U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1437
Supplement 56
Volume 1

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 56

Regarding Fermi 2 Nuclear Power Plant

Draft Report for Comment

Chapters 1 to 8

Office of Nuclear Reactor Regulation

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Regarding Fermi Nuclear Power Plant

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Chapters 1 to 8

Manuscript Completed: October 2015
Date Published: October 2015

Office of Nuclear Reactor Regulation

Proposed Action	Issuance of renewed operating license NPF-43 for Fermi 2 Nuclear Power Plant, in Frenchtown Township, Michigan
Type of Statement	Draft Supplemental Environmental Impact Statement
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Comments	Any interested party may submit comments on this supplemental environmental impact statement. Please specify NUREG–1437, Supplement 56, draft, in your comments. Comments must be received by December 28, 2015. Comments received after the expiration of the comment period will be considered if it is practical to do so, but the NRC cannot give assurance of consideration of late comments. Comments may be submitted electronically by searching for docket ID NRC-2014-0109 at the Federal rulemaking Web site, http://www.regulations.gov. Comments also may be mailed to the following address: Chief, Rules, Announcements, and Directives Branch Division of Administrative Services Office of Administration Mail Stop: OWFN-12 H08 U.S. Nuclear Regulatory Commission Washington, DC 20555-0001 Please be aware that any comments that you submit to the NRC will be considered a public record and entered into the Agencywide Documents Access and Management System. Do not provide information you would not want to be publicly available.

COVER SHEET

Responsible Agency: U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. There are no cooperating agencies involved in the preparation of this document.

Title: *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 56, Regarding Fermi 2 Nuclear Power Plant, Draft Report for Comment* (NUREG–1437). Fermi 2 is located in Frenchtown Township, Michigan.

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ABSTRACT

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by DTE Electric Company (DTE), to renew the operating license for the Fermi 2 Nuclear Power Plant for an additional 20 years.

This SEIS includes the preliminary analysis that evaluates the environmental impacts of the proposed action and the alternatives to the proposed action. Alternatives considered include: (1) natural gas combined-cycle (NGCC), (2) coal-integrated gasification combined-cycle (IGCC), (3) new nuclear power generation, (4) a combination of NGCC, wind, and solar generation, and (5) the no-action alternative (i.e., no renewal of the license).

The U.S. Nuclear Regulatory Commission (NRC) staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Fermi 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following factors:

- the analysis and findings in NUREG–1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Volumes 1 and 2;
- the Environmental Report submitted by DTE;
- consultation with Federal, state, tribal, and local government agencies;
- the NRC staff's independent environmental review; and
- consideration of public comments received during the scoping process.

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BACKGROUND

By letter dated April 24, 2014, DTE Electric Company (DTE) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to issue a renewed operating license for Fermi 2 Nuclear Power Plant (Fermi 2) for an additional 20-year period.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 51.20(b)(2), the renewal of a power reactor operating license requires preparation of an environmental impact statement (EIS) or a supplement to an existing EIS. In addition, 10 CFR 51.95(c) states that, in connection with the renewal of an operating license, the NRC shall prepare an EIS, which is a supplement to the Commission's NUREG-1437, *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants*.

Upon acceptance of DTE's application, the NRC staff began the environmental review process described in 10 CFR Part 51 by publishing a Notice of Intent to prepare a supplemental environmental impact statement (SEIS) and to conduct scoping. In preparation of this SEIS for Fermi 2, the NRC staff performed the following:

- conducted public scoping meetings on July 24, 2014, in Monroe, Michigan;
- conducted a site audit at Fermi 2 from September 8, 2014, to September 11, 2014;
- reviewed DTE's Environmental Report (ER) and compared it to the GEIS;
- consulted with Federal, state, tribal, and local agencies;
- conducted a review of the issues following the guidance set forth in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan for Operating License Renewal (NUREG-1555 Supplement 1, Revision 1, Final Report)*; and
- considered public comments received during the scoping process.

PROPOSED ACTION

DTE initiated the proposed Federal action (i.e., issuance of a renewed power reactor operating license) by submitting an application for license renewal of Fermi 2 for which the existing license (NPF-43) expires on March 20, 2025. The NRC's Federal action is to decide whether to renew the license for an additional 20 years. The regulation at 10 CFR 2.109 states that, if a licensee of a nuclear power plant files an application to renew an operating license at least 5 years before the expiration date of that license, the existing license will not be deemed to have expired until the safety and environmental reviews are completed and until the NRC has made a final decision on whether to deny the application or to issue a renewed license for the additional 20 years.

PURPOSE AND NEED FOR ACTION

The purpose and need for the proposed action (issuance of renewed license) is to provide an option that allows for power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decisionmakers, such as states, operators, and, where authorized, Federal agencies (other than the NRC). This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954, as amended, or findings in the National Environmental Policy Act of 1969, as amended, environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions as to whether a particular nuclear power plant should continue to operate.

ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL

The SEIS evaluates the potential environmental impacts of the proposed action. The environmental impacts from the proposed action are designated as SMALL, MODERATE, or LARGE. As established in the GEIS, Category 1 issues are those that meet all of the following criteria:

The environmental impacts associated with the issue are determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal.

Mitigation of adverse impacts associated with the issue is considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

> 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.

For Category 1 issues, no additional site-specific analysis is required in this SEIS unless new and significant information is identified. Chapter 4 of this SEIS presents the process for identifying new and significant information. Site-specific issues (Category 2) are those that do not meet one or more of the criteria for Category 1 issues; therefore, an additional site-specific review for these nongeneric issues is required, and the results are documented in the SEIS.

Neither DTE nor the NRC identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. This conclusion is supported by the NRC staff's review of the applicant's ER and other documentation relevant to the applicant's activities, the public scoping process and substantive comments raised, and the findings from the environmental site audit conducted by the NRC staff. Therefore, the NRC staff relied upon the conclusions of the GEIS for all Category 1 issues applicable to Fermi 2.

Table ES-1 summarizes the Category 2 issues relevant to Fermi 2 and the NRC staff's findings related to those issues. If the NRC staff determined that there were no Category 2 issues applicable for a particular resource area, the findings of the GEIS, as documented in Appendix B to Subpart A of 10 CFR Part 51, are incorporated for that resource area.

Table ES–1. Summary of NRC Conclusions Relating to Site-Specific Impacts of License Renewal

Resource Area	Relevant Category 2 Issues	Impacts
Groundwater Resources	Radionuclides released to groundwater	SMALL
Terrestrial Resources	Effects on terrestrial resources (noncooling system impacts)	SMALL
Special Status Species and Habitats	Threatened, endangered, and species and essential fish habitat	No effect[a]
Historic and Cultural Resources	Historic and cultural resources	No adverse effect[b]
Human Health	Electric shock hazards	SMALL
Environmental Justice	Minority and low-income populations	See note below[c]
Cumulative Impacts	Air Quality and Noise	SMALL
	Geology and Soils	SMALL
	Water Resources	SMALL to MODERATE
	Terrestrial Ecology	MODERATE to LARGE
	Aquatic Resources	LARGE
	Historic and Cultural Resources	SMALL
	Socioeconomic	SMALL to LARGE
	Human Health	SMALL
	Environmental Justice	See note below[c]
	Waste Management	SMALL
	Global Climate Change	MODERATE

[a] For Federally protected species, the NRC reports the effects from continued operation of Fermi 2 during the license renewal period in terms of its Endangered Species Act of 1973, as amended, findings of “no effect,” “may effect, but not likely to adversely effect,” or “may affect, and is likely to adversely affect.”

[b] The National Historic Preservation Act of 1966, as amended, requires Federal agencies to consider the effects of their undertakings on historic properties.

[c] There would be no disproportionately high and adverse impacts to minority and low-income populations and subsistence consumption from continued operation of Fermi 2 during the license renewal period and from cumulative impacts.

SEVERE ACCIDENT MITIGATION ALTERNATIVES

Since severe accident mitigation alternatives (SAMAs) have not been previously considered in an environmental impact statement or environmental assessment for Fermi 2, 10 CFR 51.53(c)(3)(ii)(L) requires DTE to submit, with the ER, a consideration of alternatives to mitigate severe accidents. SAMAs are potential ways to reduce the risk or potential impacts of uncommon, but potentially severe accidents. SAMAs may include changes to plant components, systems, procedures, and training.

The NRC staff reviewed DTE’s ER evaluation of potential SAMAs and determined whether the identified potentially cost-beneficial SAMAs are subject to aging management. Because the potential cost-beneficial SAMAs are associated with procedure changes, new hardware to improve a manual action, and a new structure between switchgear rooms, the NRC staff determined that these SAMAs do not relate to managing the effects of aging during the period of extended operation. Therefore, the potentially cost-beneficial SAMAs identified need not be implemented as part of the license renewal, pursuant to 10 CFR Part 54.

ALTERNATIVES

The NRC staff considered the environmental impacts associated with alternatives to license renewal. These alternatives include other methods of power generation, as well as not renewing the Fermi 2 operating license (the no-action alternative). The NRC staff considered the following feasible and commercially viable replacement power alternatives:

- natural gas combined-cycle (NGCC);
- coal-integrated gasification combined-cycle (IGCC);
- new nuclear power; and
- a combination of NGCC, wind, and solar power.

The NRC staff initially considered a number of additional alternatives for analysis as alternatives to the license renewal of Fermi 2. The NRC staff later dismissed these alternatives because of technical, resource availability, or commercial limitations that currently exist and that the NRC staff believes are likely to continue to exist when the current Fermi 2 licenses expire. The no-action alternative and the effects it would have were also considered by the NRC staff.

Where possible, the NRC staff evaluated potential environmental impacts for these alternatives located at both the Fermi 2 site and some other unspecified alternate location. The NRC staff considered the following alternatives, but dismissed them:

- energy conservation and energy efficiency,
- solar power,
- wind power,
- biomass power,
- hydroelectric power,
- wave and ocean energy,
- fuel cells,
- delayed retirement,
- geothermal power,
- municipal solid waste,
- petroleum-fired power,
- supercritical pulverized coal, and
- purchased power.

The NRC staff evaluated each alternative using the same resource areas that were used in evaluating impacts from license renewal.

PRELIMINARY RECOMMENDATION

The NRC staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Fermi 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following:

- the analyses and findings in the GEIS;
- the ER submitted by DTE;
- the NRC staff's consultation with Federal, state, tribal, and local agencies;
- the NRC staff's independent environmental review; and
- the NRC staff's consideration of public comments received during the scoping process.

ABBREVIATIONS AND ACRONYMS

ac	acre(s)
AC	alternating current
ACHP	Advisory Council on Historic Preservation
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954 (as amended)
ALARA	as low as is reasonably achievable
ANS	American Nuclear Society
APE	averted public exposure
APE	area of potential effect
AQCR	Air Quality Control Region
ASLB	Atomic Safety and Licensing Board (NRC)
ASME	American Society of Mechanical Engineers
ATWS	anticipated transient(s) without scram
AWEA	American Wind Energy Association
BGEPA	Bald and Golden Eagle Protection Act of 1940, as amended
Black and Veatch	Black & Veatch Corporation
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BOEM	Bureau of Ocean Energy Management
BWR	boiling water reactor
°C	degrees Celsius
CAA	Clean Air Act
CAES	compressed air energy storage
CCS	carbon capture and storage
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CET	containment event tree
CFR	*Code of Federal Regulations*
cfs	cubic foot (feet) per second
cm	centimeter
CNWR	Center for Nuclear Waste Regulatory Analysis
CO	carbon monoxide

CO_2	carbon dioxide
CO_2/MWh	carbon dioxide per megawatt hour
COL	combined license
Compact	2008 Great Lakes–St. Lawrence River Basin Water Resources Compact
CSPAR	Cross-State Air Pollution Rule
CWA	Clean Water Act
CWR	circulating water reservoir
CWS	circulating water system
CZMA	Coast Zone Management Act of 1972
dB	decibels
dBA	decibel(s) on the A-weighted scale
DBA	design-basis accident
DECo	Detroit Edison Company
DBH	diameter at breast height
DOE	U.S. Department of Energy
DRIWR	Detroit River International Wildlife Refuge
DSIRE	Database of State Incentives for Renewables and Efficiency
DSM	demand-side management
DTE	DTE Electric Company
Ducks Unlimited	Ducks Unlimited, Inc.
DWCA	Detroit Wayne County Airport
ECCS	emergency core cooling system
EDG	emergency diesel generator
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPT	Ephemeroptera-Plecoptera-Trichoptera index
EPZ	emergency planning zone
ER	Environmental Report
ERC	Energy Recovery Council

ESA	Endangered Species Act of 1973, as amended
ESBWR	economic simplified boiling water reactor
°F	degrees Fahrenheit
FDC	floor drain collector
FDCT	floor drain collector tank
FEIS	final environmental impact statement
Fermi 2	Fermi, Unit 2
Fermi 3	Fermi, Unit 3
FES-C	final environmental statement–construction
FES-O	final environmental statement–operation
FIVE	fire-induced vulnerability evaluation
FLIGHT	Facility Level Information on Green House Gases Tool
FR	*Federal Register*
FRN	*Federal Register* Notice
ft	foot (feet)
ft^3	cubic foot (feet)
FWS	U.S. Fish and Wildlife Service
g C_{eq}/kWh	gram(s) of carbon equivalent per kilowatt-hour
gal	gallon(s)
GEIS	generic environmental impact statement
GI	generic issue
GL	generic letter
GLC	Great Lakes Commission
gpm	gallon(s) per minute
GSW	general service water
ha	hectare(s)
HCLPF	high confidence in low probability of failure
HFO	high winds, floods, and other
HRA	human reliability analysis
HRSG	heat recovery steam generator
IEA	International Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
IGCC	integrated gasification combined-cycle
in.	inch(es)
IFSI	independent spent fuel storage installation

IPE	individual plant examination
IPEEE	individual plant examination(s) of external events
ISLOCA	interfacing-systems loss-of-coolant accident
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
kph	kilometer(s) per hour
kV	kilovolt(s)
kW	kilowatt(s)
$kWh/m^2/d$	kilowatt hours per square meter per day
L	liter(s)
LaMP	(Lake Erie) Lakewide Management Plan Work Group
L_{DN}	day-night sound intensity level
L_{EQ}	equivalent sound intensity level
L_n	statistical sound level
lb	pound(s)
LERF	large early release frequency
LLMW	low-level mixed waste
LOCA	loss-of-coolant accident
LOOP	loss(es) of offsite power
Lpd	liter(s) per day
L/min	liter(s) per minute
LRA	license renewal application
m/s	meter(s) per second
m^3	cubic meter(s)
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second
m^3/y	cubic meters per year
MAAP	Modular Accident Analysis Program
MAC	Michigan Administrative Code
MACCS2	MELCOR Accident Consequence Code System 2
MCPDC	Monroe County Planning Department and Commission
MACR	maximum averted cost risk
MATS	Mercury and Air Toxics Standards
MCL	Michigan Compiled Laws

MCR	main control room
MDEQ	Michigan Department of Environmental Quality
MDCH	Michigan Department of Community Health
MDHS	Michigan Department of Human Services
MDNR	Michigan Department of Natural Resources
mgd	million gallons per day
mgy	million gallons per year
mGy	milligray
mi	mile(s)
mi^2	square mile(s)
MIOSHA	Michigan Occupational Safety and Health Administration
MISO	Midcontinent Independent System Operator
mm	millimeter
MNFI	Michigan Natural Features Inventory
MOA	Memorandum of Agreement
mph	mile(s) per hour
mrad	millirad
mrem	millirem
MSA	Magnuson–Stevens Fishery Conservation and Management Act, as amended through 2006
MSL	mean sea level
MSUE	Michigan State University Extension
mSv	millisievert
MUR	measurement uncertainty recapture
MW	megawatt(s)
MWe	megawatt(s) electric
MWh	megawatt hour(s)
MWt	megawatt(s) thermal
NAAQS	National Ambient Air Quality Standards
NASS	National Agricultural Statistics Service (U.S. Department of Agriculture)
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NCES	National Center for Education Statistics
NEI	Nuclear Energy Institute

NEPA	National Environmental Policy Act of 1969, as amended
NESC	National Electrical Safety Code
NETL	National Energy Technology Laboratory
NGCC	natural gas combined-cycle
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service (National Oceanic and Atmospheric Administration)
NO_2	nitrogen dioxide
NO_x	nitrogen oxide(s)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NREPA	Michigan’s Natural Resources and Environmental Protection Act 451 of 1994, as amended
NRR	Nuclear Reactor Regulation, Office of (NRC)
NSR	New Source Review
O_3	ozone
ODCM	Offsite Dose Calculation Manual
ODNR	Ohio Department of Natural Resources
OECR	offsite economic cost risk
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OSSF	onsite storage facility
OW	open water
pCi/L	picocurie(s) per liter
Pb	lead
PDR	population dose risk
PDS	plant damage state
PEIS	programmatic environmental impact statement
PEM	palustrine emergent marsh
PFO	palustrine forested

PHAC	Public Health Agency of Canada
P-IBI	Planktonic Index of Biotic Integrity
PM	particulate matter
PRA	probabilistic risk assessment
PRE	principal residence exemption
PSDAR	post-shutdown decommissioning activities
PSS	palustrine scrub-shrub
PTS	post-treatment system
PV	photovoltaic
radwaste	radioactive waste
RAI	request(s) for additional information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
rem	roentgen equivalent(s) man
REMP	Radiological Environmental Monitoring Program
RESA	(Wayne) Regional Educational Service Agency RHR (residual heat removal)
ROI	region(s) of influence
ROW	right-of-way(s)
RPHP	Radiation and Public Health Project
RPS	reactor protection system
RPV	reactor pressure vessel
RRW	risk reduction worth
SAMA	severe accident mitigation alternative
SAR	Safety Analysis Report
SBO	station blackout
SCPC	supercritical pulverized coal
SCR	selective catalytic reduction
SEIS	supplemental environmental impact statement
SEMCOG	Southeast Michigan Council of Government
SER	safety evaluation report
SESC	Soil Erosion and Sediment Control (Michigan
SHPO	State Historic Preservation Office
SMA	seismic margin assessment
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)

SSC	structure(s), system(s), and component(s)
SSEL	Safe Shutdown Equipment List
Sv	sievert(s)
syngas	synthesis gas
TAC	technical assignment control
TEEIC	Tribal Energy and Environmental Information Clearinghouse
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
UFSAR	updated final safety analysis report
USGRCP	U.S Global Change Research Program
USGS	U.S. Geological Survey
µm	micrometer
WAPA	Western Area Power Administration
WCS	waste collector subsystem
WHC	Wildlife Habitat Council
WM	wooded marsh

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq., herein referred to as NEPA). The regulations at 10 CFR Part 51 require the preparation of an environmental impact statement for issuance or renewal of a nuclear power plant operating license.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), specifies that licenses for commercial power reactors can be granted for up to 40 years. The NRC's regulations in 10 CFR 54.31 allow for an option to renew a license for up to an additional 20 years. The initial 40-year licensing period was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility.

The decision to seek a license renewal rests entirely with nuclear power facility owners and, typically, is based on the facility's economic viability and the investment necessary to continue to meet NRC safety and environmental requirements. The NRC makes the decision to grant or deny license renewal based on whether the applicant has demonstrated that the environmental and safety requirements in the agency's regulations can be met during the period of extended operation.

1.1 Proposed Federal Action

DTE Electric Company (DTE) initiated the proposed Federal action by submitting an application for license renewal of Fermi 2 Nuclear Power Plant (Fermi 2), for which the existing license (NPF-43) expires on March 20, 2025. The NRC's Federal action is to decide whether to renew the license for an additional 20 years.

1.2 Purpose and Need for Proposed Federal Action

The purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by other energy-planning decisionmakers. This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review required by the Atomic Energy Act or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application (LRA), the NRC does not have a role in the energy-planning decisions of state regulators and utility officials as to whether a particular nuclear power plant should continue to operate.

1.3 Major Environmental Review Milestones

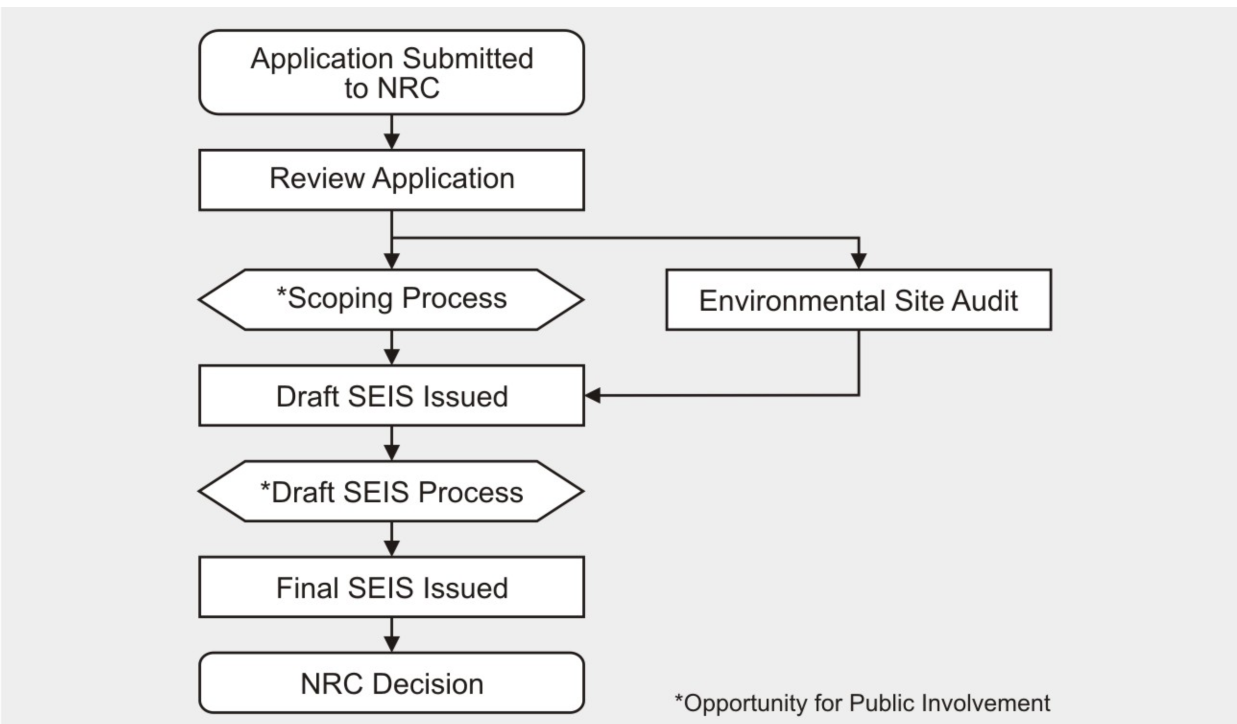
DTE submitted an Environmental Report (ER) (DTE 2014b) as part of its LRA (DTE 2014a) in April 2014. After reviewing the LRA and ER for sufficiency, the NRC staff published a *Federal Register* (FR) Notice of Acceptability and Opportunity for Hearing (79 FR 34787) on June 18, 2014. Then, on June 30, 2014, the NRC published another notice in the *Federal Register* (79 FR 36837) on the intent to conduct scoping, thereby beginning the 60-day scoping period.

Two public scoping meetings were held on July 24, 2014, in Monroe, Michigan (NRC 2014a). A report entitled, "Environmental Impact Statement, Scoping Process, Summary Report," presents the comments received during the scoping process (NRC 2015). The scoping process summary report presents NRC responses to comments that the NRC staff considered to be outside the scope of the environmental license renewal review. Appendix A of this supplemental environmental impact statement (SEIS) presents the public comments considered to be within the scope of the environmental license renewal review and the NRC responses to those comments.

To independently verify information provided in the ER, the NRC staff conducted a site audit at Fermi 2 in September 2014. During the site audit, the NRC staff met with plant personnel, reviewed specific documentation, toured the facility, and met with interested local agencies. A summary of that site audit and a list of the attendees are contained in “Summary of Site Audit in Support to the Environmental Review of the License Renewal Application for Fermi 2 (TAC No. MF4064)” that was sent to DTE by letter dated October 15, 2014 (NRC 2014b).

Upon completion of the scoping period and site audit, the NRC staff compiled its findings in this draft SEIS. This document is made available for public comment for 45 days. During this time, the NRC staff will host public meetings and collect public comments. Based on the information gathered, the NRC staff will amend the draft SEIS findings, as necessary, and publish the final SEIS. Figure 1–1 shows the major milestones of the NRC’s LRA environmental review.

Figure 1–1. Environmental Review Process



The NRC has established a license renewal process that can be completed in a reasonable period of time with clear requirements to ensure safe plant operation for up to an additional 20 years of plant life. The NRC staff conducts the safety review simultaneously with the environmental review. The NRC staff documents the findings of the safety review in a safety evaluation report. The findings in the SEIS and the safety evaluation report are both factors in the NRC’s decision to either grant or deny the issuance of a renewed license.

1.4 Generic Environmental Impact Statement

The NRC staff performed a generic assessment of the environmental impacts associated with license renewal to improve the efficiency of its license renewal review. NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) (NRC 1996, 1999, 2013), documented the results of the NRC staff's systematic approach to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. The NRC staff analyzed in detail and resolved those environmental issues that could be resolved generically in the GEIS. The GEIS originally was issued in 1996, Addendum 1 to the GEIS was issued in 1999, and Revision 1 to the GEIS was issued in 2013. Unless otherwise noted, all references to the GEIS include the GEIS, Addendum 1, and Revision 1.

The GEIS establishes separate environmental impact issues for the NRC staff to independently verify. Of these issues, the NRC staff determined that some issues are generic to all plants (Category 1). Other issues do not lend themselves to generic consideration (Category 2 or uncategorized). The NRC staff evaluated these issues on a site-specific basis in the SEIS. Appendix B to Subpart A of 10 CFR Part 51 provides a summary of the NRC staff findings in the GEIS.

