (Table 7-1) would not likely contribute to additional environmental justice impacts through socioeconomic pathways. The review team found no unusual socioeconomic circumstances, resource dependencies, or cultural practices through which minority or low-income populations would be disproportionately and adversely affected. There could be general adverse socioeconomic impacts through increased traffic and crowding of schools in the event that WSEC and STP construction coincided, but such impacts would be be the same for all segments of the population because th review team did not find any evidence of unique characteristics or practices in the minority and low-income populations that may result in different impacts compared to the general population. The review team determined that the construction periods for the WSEC and STP Units 3 and 4 are unlikely to overlap, as described in Section 7.4.1. The cost of rental housing in Matagorda County might escalate if construction workers crowded into those counties, which would be more likely if WSEC and STP and the two Port Lavaca energy projects are being built at the same time. It is unlikely that the impact would disproportionately fall on the diffuse (i.e., unmapped) minority and low-income individuals in these counties since low-income rental housing is not the usual preference of high-income construction workers; rather, if rent increases happened, all population groups would be affected. However, the review team found no evidence of any unique characteristics or practices that would result in any minority or low-income population to be disproportionately affected by such rental increases. As a result, the review team concluded that there would be no disproportionate and adverse cumulative impact on minorities and low-income populations. Therefore, the cumulative environmental justice impacts of construction, preconstruction, and operation of proposed Units 3 and 4 and other past, present, and reasonably foreseeable projects would be SMALL.

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, impacts to cultural resources from NRC-authorized construction would be SMALL. As described in Section 5.6, the review team concluded that the impacts to cultural resources from operations are 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 mitigative actions would be determined by STPNOC in consultation with the Texas State Historic Preservation Office (SHPO). STPNOC has agreed to follow procedures if historic or cultural resources are discovered. These procedures are detailed in STPNOC's Addendum 5 to procedure No. OPGP03-ZO-0025 Rev. 12 (Unanticipated Discovery of Cultural Resources) (STPNOC 2008b); the procedure includes notification of the Texas Historical Commission.

The combined impacts from construction and preconstruction were described in Section 4.6 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable projects that could affect historical and cultural resources. Chapter 2 defines the physical area of potential effect (APE) for cultural resources, which is the geographic area of interest for the assessment of potential cumulative cultural resource impacts. In addition to the physical APE, a visual APE has been established as a geographic area consisting of a 1-mi radius from the proposed project footprint. These APEs are considered the geographic area of interest for this cumulative analysis. The cumulative impacts assessment considers the eligibility of historical properties for listing on the National Register of Historic Places. Coordination with the SHPO provides 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, Native American groups known collectively by the Europeans as the Karankawa, lived in the general area of the STP site during early Spanish and French Exploration. The French attempted to settle the Matagorda Bay area in 1685 and again in 1718, but neither was successful, largely due to conflict with the Karankawa Indians. True settlement of the area commenced when Stephen F. Austin obtained a grant from the Mexican government in 1821 to permit 300 American families to settle along the Colorado River. When an additional 3000 families were allowed to settle in the area in 1828, population increased rapidly. Matagorda

County was created in 1837, shortly after Texas gained its independence from Mexico. Farming in the Matagorda region concentrated on sugar and cotton production, and following the Civil War, cattle ranching.

Table 7-1 identifies other past, present and reasonably foreseeable projects and other actions considered in the cumulative analysis of the STP site. Projects within the geographic area of interest that may have a potential cumulative impact on cultural resources include continued operation, and decommissioning for STP Units 1 and 2, and transmission lines and future urbanization. Such projects could impact cultural resources if ground disturbing activities occur, or if new above-ground structures impact the visual APE. As described in chapter 2, regional settlement patterns suggest that prehistoric people lived along the Colorado River; however, few archaeological and cultural resource surveys have been conducted along the Colorado River to identify resources. The archaeological sites record search indicated that prehistoric sites have been located adjacent to the STP plant.

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from preconstruction, construction and operation of two new nuclear generating units on the STP site and from other projects would be SMALL. However, those activities related to transmission lines and urbanization have the potential to impact cultural resources within the APEs. Should these activities result in alterations to the cultural environment, then the impact could be greater.

7.6 Air Quality

The description of the affected environment in Section 2.9 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.7, the impacts of NRC-authorized construction activities on air quality impacts would be SMALL, and no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts of operations on air quality impacts would be SMALL and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction were described in Section 4.7 and determined to be SMALL. 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 contribute to cumulative impacts to air quality. For this cumulative analysis of criteria pollutants, the geographic area of interest is Matagorda County which is within the Metropolitan Houston-Galveston Intrastate Air Quality Control Region (40 CFR 81.38). Air quality attainment status for Matagorda County as set forth in 40 CFR 81.344

reflects the effects of past and present emissions from all pollutant sources in the region. Matagorda County is not out of attainment of any National Ambient Air Quality Standard.

The air quality impact of site development for proposed Units 3 and 4 would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. The WSEC project is located about 5 mi northeast of the STP site, but it is unlikely construction of the two projects would overlap because WSEC is scheduled to begin construction 2 years earlier than construction of proposed Units 3 and 4. If construction overlaps, it is likely that construction of WSEC would be declining as construction of Units 3 and 4 is increasing (WSEC 2008). There are no land uses or projects, including the WSEC, that would have emissions during site development that would, in combination with emissions from STP, result in degradation of air quality in the region.

Combustion equipment associated with the operation of STP Units 1 and 2 is similar to the equipment that would be associated with Units 3 and 4. Releases are intermittent and made at low levels with little or no vertical velocity. Because of the intermittent nature of the releases and the small quantities of effluents being released, the review team expects that the cumulative impacts of combustion product release associated with the four STP units would be negligible.

The WSEC is a proposed 1320-MW petroleum coke/bituminous-fired plant. Impacts from the emissions from similar plants are characterized as being clearly noticeable but not destabilizing in Section 9.2.2.1. Effluents from power plants such the WSEC are typically released through stacks and with significant vertical velocity. Other new industrial projects listed in Table 7-1 would have de minimis impacts. Given that these other projects would be subject to institutional controls, it is unlikely that the air quality in the region would degrade to the extent that the region is in nonattainment of National Ambient Air Quality Standards.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the GCRP, it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one third of the greenhouse gas emissions are the result of generating electricity and heat (Karl et al. 2009). This assessment is focused on greenhouse gas emissions.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7.1, 6.1.3, and 6.3. The review team concluded that the atmospheric impacts of the emissions associated of each aspect of building, operating and decommissioning a single plant are minimal. The review team also concludes that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single source or combination of greenhouse gas emission sources must be placed in geographic context:

- The environmental impact is global rather than local or regional
- The effect is not particularly sensitive to the location of the release point
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of greenhouse gases resident in the atmosphere, and
- The total number and variety of greenhouse gas emission sources is extremely large and are ubiquitous.

These points are illustrated in Table 7-2.

Table 7-2. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global Emissions	28,000,000,000[(a)]
United States	6,000,000,000[(a)]
1000 MW Nuclear Power Plant (including fuel cycle, 90 percent capacity factor)	400,000[(b)]
1000 MW Nuclear Power Plant (operations only, 90 percent capacity factor)	5000[(b)]
Average U. S. Passenger Vehicle[(c)]	5

(a) Source: EPA 2009g
(b) Source: Appendix I
(c) Source: FHWA 2006

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The GCRP report referenced above provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP report, the review team concludes that the national and worldwide cumulative impacts of greenhouse gas 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 greenhouse gas emissions of the proposed project.

Consequently, the review team recognizes that greenhouse gas emissions, including carbon dioxide, 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

Cumulative impacts to air quality resources are estimated based in the information provided by STPNOC and the review team's independent evaluation. Other past, present and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the STP site, other projects, and the WSEC would be noticeable but not destabilizing, principally as a result of the contribution of WSEC. STP and other projects listed in Table 7-1 would have de minimis impacts. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the STP 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 MODERATE. The incremental contribution of impacts on air quality resources from building and operating proposed Units 3 and 4 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

7.7 Nonradiological Health

The description of the affected environment in Section 2.10 serves as a baseline for nonradiological health. As described in Section 4.8, the impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted other than that described in STPNOC's ER. As described in Section 5.8, the nonradiological health impacts from operation of the proposed Units 3 and 4 would also be SMALL, and would warrant no further mitigation.