For each potential environmental issue in the GEIS the NRC staff:

- describes the activity that affects the environment,
- identifies the population or resource that is affected,
- assesses the nature and magnitude of the impact on the affected population or resource,
- characterizes the significance of the effect for both beneficial and adverse effects,
- determines whether the results of the analysis apply to all plants, and
- considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance for impacts was established using the Council on Environmental Quality terminology for "significant." The NRC established three levels of significance for potential impacts—SMALL, MODERATE, and LARGE, as defined below.

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.

> **Significance** indicates the importance of likely environmental impacts and is determined by considering two variables: **context** and **intensity**.
>
> **Context** is the geographic, biophysical, and social context in which the effects will occur.
>
> **Intensity** refers to the severity of the impact in whatever context it occurs.

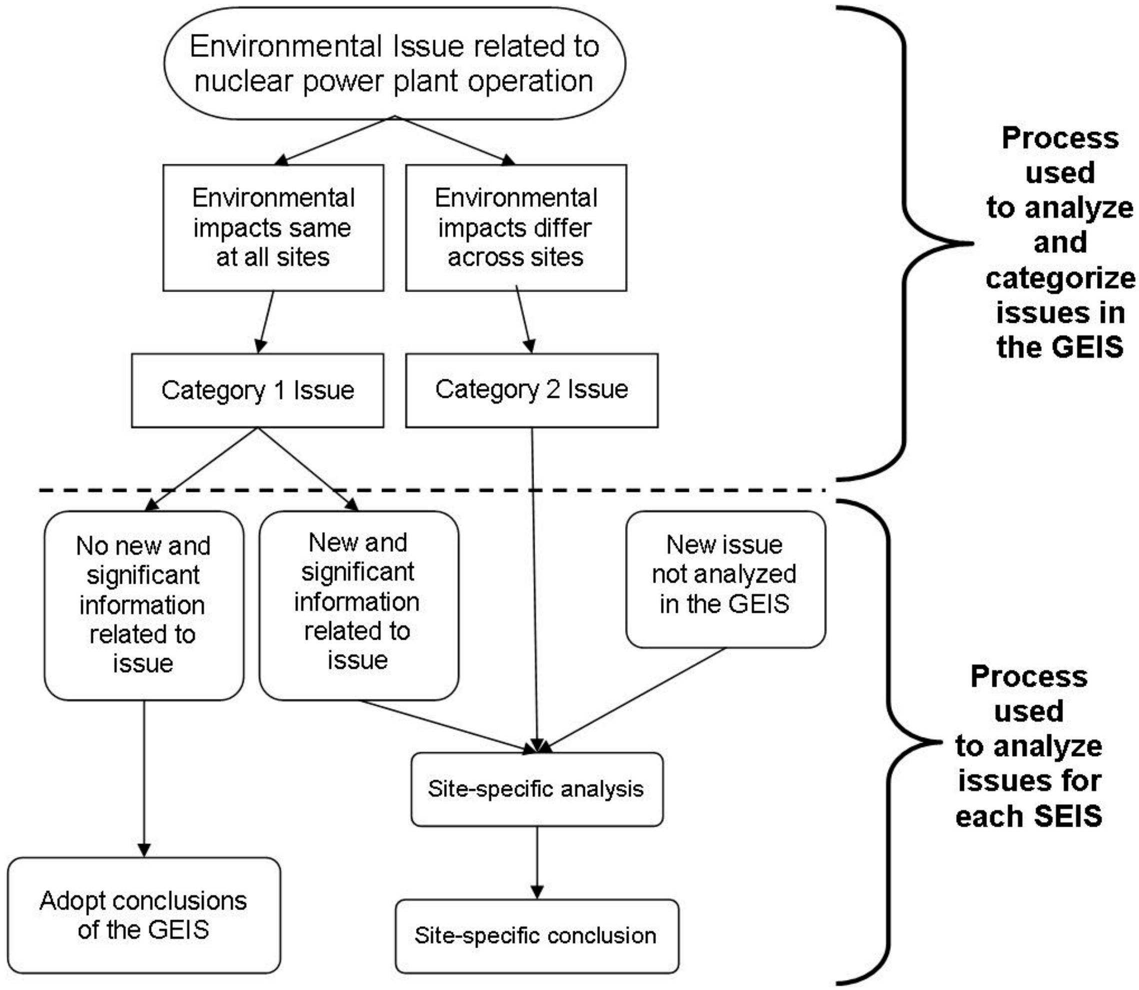
The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or Category 2 designation. As established in the GEIS, Category 1 issues are those that meet the following criteria:

- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants that have a specific type of cooling system or other specified plant or site characteristics.
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For generic issues (Category 1), no additional site-specific analysis is required in the SEIS unless new and significant information is identified. The process for identifying new and significant information for site-specific analysis is presented in Chapter 4. Site-specific issues (Category 2) are those that do not meet one or more of the criteria of Category 1 issues; therefore, additional site-specific review for these issues is required. A site-specific analysis is required for 17 of the 78 issues evaluated in the GEIS. Figure 1–2 illustrates this process. The results of that site-specific review are documented in the SEIS.

Figure 1–2. Environmental Issues Evaluated for License Renewal

In the GEIS, the NRC evaluated 78 issues.
A site-specific analysis is required for 17 of those 78 issues.



1.5 Supplemental Environmental Impact Statement

The SEIS presents an analysis that considers the environmental effects of the continued operation of Fermi 2, alternatives to license renewal, and mitigation measures for minimizing adverse environmental impacts. Chapter 4 contains analysis and comparison of the potential environmental impacts from alternatives. Chapter 5 presents the NRC's recommendation on whether the environmental impacts of license renewal are so great that preserving the option of license renewal would be unreasonable. The final recommendation will be made after consideration of comments received on the draft SEIS during the public comment period.

In the preparation of the SEIS for Fermi 2, the NRC staff carried out the following activities:

- reviewed the information provided in DTE's ER;
- consulted with Federal agencies, state and local agencies, and tribal nations;

- conducted an independent review of the issues during site audit; and
- considered the public comments received for the review (during the scoping process).

> **New and significant information**. To merit additional review, information must be both "new" and "significant," and it must bear on the proposed action or its impacts.

New information can be identified from many sources, including the applicant, the NRC, other agencies, or public comments. If a new issue is revealed, it is first analyzed to determine whether it is within the scope of the license renewal environmental evaluation. If the new issue is not addressed in the GEIS, the NRC staff would determine the significance of the issue and document the analysis in the SEIS.

1.6 Decisions To Be Supported by the SEIS

The decision to be supported by the SEIS is whether to renew the operating license for Fermi 2 for an additional 20 years. The regulation at 10 CFR 51.103(a)(5) specifies the NRC's decision standard as follows:

> In making a final decision on a license renewal action pursuant to Part 54 of this chapter, the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

There are many factors that the NRC takes into consideration when deciding whether to renew the operating license of a nuclear power plant. The analyses of environmental impacts evaluated in the GEIS will provide the NRC's decisionmaker (in this case, the Commission) with important environmental information for use in the overall decisionmaking process. There are also decisions outside the regulatory scope of license renewal that cannot be made on the basis of the GEIS analysis. These decisions include the following issues: (1) changes to plant cooling systems, (2) disposition of spent nuclear fuel, (3) emergency preparedness, (4) safeguards and security, (5) need for power, and (6) seismicity and flooding (NRC 2013).

1.7 Cooperating Agencies

During the scoping process, no Federal, state, or local agencies were identified as cooperating agencies in the preparation of this SEIS.

1.8 Consultations

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.); the Magnuson–Stevens Fisheries Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.); and the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.), require Federal agencies to consult with applicable state and Federal agencies and groups before taking action that may affect endangered species, fisheries, or historic and archaeological resources, respectively. The NRC consulted with the following agencies and groups; Appendix D discusses the consultation documents:

- U.S. Fish and Wildlife Service,
- Michigan Historical Center,
- Advisory Council on Historic Preservation,
- Keweenaw Bay Indian Community,

- Bay Mills Indian Community,
- Grand Traverse Band of Ottawa and Chippewa Indians,
- Lac Vieux Desert Band of Lake Superior Chippewa Indians,
- Little Traverse Bay Bands of Odawa Indians,
- Pokagon Band of Potawatomi Indians,
- Sault Ste. Marie Tribe of Chippewa Indians of Michigan,
- Hannahville Indian Community,
- Nottawaseppi Huron Band of the Potawatomi,
- Saginaw Chippewa Indian Tribe of Michigan,
- Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan,
- Little River Band of Ottawa Indians,
- Forest County Potawatomi,
- Shawnee Tribe,
- Delaware Nation,
- Wyandotte Nation, and
- Ottawa Tribe of Oklahoma.

1.9 Correspondence

During the course of the environmental review, the NRC staff contacted Federal, State, regional, local, and tribal agencies listed in Section 1.8. Appendices C and D contain a chronological list of all documents sent and received during the environmental review. Appendix C lists the correspondence associated with the Endangered Species Act, the Magnuson–Stevens Fisheries Conservation and Management Act, and the National Historic Preservation Act. Appendix D lists all other correspondence.

1.10 Status of Compliance

DTE is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F of the GEIS describes some of the major applicable Federal statutes. Numerous permits and licenses are issued by Federal, State, and local authorities for activities at Fermi 2. Appendix B contains further information about DTE's status of compliance.

1.11 Related State and Federal Activities

The NRC reviewed the possibility that activities of other Federal agencies might affect the renewal of the operating license for Fermi 2. There are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this SEIS.

There are no known American Indian lands within 50 miles (mi) (80 kilometers (km)) of Fermi 2 (DTE 2014b). There are 11 Federal- and 110 State-managed lands within 50 mi (80 km) of

Fermi 2, which includes 5 Federal- and 60 State-managed lands located in Ohio. In addition, there is the Federal and State jointly managed Newport NIKE Missile Battery D-57/58 site located in Carleton, Michigan, and the Federal and local jointly managed Fallen Timbers Battlefield National Historical Site located in Ohio, both located within 50 mi (80 km) of Fermi 2. Parcels of the Federally managed Detroit River International Wildlife Refuge are located on the Fermi site (DTE 2014b). Besides Federal- and State-managed lands, 10 Canadian provincial lands are located within 50 mi (80 km) of Fermi 2, including a portion of the Walpole Island First Nation Reserve (DTE 2014b).

The Walpole Island First Nation, an Indian Tribe from Ontario, Canada, sent a letter to the NRC stating that they would like an opportunity to thoroughly review the Fermi 2 license renewal process to ensure that their rights to fish and harvest resources in western Lake Erie and other nearby areas are not adversely impacted. Accordingly, the NRC invited the tribe to provide input on the Fermi 2 license renewal environmental review process (NRC 2014f).

The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain comments from any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the environmental impact statement. For example, during the course of preparing the SEIS, the NRC consulted with the U.S. Fish and Wildlife Service. Appendix C provides a complete list of consultation correspondence.

1.12 References

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 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, “Requirements for renewal of operating licenses for nuclear power plants.”

79 FR 34787. U.S. Nuclear Regulatory Commission. “DTE Electric Company; Fermi 2; License renewal application; Opportunity to request a hearing and to petition for leave to intervene.” *Federal Register* 79(117):34787–34790. June 18, 2014.

79 FR 36837. U.S. Nuclear Regulatory Commission. “DTE Electric Company; Fermi 2; Intent to prepare an environmental impact statement and conduct the scoping process.” *Federal Register* 79(125):36837–36839. June 30, 2014.

Atomic Energy Act of 1954, as amended. 42 U.S.C. §2011 et seq.

[DTE] DTE Electric Company. 2014a. *Fermi 2 License Renewal Application*. Newport, MI: DTE Electric Company. April 2014. ADAMS No. ML14121A532.

[DTE] DTE Electric Company. 2014b. *Applicant’s Environmental Report—Operating License Renewal Stage, Fermi 2*. Newport, MI: DTE Electric Company. April 2014. ADAMS Nos. ML14121A538, ML14121A539, and ML14121A540.

Endangered Species Act of 1973, as amended. 16 U.S.C. §1531 et seq.

Magnuson–Stevens Fishery Conservation and Management Act, as amended. 16 U.S.C. §1801 et seq.

National Environmental Policy Act of 1969, as amended. 42 U.S.C. §4321 et seq.

National Historic Preservation Act of 1966, as amended. 16 U.S.C. §470 et seq.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Final Report.* Washington, DC: U.S. Nuclear

Regulatory Commission. NUREG–1437, Volumes 1 and 2. May 31, 1996. ADAMS Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Section 6.3—Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants*, in *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* Washington, DC: U.S. Nuclear Regulatory Commission. NUREG–1437, Volume 1, Addendum 1. August 1999. ADAMS No. ML040690720.

[NRC] U.S. Nuclear Regulatory Commission. 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Revision 1*. Washington, DC: U.S. Nuclear Regulatory Commission. NUREG–1437, Volumes 1, 2, and 3. June 19, 2013. 1,535 p. ADAMS No. ML13107A023.

[NRC] U.S. Nuclear Regulatory Commission. 2014a. *Public Meeting To Discuss the License Renewal Process and Environmental Scoping Process for Fermi, Unit 2*. Washington, DC: U.S. Nuclear Regulatory Commission. September 18, 2014. ADAMS No. ML14233A450.

[NRC] U.S. Nuclear Regulatory Commission. 2014b. Letter from L. Perkins, Project Manager, to V. Kaminskas, DTE Electric Company. Subject: Summary of the site audit related to the review of the license renewal application for Fermi 2 (TAC No. MF4064). October 15, 2014. ADAMS No. ML14274A304.

[NRC] U.S. Nuclear Regulatory Commission. 2015. *Environmental Impact Statement Scoping Summary Report, Fermi 2, Frenchtown Township, MI*. Rockville, MD: U.S. Nuclear Regulatory Commission. October 2015. ADAMS No. ML15252A015.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Although the U.S. Nuclear Regulatory Commission's (NRC's) decisionmaking authority in license renewal is limited to deciding whether to renew a nuclear power plant's operating license, the agency's implementation of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq.), requires consideration of the environmental impacts of potential alternatives to renewing a plant's operating license. Although the ultimate decision on which alternative (or the proposed action) to carry out falls to operator, state, or other non-NRC Federal officials, comparing the impacts of renewing the operating license to the environmental impacts of alternatives allows the NRC to determine whether the environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable (Title 10 of the *Code of Federal Regulations* (10 CFR) 51.95(c)(4)).

Energy-planning decisionmakers and owners of the nuclear power plant ultimately decide whether the plant will continue to operate, and economic and environmental considerations play important roles in this decision. In general, the NRC's responsibility is to ensure the safe operation of nuclear power facilities and not to formulate energy policy or encourage or discourage the development of alternative power generation. The NRC does not engage in energy-planning decisions, and it makes no judgment as to which energy alternatives evaluated would be the most likely alternative in any given case.

The remainder of this chapter provides (1) a description of the proposed action, (2) a description of alternatives to the proposed action (including the no-action alternative), and (3) alternatives to the Fermi, Unit 2 (Fermi 2), license renewal that the NRC staff considered and eliminated from detailed study. Chapter 4 of this plant-specific supplemental environmental impact statement (SEIS) compares the impacts of renewing the operating license of Fermi 2 and continued plant operations to the environmental impacts of the alternatives.

2.1 Proposed Action

As stated in Section 1.1 of this document, the NRC's proposed Federal action is the decision whether to renew the Fermi 2 operating license for an additional 20 years. For the NRC to determine the impacts from continued operation of Fermi 2, an understanding of that operation is needed. A description of normal power plant operations during the license renewal term is provided in Section 2.1.1. Fermi 2 is a single-unit, nuclear-powered steam-electric generating facility that began commercial operation in July 1985. The nuclear reactor is a General Electric boiling water reactor (BWR) that produces 1,170 megawatts electric (MWe) (DTE 2014b).

2.1.1 Plant Operations during the License Renewal Term

Most plant operation activities during license renewal would be the same as, or similar to, those occurring during the current license term. Section 2.1.1 of NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS), Volume 1, Revision 1 (NRC 2013a), describes the general types of activities that are carried out during the operation of a nuclear power plant, such as Fermi 2. These general types of activities are:

- reactor operation;
- waste management;

- security;
- office and clerical work;
- surveillance, monitoring, and maintenance; and
- refueling and other outages.

As stated in DTE Electric Company's (DTE's) Environmental Report (ER), Fermi 2 will continue to operate during the license renewal term in the same manner as it would during the current license term except for, as appropriate, additional aging management programs to address structure and component aging in accordance with 10 CFR Part 54.

2.1.2 Refurbishment and Other Activities Associated with License Renewal

Refurbishment activities include replacement and repair of major structures, systems, and components (SSCs). The major refurbishment class of activities characterized in the GEIS is intended to encompass actions that typically take place only once in the life of a nuclear plant, if at all (NRC 2013a). Examples of these activities include, but are not limited to, replacement of BWR recirculation piping and pressurized water reactor steam generators. These actions may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the plant-specific design.

In preparation for its license renewal application, DTE performed an evaluation of these SSCs, in accordance with 10 CFR 54.21, to identify the need to undertake any major refurbishment activities that would be necessary to support the continued operation of Fermi 2 during the proposed 20-year period of extended operation (DTE 2014b).

As a result of its evaluation of SSCs, DTE did not identify the need to undertake any major refurbishment or replacement activities associated with license renewal to support the continued operation of Fermi 2 beyond the end of the existing operating license (DTE 2014b). Therefore, refurbishment activities are not discussed under the proposed action in Chapter 4.

2.1.3 Termination of Nuclear Power Plant Operations and Decommissioning after the License Renewal Term

The impacts of decommissioning are described in NUREG–0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Volumes 1 and 2, Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002). The majority of the activities associated with plant operations would cease with reactor shutdown. Some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management; office and clerical work; laboratory analysis; and surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease operations; however, impacts from the physical presence of these systems may continue if they are not removed after reactor shutdown. Impacts associated with dedicated systems that remain in place would be unchanged.

Decommissioning will occur whether Fermi 2 is shut down at the end of its current operating license or at the end of the period of extended operation. There are no site-specific issues related to decommissioning. The GEIS concludes that license renewal would have a negligible (SMALL) effect on the impacts of terminating operations and decommissioning on all resources (NRC 2013a).

2.2 Alternatives

As stated at the beginning of this chapter, the NRC is obligated to consider reasonable alternatives to the proposed action of renewing the license for a nuclear reactor. The update to the GEIS (NRC 2013a) incorporates the latest information on replacement power alternatives; however, rapidly evolving technologies are likely to outpace the information presented in the GEIS. As such, a site-specific analysis of alternatives must be performed for each SEIS, taking into account changes in technology and science since the preparation of the GEIS.

Section 2.2.1 below describes the no-action alternative in which the NRC takes no action and does not issue a renewed license for Fermi 2. Sections 2.2.2.1–2.2.2.4 describe the characteristics of replacement power alternatives for Fermi 2.

2.2.1 No-Action Alternative

At some point, operating nuclear power plants will terminate operations and undergo decommissioning. The no-action alternative represents a decision by the NRC not to renew the operating license of a nuclear power plant beyond the current operating license term. Under the no-action alternative, the NRC does not renew the operating license, and Fermi 2 shuts down at or before the end of the current license in 2025. After shutdown, plant operators will initiate decommissioning in accordance with 10 CFR 50.82.

This SEIS will only address those impacts that arise directly from plant shutdown. Several other documents, including NUREG-0586, Supplement 1 (NRC 2002); Chapter 4 of the license renewal GEIS (NRC 2013a); and Chapter 4 of this SEIS, address the environmental impacts from decommissioning and related activities. These analyses either directly address or bound the environmental impacts of decommissioning whenever DTE ceases to operate Fermi 2.

Even with a renewed operating license, Fermi 2 will eventually shut down, and the environmental impacts addressed later in Chapter 4 of this SEIS will occur at that time. As with decommissioning impacts, shutdown impacts are expected to be similar whether they occur at the end of the current license or at the end of a renewed license.

Termination of operations at Fermi 2 would result in the total cessation of electrical power production. Unlike the alternatives described below in Section 2.2.2, the no-action alternative does not expressly meet the purpose and need of the proposed action, as described in Section 1.2, because it does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the power generated by Fermi 2, the no-action alternative would likely create a need for a replacement power alternative. The following section describes the full range of replacement power alternatives (including fossil fuel, new nuclear, and renewable energy sources), and Chapter 4 assesses their potential impacts. Although the NRC’s authority only extends to deciding whether to renew the Fermi 2 operating license, the replacement power alternatives described in the following sections represent possible options for energy-planning decisionmakers if the NRC decides not to renew the Fermi 2 operating license.

2.2.2 Replacement Power Alternatives

In evaluating alternatives to license renewal, the NRC considered energy technologies or options currently in commercial operation and technologies not currently in commercial operation but that are likely to be commercially available by the time the current Fermi 2 operating license expires. The current operating license for Fermi 2 expires on March 20, 2025.

The NRC eliminated from detailed study alternatives that cannot be constructed, permitted, and connected to the grid by the time the Fermi 2 license expires.

The agency also eliminated from detailed study alternatives that cannot provide the equivalent of Fermi 2's current generating capacity and, in some cases, those alternatives whose costs or benefits do not justify inclusion in the range of reasonable alternatives. This chapter provides a brief discussion of each alternative eliminated from detailed study and provides a basis for its removal at the end of this section. In addition to the no-action alternative, the NRC staff considered 17 alternatives to the proposed action (see text box below) and then narrowed these to the four alternatives considered in Sections 2.2.2.1–2.2.2.4. The NRC staff evaluated the environmental impacts of these four alternatives (and the no-action alternative) and provides an in-depth discussion of them in Chapter 4 of this SEIS.

The GEIS presents an overview of some energy technologies, but it does not reach any conclusions about which alternatives are most appropriate. Because many energy technologies are continually evolving in capability and cost and because regulatory structures have changed to either promote or impede development of particular alternatives, the analyses in this chapter may include updated information from the following sources:

- Energy Information Administration (EIA),
- other offices within the U.S. Department of Energy (DOE),
- U.S. Environmental Protection Agency (EPA),
- industry sources and publications, and
- information submitted by DTE in its ER.

Alternatives Evaluated In Depth:

- new nuclear
- coal-integrated gasification combined cycle (IGCC)
- natural gas combined-cycle (NGCC)
- combination alternative (wind power, NGCC, and solar power)

Other Alternatives Considered:

- energy conservation and efficiency
- solar power
- wind power
- biomass
- hydroelectric power
- wave and ocean energy
- fuel cells
- delayed retirement
- geothermal power
- municipal solid waste
- petroleum–fired power
- supercritical pulverized coal (SCPC)
- purchased power

The evaluation of each alternative in Chapter 4 of this SEIS considers the environmental impacts across several impact categories, including land use and visual resources, air quality and noise, geologic environment, water resources, ecological resources, historic and cultural resources, socioeconomics, human health, environmental justice, and waste management. Most site-specific issues (Category 2) have been assigned a significance level of SMALL, MODERATE, or LARGE. For ecological and historic and cultural resources, the impact significance determination language is specific to the authorizing legislation (e.g., the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.)). The order of presentation of the alternatives is not meant to imply increasing or decreasing level of impact, nor does it imply that an energy-planning decisionmaker would be more likely to select any given alternative.

To ensure that the alternatives analysis is consistent with state or regional energy policies, the NRC reviewed energy-related statutes, regulations, and policies within the Fermi 2 region. As a result, the NRC staff considers alternatives that include wind power or solar photovoltaic (PV) power and a combination of both technologies.

Region of Influence

If the NRC does not issue a renewed license, replacement power for Fermi 2 would be required. Fermi 2 is owned and operated by DTE and provides electricity through the Midcontinent Independent System Operator (MISO) to an 11-county service area in southeastern Michigan (DTE 2014b). This service area constitutes the region of influence (ROI) for the NRC's analysis of replacement power alternatives.

In 2010, electric generators in Michigan had a net summer generating capacity of approximately 30,000 megawatts (MW). This capacity included units fueled by coal (39 percent), natural gas (37 percent), and nuclear power (13 percent), with lesser amounts fueled by hydroelectric and pumped storage (7 percent), petroleum (2 percent), and other renewable energy sources including wood, biomass, solar, and wind (2 percent) (EIA 2012).

In 2011, the electric industry in Michigan provided approximately 109 million megawatt hours (MWh) of electricity. This electrical production was dominated by coal (54 percent), nuclear (30 percent), and natural gas (12 percent). Hydroelectric and other renewable energy sources produced approximately 4 percent of the electricity in the State (EIA 2014a).

The production of renewable energy is mandated in Michigan. In 2008, Michigan enacted a Renewable Energy Standard that requires utilities to generate 10 percent of their retail electricity sales from renewable energy resources by 2015. The standard also allows energy efficiency and advanced cleaner energy systems to meet part of the requirement. Renewable energy credits can be purchased from in- or out-of-State facilities as long as the facilities are located within the retail electric service territory of a utility that is recognized by the Michigan Public Service Commission (DSIRE 2014). As of April 2015, net electricity generation in Michigan from renewable energy sources (other than hydroelectric) comprised 7.4 percent of the State total (EIA 2015).

Given known technology and technological and demographic trends, the EIA predicts that 35 percent of electricity in the United States will be generated by coal in 2040 (EIA 2013a). In all the Midwest case projections, coal accounts for 42 percent in 2040 (EIA 2013a). Nationwide, natural gas generation rose from 16 percent in 2000 to 24 percent in 2011 and is projected to increase to 30 percent in 2040 (EIA 2013a). Electricity generation from renewable energy is expected to grow nationwide, from 13 percent of total generation in 2011 to 16 percent in 2040. However, there are uncertainties that could affect this forecast, particularly the implementation of policies aimed at reducing greenhouse gas emissions, which would have a direct effect on fossil fuel-based generation technologies (EIA 2013a).