As described in Section 4.8, the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted other than that described in STPNOC's ER. 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 contribute to cumulative impacts to nonradiological health (Table 7-1). Based on the localized nature of nonradiological health impacts, the geographic area of interest for this cumulative impacts analysis includes projects within a 5-mi radius around the STP site; and for cumulative impacts associated with transmission lines, the geographic area of interest is the transmission system associated with the proposed Units 3 and 4 (as described in Section 2.2.2). These geographic areas are expected to encompass the areas where public and worker health could be influenced by the proposed project in combination with any other past, present or reasonably foreseeable future actions.

Cumulative Impacts

Current projects within the geographic areas of interest that could contribute to cumulative impacts for nonradiological health include the operation of STP Units 1 and 2, the Mouth of the Colorado River Project, operation of chemical and plastic manufacturing facilities (Equistar Chemicals LP Matagorda Facility, Celanese Ltd. Bay City Plant, Oxea Corp Bay City Plant), existing transmission lines, and existing urbanization. Reasonably foreseeable future projects in the geographic areas of interest that could contribute to cumulative impacts for nonradiological health include the WSEC and the LCRA-SAWS project, and potential future transmission line development and urbanization.

Preconstruction, construction, and operation activities that have the potential to impact the nonradiological health of the public and workers include: exposure to fugitive dust and vehicle emissions, occupational injuries, noise from construction and operation, exposure to etiological agents, exposure to electromagnetic fields (EMFs), and the transportation of construction materials and personnel to and from the STP site. There are no existing or future projects that could contribute to cumulative nonradiological health impacts of occupational injuries. Existing and potential development of new transmission lines could increase nonradiological health impacts from exposure to acute EMFs, however, as stated in Section 5.8.3, adherence to Federal criteria and State utility codes would create minimal cumulative nonradiological health impacts. With regard to chronic effects of EMFs, the scientific evidence on human health does not conclusively link extremely low frequency EMFs to adverse health impacts. Noise and vehicle emissions associated with current urbanization, three existing plastic and chemical manufacturing plants, current operations of STP Units 1 and 2, and the planned WSEC, could contribute to public nonradiological health impacts. However, as discussed in Sections 4.8 and 5.8, the proposed Units 3 and 4 contribution to these impacts would be temporary and minimal, and existing and future facilities would likely comply with local, State, and Federal regulations governing noise and emissions. Section 7.10.2 discusses cumulative nonradiological health impacts related to additional traffic on the regional and local highway networks leading to and from the STP site, and the review team determines that these impacts would be minimal.

In Section 5.8.1, the review team evaluated the health impacts of operating the existing STP Units 1 and 2 and two new proposed units at the STP site with regard to the ambient temperature of the MCR and the Colorado River, and the potential formation of thermophilic microorganisms, including those that can cause diseases (i.e., etiological agents). The evaluation indicated that operation of Units 3 and 4 would not likely increase the presence of etiological agents in the Colorado River. This is because the low frequency of discharge from the MCR would not be expected to encourage increased populations of thermophilic microorganisms, and the largest thermal plumes that could be generated would likely occur when river water conditions are not suitable for swimming or immersion. Furthermore, the low incidence of water-borne diseases in the geographic area of interest indicates that the public recreates in a manner that reduces their potential exposure to these organisms (TDSHS 2010).

Two reasonably foreseeable future projects, the WSEC and the LCRA-SAWS project, would use river water upstream of STP, and could reduce freshwater river flow and increase the ambient river water temperature (WSEC 2009b; TWDB 2006b). This cumulative effect on Colorado River conditions could be favorable for an increased presence of thermophilic microorganisms, and subsequently increase the risk of public exposure to etiological agents. However, based on the relatively low incidence rate of waterborne diseases from recreational water activities in Texas, cumulative impacts to nonradiological health from exposure to etiological agents in the Colorado River would likely be minimal (CDC 2009; TDSHS 2010).

The review team is also aware of the potential climate changes that could affect human health—a recent compilation of the state of knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed Units 3 and 4 include an increase in average temperature and a decrease in precipitation. Potential changes in water temperature and frequency of downpours could alter the presence of thermophilic microorganisms. While the changes that are attributed to climate change in these studies are not insignificant, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of water-borne diseases.