This section describes replacement power alternatives to license renewal. These alternatives include an NGCC alternative in Section 2.2.2.1; a coal-IGCC alternative in Section 2.2.2.2; a new nuclear power alternative in Section 2.2.2.3; and a combination natural gas, wind, and solar power alternative in Section 2.2.2.4. Table 2–1 summarizes key design characteristics of the alternative technologies evaluated in depth. The environmental impacts of these alternatives are evaluated in Chapter 4.

Table 2–1. Summary of Replacement Power Alternatives and Key Characteristics Considered In Depth

	NGCC Alternative	IGCC Alternative	New Nuclear Alternative	Combination Alternative
Summary of Alternative	Three 400-MWe units for a total of 1,200 MWe	Two 618-MWe units for a total of 1,236 MWe	One 1,170 MWe single-unit nuclear plant	One 400-MWe NGCC unit, a 600-MWe wind farm, and a 200-MWe solar PV facility for a total of 1,200 MWe
Location	On the Fermi site, outside the footprint of the existing Fermi 2 and proposed Fermi 3 plants: Some infrastructure upgrades may be required and would require construction of a new or upgraded gas pipeline. Some facilities (e.g., support buildings, potable water supply, and sanitary discharge structures) could be shared with the existing plant.	On or adjacent to the Fermi site, outside the footprint of the existing Fermi 2 and proposed Fermi 3 plants: Some transmission line infrastructure currently supporting Fermi 2 would be used (DTE 2014b). Some facilities (e.g., support buildings, potable water supply, and sanitary discharge structures) could be shared with the existing plant.	On or adjacent to the Fermi site, outside the footprint of the existing Fermi 2 and proposed Fermi 3 plants. Some transmission line infrastructure currently supporting Fermi 2 would be used. Some facilities (e.g., support buildings, potable water supply, and sanitary discharge structures) could be shared with the existing plant.	Spread across multiple sites throughout the ROI
Cooling System	Closed-cycle with mechanical draft cooling towers; cooling water withdrawal—7.5 mgd; consumptive water use—5.7 mgd (NETL 2010, 2013a)	Closed-cycle with mechanical draft cooling towers; cooling water withdrawal—16.5 mgd; consumptive water use—13 mgd (NETL 2013a)	Closed-cycle with natural draft cooling tower; cooling water withdrawal—32 mgd; consumptive water use—16 mgd (NRC 2013c)	For NGCC portion, closed-cycle with mechanical draft cooling towers; cooling water—33% of that required for the NGCC alternative; minimal water use for wind and solar

	NGCC Alternative	IGCC Alternative	New Nuclear Alternative	Combination Alternative
Land Require-ments	24 ac (10 ha) for the plant (NETL 2010); 4,320 ac (1,748 ha) for gas extraction and collection (NRC 1996)	1,000 ac (400 ha) for the major permanent facilities (adjacent land parcels would be acquired to provide the full complement of total land needed); 550 ac (225 ha) per year for mining (DOE 2010a)	301 ac (122 ha) (adjacent land parcels would be acquired to provide the full complement of total land needed); no expected net change in impacts associated with uranium mining and processing as these would just be redirected from Fermi 2 (DTE 2014b)	Wind farms would require 1,117 ac (452 ha) to 3,351 ac (1,356 ha) (WAPA and FWS 2013); solar PV facilities would require 3,577 ac (1,448 ha) (Ong et al. 2013). For the NGCC portion, land use would remain the same as the NGCC alternative, 24 ac (10 ha).
Work Force	1,440 workers during peak construction; 75 workers during operations (NRC 1996)	2,300 workers during peak construction; 210 workers during operations (DOE 2010a)	2,900 workers during peak construction; 900 workers during operations (NRC 2013a)	Solar PV system—528 workers during peak construction and 53 workers during operations (DOE 2010b); for wind farm—307 workers during peak construction and 187 workers during operations. The number of NGCC construction and operations workers would be less than that needed for the standalone NGCC alternative, but it would not be a linear reduction because of the minimum number of workers needed regardless of the size of the NGCC plant.

Key: ac = acres; ha = hectares; IGCC = coal-integrated gasification combined cycle; mgd = million gallons per day; MWe = megawatts electric; NGCC = natural gas combined-cycle; and ROI = region of influence.

Sources: DOE 2010a, 2010b; DTE 2014b; NETL 2010, 2013a; NRC 1996, 2013b; Ong et al. 2013; and WAPA and FWS 2013.

2.2.2.1 NGCC Alternative

In this section, the NRC staff describes the NGCC alternative. The NRC staff evaluates the environmental impacts from this alternative in Chapter 4.

Natural gas represents 37 percent of the installed generation capacity in Michigan, but provides only 12 percent of all electrical power generated in the State (EIA 2012, 2014a). Nationwide, the percentage of power generated by natural gas is expected to rise by 2040, although the actual rise in natural gas generation will depend on future natural gas prices (EIA 2013a). The NRC staff considers the construction of an NGCC power plant to be a reasonable alternative to license renewal because it is a feasible, commercially available option for providing baseload electrical generating capacity beyond the expiration of Fermi 2's current license.

Baseload NGCC power plants have proven their reliability and can have capacity factors as high as 85 percent. In an NGCC system, electricity is generated using a gas turbine that burns natural gas. A steam turbine uses the heat from gas turbine exhaust through a heat recovery steam generator to produce additional electricity. This two-cycle process has a high rate of efficiency because the NGCC system captures the exhaust heat that would otherwise be lost and reuses it. Like other fossil fuel sources, NGCC power plants are a source of greenhouse gases, including carbon dioxide. However, an NGCC power plant produces significantly fewer greenhouse gases per unit of electrical output than conventional coal-powered plants (NRC 2013a).

To replace the electricity that Fermi 2 generates, the NRC staff considered three NGCC units, each with a net capacity of 400 MWe. The NRC staff assumes that each plant configuration consists of two combustion turbine generators, two heat recovery steam generators, and one steam turbine generator with mechanical draft cooling towers for heat rejection. The power plant is assumed to incorporate a selective catalytic reduction system to minimize the plant's nitrogen oxide emissions (NETL 2007). Natural gas would be extracted from the ground through wells and then treated to remove impurities and blended to meet pipeline gas standards before being piped through the State's pipeline system to the plant site. This NGCC alternative would produce relatively little waste, primarily in the form of spent catalysts used for control of nitrogen oxide emissions.

The NRC assumes that the NGCC alternative is located within the existing Fermi site to maximize availability of infrastructure and to reduce other environmental impacts. Depending on its specific configuration within the site, construction of new intake and discharge facilities and a new cooling system may be necessary. Because NGCC power plants generate much of their power from a gas-turbine combined-cycle plant, and because the overall thermal efficiency of this type of plant is high, an NGCC alternative would require less cooling water than Fermi 2 would. This system would withdraw 7.5 mgd (28 million liters per day (Lpd)) of water and consume 5.7 mgd (22 million Lpd). The NRC staff assumes the cooling system would use a closed-cycle system with mechanical draft cooling towers. Onsite visible structures could include the cooling towers, exhaust stacks, intake and discharge structures, transmission lines, natural gas pipelines, and an electrical switchyard. Construction materials could be delivered by a combination of rail spur, truck, and barge, depending on the location of the plant within the Fermi site. Modifications may be required to deliver such materials, including upgrades to existing rail lines or access roads.

2.2.2.2 IGCC Alternative

In this section, the NRC staff describes the IGCC alternative. The NRC staff evaluates the environmental impacts from this alternative in Chapter 4.

Coal provides the greatest share of electrical power in Michigan. In 2010, coal represented 39 percent of installed generation capacity and accounted for 59 percent of all electricity generated in the State (EIA 2012). IGCC is a technology that generates electricity from coal and combines modern coal gasification technology with both gas- and steam-turbine power generation. The technology generates fewer pollutants than conventional pulverized coal plants do because major pollutants are removed from the gas stream before combustion. An IGCC power plant consists of coal gasification and combined-cycle power generation. Coal gasifiers convert coal into a gas (synthesis gas, also referred to as syngas) that fuels the combined-cycle power generating units. The combined-cycle system for a 618-MWe IGCC power plant includes two combustion turbines, two heat recovery steam generators, and a steam turbine. The combined-cycle units combust gas in one or more combustion turbines, and the resulting hot exhaust gas is then used to heat water into steam to drive a steam turbine. The steam turbine then uses the heat from the gas turbine's exhaust through a heat recovery steam generator to produce additional electricity (DOE 2010a). This two-cycle process has a high rate of efficiency because the IGCC system captures the exhaust heat that would otherwise be lost and reuses it. In addition, the power plant would reduce sulfur dioxide, nitrogen oxides, mercury, and particulate emissions by removing constituents from the syngas before combustion. Nearly 100 percent of the nitrogen from the syngas would be removed before combustion in the gas turbines and would result in lower nitrogen oxide emissions compared to emissions from conventional coal-fired power plants (DOE 2010a).

IGCC power plants have been in operation since the mid-1990s. The Wabash Rice IGCC repowering project in Indiana and the Polk Power Station in Florida are two examples of operating IGCC plants. Recently, interest in new IGCC projects has increased, and multiple new projects have been proposed or recently have begun operations in the United States. The Duke Energy Edwardsport Generation Station in neighboring Indiana is a 618-MWe IGCC power plant in the ROI that began commercial operation in June 2013. Duke Energy estimates that the IGCC plant will produce 10 times as much power as the retired coal plant it replaced with 70 percent fewer emissions of sulfur dioxide, nitrogen oxides, and particulates. The IGCC plant will reduce carbon emissions per megawatt hours by nearly half (Duke Energy 2013). In addition, the Edwardsport Generation Station has the potential for carbon capture and geologic sequestration. Space has been reserved at the site for carbon dioxide capture equipment (NETL 2013b).

Many IGCC power plants have been designed with carbon capture and storage (CCS) to further reduce carbon dioxide emissions. The Kemper County IGCC project in east-central Mississippi proposes to use CCS to reduce carbon dioxide emissions by almost 70 percent by removing carbon from the syngas postgasification (DOE 2010a). According to a 2013 National Energy Technology Laboratory (NETL) report, nine IGCC projects totaling over 4,000 MW are currently active; these projects are in the planning stages, or they have begun construction. Thirteen projects have been proposed and subsequently cancelled for a variety of reasons, including air quality issues, State laws and regulations, redirected focus on gas-fired generation and renewables, and unanticipated rising costs (NETL 2013c). IGCC technology and proposed projects have experienced a number of setbacks and opposition that have hindered the full integration of the technology into the energy market. The high capital cost of the IGCC technology is the most significant roadblock compared to the cost of conventional coal-fired power plants. Cost overruns have been experienced at both the Edwardsport IGCC project and the Kemper County IGCC project. FutureGen, an IGCC plant featuring CCS, lost DOE financial support because of escalating cost estimates (Reuters 2012). Other issues include construction timeline overruns, a limited track record for reliable performance, and opposition from an environmental perspective.

Despite some of the current setbacks and concerns associated with IGCC projects, the NRC staff considers IGCC technology to be a reasonable source of baseload power to replace Fermi 2 by the time its license expires in 2025 because of the current regulatory framework and the number of IGCC plants that have, or are expected to become, operational. For example, on August 3, 2015, EPA signed a final rule for carbon pollution that would apply to new fossil fuel-fired power plants (EPA 2015). The action establishes performance standards for utility boilers and IGCC units based on partial implementation of a CCS system as a method of emission reduction. The emission limit for these sources is 1,305 pounds (lb) of carbon dioxide per megawatt hour (CO_2/MWh), and any new coal-fired power plants could require CCS to achieve this emission limit. Therefore, the NRC staff considers IGCC power plants as an alternative to Fermi 2 in this section because the Edwardsport IGCC project in Indiana is currently in operation and because the Kemper IGCC project in Mississippi is under construction. The technology parameters for these plants are considered the current state of technology and are used here to describe a hypothetical IGCC power plant located on, or adjacent to, the current Fermi property.

To replace the electricity that Fermi 2 generates, the NRC staff considered two IGCC units, each with a net capacity of 618 MWe. Various coal sources are available to coal-fired power plants in the ROI. For the purpose of this evaluation, the NRC staff assumes that the IGCC alternative would burn a sub-bituminous Powder River Basin coal, consistent with the type of coal used in other DTE electric plants. In addition, the units would be designed with the potential to add CCS later. In a CCS, carbon dioxide emissions would be compressed and piped off site where the compressed emissions could be sold for beneficial use or geologic storage. Additional discussion of air quality impacts associated with the IGCC alternative is discussed in Section 4.3.

The IGCC alternative would be located on, or adjacent to, the existing Fermi property to maximize availability of infrastructure and to reduce other environmental impacts. Depending on its specific configuration within the site, there might be a need to construct new intake and discharge facilities and a new cooling system. The IGCC alternative would use a similar amount of water as that of the Edwardsport IGCC plant. The NRC staff assumes the cooling system would use a closed-cycle system with mechanical draft cooling towers. This system would withdraw 16.5 mgd (62 million Lpd) of water and consume 13 mgd (49 million Lpd). Onsite visible structures could include the boilers, exhaust stacks, intake and discharge structures, mechanical draft cooling towers, transmission lines, and an electrical switchyard. Construction materials could be delivered by a combination of rail spur, truck, and barge, depending on the specific site location. Modifications may be required to deliver such materials and could include new rail lines or access roads.

2.2.2.3 New Nuclear Power Alternative

In this section, the NRC staff describes the new nuclear power alternative. The NRC staff evaluates the environmental impacts from this alternative in Chapter 4.

The NRC staff considered the construction of a new nuclear power plant to be a reasonable alternative to license renewal. For example, nuclear power generation currently provides 31 percent of electricity generation in Michigan (EIA 2015). In addition to Fermi 2, two other nuclear power plants operate in Michigan and have received renewed licenses (NRC 2013b). In September 2008, DTE filed an application for a combined license (COL) to build and operate a new reactor unit (Fermi 3) on the existing Fermi site. The NRC staff published the final environmental impact statement (FEIS) for Fermi 3 in January 2013 (NRC 2013c). On May 1, 2015, the NRC issued the license authorizing DTE to build and operate an economic simplified boiling water reactor at the Fermi site (80 FR 26302).

In evaluating the new nuclear power alternative, the NRC staff assumed that one new nuclear reactor, in addition to the proposed Fermi 3, would be built on the existing Fermi site to allow for the maximum use of existing ancillary facilities, such as support buildings and transmission infrastructure. The location of this new reactor would be outside the footprints of the existing Fermi 2 and proposed Fermi 3 units and may require DTE to acquire additional land parcels adjacent to the current Fermi property to accommodate the buildout of this new plant. For the purposes of this analysis, the NRC relied on the Fermi 3 COL FEIS to scale technological parameters for the new nuclear power alternative because the NRC staff considers the proposed Fermi 3 plant to be a new nuclear reactor representative of the reactor type that could be constructed before Fermi 2's license expires. Consistent with DTE's ER, the NRC staff assumed that one economic simplified boiling water reactor with a net electrical output of approximately 1,170 MWe would replace Fermi 2's current reactor for this alternative (DTE 2014b).

In the Fermi 3 COL FEIS, the NRC estimated 301 ac (121 ha) would be required for construction of a new unit (NRC 2013a). In its ER, DTE further indicated that it did not expect any net change in impacts associated with uranium mining and processing because these impacts would just replace those previously attributed to Fermi 2 (DTE 2014b). The NRC staff considers these assessments to be valid for determining impacts associated with a new nuclear power alternative at Fermi.

The heat rejection demands of a new nuclear power alternative would be similar to those of Fermi 2. The new reactor may require a new cooling system (including natural draft cooling towers and intake and discharge structures). The NRC staff assumes that water requirements for the new nuclear alternative would be similar to current water use at Fermi 2. The existing transmission lines leaving the site, as well as construction and drinking water wells, are expected to serve the replacement reactor with few modifications required. A new onsite transmission line may be required if insufficient transmission occurs on site. Construction materials could be delivered by a combination of rail spur, truck, and barge, depending on the specific site location of the plant within the Fermi site. Modifications may be required to deliver such materials and could include upgrades to new existing rail lines or access roads. The NRC staff also considered the installation of multiple small modular reactors as an alternative to renewing the Fermi 2 license. The NRC established the Advanced Reactor Program in the Office of New Reactors because of considerable interest in small modular reactors along with anticipated license applications by vendors. Small modular reactors are approximately 300 MW or less, would have lower initial capacity than large-scale units, and would have siting flexibility for locations that are not large enough to accommodate traditional nuclear reactors (DOE undated b). As of January 2015, no applications for small modular reactors have been submitted to the NRC. The DOE has estimated that the technology may achieve commercial operation by 2021 to 2025 (DOE undated b). Because small modular reactors may not be operational on a commercial scale until near the expiration of Fermi 2's license, the construction of four new small modular reactors (i.e., the number of units required to replace Fermi 2's current output) in the ROI is unlikely; therefore, this analysis focuses on nuclear power generation by larger nuclear units.

2.2.2.4 Combination Alternative (NGCC, Wind, and Solar)

In this section, the NRC staff describes a combination alternative to the continued operation of Fermi 2 that would consist of an NGCC facility constructed on the Fermi 2 plant site operating in conjunction with land-based wind farms and solar energy facilities—all of which would be located within the ROI. The NRC staff evaluates the environmental impacts from this alternative in Chapter 4.

To serve as an effective baseload power alternative to the Fermi 2 reactor, this combination alternative must be capable of providing an equivalent amount of baseload power. For the purpose of this evaluation, the NRC staff presumes that the combination alternative would comprise NGCC, wind farms, and solar PV facilities.

<u>NGCC Portion of the Combination Alternative</u>

To produce its required share of power, the NGCC portion, operating at an expected capacity factor of 85 percent (NETL 2007), would need a nameplate rating of approximately 470 MWe.

In 2013, EIA reported that natural gas-fired power plants are generally used for shorter periods to meet peak demand on an infrequent basis. Capacity factors for natural gas plants averaged less than 5 percent during off-peak demand hours for most regions of the country. Natural gas is used for these “peaker plants” because natural gas combustion turbines can respond quickly to meet short-term increases in electricity demand (EIA 2013d). A report prepared by CITI Research stated that gas-fired power plants can help overcome the intermittent nature of renewable energy (Channell et al. 2012).

The NRC staff assumed that one new NGCC unit of the type described in Section 2.2.2.1 would be constructed and installed at the Fermi site with a total net capacity of 400 MWe. The configuration of the NGCC unit would be similar to that of the full NGCC alternative considered in Section 2.2.2.1, although only one unit would be constructed. The NRC staff assumes that the NGCC portion of this alternative would use existing electrical switchyards, substations, and transmission lines. Depending on the existing site conditions, it is possible that intake and discharge structures of the existing cooling system could continue in service, but would be connected to a new closed-cycle cooling system. For the purposes of this analysis, the NRC staff assumes that the NGCC portion of the combination would use mechanical draft cooling towers.

<u>Wind Portion of the Combination Alternative</u>

The NRC staff assumes that the wind-generated power from this combination alternative would come from land-based wind farms that would be located within the ROI. The wind portion, assuming a capacity factor of 30 percent, would require a nameplate capacity of 2,000 MWe (WAPA and FWS 2013).

The American Wind Energy Association (AWEA) reports a total of approximately 62,000 MW of installed wind energy capacity nationwide as of July 2014 (AWEA 2014). As of December 2014, Texas is the leader with 14,098 MW of installed land-based wind energy capacity. Michigan has the 14th largest installed wind energy capacity in the Nation at 1,525 MW (DOE 2015). DTE currently has nine wind energy facilities that generate approximately 800 MW (DTE 2015a). Therefore, NRC staff considers 2,000 MW of wind energy to be a reasonable amount by the time the Fermi 2 license expires in 2025.

As is the case with other renewable energy sources, the feasibility of wind resources serving as alternative baseload power is dependent on the location (relative to expected load centers), value, accessibility, and constancy of the resource. Wind power installations, which may consist of several hundred turbines, produce variable amounts of electricity. However, Fermi 2 produces electricity almost constantly. Because there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources, wind power cannot substitute for existing baseload generation on a one-to-one basis.

The energy potential in wind is expressed by wind power classes, which range from 1 (least energetic) to 7 (most energetic). At the current stage of wind energy technology development, wind resources in Wind Power Class 3 and higher areas are suitable for most utility scale applications (NREL 2014). Wind power Class 3 is defined as having a wind speed of 15.7 miles per hour (7.0 meters per second) and a wind density of 500 watts per square meter at 164 feet (50 meters) (NREL 2014). The ROI contains the highest concentration of wind resources in Michigan that meet this power class (NREL 2004). Individual wind turbine capacity increased from 0.71 MW in 1999 to 1.79 MW in 2010. The size of turbine most frequently installed in the United States in recent years is the 1.5-MW turbine (WAPA and FWS 2013). For the purposes of this analysis, the NRC staff assumes wind turbines with a capacity of 1.79 MW. For the wind portion of the combination alternative, the NRC staff assumed a capacity factor of 30 percent, resulting in an estimated total net capacity of 600 MWe. Wind farms require substantial amounts of land because wind turbines must be well separated from each other to avoid interferences to wind flowing through the wind farm. Wind turbines may require as much as 1 to 3 ac (0.4 to 1.2 ha) of land for each turbine (WAPA and FWS 2013). Based on the size of the turbines and amount of land required between each turbine, the wind portion of the combination alternative would require approximately 1,117 turbines and 1,117 to 3,351 ac (452 to 1,356 ha).

Wind energy's intermittency affects its viability as a baseload power source. However, the variability of wind-generated electricity can be lessened if the proposed wind farms were located at a large distance from one another, allowed to operate as interconnected wind farms, and controlled in aggregate from a central point. Distance separation ensures that the two wind farms will not simultaneously experience the same climate, and power will likely be produced at some of the wind farms at any given time (Archer and Jacobson 2007).

Solar Photovoltaic Portion of the Combination Alternative

The solar PV portion of the combination alternative would be generated through one or more solar PV energy facilities located in the ROI. Assuming a capacity factor of 19 percent, the solar energy facilities would need a collective nameplate capacity of 1,052 MWe. Solar PV technologies could be installed on building roofs at existing residential, commercial, or industrial sites or at larger standalone solar facilities.

Solar PV uses solar panels to convert solar radiation into usable electricity. Solar manufacturers form solar cells into solar panels that can then be linked into PV arrays to generate electricity. The electricity generated can be stored, used directly, fed into a large electricity grid, or combined with other electricity generators as a hybrid plant. Solar PV systems can generate electricity whenever there is sunlight, regardless of whether the sun is directly shining on solar panels. Therefore, solar PV technologies do not need to directly face and track the sun, which has allowed solar PV systems to have broader geographical use than concentrated solar power (Ardani and Margolis 2011).

Nationwide, growth in large solar PV facilities (greater than 5 MW) has resulted in an increase from 70 MW in 2009 to over 700 MW installed capacity in 2011. As of January 2012, it is estimated that more than 11,000 MW of large solar PV projects have signed power purchase agreements (Mendelsohn et al. 2012). Over 9,000 MW of those solar projects are 50 MW or greater, and most are located in the southwestern United States (Mendelsohn et al. 2012). Under a program begun in 2009, DTE obtains easement rights to locate large (100-kilowatts (kW) to 500-kW) solar arrays on suitable property in southeastern Michigan, and it has allocated 15 MW for this program (DTE 2015b). As of 2014, 20 projects totaling approximately 8.2 MW of solar PV capacity had been installed in the ROI, and 3 other projects representing 5.2 MW were in the construction, design, or feasibility stages (MPSC 2015).

Solar PV resources in the ROI and across Michigan range from 4.0 to 4.5 kilowatt hours per square meter per day ($kWh/m^2/d$) (NREL 2013c). Economically viable solar resources are considered to be 6.75 $kWh/m^2/d$ and greater (BLM and DOE 2010). As is the case with wind energy sources, the feasibility of solar energy resources serving as alternative baseload power depends on the location, value, accessibility, and constancy of the resource.

For the purposes of this analysis, the NRC staff assumes solar PV facilities with a capacity factor of 19 percent (Ardani and Margolis 2011). Solar PV facilities may require 6.2 ac (2.5 ha) per megawatt of land. Although not all this land would be cleared of vegetation and permanently affected, it represents the land enclosed in the total site boundary of the solar facility (Ong et al. 2013). For the solar portion of this combination alternative, approximately 3,577 ac (1,448 ha) would be required to support an installed net capacity of 200 MWe. In this analysis, the NRC staff does not speculate on the number and size of individual solar facilities, nor their locations within the ROI. However, as stated above, some of the output could be realized by solar PV installations on building roofs at existing residential, commercial, or industrial sites or at larger standalone solar facilities. To the extent that rooftop or building-integrated solar PV installations remain popular, land impacts would be relatively minor. Solar PV systems do not require water for cooling purposes, but a small amount of water is needed to clean the panels and for potable water for the workforce. The U.S. Department of the Interior Bureau of Land Management (BLM) and DOE's Solar Energy Programmatic Environmental Impact Statement (PEIS) (BLM and DOE 2010, 2012), among other technical reports, provides information on impacts used in the analyses presented in the impact sections in Chapter 4.

Although solar PV resources in Michigan are modest in comparison to solar resources available elsewhere in the Nation, solar PV systems remain a commercially available option for providing electrical generating capacity that is supported through the Michigan Renewable Energy Standard (DSIRE 2014). Therefore, the NRC staff considers the construction of solar PV facilities to be a reasonable alternative to license renewal when combined with wind and NGCC.

2.3 Alternatives Considered but Dismissed

This section presents alternatives to Fermi 2 license renewal that the NRC considered and eliminated from detailed study. These alternatives were eliminated because of technical resource availability or current commercial limitations. Many of these limitations would continue to exist when the current Fermi 2 license expires.

2.3.1 Energy Conservation and Energy Efficiency

Energy conservation can include reducing energy demand through behavioral changes or through altering the shape of the electricity load and usually does not require the addition of new generating capacity. Conservation and energy efficiency programs are more broadly referred to as demand-side management (DSM).

Conservation and energy efficiency programs can be initiated by a utility, transmission operators, the State, or other load-serving entities. DTE currently offers its customers several conservation and DSM programs to reduce peak electricity demands and daily power consumption (DTE 2014b). A recent Michigan Public Service Commission study estimated that energy efficiency programs potentially could reduce demand in the DTE service area by approximately 800 MW by 2023 (MPSC 2013, DTE 2014b).

In general, residential electricity consumers have been responsible for the majority of peak load reductions, and participation in most programs is voluntary. Therefore, the existence of a program does not guarantee that reductions in electricity demand would occur. The GEIS concludes that while the energy conservation or energy efficiency potential in the United States is substantial, cases in which an energy efficiency or conservation program has been implemented expressly to replace or offset a large baseload generation station (NRC 2013a) are unlikely. Although significant energy savings are possible in the ROI through DSM and energy efficiency programs, conservation and energy efficiency programs are not likely to replace Fermi 2 as a standalone alternative; therefore, the NRC staff does not consider conservation and energy efficiency to be a reasonable alternative to license renewal.

2.3.2 Solar

Solar power, including solar PV systems and concentrated solar power technologies, produce power generated from sunlight. PV systems convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam to drive a turbine connected to a generator to produce electricity (NREL 2013d). To be considered a viable alternative, a solar alternative must replace the amount of electricity that Fermi 2 provides. Assuming a capacity factor of 19 percent (Ardani and Margolis 2011), solar energy facilities in the ROI would need to generate approximately 6,160 MWe of electricity.

In 2015, approximately 5.2 MW of electricity was generated from solar energy in the ROI (DTE 2015b). DOE's National Renewable Energy Laboratory (NREL) reports that Michigan receives solar insolation of 4.0 to 4.5 kWh/m^2/d, which is considered low to average (NREL 2013c). For utility-scale development, insolation levels below 6.5 kWh/m^2/d are not considered economically viable given current technologies (BLM and DOE 2010). More potential for solar development exists using local PV applications, such as rooftop solar panels, than through utility-scale solar facilities. In addition, a solar facility can only generate electricity when the sun is shining. Energy storage can be used to overcome intermittency for concentrating solar power facilities; however, current and foreseeable storage technologies that have been paired with solar power facilities have a much smaller capacity than that necessary to replace Fermi 2's baseload generation. Given all the factors above, using solar PV systems or concentrated solar power technologies as baseload power in the ROI to replace Fermi 2's current electricity output is unlikely. Given the modest levels of solar energy available throughout the ROI, the lack of substantial installed solar capacity in the ROI, and the weather-dependent intermittency of solar power, the NRC staff concludes that a solar power energy facility in the ROI would not be a reasonable standalone alternative to license renewal. However, the NRC staff describes an alternative using solar power in combination with wind and an NGCC plant in Section 2.2.2.4.

2.3.3 Wind

The installed wind capacity in Michigan is among the largest and fastest growing in the Nation (DOE 2015, EIA 2015). All of the wind energy facilities and the electricity generation from wind currently being produced in Michigan are land-based. A wind alternative must replace the amount of electricity Fermi 2 provides in order to be considered a viable alternative. Assuming a capacity factor of 30 percent for land-based wind and 40 percent for offshore wind, some combination of land-based and offshore wind energy facilities in the ROI would need to generate a range of 2,925 to 3,900 MWe of electricity.

As is the case with other renewable energy sources, the feasibility of using wind resources for alternative baseload power depends on the location (relative to expected load centers), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point at which it is extracted, and there are limited energy storage opportunities available to overcome the intermittency and variability of wind resource availability. Although wind power is intermittent and individual facilities are unable to provide baseload power, multiple interconnected wind installations separated by long distances could theoretically function as a virtual power plant and could provide baseload power because individual facilities would be exposed to different weather and wind conditions. However, no states or utilities to date operate arrays of wind installations as virtual power plants.

Given the amount of wind capacity necessary to replace Fermi 2 and the intermittency of wind power, the NRC staff finds a completely wind-based alternative to be unreasonable. However, the NRC staff also concludes that wind energy can provide a viable alternative when it is used in combination with other technologies with inherently higher capacity factors. The NRC staff describes such a possible combination in Section 2.2.2.4.

2.3.3.1 Offshore Wind

The United States does not have any offshore wind farms in operation; however, approximately 20 projects representing more than 2,000 MW of capacity are in the planning and permitting process as of 2010 (Musial and Ram 2010). Offshore wind projects have been developed in Europe; most of them are located close to shore and in shallow water less than 98.4 feet (30 meters) in depth. Total worldwide installed capacity has been estimated at 2,377 MW (Musial and Ram 2010).

Although wind data suggest that the potential exists for offshore wind farms in the Great Lakes, project costs likely will limit the future potential of large-scale projects (Tidball et al. 2010). NREL estimated that offshore project costs would run approximately 200 to 300 percent higher than land-based systems (Tidball et al. 2010). In addition, based on current prices for wind turbines, the 20-year levelized cost of electricity produced from an offshore wind farm would be above the current production costs from existing power generation facilities. In addition to cost, other barriers include the immature status of the technology, limited resource area, and high risks and uncertainty (Tidball et al. 2010). Because no offshore wind capacity yet exists either in the Great Lakes or on the Atlantic Coast and because none appears likely to exist on a large commercial scale in the Great Lakes by 2025 (given the current state of development), the NRC staff finds that offshore wind will not be a reasonable alternative to Fermi 2.

2.3.3.2 Wind Power with Storage

Energy storage is one possible way to overcome intermittency. Besides pumped hydroelectric facilities, compressed air energy storage (CAES) is the technology most suited for storage of large amounts of energy. In CAES systems, electricity generated during low-demand periods can be stored by using a compressor to pressurize and store air, and during high-demand periods, the compressed air can be used to drive a turbine to generate electricity. A 2011 DOE report analyzed various power generation sources, including wind, coupled with CAES systems (Ilic et al. 2011). The report considered siting criteria, using (1) proximity to natural gas lines, high-voltage transmission, and a market for wholesale electric power and (2) availability of geology and wind resources. Without detailed wind-speed data, specific site information, and detailed information on the energy-storage capacity of potential CAES sites, estimating how much wind capacity would be necessary and determining whether it could provide for an all-wind alternative are difficult. Furthermore, the NRC staff is not aware of a CAES project coupled with wind generation that is providing baseload power. Therefore, the NRC staff concludes that the use of CAES in combination with wind turbines to replace the Fermi 2 power plant is unlikely.

2.3.3.3 Conclusion

Despite the relatively high reliability demonstrated by modern turbines, the recent technological advancements in turbine design and wind farm operation, and wind energy’s dramatic market penetrations of recent years, empirical data on wind farm capacity factors and wind energy’s limited ability to store power for delayed production of electricity cause the NRC staff to conclude that wind energy—on shore, off shore, or a combination thereof—could not serve as a discrete alternative to the baseload power supplied by Fermi 2. However, the NRC staff also concludes that, when used in combination with other technologies with inherently higher capacity factors, wind energy can provide a viable alternative. The NRC staff describes such a possible combination in Section 2.2.2.4.

2.3.4 Biomass

Resources used for biomass-fired generation include agricultural residues, animal manure, wood wastes from forestry and industry, residues from food and paper industries, municipal green wastes, dedicated energy crop, and methane from landfills (IEA 2007). Using biomass-fired generation for baseload power depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. For this analysis, the NRC staff assumed that biomass would be combusted for power generation in the electricity sector. Biomass is also used for space heating in residential and commercial buildings and can be converted to a liquid form for use in transportation fuels (Haq undated). In the GEIS, the NRC staff indicated that a wood waste facility could provide baseload power and could operate with capacity factors between 70 and 80 percent (NRC 2013a). With over one-half of the State forested, Michigan has abundant woody biomass (EIA 2015). However, most biomass resources are concentrated in northern Michigan and are far-removed from the DTE service area (NRC 2013c). DTE operates three biomass fuel facilities, the largest of which has a capacity of 17 MWe (DTE 2014b). Based on the relatively low-electricity generation currently produced at biomass plants, it is unlikely that these plants, or the construction of several new biomass plants, could increase capacity by adding 1,170 MWe of electricity from biomass-fired generation by the expiration of Fermi 2's license in 2025.

For utility-scale biomass electricity generation, the NRC staff assumes that the technologies used for biomass conversion would be similar to fossil fuel plants, including the direct combustion of biomass in a boiler to produce steam (NRC 2013a). Biomass generation is generally more cost effective when it is co-fired with coal plants (IEA 2007). Biomass-fired generation plants generally are small and can reach capacities of 50 MWe, which means that more than 20 new facilities would be required before the Fermi 2 license expires. After reevaluating current technologies, the NRC staff finds that biomass-fired alternatives are still unable to reliably replace the Fermi 2 capacity. For this reason, the NRC staff does not consider biomass to be a reasonable alternative to Fermi 2 license renewal.

2.3.5 Hydroelectric

Hydroelectric power uses the force of water to turn turbines that spin a generator to produce electricity. There are two types of hydroelectric power systems: (1) run-of-the-river systems and (2) storage systems. In a run-of-the-river system, the force of a river current provides the force to create the needed pressure for the turbine. In a storage system, water is accumulated in reservoirs created by dams and is released as needed to generate electricity.

DOE's Idaho National Environmental Engineering Laboratory (now Idaho National Laboratory) completed a comprehensive survey of hydropower resources in 1997. Michigan has a hydroelectric generating potential of 389 MW, adjusting for environmental, legal, and institutional constraints (Conner et al. 1998). These constraints could include (1) scenic, cultural, historical, and geological values, (2) Federal and State land use, and (3) legal protection issues, such as wild and scenic legislation and threatened or endangered fish and wildlife legislative protection. A separate assessment by DOE of nonpowered dams (dams that do not produce electricity) concludes that there is potential for only 48 MW of electricity in the State (ORNL 2012). These nonpowered dams serve various purposes, such as providing water supply to inland navigation.

Generating capacity of hydroelectric power is projected to continue decreasing through 2040 (EIA 2013b). In 2014, hydroelectric power represented 1 percent of Michigan’s total electricity (EIA 2015). Given the decrease in projected power generation from hydroelectric facilities and the low potential for developing additional capacity within Michigan, the NRC staff does not consider hydroelectric power to be a reasonable alternative to Fermi 2 license renewal.

2.3.6 Wave and Ocean Energy

Waves, currents, and tides are often predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies may be suitable to harness wave energy: (1) terminator devices that range from 500 kW to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM undated). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving a generator to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves then enter a tube and compress air that is used to drive a generator that produces electricity (NRC 2013a). Some designs are undergoing demonstration testing at commercial scales, but none are currently used to provide baseload power (BOEM undated).

The Great Lakes do not experience large tides, and energy output for wave technologies in the region is limited. The Electric Power Research Institute (EPRI) published a document that assessed ocean wave energy resources in the United States (EPRI 2011). The analysis did not include the Great Lakes, and there are no major studies that address the use of wave energy in the Great Lakes on a commercial scale. Consequently, the infancy of the technologies and the lack of associated studies addressing the resource potential of the Great Lakes support the NRC staff’s conclusion that wave and ocean energy technologies are not feasible substitutes for Fermi 2.

2.3.7 Fuel Cells

Fuel cells oxidize fuels without combustion and its environmental side effects. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts (depending on fuel characteristics) are heat, water, and carbon dioxide (depending on hydrogen fuel type) (DOE undated a). Hydrogen fuel can come from a variety of hydrocarbon resources, including natural gas.

Fuel cells are not economically or technologically competitive with other alternatives for electricity generation. EIA projects that fuel cells may cost $6,835 per installed kilowatt (total overnight capital costs, 2010 dollars), which is greater than other alternative replacement power technologies analyzed in this section (EIA 2010). More importantly, fuel cell units are likely to be small in size (approximately 10 MWe). Replacing the power that Fermi 2 provides would be cost prohibitive because it would require approximately 117 units and modifications to the existing transmission system. Given the immature status of fuel cell technology and its high cost, the NRC staff does not consider fuel cells to be a reasonable alternative to Fermi 2 license renewal.

2.3.8 Delayed Retirement

The retirement of a power plant ends its ability to supply electricity. Delaying the retirement of a power plant enables it to continue supplying electricity. A delayed retirement alternative would consider deferring the retirement of generating facilities within or near the DTE service area.

There are no nuclear plants in DTE's service area or elsewhere in Michigan for which delayed retirement could replace the baseload generating capacity of Fermi 2 by 2025 (DTE 2014). As described in Appendix E of this report, the J.R. Whiting Power Plant and two units of the Trenton Channel Power Plant are scheduled for retirement by 2016. Delayed retirement of these coal plants could retain approximately 550 MW of capacity. However, the Annual Energy Outlook 2014 (EIA 2013b) predicts that there will be more coal plant retirements before 2016 than previously predicted. These accelerated retirements are driven by low natural gas prices, slow growth in electricity demand, and the requirements of the Mercury and Air Toxics Standards that will impose significant reductions in plant emissions (EIA 2014b).

Most retired units generate more pollutants and are less efficient than new units. Often, units are retired because operation is no longer economical. In some cases, the cost of environmental compliance or necessary repairs and upgrades are too great to justify continued operation. For these reasons, the NRC staff does not consider delayed retirement to be a reasonable alternative to Fermi 2 license renewal.

2.3.9 Geothermal

Geothermal technologies extract the heat contained in geologic formations to produce steam to drive a conventional steam turbine generator. Facilities producing electricity from geothermal energy have demonstrated capacity factors of 95 percent or greater, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal power generation to provide baseload power depends on the regional quality and accessibility of geothermal resources. Utility-scale geothermal energy generation requires geothermal reservoirs with a temperature above 200 °F (93 °C). Utility-scale power plants range from small 300 kilowatts electric to 50 MWe and greater (TEEIC undated). Geothermal resources are concentrated in the western United States. Specifically, these resources are found in Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming (USGS 2008). In general, most assessments of geothermal resources have been concentrated on these western states. The DOE also has quantified geothermal resources in Minnesota and Vermont but not in Michigan (DOE 2013c). Geothermal resources are used in the ROI for heating and cooling purposes, but no electricity is currently being produced in the ROI from these resources (DTE 2015c, EIA 2014a). Given the low resource potential in the ROI, the NRC staff does not consider geothermal energy to be a reasonable alternative to Fermi 2 license renewal.

2.3.10 Municipal Solid Waste

Energy recovery from municipal solid waste converts nonrecyclable waste materials into usable heat, electricity, or fuel through combustion (EPA 2013b). The three types of combustion technologies are mass burning, modular systems, and refuse-derived fuel systems (EPA 2013a). Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is used to drive a turbine generator to produce electricity. Ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2013a). As of 2010, approximately 86 waste-to-energy plants are in operation in 25 States, processing more than 28 million tons of waste per year (EPA 2013b). These waste-to-energy plants have an aggregate capacity of 2,720 MWe, and although some plants have expanded to handle additional waste and to produce more energy, no new plants have been built in the United States since 1995 (EPA 2013b). The average waste-to-energy plant produces about 50 MWe of electricity, with some producing up to 77 MWe of electricity, and can operate at capacity factors greater than 90 percent (Michaels 2010). Michigan has three waste-to-energy facilities that produce approximately 89 MW of electricity (Michaels 2014). One of these three facilities is located in the ROI. On average, nearly 40 such plants would be necessary to provide the same level of output as Fermi 2.

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than energy considerations. Given the improbability that additional stable supplies of municipal solid waste would be available to support approximately 40 new facilities, and that so few existing plants operate in the ROI, the NRC staff does not consider municipal solid waste combustion to be a reasonable alternative to Fermi 2 license renewal.

2.3.11 Petroleum-Fired Power

EIA projects that petroleum-fired plants will account for very little of the new generation capacity constructed in the United States during the 2008 to 2030 time period (EIA 2013a). In 2014, Michigan generated 0.3 percent of its total electricity from petroleum (EIA 2015).

The variable costs of petroleum-fired generation tend to be greater than those of nuclear or coal-fired operations, and petroleum-fired generation tends to have greater environmental impacts than natural gas-fired generation. The high cost of petroleum has resulted in a steady decline in its use for electricity generation (EIA 2013a). Given the cost of petroleum and the small generating capacity from petroleum-fired power plants in the State, the NRC staff does not consider petroleum-fired generation a reasonable alternative to Fermi 2 license renewal.

2.3.12 Supercritical Pulverized Coal

In general, SCPC power plants are feasible, commercially available options for providing electrical generating capacity. Baseload coal units have proven their reliability and can sustain capacity factors as high as 79 percent. Pulverized coal power generation uses crushed coal that is fed into a boiler where it is burned to create heat. The heat produces steam that is used to turn one or more turbines to generate electricity. Among the technologies available, pulverized coal boilers that produce supercritical steam (SCPC boilers) are increasingly common for new coal-fired plants because of their high operating temperatures and pressures, which increase thermal efficiencies and overall reliability. SCPC facilities consume less fuel per unit output, thus reducing environmental impacts (NETL undated).

As described in Section 2.2.2.2, EPA has signed a final rule for carbon pollution that would apply to new fossil fuel-fired power plants, including SCPC facilities (EPA 2015). The action establishes performance standards and has identified a CCS system as a method of emission reduction. The emission limit for these sources is 1,305-lb CO_2/MWh, and any new coal-fired power plants could require CCS to achieve this emission limit.

In addition, given known technology and technological and demographic trends, EIA predicts that by 2040 natural gas will surpass coal as the largest share of U.S. electric power generation (EIA 2013a). This does not consider the EPA rule described above but indicates a general trend away from coal-fired facilities in favor of natural gas-fired power plants resulting from falling natural gas prices. MISO projected that the EPA regulations could lead to increased coal plant retirements and estimated retirements from 3,000 to 12,600 MW, which could have a large impact on MISO's reserve margin in the future (MISO 2011).

Given the potential for stringent air quality regulations and trends toward natural gas-fired power plants, the NRC staff does not consider SCPC to be a reasonable alternative to Fermi 2 license renewal. Instead, the NRC staff describes an IGCC plant as an alternative in Section 2.2.2.2.

2.3.13 Purchased Power

Power to replace the capacity of Fermi 2 could be purchased from sources within the United States or from sources within Canada, or both. The power purchased likely would be generated from coal, natural gas, nuclear, renewables, or some combination similar to the alternatives considered in this chapter. Unlike those alternatives considered in this chapter, facilities to supply purchased power would not likely be constructed solely to replace Fermi 2, although they may require construction of new transmission lines, on slightly older and less efficient technologies, and may operate at higher capacities.

One of the objectives that the State of Michigan is proposing is to "avoid undue reliance on energy produced by other states." Thus, reliance on electrical power produced outside the State of Michigan is contrary to the objectives of Michigan's 21st Century Electric Energy Plan (MPSC 2007). In addition, purchased power is generally economically adverse because the cost of generated power historically has been less than the cost of the same power provided by a third party (NRC 2013c). Power purchase agreements also have an inherent risk that the power contracted for will not be delivered.

For these reasons, the NRC staff does not consider purchasing power from other utilities or power generators to be a reasonable alternative for replacement of Fermi 2's baseload generation.

2.4 Comparison of Alternatives

In this chapter, the NRC staff considered the following alternatives to Fermi 2 license renewal: (1) NGCC generation, (2) IGCC generation, (3) new nuclear power generation, and (4) a combination alternative of natural gas, wind, and solar. The NRC staff also considered the no-action alternative and its impacts. The impacts for all alternatives to Fermi 2 license renewal are discussed in Chapter 4 and summarized in Table 2–2 below.

The environmental impacts of the proposed action (issuing a renewed Fermi 2 operating license) would be SMALL for all impact categories. The environmental impacts from all other alternatives would be larger than the proposed license renewal, as indicated in Table 2–2.

In conclusion, the environmentally preferred alternative is the granting of a renewed license for Fermi 2. All other alternatives capable of meeting the needs currently served by Fermi 2 entail potentially greater impacts than the proposed action of renewing the license for Fermi 2. To make up the lost generation of electricity if a renewed license is not issued (the no-action alternative), one alternative or a combination of alternatives would be implemented—all of which have greater impacts than the proposed action. Hence, the NRC staff concludes that the no-action alternative will have environmental impacts greater than or equal to the proposed license renewal action.

Table 2–2. Summary of Environmental Impacts of the Proposed Action and Alternatives

Impact Area (Resource)	Fermi 2 License Renewal (Proposed Action)	No-Action	NGCC Alternative	IGCC Alternative	New Nuclear Power Alternative	Combination of Alternatives (NGCC, Wind, and Solar)
Land Use	SMALL	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO LARGE	SMALL TO LARGE	SMALL TO MODERATE
Visual Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL TO LARGE
Air Quality	SMALL	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE	SMALL	SMALL TO MODERATE
Noise	SMALL	SMALL	SMALL	SMALL TO MODERATE	SMALL	SMALL TO MODERATE
Geologic Environment	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Surface Water Resources	SMALL	SMALL	SMALL	SMALL TO MODERATE	SMALL	SMALL
Groundwater Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Terrestrial Resources	SMALL	SMALL	SMALL TO MODERATE	MODERATE TO LARGE	SMALL TO LARGE	SMALL TO MODERATE
Aquatic Resources	SMALL	SMALL	SMALL	SMALL TO MODERATE	SMALL	SMALL
Special Status Species and Habitats	NO EFFECT	SEE NOTE[1]	SEE NOTE[1]	SEE NOTE[1]	SEE NOTE[1]	SEE NOTE[1]
Historic and Cultural Resources	SEE NOTE[2]	NO EFFECT	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO LARGE
Socioeconomics	SMALL	SMALL TO LARGE	SMALL TO LARGE	SMALL TO LARGE	SMALL TO LARGE	SMALL

[1] The magnitude of impact could vary widely based on site selection and the presence or absence of special status species and habitats when the alternative is implemented; therefore, the NRC staff cannot forecast a level of impact for this alternative.

[2] Based on (1) fulfillment of the MOA stipulations regarding the NRHP-eligible Fermi 1, (2) there currently being no other known NRHP-eligible historic properties on the Fermi site, (3) DTE's site procedures and work instructions for protecting cultural resources, (4) the assurance that no license renewal-related physical changes or ground-disturbing activities would occur, (5) Michigan SHPO input, and (6) this cultural resource assessment, no historic properties would be adversely affected by the license renewal decision (36 CFR Section 800.4(d)(1)).

Impact Area (Resource)	Fermi 2 License Renewal (Proposed Action)	No-Action	NGCC Alternative	IGCC Alternative	New Nuclear Power Alternative	Combination of Alternatives (NGCC, Wind, and Solar)
Transportation	SMALL	SMALL	SMALL TO LARGE	SMALL TO LARGE	SMALL TO LARGE	SMALL TO MODERATE
Human Health	SMAL[3]	SMALL[3]	SMALL	SMALL	SMALL[3]	SMALL
Environmental Justice	SEE NOTE[4]	SEE NOTE[5]	SEE NOTE[6]	SEE NOTE[7]	SEE NOTE[8]	SEE NOTE[9]
Waste Management	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL

3 The impacts on human health from Fermi 2 License Renewal and the New Nuclear Power Alternative overall are SMALL; however, the impacts from chronic effects of electromagnetic fields are categorized as UNCERTAIN.

4 Continued operation of Fermi 2 would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

5 The No-Action alternative could disproportionately affect minority and low-income populations that may have relied on the public services provided by Monroe County.

6 Based on available information, it is not likely that the NGCC alternative would have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations.

7 Based on available information, it is not likely that the IGCC alternative would have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations.

8 Based on available information, it is not likely that the new nuclear alternative would have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations.

9 Based on the available information, it is not likely that the Combination (NGCC, wind, and solar) alternative would have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations.

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3.0 AFFECTED ENVIRONMENT

In this supplemental environmental impact statement (SEIS), the “affected environment” is the environment that currently exists at and around Fermi 2. Because existing conditions are at least partially the result of past construction and operation at the plant, the impacts of these past and ongoing actions and how they have shaped the environment are presented here. The facility and its operation are presented in Section 3.1. Sections 3.2 to 3.13 present the affected environment.

3.1 Description of Nuclear Power Plant Facility and Operation

Fermi 2 is a single-unit nuclear power plant located in Frenchtown Township, Michigan. It began commercial operation in July 1985. Generally, the U.S. Nuclear Regulatory Commission (NRC) staff drew information about Fermi 2’s facilities and operation from the DTE Electric Company’s (DTE’s) Environmental Report (ER) (DTE 2014d).