Cumulative impacts to nonradiological health are based on information provided by STPNOC and the review team's independent evaluation of impacts resulting from the building and operation of proposed Units 3 and 4, along with a review of potential impacts from other past, present, and reasonably foreseeable projects and urbanization located in the geographic area of interest. The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL, and that mitigation beyond what is discussed in Sections 4.8 and 5.8 would not be warranted. The review team does acknowledge that there is no conclusive link between EMF exposure and human health impacts.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.10 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 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 construction and preconstruction were described in Section 4.9 and determined to be SMALL. In addition to impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For this analysis, the geographic area of interest is the area within a 50-mi radius of the proposed Units 3 and 4. 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 geographic area of interest includes the existing operating STP Units 1 and 2, the Old Steam Generator Storage Facility, and the Onsite Staging Facility. STPNOC also plans to construct a Long Term Storage Facility to store replaced reactor vessel heads. Also, within the 50-mi radius of the site, there are likely to be hospitals and industrial facilities that use radioactive materials.

As stated in Section 2.11, STPNOC has conducted a radiological environmental monitoring program (REMP) around the STP site since 1986. The REMP measures radiation and radioactive materials from all sources, including the existing STP Units 1 and 2, hospitals, and industrial facilities. In 2008, the REMP detected concentrations of tritium in the MCR with maximum levels about 65 percent of the EPA drinking-water standard, which is 20,000 picocuries per liter (pCi/L) for tritium, and in monitoring and relief wells within the site boundary at about 28 percent of the EPA standard. Tritium would be expected to be released by Units 3 and 4 in addition to that released by Units 1 and 2. Because Units 1 and 2 are pressurized water reactors and the proposed Units 3 and 4 are ABWRs, the additional annual contribution of tritium to the MCR from Units 3 and 4 is estimated to be a small fraction of current releases from Units 1 and 2. For example, the last five years' annual effluent reports from STP (STPNOC 2005, 2006, 2007a, 2008a, 2009d) indicate that the annual average amount of tritium released from Units 1 and 2 was 2080 curies (Ci), with a standard deviation of about 460 Ci. Units 3 and 4 combined would annually release 16 Ci of tritium to the MCR, which is approximately 1 percent of the average release from Units 1 and 2. This amount is within the annual variation of the releases from Units 1 and 2.

As described in Section 4.9, the estimate of doses to construction workers during building of the proposed Units 3 and 4 are well within NRC annual exposure limits (i.e., 100 millirem) designed to protect the public health. This estimate includes exposure from Units 1 and 2, the Old Steam Generator Storage Facility, the Onsite Staging Facility and the planned Long Term Storage Facility. The estimate of doses to construction workers during building Unit 4 includes Unit 3 as a source of exposure. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the STP site are well below NRC regulatory limits and standards. In addition, the dose to the maximally exposed individual (MEI) from the existing Units and the proposed Units 3 and 4 at the STP site would be well within the EPA regulatory standard of 40 CFR Part 190. Also, based on results of the REMP and the estimates of doses from proposed Units 3 and 4 to biota given in Chapter 5.9, the NRC staff concludes that the cumulative radiological impact on biota would not be significant. The results of the REMP indicate that effluents and direct radiation from area hospitals and industrial facilities that use radioactive materials do not contribute measurably to the cumulative dose.

Currently, there are no other nuclear facilities planned within 50 mi of the STP site. The NRC, the U.S. Department of Energy, and the State of Texas 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 two new units, along with the existing units at STP and the influence of other man-made sources of radiation nearby would be SMALL, and no further mitigation would be warranted.

7.9 Postulated Accidents

As described in Section 5.11.4, the NRC staff concludes that the potential environmental impacts (risk) from a postulated accident from the operation of proposed Units 3 and 4 would be SMALL. Section 5.11 considers both design basis accidents (DBAs) and severe accidents.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the STP site would be SMALL for an ABWR. 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 an ABWR reactor at the STP 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 Units 3 and 4. The 50-mi radius was selected to cover any potential risk overlaps from 2 or more nuclear facilities. The only existing reactors within a 50-mi radius of the STP site are STP Units 1 and 2. However, a nuclear power plant has been proposed for a site near Victoria, Texas, approximately 55 mi from the STP site. If the Victoria plant were to be constructed and an accident were to occur at that facility, the consequences could potentially effect locations within the 50-mi radius of the STP site.