3.1.1 External Appearance and Setting

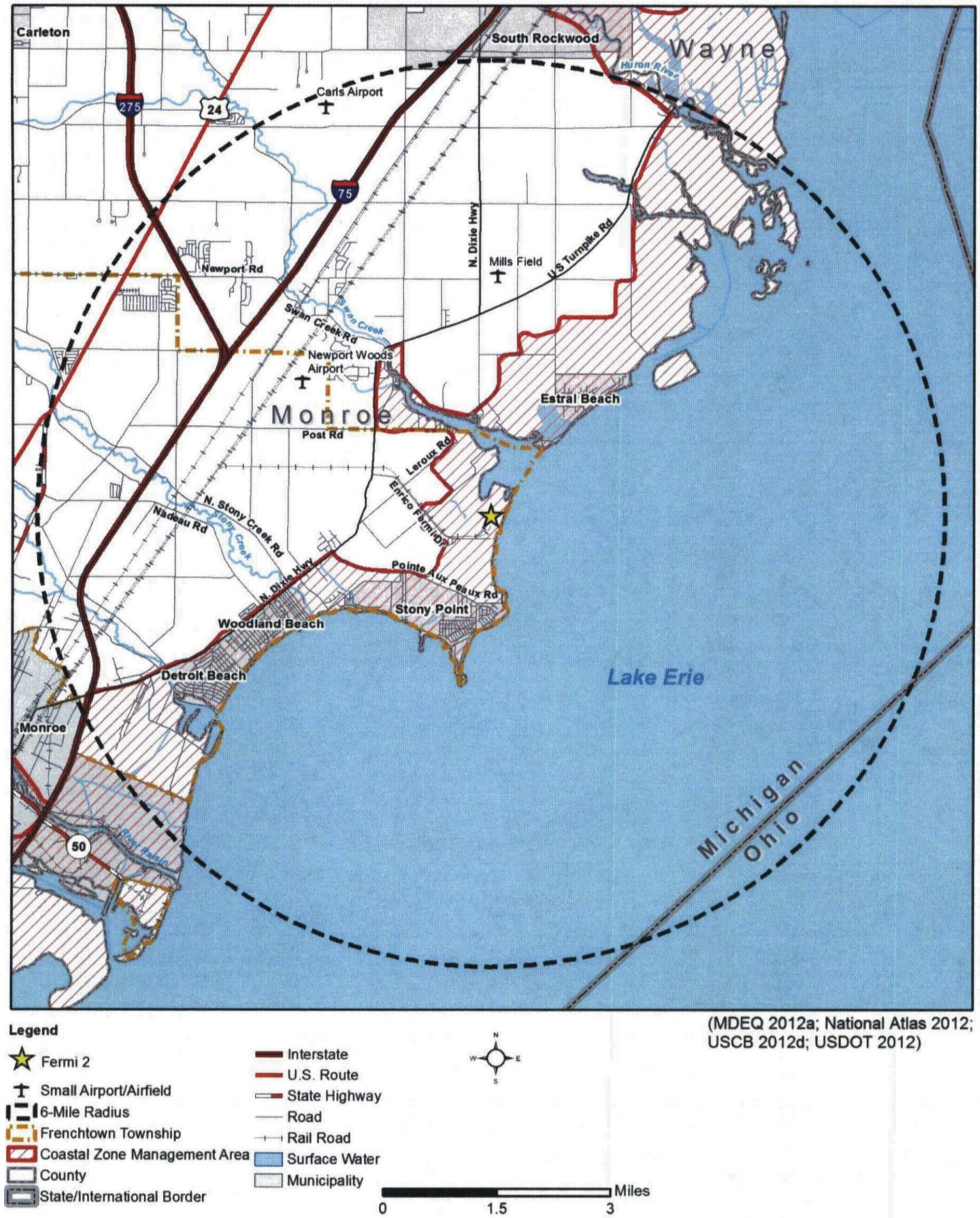
The Fermi site is located on the western shore of Lake Erie in Frenchtown Township, Monroe County, Michigan, approximately 8 miles (mi) (13 kilometers (km)) east-northeast of Monroe, 28 mi (45 km) south-southwest of Detroit, and 26 mi (42 km) northeast of Toledo, Ohio (Figure 3–1) (DTE 2014d).

Fermi 2 is located on approximately 1,260 acres (ac) (510 hectares (ha)) of land owned by DTE (Figure 3–2 and Figure 3–3). The principal structures at Fermi 2 consist of the reactor building, turbine building, auxiliary building, radioactive waste building, 120-kilovolt (kV) and 345-kV switchyards, residual heat removal (RHR) complex, two natural draft hyperbolic cooling towers, general service water (GSW) pump house, circulating water pump house, circulating water reservoir (CWR), meteorological tower, auxiliary boiler house, training center, and independent spent fuel storage installation (ISFSI) pad (DTE 2014d).

Figure 3–1. Fermi 2 50-mi (80-km) Radius Map

Source: DTE 2014d

1 **Figure 3–2. Fermi 2 6-mi (10-km) Radius Map**



2

3 Source: DTE 2014d

Figure 3–3. Fermi 2 Site Boundary

Source: NRC 2013a, Figure 2–1

3.1.2 Nuclear Reactor Systems

Fermi 2 uses a General Electric Company single-cycle, forced-circulation boiling water reactor (BWR) of the BWR 4 Class, with a pressure-suppression Mark I containment. The reactor pressure vessel contains the core and supporting structures; steam separators and dryers; jet pumps; control rod guide tubes; distribution lines for the feedwater; core sprays; and standby liquid control, in-core instrumentation, and other components. The main connections to the reactor pressure vessel include the steam lines, the coolant recirculation lines, feedwater lines, control rod drive housings, and emergency core cooling system lines (DTE 2014d).

The reactor recirculation system consists of two recirculation pump loops that are external to the reactor vessel but are inside the primary containment. These loops provide the piping path for the driving flow of water to the reactor vessel jet pumps that provide continuous internal circulation of the core coolant flow (DTE 2014d).

On February 10, 2014, the NRC approved Fermi 2's measurement uncertainty recapture (thermal power optimization) request to increase the thermal power limit from 3,430 megawatts thermal (MWt) to 3,486 MWt (NRC 2014a). This measurement uncertainty recapture increases the net electrical capacity from 1,150 megawatts-electric (MWe) to approximately 1,170 MWe. Fuel for the reactor core consists of enriched uranium dioxide pellets sealed in Zircaloy-2 tubes. Fuel enrichment and average peak rod burnup conditions are no more than 5 percent uranium-235 and 60,000 megawatt-days per metric ton of uranium, respectively (DTE 2014d).

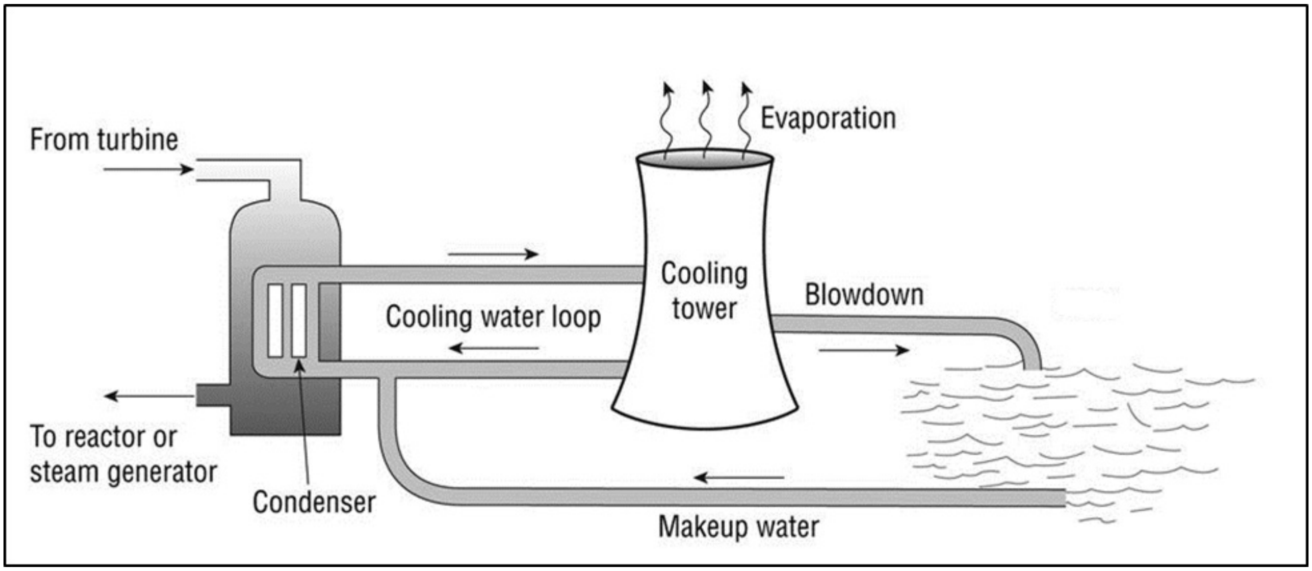
3.1.3 Cooling and Auxiliary Water Systems

Fermi 2 uses a closed-cycle (cooling-tower-based) heat dissipation system that during normal plant operating conditions withdraws makeup water from, and discharges cooling water back to, Lake Erie. Two concrete natural draft cooling towers are used for heat dissipation.

Fermi 2's GSW system supplies water to the plant heat exchangers for use in waste heat removal and other nonsafety-related plant systems. Water is withdrawn from Lake Erie for GSW makeup through a shoreline pump house and intake canal located southeast of the main plant complex. In turn, discharge from the GSW system provides a source of makeup water for the circulating water system (CWS) and the CWR, which supplies the main condenser (DTE 2014d).

A BWR, like the one used at Fermi 2, generates steam directly in the reactor vessel. The steam passes through moisture separators and steam dryers and then flows to the turbine. Such systems contain only two heat transfer (exchange) loops (DTE 2014d; NRC 2013b). The primary loop transports the steam from the reactor vessel directly to the turbine, which generates electricity. The secondary cooling water loop removes excess heat from the primary loop in the main condenser. From the condenser, the primary condensate is returned as feedwater to the reactor; the secondary cooling water loop removes the excess heat and then routes it to the cooling towers. The cooling towers dissipate the excess heat to the atmosphere. Water that is not lost to evaporation is either recirculated through the system or discharged as blowdown (i.e., water that is periodically rinsed from the cooling system to remove impurities and sediment that may degrade plant performance) to a receiving water body. Water that is lost to evaporation or that is discharged as blowdown must be replaced with fresh water; this water is referred to as makeup water (NRC 2013b). Figure 3–4 provides a basic schematic diagram of a once-through cooling system with a natural draft cooling tower.

Figure 3–4. Closed-Cycle Cooling System with Natural Draft Cooling Tower



Source: Modified from NRC 2013b

No onsite groundwater is used at the site. Water for potable and other related uses is supplied by the Frenchtown municipal system, which also withdraws water from Lake Erie.

Unless otherwise cited for clarity, the NRC drew information about Fermi's cooling and auxiliary water systems from the DTE's ER (DTE 2014d) and from the updated final safety analysis report (UFSAR) (DECo 2012e, 2012f). The NRC staff visited the facilities cited herein during the September 2014 environmental site audit (NRC 2014d). Individual plant systems that interact with the environment are discussed further below.

3.1.3.1 General Service Water and Intake System

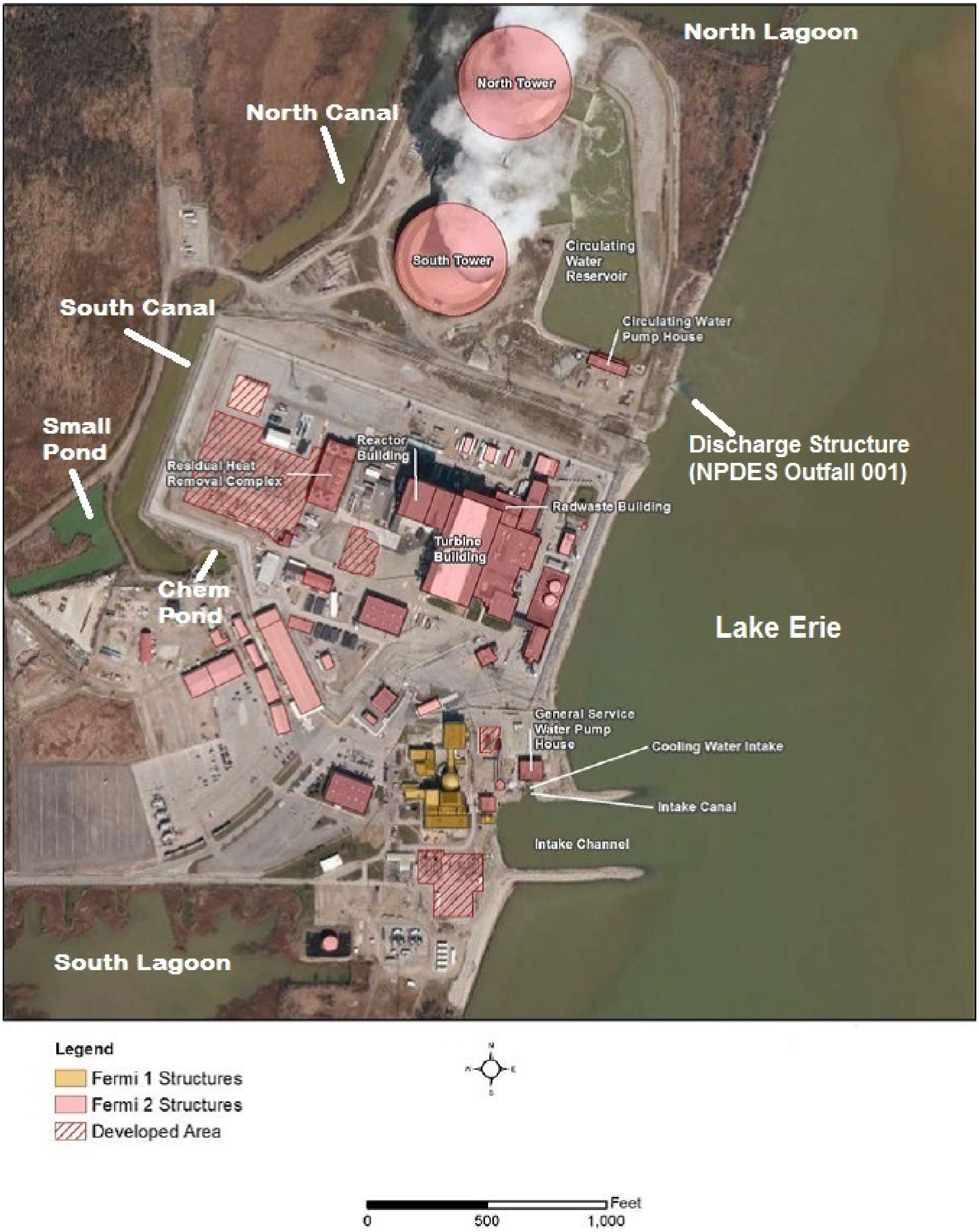
The GSW system consists of two trash racks, two traveling screens, sluice gates, five GSW pumps located in the GSW pump house and two CWR makeup pumps to provide additional makeup water to the CWR, five strainers on the discharge of the GSW pumps, and the necessary piping and other equipment and controls to operate the system components. As discussed later, the GSW pump house also contains two 100-percent-capacity CWR makeup pumps and two 100-percent-capacity fire water pumps.

The GSW system provides water to support both continuous and intermittent demands at Fermi 2. It provides a continuous flow to the biocide injection system and plant heat exchanger equipment, the reactor building and turbine building closed cooling water heat exchangers, the main generator hydrogen coolers, and the main turbine lube oil coolers. The return flow from these sources is discharged into the CWR for circulating water makeup usage. Intermittent flow is provided to the auxiliary boiler house, the traveling screen backwashing system, the fire protection system, the lawn sprinkling system, and the RHR complex.

Makeup water for the GSW system is withdrawn through a lakeshore intake structure at the head of a concrete intake canal (Figure 3–5) that originally served Fermi 1. The head of the canal is 33 feet (ft) (10 meters (m)) wide with an average water depth of 12.5 ft (3.8 m) that increases down the canal toward the pump house. The canal runs approximately 61 ft (19 m) from its entrance to the submerged opening into the GSW pump house, with the last 25 ft (7.6 m) of the canal separated into two channels by a concrete pier. Water enters through the pump house's two submerged intake openings and passes through two stationary steel-bar trash racks (with a 3-inch (in.) (7.6-centimeter (cm)) spacing) that are equipped with a sliding steel rake system to remove floating debris. Trash and other debris collected by the rake system are discharged to a collection cart before disposal.

After the trash racks, intake water then flows through two screen bays, each 11.75 ft (3.6 m) in width. Each bay has a vertical traveling screen designed to prevent small debris that is not intercepted by the trash racks and fish from entering the pump pits. Each screen has 3/8-in. (0.95-cm) woven wire openings that are mounted on two strands of endless roller chains. Based on intake velocity studies performed between 1991 through September 1992, no average velocity at the intake forebay or traveling screens exceeded 0.5 feet per second (0.15 meter per second). The traveling screens can operate in automatic or manual modes, and a line from the GSW discharge header provides high-pressure water to backwash each screen. The screens are also equipped with a separate line that supplies warm water for deicing. Backwashing is automatically initiated when differential pressure readings across the screens rise above a predetermined value (DECo 2012f). The backwash system sprays water out through the screens to remove debris while the screens are rotating, and a smaller traveling screen filters the debris. Backwash can be directed to the GSW backwash system or the Fermi 1 overflow canal (North Canal) through a permitted outfall, and an auger system collects and conveys the debris and any fish removed from the screens to a collection container for proper disposal. The intake has neither a low-pressure wash to remove impinged fish from the screens nor a separate fish return system. The configuration of the backwash system allows for the addition of biocides to the entire GSW to prevent fouling of piping from zebra mussel (*Dreissena polymorpha*) infestation.

1 **Figure 3–5. Fermi 2 Cooling Water Supply Facilities and Major Surface Water Features**



2

3 Source: Modified from DTE 2014d

Water passing through the traveling screens enters the GSW pump pits, which are equipped with sluice gates that allow the pits to be closed off to Lake Erie. The GSW pump house houses five GSW pumps that take suction from the pits. Each pump has a capacity of 7,700 gallons per minute (gpm) (17 cubic feet per second (cfs) or 0.48 cubic meter per second (m^3/s)), and each has its own basket strainer to remove any remaining debris with automatic backwashing. As demand varies, the pumps are operated as necessary from the Fermi 2 main control room (DECo 2012f). During the winter months, two pumps are normally in service, and four are in service during the summer. Consequently, with four GSW pumps operating, Fermi 2 withdraws approximately 30,800 gpm (68.6 cfs (1.94 m^3/s)) or about 44.4 million gallons per day (mgd) (168,000 cubic meters per day (m^3/d)) of water from Lake Erie.

3.1.3.2 Circulating Water System and Blowdown Discharge

The CWS provides water to the main condenser to condense the steam discharged from the Fermi 2 turbine. Cooling occurs as heat is rejected from the circulating water to the atmosphere through the plant's natural draft cooling towers. The system normally supplies water to the main condenser at temperatures ranging from 55 °F to 94 °F (13 to 34 °C). However, when lake intake temperatures fall to 35 °F (1.7 °C), the cooling towers are bypassed within the circulating water flow.

The CWS encompasses the main condenser, two cooling towers, the CWR, and associated circulating water pumps and piping. The CWR is a 5.5-ac (2.2-ha) impoundment located immediately east of, and adjacent to, Fermi's two natural-draft cooling towers (Figure 3–5). From the CWR, water is pumped through the CWS piping from the circulating water pump house located at the southern end of the CWR. This structure contains five circulating water pumps. Each pump has a rated capacity of 180,000 gpm (400 cfs (11.3 m^3/s)). Based on plant heat load demand and weather, one to five circulating pumps may be operated to meet circulating water needs. The pumps take suction from the CWR, and the water is passed through a stationary screen for debris removal. Sodium hypochlorite is added as a biocide to the circulating water to limit biofouling of condenser tube surfaces. The circulating water is then discharged through two pipelines to the plant's main condenser. Heated water returns through two interconnected 12-ft- (3.7-m)-diameter pipes and conveyed to Fermi 2's natural draft cooling towers, with cooled water exiting the base of the towers and flowing back to the CWR.

The CWS also includes a blowdown (decanting) system to keep dissolved solid concentrations in the circulating water at acceptable levels. Blowdown is discharged continuously to Lake Erie at a rate ranging from approximately 10,000 to 30,000 gpm (22.3 to 67 cfs (0.63 to 1.9 m^3/s), or 14.4 to 43.3 mgd)). Decanting pumps discharge blowdown through a 3-ft- (1-m)-diameter discharge line that runs east from the circulating water pump house to a shoreline discharge structure, which is Fermi 2's primary National Pollutant Discharge Elimination System (NPDES) permit (No. MI0037028) (MDNR 2010) that allows the plant to discharge blowdown through Outfall 001 to Lake Erie (Figure 3–5). As further described in Section 3.5.1.3 of this SEIS, the Fermi 2 NPDES permit imposes limits on the blowdown discharge and specifies monitoring of residual chlorine and other listed biocides (used for zebra mussel control) from Outfall 001. Sodium bisulfite is added to dechlorinate the blowdown stream in accordance with NPDES permit provisions. The plant's NPDES permit does not impose any thermal effluent limits, such as either a maximum temperature or a change in receiving water temperature per unit of time. The nominal (design) temperature rise in the circulating water passing through the main condenser results in a discharge temperature to the lake that is typically no higher than approximately 18 °F (10 °C) above that of the intake water. Fermi 2's NPDES permit does include a cold shock prevention requirement (applicable November through March) for the gradual reduction of discharges to allow aquatic life to acclimate to reduced temperatures near Outfall 001.

Makeup water is needed to replace evaporative (cooling tower evaporation and drift and evaporation from the CWR) and blowdown losses from normal operation of the CWS, as described above. Normally, when losses exceed the normal makeup rate from the GSW, two circulating water makeup pumps located in the GSW pump house provide additional makeup water to the CWR through a 54-in. (138-cm) pipeline that connects the GSW pump house and the CWR. Each 100-percent capacity pump is rated at 15,000 gpm (33.4 cfs (0.94 m^3/s)) (DECo 2012f). Alternatively, the pipeline can also be used to supply heat loads normally serviced by the GSW by opening the normally closed valve in the connecting pipeline between the CWR and the GSW pump intake pit while closing the sluice gates to the intake canal. In this manner, the GSW and CWSs can operate sufficiently long enough to support plant load reduction and shutdown. This dual capability guards against low lake levels or otherwise from the loss of the intake structure.

3.1.3.3 Residual Heat Removal Complex

Although Fermi 2's natural-draft cooling towers provide the normal heat sink for the plant's main condenser and auxiliary cooling systems, the RHR complex serves as the ultimate heat sink for plant shutdown and recovery from the loss of normal cooling during emergency conditions. The RHR complex comprises seismic Category I (safety-related) structures, including a highly reliable water supply reservoir; mechanically induced draft cooling towers for heat rejection; four emergency diesel generators for emergency power; a makeup water supply and blowdown system; and associated pumps, piping, and controls. The ultimate heat sink system is sized to provide sufficient cooling for 7 days following a reactor shutdown without makeup water addition to the RHR reservoir (DECo 2012f).

The RHR complex reservoir consists of two one-half-capacity reinforced-concrete structures, each storing 3.41 million gal (12,900 m^3) of water. Each reservoir structure is equipped with a two-cell induced draft cooling tower located on top of it that is designed to cool one division of the plant load and provide complete redundancy. Blowdown from the induced-draft cooling towers is discharged to the CWR. The GSW system provides makeup water to the RHR complex to replace evaporation and blowdown losses during normal shutdown cooling.

3.1.3.4 Potable Water System

Potable water is supplied to the Fermi site through a distribution pipeline from the Frenchtown Township Water Department. Delivered water is stored in a 100,000-gal (380-m^3) elevated storage tank from where potable water is distributed to restrooms, drinking fountains, kitchen facilities, and safety showers throughout the Fermi site and to the turbine building heating, ventilation, and air conditioning evaporative coolers. Potable water is also supplied to the demineralized water makeup system, which provides demineralized water to Fermi 2's reactor core. Fermi site's potable demand is approximately 20,000 gallons per day (76 m^3/d), or about 14 gpm) (DTE 2014d).

The source of Frenchtown Township's water supply is Lake Erie, and it shares a raw water intake with the City of Monroe at Pointe Aux Peaux located south of the Fermi site. In 2006, the township upgraded its water treatment plant's capacity to 8 mgd (30,300 m^3/d, or about 5,560 gpm). The township's current excess supply capacity is approximately 4 mgd (15,140 m^3/d, or about 2,780 gpm) (MCPDC 2010; NRC 2013a).

3.1.3.5 Fire Protection Water System

Fire protection water mains encircling the Fermi site are normally supplied with makeup water from the GSW system. However, firewater can also be supplied directly through two interconnected fire-water pumps housed in the GSW pump house. One pump is electric-driven, and the other is a diesel-driven pump. Both pumps have a capacity of 2,500 gpm (51 cfs or

1.44 m^3/s), and each can supply the required fire protection water demands. The pumps are normally in standby mode as the fire mains are supplied with makeup water and pressurization from the fire protection jockey pump, which takes suction from the GSW pump header. Changes in pressure between the fire protection and GSW supply headers will automatically trigger the pumps in sequence as demands dictate (DECo 2012f; DTE 2014d).

3.1.4 Radioactive Waste Management Systems

As part of normal operations and as a result of equipment repairs and replacements due to normal maintenance activities, nuclear power plants routinely generate both radioactive and nonradioactive wastes. Nonradioactive wastes include hazardous and nonhazardous wastes. There is also a class of waste, called mixed waste, that is both radioactive and hazardous. The systems used to manage (i.e., treat, store, and dispose of) these wastes are described in this section. Waste minimization and pollution prevention measures commonly employed at nuclear power plants are also discussed in this section.

All nuclear plants were licensed with the expectation that they would release radioactive material to both the air and water during normal operation. However, the NRC's regulations require that gaseous and liquid radioactive releases from nuclear power plants must meet radiation dose-based limits specified in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, and the as low as is reasonably achievable (ALARA) criteria in Appendix I to 10 CFR Part 50. Regulatory standards in 10 CFR 20.1301 limit the radiation dose that members of the public can receive from radioactive effluents released by a nuclear power plant. All nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

Fermi 2 uses liquid, gaseous, and solid waste processing systems to collect and process, as needed, radioactive materials produced as a by-product of plant operations. The liquid and gaseous radioactive effluents are processed to reduce the levels of radioactive material before such materials are discharged to the environment to ensure that the dose to members of the public from radioactive effluents is reduced to levels that are ALARA in accordance with the NRC's regulations. The radioactive material removed from the effluents is either released into the environment or converted into a solid form for disposal at a licensed radioactive disposal facility. Fermi 2 has an Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters used to calculate offsite doses resulting from liquid and gaseous radioactive effluents (DTE 2014d).

Fermi 2 assesses the impact to the environment from its radioactive effluents through the use of a radiological environmental monitoring program (REMP). The REMP measures the aquatic, terrestrial, and atmospheric environment for radioactivity, as well as the ambient radiation. The REMP monitors and/or obtains samples from indicator stations close to the plant to determine direct impacts from Fermi 2 operations and has control stations located farther away from the plant to measure background radiation (i.e., cosmic sources; global fallout; and naturally occurring radioactive material, including radon). The Fermi 2 REMP was established in 1978 before the nuclear operations to obtain data on background radiation and radioactivity levels in the local environment (DTE 2014d).

3.1.4.1 Radioactive Liquid Waste Management

The liquid radioactive waste system at Fermi 2 collects, monitors, processes, stores, and returns radioactive liquid wastes to the plant for reuse or to the CWR blowdown line for controlled discharge. The collection and processing are done in a controlled, preplanned manner in compliance with established regulatory requirements. Any leakage or spillage due to equipment failure or malfunction is contained and recollected in the system. The system is capable of handling anticipated quantities of liquid radioactive waste without affecting the normal operation or availability of the plant.

At times, the liquid radioactive waste system may produce water that may not be required for reuse; in this case, the liquid effluent could be discharged in a controlled manner to the CWR blowdown line. Processed liquid not meeting the criteria for either discharge or reuse is normally returned to the system for reprocessing.

Fermi 2 operates three radioactive liquid waste subsystems: (1) the floor drain collector (FDC) subsystem, (2) the waste collector subsystem (WCS), and (3) the side stream liquid radioactive waste processing subsystem (DTE 2014d).

Floor Drain Collector Subsystem

The FDC subsystem receives inputs from various floor drains in the plant. The inputs to this subsystem have been segregated from the WCS because the generally poor quality water from the FDC inputs has high conductivity and higher concentrations of suspended and dissolved solids. However, the radioactivity levels are generally lower than that of the WCS. Periodic and variable quantities of oil and grease are also handled by this subsystem and, when necessary, are removed by filters and an oil coalescer, which combines the oil into a mass that can be readily removed from the waste stream. Evaporators can also be used to separate the FDC subsystem low-purity liquid by evaporation and condensation into a concentrated liquid that is sent to the radioactive solid waste system and a high-purity distillate that is sent to the FDC and waste collector demineralizers. The FDC and waste collector streams are normally passed through demineralizers. If needed, additional filters can be used to provide additional cleanup of the waste stream. The estimated design-basis daily volume inputs for the FDC subsystem is 15,219 gal (57,608 liters (L)), and the maximum daily volume input is calculated to be 42,284 gal (160,058 L) (DTE 2014d).

Waste Collector Subsystem

The WCS receives inputs from a variety of plant equipment drain sources. The equipment drain sources have been segregated from the FDC subsystem (and other sources) because the WCS inputs are generally of a higher purity, having lower conductivity and suspended solids, than that of the FDC inputs. The radioactive material concentrations handled by the WCS are generally higher than they are in the FDC subsystem. Oil and grease may be present in the WCS but less frequently than they are in the FDC subsystem. Oil coalescers are available for oil removal, as needed. The WCS also handles liquid waste generated by the radioactive solid waste system that dewaters solid waste for disposal.

The estimated design-basis daily volume inputs for the WCS total 28,805 gal (109,035 L). The maximum daily equipment drain volume input to this subsystem is calculated to be 48,846 gal (184,897 L). A waste surge tank, which has a working volume of about 65,700 gal (248,694 L) serves as the backup collection point for any excess volume input to the WCS (DTE 2014d).

Side Stream Liquid Radioactive Waste Processing Subsystem

The side-stream liquid radioactive waste processing subsystem processes chemical waste tank contents before forwarding it to the floor drain collector tank (FDCT). In addition, it processes liquids, such as sludge from various building sumps, water collected in drums from the standby liquid control system rinses during refueling outages, and water from mopping the building floors.

The side-stream liquid radioactive waste processing subsystem includes two evaporators and two components that makeup the post-treatment system (PTS). The PTS consists of a granulated active charcoal filter; an ultraviolet total organic carbon reducing system; a mixed bed filter; and associated tanks, pumps, and other system components.

Each evaporator can process liquids in 55-gal (208-L) batches at a nominal rate of 0.2 gpm (0.8 liters per minute (L/min)). The vapor from the evaporator is condensed and collected in the post-treatment batch tank. The evaporator residue is processed and shipped as radioactive solid waste. Liquids from the post-treatment batch tank are processed by the PTS. The PTS can process FDCT liquids at a nominal 40 gpm (151 L/min) rate. The processed liquid is collected in the sample batch tank and returned to the FDCT through the radioactive waste building basement floor drain system (DTE 2014d).

The use of these radioactive waste systems and the procedural requirements in the Fermi 2 ODCM ensure that the dose to members of the public from radioactive liquid effluents complies with NRC and U.S. Environmental Protection Agency (EPA) regulatory dose standards.

Dose estimates for members of the public are calculated based on radioactive liquid effluent release data and aquatic transport models. DTE's annual radiological effluent release report contains a detailed presentation of any radioactive liquid effluents released from Fermi 2 and the resultant calculated doses. The NRC staff reviewed 5 years of radioactive liquid effluent release data: 2009 through 2013 (DECo 2010b, 2011d, 2012c, 2013b; DTE 2014e). A 5-year period provides a data set that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance activities, that can affect the generation of radioactive effluents. As noted by DTE in its ER, Fermi 2's last planned radioactive liquid effluent release was in 1994. Since that time, Fermi 2 has operated as a zero-discharge radioactive liquid effluent release facility with a goal to continue operating in the manner in the future. The NRC staff's review of the radioactive liquid effluent release data shows that Fermi 2 had not had any planned radioactive liquid effluent releases in Lake Erie for the years 2009 through 2013. However, DTE reported in its "2010 Annual Radiological Environmental Operating Report and Radiological Effluent Release Report for Fermi 2" that on December 1, 2010, there was an inadvertent (abnormal) release of radioactive water from a spill inside its radiological restricted area into its sanitary sewer system. As a result, some of this water entered the sewer line leading to the Monroe wastewater treatment plant and was discharged into Lake Erie. The potential dose to a member of the public from this abnormal release was calculated by Fermi 2 personnel to be 1.3×10^{-6} millirem (mrem) (1.3×10^{-8} millisievert (mSv)) to the total body and 4.5×10^{-6} mrem (4.5×10^{-8} mSv) to the gastrointestinal tract (DECo 2011d).

The NRC staff compared these calculated doses against the NRC's ALARA dose criteria in Appendix I to 10 CFR Part 50. The 1.3×10^{-6} mrem (1.3×10^{-8} mSv) total body dose is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50. The 4.5×10^{-6} mrem (4.5×10^{-8} mSv) dose to the gastrointestinal tract is well below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50.

As previously discussed, there were no planned radioactive liquid effluent releases from Fermi 2 during the 5-year period from 2009 through 2013. Therefore, there was no dose to members of the public from radioactive liquid effluents other than the dose from the abnormal release in 2010.

Routine plant refueling and maintenance activities currently performed will continue during the license renewal term. Based on the past performance of the radioactive waste system to maintain doses from radioactive liquid effluents within NRC and EPA radiation protection standards and on the DTE's goal to maintain Fermi 2 as a zero-discharge radioactive liquid effluent release facility in the future, similar performance is expected during the license renewal term.

3.1.4.2 Radioactive Gaseous Waste Management

The radioactive gaseous waste system at Fermi 2 reduces radioactive materials in gaseous effluents before being released into the environment.

Gaseous radioactive wastes are released into the atmosphere in a controlled and monitored manner. The radioactive gaseous waste sampling and analysis program specifications provided in the Fermi 2 ODCM address the gaseous release type, sampling frequency, minimum analysis frequency, type of activity analysis, and lower limit of detection (i.e., sensitivity) for the radiation monitors.

Gaseous wastes are generated from the main condenser, the turbine gland seal condenser, and various plant ventilation systems that collect gases from the main steam line and primary coolant system.

The noncondensible gases (offgas) removed from the main condenser is the largest single source of radioactive gaseous waste from the plant. Other sources of radioactive gaseous waste include releases from the turbine gland seal steam condenser and releases from various plant ventilation systems from potential leakage of the main steam line and primary reactor coolant system.

Fermi 2 uses an offgas system to reduce the amount of radioactive material released into the environment. Above low power operation, the offgas system processes the condenser offgas by delaying the gases in six charcoal beds so that significant radioactive decay of the radionuclides occurs before their release from the plant.

During plant operation, offgas released from the steam-jet air ejectors is diluted with steam to control hydrogen concentrations. The gas is heated and enters a component that uses a catalytic process to combine the hydrogen and oxygen into water. The gases are routed to a long pipe that takes them approximately 2.2 minutes to transit. This time delay allows the short half-life radionuclides to decay away. The gases are then passed through a sand filter followed by charcoal adsorbers. A system vacuum pump maintains a slightly negative pressure throughout the offgas system to minimize system leakage. The condenser offgas system removes most of the radioactivity from the waste gases and removes essentially all of the hydrogen. The effluent from the offgas system is discharged from the plant after dilution in the reactor building ventilation system exhaust (DTE 2014d).

The use of these radioactive waste systems and the procedural requirements in the Fermi 2 ODCM ensure that the dose to members of the public from radioactive gaseous effluents complies with NRC and EPA regulatory dose standards.

Dose estimates for members of the public are calculated based on radioactive gaseous effluent release data and atmospheric transport models. DTE's annual radioactive material release report contains a detailed presentation of the radioactive gaseous effluents released from Fermi 2 and the resultant calculated doses. The NRC staff reviewed 5 years of radioactive effluent release data: 2009 through 2013 (DECo 2010b, 2011d, 2012c, 2013b; DTE 2014e). A 5-year period provides a data set that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance activities, that can affect the generation of radioactive effluents. The NRC staff compared the data against NRC dose limits and looked for indication of adverse trends (i.e., increasing dose levels) over the period of 2009 through 2013. The following information summarizes the calculated doses from radioactive gaseous effluents released from Fermi 2 during 2013:

- The air dose at the site boundary from gamma radiation in gaseous effluents from Fermi 2 was 3.15×10^{-3} millirad (mrad) (3.15×10^{-5} milligray (mGy)), which is well below the 10 mrad (0.1 mGy) dose criterion in Appendix I to 10 CFR Part 50.
- The air dose at the site boundary from beta radiation in gaseous effluents from Fermi 2 was 1.43×10^{-3} mrad (1.43×10^{-5} mGy), which is well below the 20 mrad (0.2 mGy) dose criterion in Appendix I to 10 CFR Part 50.
- The dose to an organ (bone) from radioactive iodine, radioactive particulates, and carbon-14 from Fermi 2 was 2.20×10^{-1} mrem (2.20×10^{-3} mSv), which is well below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50.

The NRC staff's review of Fermi 2's radioactive gaseous effluent control program showed that radiation doses to members of the public were controlled within NRC and EPA radiation protection standards in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190. No adverse trends were observed in the dose levels.

Routine plant refueling and maintenance activities currently performed will continue during the license renewal term. Based on the past performance of the radioactive waste system to maintain doses from radioactive gaseous effluents within NRC and EPA radiation protection standards, similar performance is expected during the license renewal term.

3.1.4.3 Radioactive Solid Waste Management

Low-level radioactive waste (LLW) is generated by the removal of radioactive material from liquid waste streams, filtration of gaseous effluents, and removal of contaminated material from various reactor areas.

The radioactive solid waste system at Fermi 2 collects, processes, and packages LLW for disposal at a licensed LLW disposal facility. Radioactive liquid and wet solid wastes and slurries are processed to remove the water from the waste and are stored temporarily until they are transported to a licensed LLW disposal facility. A subsystem packages, stores, and prepares dry wastes generated during plant operations for disposal. The dry waste includes paper, rags, and other disposables that are usually compacted to reduce their volume. The equipment used to process the solid waste is designed to minimize the release of radioactive material and radiation exposure to plant personnel. Radioactive solid waste processing is performed in the onsite storage facility (OSSF) using a vendor-supplied system.

The Fermi 2 solid radioactive waste system has a portable solidification and dewatering system supplied and operated by a vendor. The types and quantities of waste to be processed are the same as those for the Fermi radioactive liquid radioactive waste system discussed above. The OSSF was specifically designed and constructed to contain and handle the waste processing systems. The basic design of the processing areas and the methods of system operation incorporate features to minimize radioactive exposure to plant personnel. Concrete floors and walls use a protective coating, and drains are routed back to the liquid radioactive waste system. The waste is transported in a shielded tunnel directly to the vendor's processing equipment. A remote-operated overhead crane is available to move equipment onto or from trucks located in the facility's truck bay.

Radioactive liquid waste is either solidified or dewatered and placed into either a steel liner or a high-integrity container for transport to a licensed low-level radioactive disposal facility. Depending on the radiation levels, the steel liner or high-integrity container may be put into a shielded shipping cask to reduce the external radiation levels to minimize radiation exposure to workers and members of the public during transport.

Transportation of radioactive solid waste for further processing or disposal is performed in accordance with the NRC's regulations at 10 CFR Part 71 and with the U.S. Department of Transportation's regulations at 49 CFR 171–178. In 2013, 46 shipments were made from Fermi 2 to treatment facilities for processing and disposal. The radioactive waste was sent to three locations in 2013: (1) the EnergySolutions facility in Clive, Utah, (2) the EnergySolutions processing facility in Oak Ridge, Tennessee, where the waste is further processed before disposal, and (3) the EnergySolutions disposal facility in Barnwell, South Carolina. The total volume and radioactivity of LLW shipped offsite in 2013 was $9.87 \times 10^{+2}$ m^3 ($3.48 \times 10^{+4}$ cubic feet (ft^3) and $3.51 \times 10^{+3}$ curies ($1.30 \times 10^{+8}$ megabecquerels), respectively (DTE 2014e). Radioactive waste can also be shipped to the Waste Control Specialist facility in Andrews, Texas, as needed; however, no shipments were made to the Waste Control Specialist facility in 2013. Routine plant operation, refueling outages, and maintenance activities that generate radioactive solid waste will continue during the license renewal term. Radioactive solid waste is expected to be generated and shipped off site for disposal during the license renewal term.

3.1.4.4 Radioactive Waste Storage

LLW is stored temporarily on site in restricted areas until it can be shipped off site for disposal at a licensed LLW disposal facility.

LLW is classified as Class A, Class B, Class C, or greater than Class C. Class A includes both dry active waste and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated hardware. The majority of LLW generated at Fermi 2 is Class A waste. It can be shipped to licensed processors for volume reduction and repackaging, or it can be shipped from Fermi 2 directly to a licensed LLW disposal facility. Classes B and C wastes constitute a low percentage by volume of the total LLW generated and are stored at Fermi 2. The Waste Control Specialist facility in Andrews, Texas, is licensed by the State of Texas for disposal of Classes A, B, and C wastes; therefore, this facility could be used for disposal of Fermi 2 Class B and Class C wastes as needed. Disposal of greater than Class C waste is the responsibility of the Federal Government (DTE 2014d).

Fermi 2 uses the OSSF for holding LLW. It provides interim storage capacity for the amount of waste estimated to be generated during a 5-year period of plant operation. The storage capacity allows Fermi 2 to continue operating in the event that LLW disposal facilities may be temporarily unavailable. Under normal conditions, a portion of the storage facility is used as a staging area to load the LLW onto transport vehicles.

Fermi 2 has developed long-term plans to ensure that LLW generated during the license renewal term would be sent directly for disposal, stored on site in existing structures, or shipped to an offsite licensed facility for processing and disposal. Fermi 2 expects that there will be adequate LLW processing and storage capacity so that construction of additional LLW storage facilities will not be needed (DTE 2014d).

Fermi 2 stores its spent nuclear fuel in a spent fuel pool and on an ISFSI storage pad. An ISFSI is used to safely store spent fuel in licensed and approved dry cask storage containers on site. The installation and monitoring of an ISFSI is governed by NRC requirements in 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste."

The Fermi 2 ISFSI storage pad is a 141-ft- x 141-ft- (43-m- x 43-m)-square reinforced concrete structure that is 2 ft (0.6 m) thick. The pad is designed to accommodate 64 dry storage casks. Additionally, the area to the north of the pad has been prepared for possible future expansion of the pad to allow up to an additional 32 dry storage casks (DTE 2014d).

3.1.4.5 Radiological Environmental Monitoring Program

DTE conducts an REMP to assess the radiological impact, if any, to the public and the environment from the operations at the Fermi site.

The REMP measures the aquatic, terrestrial, and atmospheric environment for radioactivity, as well as the ambient radiation, by sampling air, water, milk, leafy vegetables, fish, and sediment. In addition, the REMP measures background radiation (i.e., cosmic sources; global fallout; and naturally occurring radioactive material, including radon). The radiation detection devices and analysis methods used to determine the radioactivity in environmental samples are very sensitive to small amounts of radioactivity (DTE 2014e).

The Fermi 2 REMP is designed to perform the following:

- Analyze atmospheric and liquid pathways for anticipated types and quantities of radioactive effluents released from Fermi 2.
- Assess the potential buildup of long-lived radionuclides in the environment and identify physical and biological accumulations that may contribute to human exposures.
- Consider the potential radiation exposure to plant and animal life in the environment surrounding Fermi 2.
- Correlate levels of radiation and radioactivity in the environment with radioactive effluent releases from Fermi 2.

The Fermi 2 REMP was established in 1978 before the station became operational to provide data on background radiation and radioactivity normally present in the airborne, direct radiation, waterborne, and ingestion pathways.

The REMP includes sampling indicator and control locations. The REMP uses indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation and control locations farther away from the site to indicate the presence of naturally occurring radioactivity. Fermi 2 personnel compare indicator results with control and preoperational results to assess any impact that Fermi 2 operations may have had on the surrounding environment (DTE 2014d).

In addition to the REMP, Fermi 2 has an onsite groundwater protection program designed to monitor the onsite plant environment to improve the management and response to instances in which the inadvertent release of radioactive material may result in detectable levels of plant-related radioactive material in subsurface soils and water (DTE 2014d). Section 3.5.2 of this SEIS contains information on the groundwater protection program.

The NRC staff reviewed 5 years of annual radiological environmental monitoring data: 2009 through 2013 (DECo 2010b, 2011d, 2012c, 2013b; DTE 2014e). A 5-year period provides a data set that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance activities, that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indication of adverse trends (i.e., buildup of radioactivity levels) over the period of 2009 through 2013.

The NRC staff's review of the DTE's data showed no indication of an adverse trend in radioactivity levels in the environment. The data showed that there was no measurable impact to the environment from operations at Fermi 2.

3.1.5 Nonradioactive Waste Management Systems

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals. These wastes include trash, paper, wood, and sewage (NRC 2013b).

Fermi 2 has a nonradioactive waste management program to handle its nonradioactive hazardous and nonhazardous wastes. The waste is collected in central collection areas within the Fermi site and managed in accordance with DTE's procedures. The materials are received in various forms and packaged to meet regulatory requirements before their final disposition at an offsite facility licensed to receive and manage the waste. The following list summarizes of the types of waste materials generated and managed at Fermi 2:

- Fermi 2 is classified as a small quantity hazardous waste generator. The amounts of hazardous wastes generated are only a small percentage of the total wastes generated. These wastes consist of paints and paint-related materials; spent, off-specification, and shelf-life expired chemicals; laboratory chemical wastes; and occasional project-specific wastes. Fermi 2 has processes in place to transfer hazardous waste to licensed offsite treatment and disposal facilities (DTE 2014d).

- Fermi 2's nonhazardous wastes include used oil and ethylene glycol. Universal wastes, such as batteries, mercury-containing lamps, oils, scrap metal, aluminum cans, plastic bottles, cardboard, and paper, are recycled when possible in accordance with DTE's procedures (DTE 2014d). General plant trash is collected in dumpsters and transported to a State-licensed regional landfill permitted to accept solid wastes.

- Low-level mixed waste (LLMW) is waste that contains a low-level radioactive component regulated under the Atomic Energy Act of 1954, as amended (AEA) (42 U.S.C. 2011 et seq.), and a hazardous component regulated under the Resource Conservation and Recovery Act of 1976, as amended (RCRA) (42 U.S.C. 6901 et seq.). The State of Michigan regulates the hazardous component of the mixed waste through RCRA, and the NRC regulates the radioactive component through the AEA. Mixed wastes generated at Fermi 2 may consist of paint debris, oil laboratory waste, halogenated oil, grease, solvents, parts cleaner filters, and aerosol cans. These wastes are managed in accordance with Fermi 2's waste management program to ensure compliance with applicable regulatory requirements and good practices. Once the wastes are moved to the OSSF, they are managed in accordance with Fermi 2's LLMW management procedure, which prescribes the storage and disposal requirements. Fermi 2 operates under the conditional exemption for LLMW storage and disposal per Michigan Administrative Code (MAC) R299.9822 (MI 2014). Liquid LLMW is transported to Diversified Scientific Services, Inc., in Kingston, Tennessee, which is licensed to accept and manage the wastes. Solid and semi-solid LLMW is stored at the OSSF and has not been shipped offsite for disposal.

- DTE transfers domestic sewage to the City of Monroe wastewater collection system for treatment. Effluent discharge is regulated under the pretreatment effluent limitations and other conditions specified in the Fermi 2 discharge permit (DTE 2014d).

3.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at nuclear power plants typically interfaces with public infrastructure systems available in the region. Such infrastructure includes utilities, such as suppliers of electricity, fuel, and water, and roads and railroads that provide access to the site. The following sections briefly describe the existing utility and transportation infrastructure at Fermi 2.

3.1.6.1 Electricity

Fermi 2 uses electricity supplied by other independent power plants to operate. Six transmission lines provide offsite power to Fermi 2 from the grid, as needed. DTE owns three of these lines, which extend approximately 640 ft (200 m) from the 345-kV switchyard to Fermi 2 Division II systems. The International Transmission Company (ITC Transmission) owns the remaining three lines, which extend approximately 1,550 ft (474 m) from the 345-kV switchyard to the Fermi 2 circulating water pump house. Additionally, three underground 13.2-kV medium voltage cables provide offsite power to Fermi 2 Division I systems, the GSW pump house, and the cooling tower circulating water pumps. DTE also maintains four emergency diesel generators as a standby power source for RHR (DTE 2014d).

3.1.6.2 Fuel

Two underground fiberglass storage tanks—one 8,000-gal (30,000-L) gasoline tank and one 6,000-gal (23,000-L) diesel fuel tank—provide fuel for onsite vehicles (DTE 2014d). DTE also maintains a number of nonnuclear fuels on site to operate emergency generators, auxiliary boilers for heating the plant, and peaker units (DTE 2014g). Table 3–1 lists and describes these fuel storage units. Additionally, some building heat is generated from propane (DTE 2014g). Section 3.1.4 discusses nuclear fuel and radioactive waste systems.

Table 3–1. Fermi 2 Nonnuclear Fuel Storage Units

Storage Unit	Fuel Type	Location	Capacity (in gal)[(a)]
Combustion Turbine Generator Diesel Storage Tank	Diesel	Southwest of Fermi 1 site adjacent to South Lagoon	845,970
Temporary Diesel Generator Diesel Storage Tank	Diesel	North side of peaker yard, east of enclosure	1,000
Emergency Diesel Generator (EDG) Fuel Oil Tank	Diesel	In RHR complex	168,00 total (4 tanks)
EDG Diesel Storage Tanks	Diesel	In RHR complex	2,200 total (4 tanks)
Auxiliary Boiler Fuel Oil Tank	Diesel	North of auxiliary boiler house	159,000
Fermi 2 Diesel Fire Pump Oil Tank	Diesel	North exterior side of the GSW pump house	275
Nuclear Operations Center Emergency Diesel Storage Tank	Diesel	South side of Nuclear Operations Center building (west of back entrance)	500
Security EDG Diesel Storage Tanks	Diesel	North and south side of reactor building	1,000 total (2 tanks)
Liquid Propane Gas	Propane	Various locations outside the protected area	Currently 13,000 (15 tanks)

[(a)] To convert U.S. gallons to liters, divide gallons by 0.26417.

Source: DTE 2014g

3.1.6.3 Water

The Frenchtown Township water system supplies the Fermi site with potable water for the demineralized water makeup system; sanitary plumbing; drinking fountains; washrooms; kitchen facilities; safety showers; and heating, ventilation, and air conditioning evaporative coolers in the turbine building. Potable water coming into the site flows into a 100,000-gal (380,000-L) elevated storage tank, and underground piping distributes water from the tank to the various onsite facilities (DTE 2014d). Section 3.1.3 describes the Fermi 2 cooling and auxiliary water systems.

3.1.6.4 Transportation Systems

Enrico Fermi Drive serves as the main entrance to the Fermi site. Enrico Fermi Drive connects to North Dixie Highway, which links the site to local communities north and south and to many other key local and regional highways. Interstate 75 (I-75) lies 2 mi (1.2 km) west of the Fermi site and is the closest interstate access point to the site (DTE 2014d). Section 3.10.6 describes local transportation systems, including roadway access, in more detail.

Three major railway systems provide service near the Fermi site: (1) Canadian National Railway, (2) CSX Transportation, Inc., and (3) Norfolk Southern Corporation (DTE 2014d). The Canadian National Railway maintains one active railroad spur off of its main line that traverses the Fermi site in a west-east direction parallel to Enrico Fermi Drive (DECo 2011b). DTE (2014d) transports large and heavy equipment to and from the site via this rail spur.