Table 5-18 and 5-19 in Section 5.11.2 provide comparisons of estimated risk for the proposed ABWR units at the STP site and current-generation reactors. The estimated population dose risk for the proposed ABWR units at the STP site is well below the 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). For existing plants within the geographic area of interest (STP Units 1 and 2), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR 51, Appendix B, Table B-1). It is expected that risks for any new reactors at the Victoria site would be well below the risks for current-generation reactors and meet the Commission’s safety goals. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the STP site likely would be SMALL and no further mitigation would be warranted.

7.10 Fuel Cycle, Transportation, and Decommissioning

The cumulative impacts related to the fuel cycle, radiological and nonradiological aspects of transportation, and facility decommissioning for the proposed site are described below.

7.10.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the impacts of the fuel cycle due to operation of proposed Units 3 and 4 would be SMALL. Fuel-cycle impacts would occur not only at the STP site but would also be scattered through other locations in the United States or, in the case of foreign-purchased uranium, in other countries.

In addition to fuel-cycle impacts from proposed Units 3 and 4, this cumulative analysis also considers fuel-cycle impacts from existing Units 1 and 2. There are no other nuclear power plants within 50 mi of the STP site. The fuel-cycle impacts of Units 1 and 2 would be similar to that of proposed Units 3 and 4. Per 10 CFR 51.51(a), the NRC staff concludes that impacts would be acceptable for the 1000-MW(e) reference reactor. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 would reduce 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. In Section 6.1, the NRC staff multiplied the values in Table S–3 by a factor of approximately three, to scale the impacts up from the 1000-MW(e) LWR model to address the fuel cycle impacts of proposed Units 3 and 4. Adding the fuel cycle impacts from Units 1 and 2 would increase the scaling to no more than a factor of five. Therefore, the NRC staff considers the cumulative fuel-cycle impacts of operating STP Units 3 and 4 to be SMALL.

7.10.2 Transportation

The description of the affected environment in Section 2.5.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the STP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, and 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 STP site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the STP 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 that other projects in the region could potentially increase nonradiological impacts. The most significant cumulative nonradiological impacts in the vicinity of the STP site would result from major construction projects, including the WSEC, Calhoun LNG Terminal, ES Joslin Power Plant Project, and highway improvement projects. The WSEC project is located about 5 mi northeast of the STP site, but it is unlikely construction of the two projects would overlap because WSEC is scheduled to begin construction 2 years earlier than construction of proposed Units 3 and 4. If construction overlaps, it is likely that construction of WSEC would be declining as construction of Units 3 and 4 is increasing (WSEC 2008). Consequently, interactions among construction traffic are unlikely to exacerbate congestion and potentially increase nonradiological transportation impacts. The other construction projects are more than 25 mi from the STP site, and therefore the traffic from these projects is not likely to interact with traffic associated with building and operating the STP site.

Traffic associated with the existing STP Units 1 and 2 and the WSEC could interact with traffic associated with proposed Units 3 and 4. However, STPNOC has identified mitigation measures designed to reduce traffic impacts in the vicinity of the STP site; these mitigation measures would also reduce traffic impacts to and from the WSEC. Traffic flow to and from operating facilities in the region would be of lesser importance because fewer workers and material shipments are needed to support operating facilities than major construction projects. The operating facilities with potential for cumulative nonradiological impacts include the Equistar Chemicals LP Matagorda Facility, Celanese Ltd Bat City Plant, Oxea Corp Bay City Plant, Texas Liquid Fertilizer Co. Point Comfort. As with the construction projects, the mitigation measures identified by STPNOC for the proposed new units would also mitigate traffic concerns and reduce the potential cumulative nonradiological impacts associated with operating facilities.