The Great Lakes St. Lawrence Seaway System is a deep draft waterway that extends 2,340 mi (3,700 km) from the Atlantic Ocean to the head of the Great Lakes and into mid-Lake Erie (SLSMC 2014). Most barge traffic in the vicinity of the Fermi site travels to and from the Ports of Toledo, Detroit, and Monroe. A former barge slip, which was used to offload equipment during Fermi 2 construction, lies in the northeast corner of the site near the cooling towers (DECo 2011b). The barge slip is no longer operational, but Fermi 3, if constructed by the applicant, would include the construction of a new barge slip east of the 120-kV switchyard (DECo 2011b). The Fermi 3 barge slip would remain on the site during the proposed Fermi 2 license renewal term.

The Wayne County Airport Authority operates the Detroit Metropolitan Wayne County Airport and the Willow Run Airport, which are located 19 mi (31 km) north and 7 mi (11 km) west of the Fermi site, respectively. Detroit Metropolitan Wayne County Airport is the largest commercial airport in the region, and Willow Run Airport is the largest cargo airport in the region. Several other smaller cargo, passenger, and private airports lie in the vicinity of the Fermi site (NRC 2013a).

3.1.6.5 Power Transmission Systems

ITC Transmission owns and operates the transmission system in Southeastern Michigan, including a 120-kV switchyard and a 345-kV switchyard on the Fermi site and the lines extending from these switchyards that connect to the regional electric grid. The 120-kV switchyard was originally built to service the decommissioned Fermi 1; it now services four diesel fuel-fired turbine generators that provide power to the Fermi 2 Division I systems. The 345-kV switchyard transfers electricity generated by Fermi 2 into a regional grid and transfers offsite power onto the site for station use (DECo 2011b; DTE 2014d).

For license renewal, the NRC (2013b) evaluates those transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid.

DTE (2014d) has determined that the following transmission lines are in-scope for the license renewal environmental review:

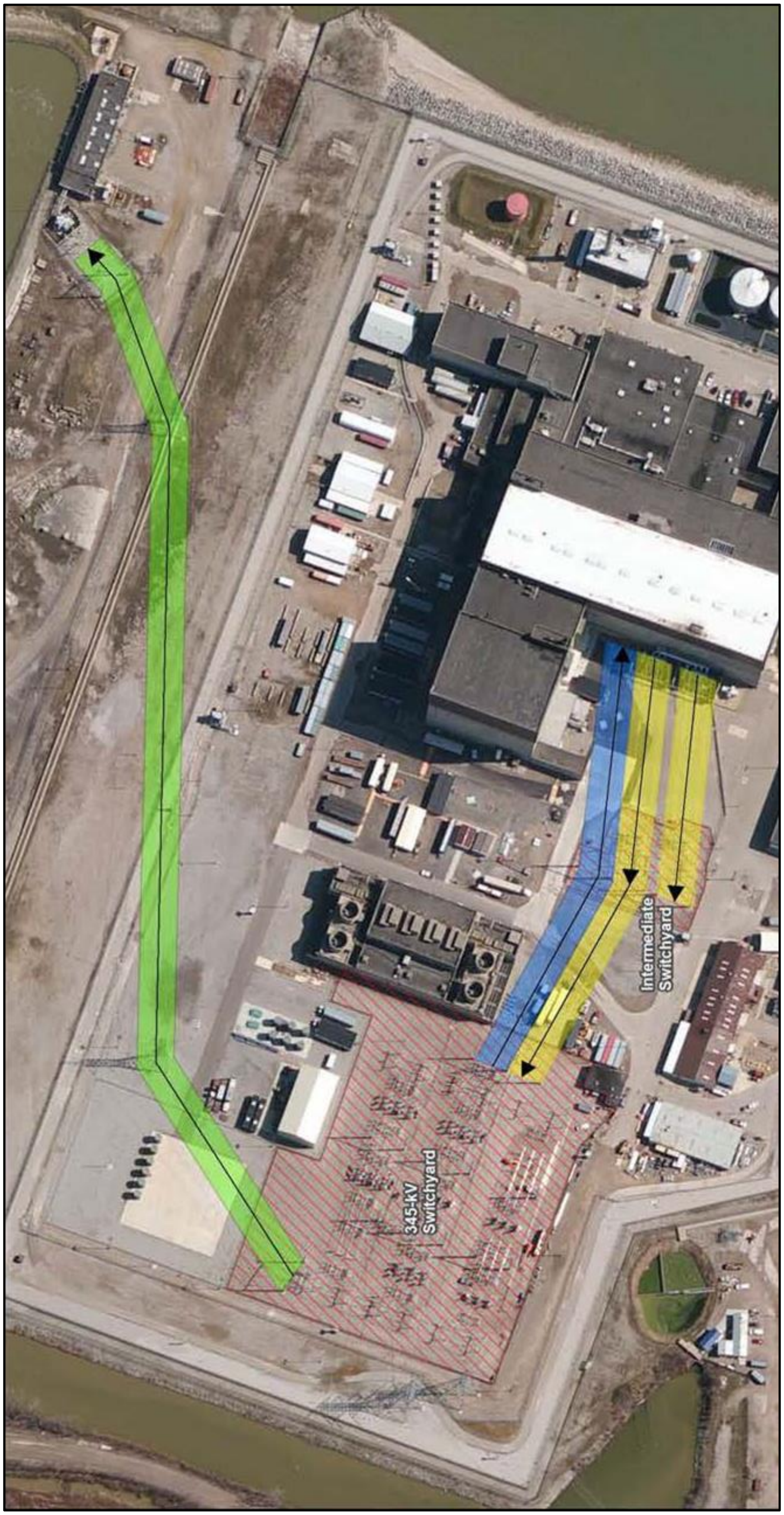
- Six transmission lines that transmit electricity from Fermi 2 to the electrical grid. These lines extend from the Fermi 2 turbine building, combine into three lines through a common bus, and terminate at the 345-kV switchyard. The total length of the lines is 315 ft (96 m).

- Six transmission lines that provide offsite power to Fermi 2. Three lines extend approximately 640 ft (195 m) from the 345-kV switchyard to the plant and provide offsite power to the Fermi 2 Division II systems. The remaining three lines extend approximately 1,550 ft (472 m) from the 345-kV switchyard to the Fermi 2 circulating water pump house.

All of the in-scope transmission lines lie within the owner-controlled and industrial use area of the site. Figure 3–6 depicts the in-scope transmission lines.

The out-of-scope portions of the transmission lines (those that would stay in service regardless of Fermi 2 license renewal) extend from the 345-kV switchyard west to the Fermi site perimeter fences. An associated transmission line corridor traverses the site, and DTE and the U.S. Fish and Wildlife Service (FWS) have collaboratively restored a small area near the west property boundary to native prairie (discussed in Section 3.6). The lines continue from the site boundary about 5 mi (8 km) to a point west of I-75 where the lines turn north and run adjacent to I-275 for about 12 mi (19 km) before terminating at the Brownstown Substation in Woodhaven, Michigan (DECo 2011b).

Figure 3–6. Fermi 2 In-Scope Transmission Lines



Source: DTE 2014d, Figure 2.2–7

3.1.7 Nuclear Power Plant Operations and Maintenance

Maintenance activities conducted at Fermi 2 include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. Various programs and activities are currently in place at Fermi 2 to maintain, inspect, and monitor the performance of facility structures, components, and systems. These activities include in-service inspections of safety-related structures, systems, and components, quality assurance and fire protection programs, and radioactive and nonradioactive water chemistry monitoring.

Additional programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications and include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Certain program activities are performed during the operation of the units, whereas others are performed during scheduled refueling outages (DTE 2014d). Reactor refueling occurs on an 18-month cycle (DTE 2014d).

3.2 Land Use and Visual Resources

3.2.1 Land Use

3.2.1.1 Onsite Land Use

The Fermi site encompasses approximately 1,260 ac (510 ha) in Frenchtown Township, Monroe County, Michigan. The site lies on the west bank of Lake Erie approximately 30 mi (48 km) southwest of Detroit, Michigan; about 24 mi (39 km) northeast of Toledo, Ohio; and 7 mi (11 km) east of the United States-Canada border, which runs through Lake Erie (NRC 2013a).

The site is bounded on the north by Swan Creek, on the east by Lake Erie, on the south by Pointe Aux Peaux Road, and on the west by a private road owned by DTE. Large lagoons dominate the northern and southern areas of the site, whereas the western side of the site includes several wood lots and a series of small quarry lakes. Site elevation ranges from lake level on the eastern edge of the site to approximately 25 ft (7.6 m) above lake level on the western edge of the site (DTE 2014f).

Land on the Fermi site is designated as “industrial” by Monroe County and is zoned as “public service” by Frenchtown Township. Future land use maps produced by both planning agencies indicate that these uses will continue on the Fermi 2 property (Anulewicz and McKenna 2003; MCPDC 2010). Table 3–2 lists, and Figure 3–7 depicts, site land uses.

Table 3–2. Fermi Site Land Uses by Area

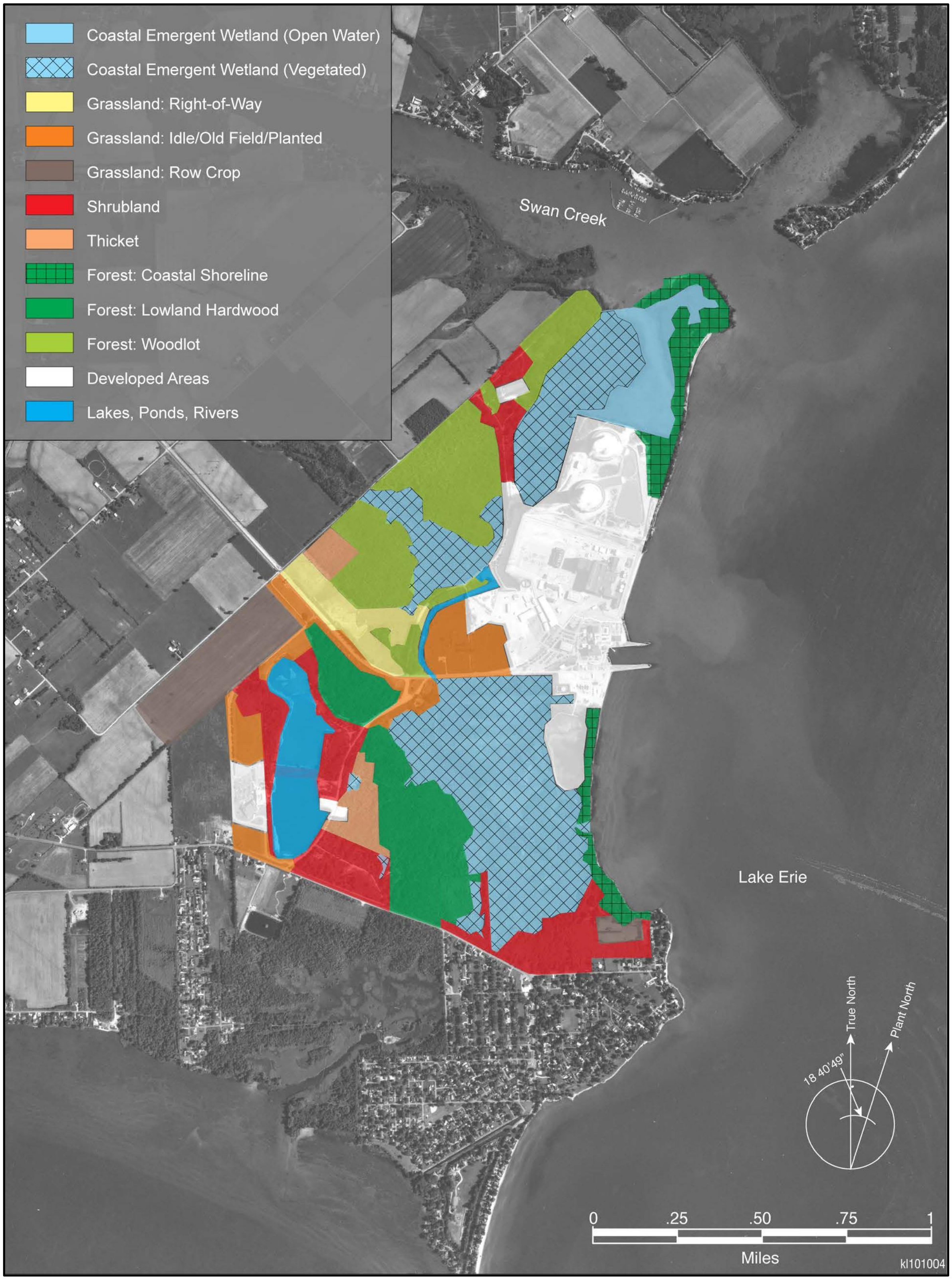
Land Use	Area (in acres)	Percent
Developed Areas	212	16.8
Decommissioned Fermi 1	6.7	0.5
Fermi 2 plus associated support facilities	205.3	16.3
Fermi 3	0[(a)]	0.0
Coastal Emergent Wetland	273	21.7
Forest	256	20.3
Coastal shoreline	47	3.7
Lowland hardwood	92	7.3

Land Use	Area (in acres)	Percent
Woodlot	117	9.3
Water	215	17.1
Lakes, ponds, rivers	44	3.5
Lake Erie	171	13.6
Grassland	168	13.3
Row crops	64	5.1
Idle/old field/planted	75	5.9
Right-of-way	29	2.3
Shrubland	113	9.0
Thicket	23	1.8
Total	**1,260**	**100.0**

(a) At this time, no land has been committed to the proposed Fermi 3. However, if Fermi 3 is built, 301 ac (122 ha) would be required, and 112 ac (45 ha) of the 301 ac (122 ha) would have been land that was previously disturbed during Fermi 1 or 2 construction (DTE 2014g).

Sources: NRC 2013a; DECo 2011b; DTE 2014d, 2014g

1 **Figure 3–7. Fermi Site Land Uses**

2 

3 Source: DECo 2011b, Figure 2–10

Developed Areas

Approximately 212 ac (86 ha) of the site are developed and in industrial use. In addition to the Fermi 2 facilities described in Section 3.1.1, Fermi 1, an experimental sodium-cooled breeder reactor that operated from 1957 through 1972, also lies on the site. Fermi 1 is permanently shut down and in safe storage status with a possession-only license that expires in 2025 (DTE 2014b). At a future date, decommissioning activities will continue to remove the remaining radioactive material associated with Fermi 1 and to terminate the Fermi 1 license (DTE 2014b).

Fermi 3, a proposed economic simplified boiling water reactor, for which the NRC approved a combined license (COL) application on May 1, 2015 (NRC 2015), would also be contained within the footprint of the existing site if constructed by the applicant. Fermi 3 would share some facilities with Fermi 2, including office buildings, potable water supply, and sanitary discharge structures. Fermi 3 would require the construction of a new reactor building, an additional cooling water intake, a new natural draft cooling tower, an underwater discharge pipe, a switchyard, transmission lines, and other buildings and facilities that would directly support power generation (NRC 2013a). Construction would disturb an estimated 301 ac (122 ha); 154 ac (62 ha) of those acres would be permanently occupied (NRC 2013a). Approximately 189 ac (77 ha) of the land that would be disturbed is currently undeveloped. The NRC (2013a) considered the environmental impact of construction and operation of Fermi 3 in NUREG–2105, "Environmental Impact Statement for the Combined License (COL) for Enrico Fermi Unit 3," and Section 4.16 of this SEIS considers contributions from the cumulative impacts of Fermi 3 during the proposed license renewal period.

The site also includes transmission lines, a railroad spur that connects to the Canadian National main line, and a former barge slip—all of which are discussed in Section 3.1.6. Figure 3–3 depicts the site layout.

Natural Areas

The majority of the site (1,048 ac (424 ha) or 83.1 percent) consists of natural areas, including coastal emergent wetlands, forests, grasslands, shrublands, thickets, Lake Erie, and other various waterbodies (Table 3–2). The northern and southern portions of the site feature large lagoons, whereas the western portion includes coastal emergent wetlands and a series of quarry lakes (DTE 2014d; NRC 2013a). The quarry lakes formed when water filled abandoned rock quarries that were created to provide crushed limestone to raise the site elevation and prevent flooding during Fermi 2 construction (DECo 2011b). Small parcels of forested land occur in the northwestern and southwestern portions of the site and along the Lake Erie shoreline. Site elevation ranges from the Lake Erie water level to approximately 25 ft (7.6 m) above lake level (DECo 2011b). Sections 3.6 and 3.7 describe the terrestrial and aquatic resources, respectively, and provide more information on the site's natural areas.

Detroit River International Wildlife Refuge

Since September 2003, DTE has maintained a cooperative agreement with the FWS to allow the FWS to manage 62.6 percent (656 ac (265 ha)) of the site's natural areas as part of the Detroit River International Wildlife Refuge (DRIWR) (DECo 2011b; DECo and FWS 2003). Congress established the DRIWR in 2001, and it is the only international wildlife refuge in North America. The refuge includes islands, coastal wetlands, marshes, shoals, and waterfront lands along 48 mi (77 km) of the western Lake Erie shoreline and Detroit River (EPA 2009b). The DRIWR lands on the Fermi site constitute the refuge's Lagoona Beach Unit (DTE 2014d) (Figure 3–8). The general public does not have access to the Lagoona Beach Unit (DECo 2011b). Section 3.6 discusses the DRIWR in more detail.

Figure 3–8. Detroit River International Wildlife Refuge, Lagoona Beach Unit Boundaries on the Fermi Site

Source: DTE 2014d, Figure 3.6–1

Leased Cropland

DTE leases approximately 64 ac (26 ha) in the western-most portion of the site to private individuals for agricultural use (DECo 2011b). This land is typically planted with one crop—either corn or soybeans—and harvested annually (DECo 2011b). Figure 3–7 depicts the area leased for cropland.

According to the Natural Resources Conservation Service's (NRCS's) maps (NRCS 1997), a portion of the leased cropland contains prime farmland. The U.S. Department of Agriculture (USDA) defines "prime farmland" as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is also available for these uses (USDA 1993). Although much of the Fermi site likely once qualified as prime farmland, DTE (2014d) indicates that construction- and operation-related disturbances would no longer qualify most areas on the site as potential prime farmland.

Mineral and Surface Rights

In Michigan, minerals can be owned by the surface property owner or by a different party. DTE owns and controls 99.93 percent of mineral rights within the Fermi site (DECo 2011b). In the far southeastern portion of the site near the meteorological tower, the Michigan Department of Natural Resources (MDNR) owns 0.88 ac (0.36 ha) of mineral rights (DECo 2011b). DTE (2014d) indicates that presently there is no exploration or commercial mineral production on the Fermi site or on properties adjoining the site and that no such projects are anticipated to occur in the foreseeable future.

DTE (2014d) has acquired surface ownership of all land on the Fermi site and would maintain ownership during the proposed license renewal term.

Coastal Zone

The Fermi site lies within Michigan's coastal zone (i.e., the coastal waters and the adjacent shore lands strongly influenced by one another, which may include islands, transitional and intertidal areas, salt marshes, wetlands, beaches, and Great Lakes waters). In 1972, Congress promulgated the Coastal Zone Management Act of 1972 (CZMA) (16 U.S.C. 1451 et seq.) to encourage and assist states and territories in developing management programs that preserve; protect; develop; and, where possible, restore or enhance, the resources of the coastal zone. Individual states are responsible for developing a Federally approved Coastal Management Plan and implementing a coastal management program in accordance with such a plan. In Michigan, the Michigan Department of Environmental Quality (MDEQ) administers the coastal management program.

Section 307(c)(3)(A) of the CZMA requires that applicants for Federal permits whose proposed activities could reasonably affect coastal zones certify to the licensing agency (here, the NRC) that the proposed activity would be consistent with the state's coastal management program. The regulations that implement the CZMA indicate that this requirement is applicable to renewal of Federal licenses for actions not previously reviewed by the state (15 CFR 930.51(b)(1)).

In a September 3, 2013, telephone conversation between the MDEQ and DTE, the MDEQ indicated that once DTE submits the license renewal application to the NRC, it should request a consistency determination review by formal letter. On October 29, 2013, DTE (2013a) sent the MDEQ a letter summarizing the September 3, 2013, telephone conversation. Subsequently, in a May 16, 2014, letter, DTE (2014g) submitted its request and a copy of the Fermi 2 license renewal application to the MDEQ. The MDEQ (2014b) responded in a letter dated July 28, 2014. In that letter, the MDEQ indicated that no adverse impacts to coastal resources are anticipated from the license renewal as long as all required permits are issued and that DTE complies with those permits. DTE (2014g) has indicated that all required permits for Fermi 2 have been issued and that DTE is in compliance with those permits. Accordingly, the proposed Fermi 2 license renewal is consistent with Michigan's Coastal Management Program.

3.2.1.2 Offsite Land Use

Within a 6-mi (10-km) radius of the Fermi site, most lands are contained within Monroe County; however, the radius also includes a small area of land in Wayne County and a portion of Lake Erie within the State of Ohio. Lake Erie comprises the majority of the area within this radius (about 52.2 percent). Agriculture, which accounts for about 20.5 percent, is the largest land use. Developed land, including open space and low-intensity, medium-intensity, and high-intensity developed categories, comprises 11.3 percent. Figure 3–9 illustrates land uses and land cover within 6 mi (10 km) of the Fermi site (DTE 2014d).

Monroe County is a predominantly agricultural County with two major residential areas (the City of Monroe and Bedford Township), other scattered small towns, forested areas, and wetlands (MCPDC 2010). The County encompasses 549.4 square miles (mi^2) (1,423 square kilometers (km^2)) (351,600 ac or 142,400 ha) (USCB 2014f), and according to the 2012 Census of Agriculture (USDA 2014b), 49.3 percent of land within Monroe County is farmland devoted to either crop or livestock production. This value is down from the Southeast Michigan Council of Government's (SEMCOG's) estimate of 54.2 percent in 2008 (SEMCOG 2014a). Monroe County's major agricultural crops include corn, soybeans, wheat, vegetables, and forage, and major livestock commodities include laying hens, cattle, calves, horses, ponies, sheep, and lambs (USDA 2014b). The County's land cover is predominantly characterized as open space (72 percent), which includes agricultural fields, grasslands, and turf grass (SEMCOG 2014a). The Monroe County Comprehensive Plan (MCPDC 2010) indicates that a substantial portion of the County is prime farmland. Table 3–3 and Table 3–4 summarize Monroe County's land uses in 2008 and land cover in 2010, respectively.

Table 3–3. Monroe County Land Use, 2008

Land Use	Area (in acres)	Percent
Agricultural	193,439	54.2
Residential	111,596	31.3
Commercial	8,398	2.4
Industrial	8,134	2.3
Governmental/Institutional	5,780	1.6
Park, recreation, and open space	10,066	2.8
Airport	316	0.1
Transportation, communication, and utility	14,036	3.9
Water	4,981	1.4
Total	**356,746**	**100.0**

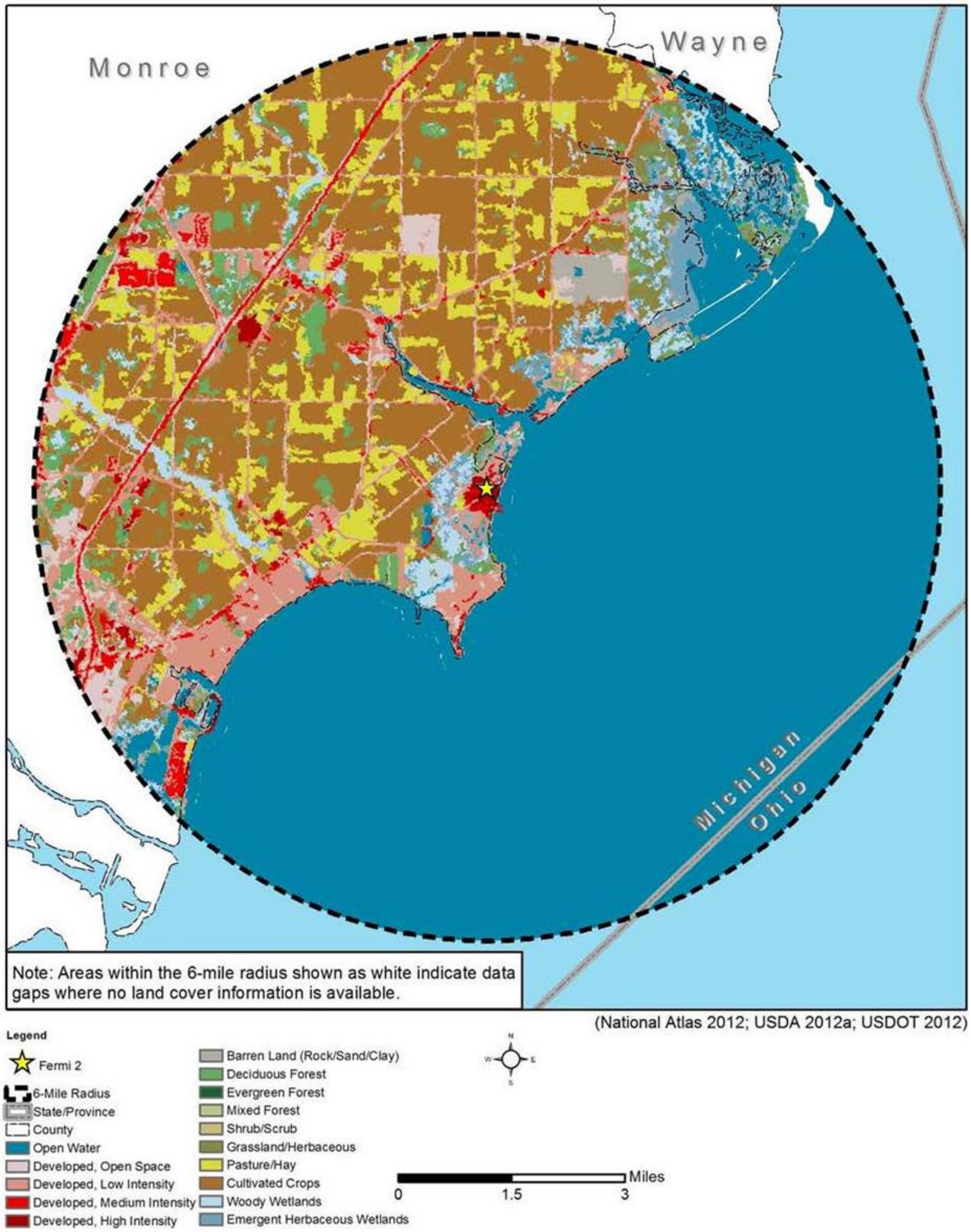
Source: SEMCOG 2014a

Table 3–4. Monroe County Land Cover, 2010

Type	Description	Area (in acres)	Percent
Open Space	agricultural fields, grasslands, turf grass	257,905	72.3
Trees	woody vegetation, trees	66,784	18.7
Impervious	buildings, roads, driveways, parking lots	21,486	6.0
Water	rivers, lakes, drains, ponds	7,114	2.0
Bare	soil, aggregate piles, unplanted fields	3,507	1.0
Total		**356,797**	**100.0**

Source: SEMCOG 2014a

Figure 3–9. Land Use and Land Cover within a 6-mi (10-km) Radius of the Fermi Site



Source: DTE 2014d, Figure 3.1–2

The Monroe County Comprehensive Plan (MCPDC 2010) anticipates that the County will experience a slight (8-percent) increase in population over the next 20 years. The County plans to manage its land resources in a manner that will discourage sprawl and encourage future development to occur in and around existing developed areas so that farmland, open spaces, and natural and cultural resources are preserved.