Finally, one park listed in Table 7-1, the Brazos Bend State Park, is located within the geographic area of interest. However, the park is located approximately 35 mi northeast of the STP site and no reasonably foreseeable potential park improvements have been identified. If potential improvements occur, they are generally of smaller scope and have lower resource and personnel requirements than constructing 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 STP site is a small fraction of the existing nonradiological impacts in Matagorda County, Texas. Mitigation measures designed to improve traffic flow at the STP site have been identified by STPNOC (2009a). Based on the magnitude of nuclear power plant construction relative to the other construction activities listed above, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed new reactor at the STP site would be SMALL and no further mitigation is warranted.

As described in Section 6.2, the NRC staff concludes that impacts transporting unirradiated fuel to the STP site and irradiated fuel and radioactive waste from the STP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis also 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 STP site.

Historically, the radiological impacts to the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the STP site have been primarily associated with shipments of fuel and waste to and from the existing STP Units 1 and 2. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the STP site, 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 region of interest. The past, present, and reasonably foreseeable impacts in the region surrounding the STP site are a small fraction of the impacts from natural background radiation.

As discussed in Section 6.2, the addition of the proposed new units to the existing STP site would result in the need for additional unirradiated nuclear fuel and generation of additional spent nuclear fuel and radioactive waste. The impacts of transporting this fuel and radioactive waste to and from the STP site would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes from current-generation reactors presented in Table S-4 of 10 CFR 51.52, which the NRC staff considers to be acceptable for the 1000-MW(e) reference reactor. Advances in reactor technology and operations since the development of Table S-4 would reduce environmental impacts relative to the values in Table S-4. For example, fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel requirements. This leads to fewer unirradiated and spent fuel shipments than the 1000 MW(e) reference reactor discussed in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capabilities would result in fewer shipments of spent fuel to offsite storage or disposal facilities.

Therefore, the NRC staff considers the cumulative radiological and nonradiological transportation impacts of operating the proposed new reactors at the STP site to be SMALL and no further mitigation would be warranted.

7.10.3 Decommissioning

As discussed in Section 6.3, the environmental impacts from decommissioning the proposed Units 3 and 4 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 STP site. In addition to the proposed Units 3 and 4, the only other nuclear power plants within this geographic area of interest are the existing STP Units 1 and 2. The impacts of decommissioning nuclear power plants are bounded by the assessment in Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities.* In that document, 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). In addition, the NRC staff concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be SMALL. Therefore, the cumulative impacts for the STP site would be SMALL, and further mitigation would not be warranted.

7.11 Conclusions and Recommendations

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of two additional nuclear units at the STP site together with other past, present, and reasonably foreseeable future actions. 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 were assessed. This assessment included the impacts of construction and operation for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning impacts 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 on the following page summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although there could be MODERATE or LARGE impacts for some resources, as discussed below.

Cumulative land-use impacts in the geographic area of interest would be MODERATE, primarily due to the proposed WSEC project and associated transmission lines, future urbanization, and GCC. The incremental impact from NRC-authorized activities on land use would be SMALL because the affects to land use from building and operating Units 3 and 4 would be minimal.

Table 7-3. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Units 3 and 4

Resource Category	Impact level
Land-Use	MODERATE
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
Socioeconomic	
Physical Impacts	SMALL to MODERATE
Demography	SMALL to MODERATE
Taxes and Economy	SMALL to LARGE (beneficial)
Infrastructure and Community Service	SMALL to MODERATE
Environmental Justice	SMALL
Historic and Cultural Resources	SMALL
Air Quality	MODERATE
Nonradiological Health	SMALL
Radiological Health	SMALL
Severe Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

The cumulative surface water use impacts would be MODERATE, primarily due to the impacts from existing and reasonably foreseeable projects that use surface water in Region K. The incremental impacts from the proposed action and NRC-authorized activities would be SMALL and not noticeably alter water use in the Region. The cumulative surface water quality impacts in the geographic area of interest would be MODERATE, primarily due to point and nonpoint sources that have resulted in the impairment of the Colorado River, which is currently on the State's 303(d) list. The incremental impact from NRC-authorized activities would be SMALL because such impacts would be localized and temporary.

Cumulative terrestrial ecology impacts in the geographic area of interest would be MODERATE, primarily due to detectable alteration of habitat, loss of habitat, increased fragmentation, and increased risk of collision and electrocution in the Central Migratory Corridor from urbanization, new transmission lines associated with WSEC and other energy projects, and climate change.

The incremental impact from NRC-authorized activities on terrestrial ecology would be SMALL because the contribution from STP Units 3 and 4 to these impacts is minimal.

The review team concludes that cumulative impacts from past, present, and reasonably foreseeable actions to aquatic resources in the geographic area of interest would be MODERATE. Future development of industries that compete for water in the Colorado River as well as management of water budgets across the State of Texas through diversion projects like LCRA-SAWS project would likely affect aquatic resources in the lower Colorado River. Direct and indirect anthropogenic stressors, including GCC, in the geographic area of interest would cumulatively lead to effects on the aquatic communities that would be noticeable. The incremental contribution of impacts to aquatic resources in onsite water bodies from the operation of the proposed Units 3 and 4, in the Colorado River from operation of the RMPF and the discharge structure, and in offsite water bodies from maintenance and operation of the transmission corridors would be SMALL although under certain conditions, the thermal plume from the discharge of MCR water into the Colorado River could affect passage and potentially survival of some aquatic organisms in the river.

For socioeconomics, cumulative impacts on taxes and economy would be SMALL to LARGE and beneficial. In Matagorda County, the cumulative impacts would be LARGE and beneficial once both Units 3 and 4 and WSEC are operational. The incremental impact on taxes and the economy from NRC-authorized activities in Matagorda County would be MODERATE and beneficial. In Calhoun County, the cumulative impacts on taxes and the economy would be SMALL to MODERATE and beneficial primarily due to the proposed Port Lavaca plants. The incremental impact on taxes and the economy from NRC-authorized activities in Calhoun County would be SMALL and beneficial. The cumulative impacts on demography and infrastructure (roads, housing, public services, and education) in Matagorda County would be MODERATE. Although NRC-authorized activities would contribute to noticeable alterations in demography and infrastructure, they would not likely result in destabilization of either resource. The cumulative aesthetics impacts would be MODERATE, principally because WSEC would noticeably change the viewshed in the vicinity of STP. The incremental contribution from NRC-authorized activities would be SMALL because the offsite view of the STP site would not change significantly with the addition of Units 3 and 4 given that Units 1 and 2 are currently within this viewshed.

Cumulative air quality impacts in the geographic area of interest would be MODERATE, primarily due to national and world-wide impacts of greenhouse gases emissions and due to the impacts on criteria pollutants from the WSEC project. The incremental impacts from NRC-authorized activities would be SMALL, since such impacts would be minimal.

The Galveston District of the Corps has developed a detailed approach to assessing the cumulative effects of a proposed action when considered with other past, present, and reasonably foreseeable projects in the geographic area of interest for each resource. This approach was developed by the Corps to comply with the findings of several Federal court cases including: Fritiofson v. Alexander; Stewart v. Potts; Lafitte's Cove at Pirates' Beach Nature Society v. U.S. Army Corps of Engineers; and Galveston Beach to Bay Preserve v. U.S. Army Corps of Engineers. This method is in accordance with CEQ's regulations (40 CFR 1500-1508) and the CEQ's guide to Considering Cumulative Effects Under the National Environmental Policy Act. Appendix J provides a table indicating which resources were considered in the Corps' Cumulative Effects Assessment, which resources were included in this draft EIS and the sections of this draft EIS that detail the Corps considerations, and identifies which resources in the table were not considered in this draft EIS.

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10. SUPPLEMENTARY NOTES

Docket Nos. 52-012, 52-013

11. ABSTRACT *(200 words or less)*

This environmental impact statement (EIS) has been prepared in response to an application submitted by STP Nuclear Operating Company (STPNOC) to the U.S. Nuclear Regulatory Commission (NRC) for combined licenses (COLs) for Units 3 and 4 at the South Texas Project Electric Generating Station (STP) site in Matagorda County, Texas. This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action and mitigation measures for reducing and avoiding adverse impacts.

The NRC staff's preliminary recommendation to the Commission, considering the environmental aspects of the proposed action, is that the COLs be issued. This recommendation is based on (1) the COL application, including the Environmental Report submitted by STPNOC; (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 mitgation measures identified in the ER and this EIS.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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