Several Federal lands, State wildlife areas, and parks occur in the vicinity of the Fermi site. In addition to the onsite DRIWR Lagoona Beach Unit, nine other DRIWR units lie to the north and south. The River Raisin National Battlefield Park lies 7 mi (11 km) southwest of the site. State lands within 10 mi (16 km) include Pointe Aux Peaux State Wildlife Area, Pointe Mouillee State Game Area, Pointe Mouillee Natural Area, Sterling State Park, Point Mouillee State Game Area Celeron Island Unit, and Bolles Harbor. Monroe County has five County parks, including Heck Park and Nike Park, which are located about 6 mi (10 km) from the Fermi site (DTE 2014d).

3.2.1.3 Land Use Planning

Three agencies are responsible for land use planning in the vicinity of the Fermi site. At the regional level, the SEMCOG is a regional planning partnership that assists County and local governments with regional transportation planning, housing and land use planning, economic development, and water and air quality matters (SEMCOG 2014b). At the County level, the Monroe County Planning Department and Commission (MCPDC) prepares and updates the Monroe County Comprehensive Plan; develops and maintains a central bank of planning information; reviews zoning amendments in unincorporated portions of the County; and coordinates with Federal and State agencies and other Counties on economic, social, and physical development matters (MCPDC 2009). Locally, Frenchtown Township maintains the township's Master Plan and has zoning authority over the township's land, including the Fermi site (Anulewicz and McKenna 2003).

3.2.2 Visual Resources

As described in the previous section, the Fermi site is located on the western shore of Lake Erie in a predominantly agricultural region. The site's grade elevation is approximately 581.8 ft (177.3 m) (referenced to the North American Vertical Datum of 1988 (NAVD88)). The site includes Fermi 2 and the decommissioned Fermi 1. During the proposed license renewal term, the site could potentially contain an additional reactor (Fermi 3) within the footprint of the existing site if Fermi 3 is constructed by the applicant.

Fermi 2's buildings have a natural concrete exterior and neutral gray color, which tends to minimize visual impact. Two 450-ft (140-m) diameter concrete natural draft cooling towers rise approximately 400 ft (120 m) above grade elevation. The cooling towers are the tallest, most predominant features of the site and are visible from outside the property boundary. The transmission lines associated with Fermi 2 and that are considered within the scope of the license renewal review lie within the developed area of the site (DTE 2014d).

Because the land surrounding Fermi 2 is primarily agricultural, the areas most likely to experience visual impacts would be adjacent residents and traffic associated with the Dixie Highway and smaller arterial roads. Depending on air and weather conditions, the cooling towers may also be seen from I-75 and I-275 and in Sterling State Park and the Pointe Mouillee State Game Area (DTE 2014d).

3.3 Meteorology, Air Quality, and Noise

3.3.1 Meteorology and Climatology

Fermi 2 is located within the Lower Michigan Peninsula, with Lake Michigan to the west and Lake Huron, St. Clair, and Erie to the east. The regional climate is characterized as a quasi-marine type (NCDC undated). Latitude, the Great Lakes, and elevation play a major role in controlling Michigan's climate. The Lower Peninsula topography varies from level terrain in the southeast to gently rolling hills with elevations of 800 to 1,000 ft (240 to 305 m) in the southwest. Because of Michigan's mid-latitude location, prevailing winds are from a westerly direction. During the summer months, prevailing winds are influenced by the position of the semi-permanent high-pressure system, known as the Bermuda high, located in the southeastern region of the United States resulting in winds predominantly from the southwest. Michigan is influenced by the temperature moderating effects of the Great Lakes, which results in late arrivals of summer and winter, cooler spring temperatures, and warmer fall temperatures. Proximity to the Great Lakes also results in localized wind patterns in the summer; during the day, the warmer air over the land rises and cooler air over the lakes moves inland, and at night this pattern is reversed. Annual precipitation in Michigan is approximately 31 in. (79 cm) with summer precipitation in the form of showers and thunderstorms and winter precipitation, including a combination of snow, rain, freezing rain, and sleet.

The NRC staff obtained climatological information with 30-year averages from the Detroit Wayne County Airport (DWCA) weather station; this station is approximately 18 mi (28.9 km) north-northwest of the Fermi site and is used to characterize the region's climate because of its nearby location and long period of record. Additionally, DTE maintains a meteorological tower that consists of 10- and 60-m sensors that measure wind speed and direction, dew point, temperature, and precipitation. Recent meteorological observations from the Fermi site were made available to the NRC staff; these data were evaluated in context of the longer climatological record from the DWCA's weather station.

The prevailing wind direction at the DWCA's weather station is from the southwest during most of the year, except during the spring months (March, April, and May) when it is from the northwest (NCDC 2013). Mean annual wind speed is 9.6 miles per hour (mph) (15 kilometers per hour (kph), and mean monthly wind speed ranges from 7.5 mph (12 kph) in August to 11.2 mph (18 kph) in January. Annual wind rose data from the meteorological tower at Fermi 2 displays a prevailing wind direction from the southwest and a mean annual wind speed of 6.92 knots (8 mph (13 kph)) during the 2008–2012 period (DTE 2014d).

The mean annual temperature for the period of record (1984–2013) at the DWCA's station is 50.3 °F (10.1 °C) with a mean monthly temperature ranging from a low of 25.9 °F (-3.4 °C) in January to a high of 73.9 °F (23.3 °C) in July (NCDC 2013). The hottest year over the period of record was in 2012, and the coolest was in 1989. Recent (2009–2013) temperature observations at Fermi 2 are consistent with these values; mean annual temperature taken at Fermi 2's meteorological tower for the identified timeframe is 48.6 °F (9.2 °C), with a mean monthly temperature ranging from a low of 23.1 °F (-4.9 °C) in January to a high of 72.8 °F (22.7 °C) in July (DTE 2014g).

Mean annual liquid precipitation measured at the DWCA's weather station is 33.73 in. (85.7 cm). The wettest year for the period of record is 47.70 in. (121 cm) in 2012 (NCDC 2013); the driest year from the same period is 26.27 in. (66.7 cm) in 1984 (NCDC 2013). Monthly precipitation amounts tend to be evenly distributed throughout the year and range from an average of 2.01 in. (5.1 cm) in January to 3.43 in. (8.7 cm) in July (NCDC 2013). Mean total annual precipitation measurements taken at Fermi 2's meteorological tower for the 2009–2013 period is 51.68 in. (131 cm) (DTE 2014g). Snowfalls are common in the region; average annual snowfall at the DWCA's weather station is 44.7 in. (113.5 cm) (NCDC 2013), with a maximum monthly snowfall of 31.7 in. (80.5 cm) recorded in February 2010.

Monroe County, where Fermi 2 is located, experiences severe weather events, such as hail, tornadoes, floods, and heavy snow. In the past 64 years (1950–2014), the following number of days with severe events has been reported in Monroe County (NCDC 2014):

- Hail—56 days,
- Tornadoes—24 days,
- Blizzard—1 day, and
- Floods—12 days.

The tornadoes identified above varied in intensity between F0–F4 and EF0–EF2 on the Fujita scale.[10] On June 6, 2010, an EF2 tornado with maximum sustained winds of 130 to 135 mph (209 to 217 kph) moved through Monroe County (NCDC 2014). As a result of the tornado, a partial loss of offsite power at Fermi 2 occurred, and the licensee declared an Unusual Event, the lowest of the NRC's four emergency level classifications. The reactor was shut down and put into a stable condition (NRC 2010). There were no radiological releases from this event and power was restored to the site (NRC 2010).

3.3.2 Air Quality

Under the Clean Air Act of 1970, as amended (CAA) (42 U.S.C. 7410), EPA has set primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) for six common criteria pollutants to protect sensitive populations and the environment. The NAAQS criteria pollutants include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). Particulate matter is further categorized by size—PM_{10} (diameter between 2.5 and 10 micrometers (μm) and $PM_{2.5}$ (diameter of 2.5 μm or less).

The EPA designates areas of "attainment" and "nonattainment" with respect to the NAAQS. Areas that have insufficient data to determine designation status are denoted as "unclassifiable." Areas that were once in "nonattainment," but are now in "attainment," are called "maintenance" areas; these areas are under a 10-year monitoring plan to maintain the attainment designation status. States have primary responsibility for ensuring attainment and maintenance of the NAAQS. Under Section 110 of the CAA and related provisions, states are to submit, for EPA approval, State Implementation Plans that provide for the timely attainment and maintenance of the NAAQS.

Air quality designations generally are made at the county level. For the purpose of planning and maintaining ambient air quality with respect to the NAAQS, EPA has developed Air Quality Control Regions (AQCRs). The AQCRs are intrastate or interstate areas that share a common airshed (40 CFR Part 81). Monroe County, Michigan, where Fermi 2 is located, along with two Counties (Lucas and Wood County) in the State of Ohio are part of the Metropolitan Toledo Interstate AQCR (40 CFR 81.43). With regard to the NAAQS criteria pollutants, Monroe County is designated a maintenance area for the 8-hour ozone 1997 standard and for the $PM_{2.5}$ 1997

[10] The original Fujita six-point scale (F0 to F5) was used to rate the intensity of a tornado based on the damage it inflicts to structures and vegetation from the lowest intensity, F0, to the highest, F5. In February 2007, the enhanced Fujita scale replaced the original Fujita scale. The enhanced Fujita scale still uses six categories of tornado intensity (EF0 to EF5), but the new scale more accurately matches wind speeds to the severity of damage caused by the tornado.

and 2006 standard (EPA 2014a). The currently designated nonattainment or maintenance Counties adjacent to the Fermi site (within a 50-mi (80-km) radius of the Fermi site) are as follows:

- Wayne County, Michigan: nonattainment for sulfur dioxide (2010 standard), maintenance area for 8-hr ozone (1997), particulate matter less than 2.5 μm in diameter (1997 and 2006 standard), and carbon monoxide;
- Washtenaw County, Michigan: maintenance area for 8-hr ozone (1997 standard) and particulate matter less than 2.5 μm in diameter (1997 and 200 standard);
- Oakland County, Michigan: maintenance area for particulate matter less than 2.5 μm in diameter (1997 and 2006 standard), carbon monoxide, and 8-hr ozone (1997 standard);
- Macomb County, Michigan: maintenance area for particulate matter less than 2.5 μm in diameter (1997 and 2006 standard), carbon monoxide, and 8-hr ozone (1997 standard);
- Livingston County, Michigan: maintenance area for particulate matter less than 2.5 μm in diameter (1997 and 2006 standard) and 8-hr ozone (1997 standard);
- Lenawee County, Michigan: maintenance area for 8-hr ozone (1997 standard);
- Lucas County, Ohio: maintenance area for 8-hr ozone (1997 standard) and sulfur dioxide (1971 standard); and
- Wood County, Ohio: maintenance area for 8-hr ozone.

Michigan air pollution control rules are issued under Act 451, Natural Resources and Environmental Protection Act (NREPA), Part 55, "Air Pollution Control" (451 MCL 324.5501-5542). DTE maintains a Renewable Operating Permit (Permit No. MI-ROP-B4321-2013) issued by the MDEQ for sources of air emissions at Fermi 2. Michigan's Renewable Operating Permit (ROP) program consolidates all Federal and State requirements intended to protect air quality into a single permit/document. The ROP folds in Fermi 2's permit to install, which includes legally enforceable limits designed specifically to limit air emissions from the permitted sources identified in the permit, commonly known as a synthetic minor air permit.[11] Fermi 2's ROP became effective on November 1, 2013, and must be renewed every 5 years. Fermi 2's ROP identifies monitoring, reporting, and emission limit requirements (DTE 2014g). For instance, DTE is required to submit annual reports to the MDEQ that include an emissions inventory, known as the Michigan Air Emissions Reporting System.

Permitted sources at Fermi 2 include combustion turbines (peakers), auxiliary boilers, diesel driven fire pump, diesel generators, and cold (degreaser) cleaner units. Emissions provided in Table 3–5 are associated with infrequent use of permitted sources during testing or outages. Combustion turbines (peakers) are intermittently used to provide additional electricity to the power grid when needed during peak demand periods (MDEQ 2013b). R 336.1280 (Rule 280) of the MAC rules for air pollution control exempts water cooling towers from the MDEQ's air permitting requirements. However, annual particulate matter emissions of less than 10 μm associated with each tower is estimated to be 0.10 tons per year (DTE 2014d, 2014g). The NRC staff reviewed the five most recent Michigan Air Emissions Reporting System reports submitted to the MDEQ by DTE (DTE 2014g). Fermi 2 has been in compliance with the

[11] A synthetic minor source has the potential to emit air pollutants in quantities at or above the major source threshold levels but has accepted enforceable limitations to keep the emissions below such levels.

requirements set forth in the air permit, and there are no reported violations in the last 5 years (EPA 2014a; DTE 2014g). Section 4.15.3 discusses greenhouse gas emissions resulting from operation of Fermi 2.

Table 3–5. Air Emission Estimates for Permitted Combustion Sources at Fermi 2

Year	CO (T)	NOx (T)	PM10 (T)	SOx (T)	VOCs (T)	HAPs (T)
2008	3.27	21.62	0.82	1.34	0.24	.0056
2009	2.43	34.37	0.92	1.84	0.16	.0112
2010	4.25	46.39	1.47	1.27	0.26	.0144
2011	2.70	44.85	1.01	0.47	0.20	.0113
2012	2.83	21.40	0.65	0.07	0.24	.0017

Key: CO = carbon monoxide; MT = metric ton; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 µm; SO_x = sulfur oxides; T = ton; VOCs = volatile organic compounds; and HAPs = hazardous air pollutants.

To convert T to MT, multiply by 0.9072.

Source: DTE 2014d

EPA issued the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze, which is caused by numerous, diverse sources located across a broad region (40 CFR 51.308–309). Specifically, 40 CFR 81 Subpart D lists mandatory Class I Federal Areas where visibility is an important value. The Regional Haze Rule requires states to develop State Implementation Plans to reduce visibility impairment at Class I Federal areas. The nearest Class I Federal area for visibility protection is the Otter Creek Wilderness, which is about 269 mi (432.9 km) from the Fermi site. The EPA recommends that emission sources located within 62 mi (100 km) of a Class I area be modeled to consider adverse impacts (EPA 1992). Considering the distance to the nearest Class I area and the minor nature of air emissions from the site, there is little likelihood that ongoing activities at the Fermi site adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) in any of the Class I areas.

3.3.3 Noise

Noise is unwanted sound and can be generated by many sources. Sound intensity is measured in logarithmic units called decibels (dB). A dB is the ratio of the measured sound pressure level to a reference level equal to a normal person's threshold of hearing. Most people barely notice a difference of 3 dB or less. Another characteristic of sound is frequency or pitch. Noise may be composed of many frequencies, but the human ear does not hear very low or very high frequencies. To represent noise as closely as possible to the noise levels people experience, sounds are measured using a frequency-weighting scheme known as the A-scale. Sound levels measured on this A-scale are given in units of A-weighted decibels (dBA). Table 3–6 presents common noise sources and their respective noise levels. Noise levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each increase of 10 dBA sounds twice as loud (EPA 1981).

Table 3–6. Common Noise Sources and Noise Levels

Noise Source	Noise Level (dBA)
Human hearing threshold	0
Soft whisper	30
Quiet residential area	40
Dishwasher	55–70
Lawn mower	65–95
Blender	80–90
Ambulance siren, jet plane	120

Source: CHC undated

Several different terms are commonly used to describe sounds that vary in intensity over time. The equivalent sound intensity level (L_{eq}) represents the average sound intensity level over a specified interval, often 1 hour. The day-night sound intensity level (L_{DN}) is a single value calculated from hourly L_{eq} over a 24-hr period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. This addition accounts for the greater sensitivity of most people to nighttime noise. Statistical sound level (L_n) is the sound level that is exceeded "n" percent of the time during a given period. For example, L_{90} is the sound level exceeded 90 percent of the time and is considered the background level.

Nuclear power generation is an industrial process that can generate noise. Common noise sources from nuclear power plant operations include cooling towers, transformers, and worker vehicles. Major noise sources at Fermi 2 that are audible beyond the site-boundary include the cooling towers, firing range, and transmission lines (DECo 2011b). Offsite noise sources in the vicinity of the Fermi site include road traffic; animals (birds, dogs, and coyotes); and trains (DECo 2011b). The nearest noise sensitive receptor to Fermi 2 is a residence approximately 0.72 mi (1.2 km) from the reactor and cooling towers, 0.1 mi (0.16 km) from the site boundary, and 0.4 mi (0.6 km) from the shooting range (DTE 2014g).

DTE conducted an ambient sound level survey around the Fermi site. Continuous and/or short-term measurements were taken at seven noise sensitive receptors (including the nearest residence identified above) located within 5 mi (8 km) of the Fermi site (DECo 2011b). Noise sources documented during the survey included road traffic, trains, Fermi 2 firing range, transmission lines, and Fermi 2 cooling towers. Continuous measurements taken at three noise sensitive receptors resulted in day-night L_{DN} between 54 and 63 dBA. L_{90} sound levels at the seven receptors measured between 32 and 42 dBA. Hourly L_{eq} sound levels at the receptors were the greatest between 10 a.m. and 2 p.m. and ranged between 52 dBA and 70 dBA and were the lowest between 11 p.m. and 3 a.m. and ranged between 36 and 48 dBA (DECo 2011b).

There are no Federal regulations[12] for public exposures to noise. The EPA recommends day-night average sounds levels (L_{DN}) of 55 dBA as guidelines or goals for outdoors in residential areas (EPA 1974). However, these are not standards. The Federal Housing Administration has established noise assessment guidelines for housing projects and finds that day-night average

[12] In 1972, Congress passed the Noise Control Act of 1972 (42 U.S.C. 4901 et seq.) establishing a national policy to promote an environment free of noise that impacts the health and welfare of the public. However, in 1982 there was a shift in the Federal noise control policy to transfer the responsibility of regulating noise to state and local governments. The Noise Control Act of 1972 was never rescinded by Congress but remains unfunded (EPA 2014b).

sound levels (L_{DN}) of 65 dBA or less are acceptable (HUD 2014. Day-night sound levels measured at the sensitive noise receptors near Fermi 2 are above EPA-recommended sound levels but below the Federal Housing Administration guideline. The Frenchtown Charter Township Noise Ordinance (Ordinance No. 184) prohibits excessive or loud noise and disturbance as specified in the ordinance (FTC 2015). However, acceptable noise levels or limits are not specified in the noise ordinance. Beyond the Frenchtown Township ordinances, there are no State or County ordinances for public exposures to noise applicable to Fermi 2.

DTE has received noise complaints regarding activities associated with the firing range. Specifically, the noise complaints have been limited to nighttime fire training at the range. Nighttime shooting training takes place between the hours of 4:30 p.m. and 10 p.m. and occurs 12 to 15 times a year (DTE 2014g). In response to these complaints, DTE notifies the nearby municipalities of upcoming scheduled training at the range and provides information about upcoming activities (DTE 2014g).

3.4 Geologic Environment

This section describes the geologic environment of the Fermi site and vicinity, including landforms, geology, soils, and seismic conditions.

3.4.1 Physiography and Geology

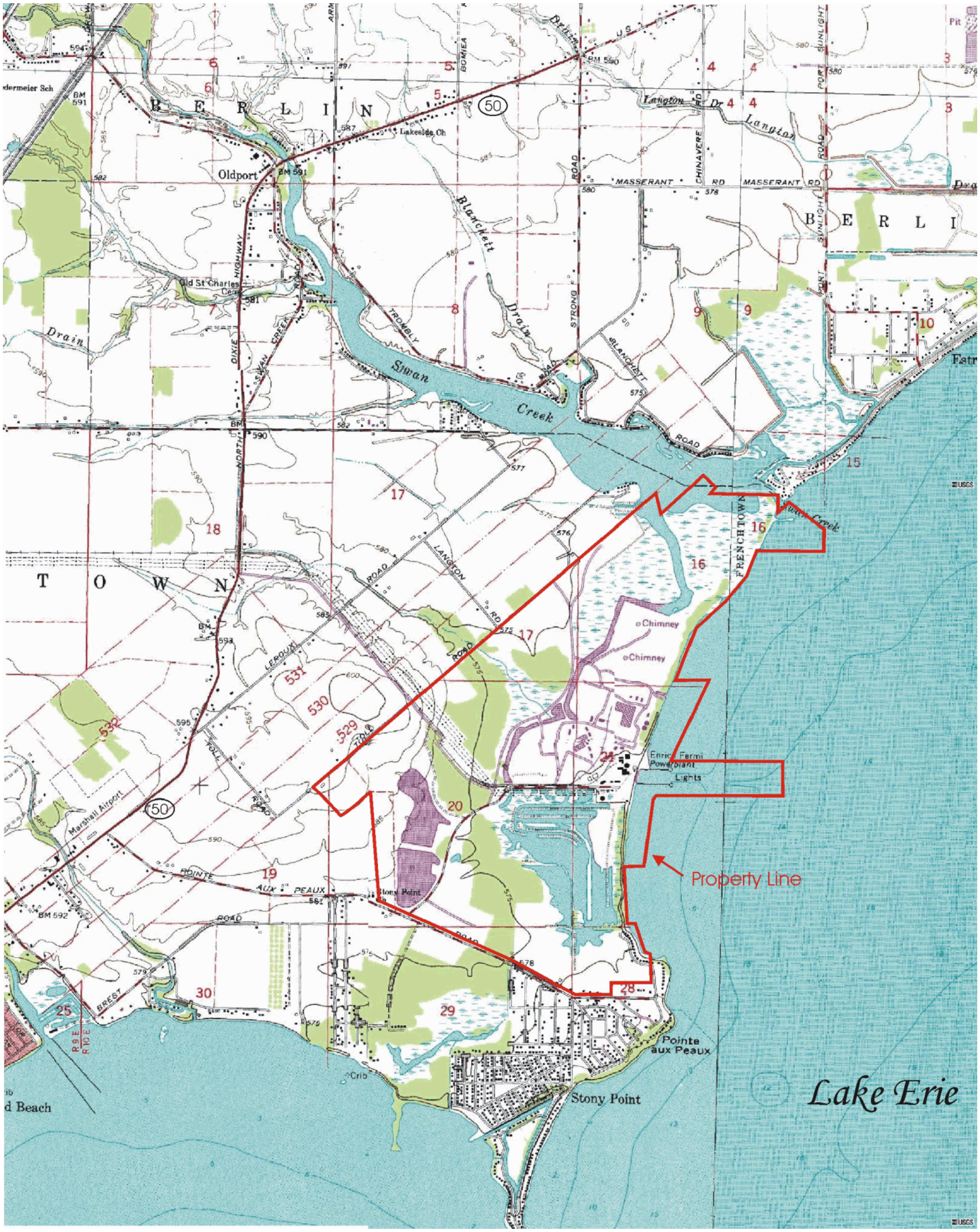
The Fermi site is located in the Eastern Lake Section of the Central Lowland physiographic province on the western shore of Lake Erie. The area has little topographic relief and is drained by streams and rivers that flow eastward into Lake Erie (Figure 3–10). Because the Fermi site lies on significant volumes of imported fill material that was put in place and then graded, it has very little relief (DECo 2011b). Surface elevations within the site boundary range from approximately 575 to 595 ft (175 to 181 m) above mean sea level (MSL). The average water elevation for Lake Erie is estimated to be 571.6 ft (174 m) above MSL. A rock barrier is located along the shoreline to protect the site against high water levels in Lake Erie. The crest of the rock barrier is 581.8 ft (177 m) above MSL (DTE 2014d; NRC 2013a).

The site is in an area of unconsolidated glacial and lake formed sediments (interbedded silt, clays, and sands) that are underlain by bedrock consisting of a large thick sequence of sedimentary rocks. The bedrock is made up of more than 2,500 ft (762 m) of limestone, dolomite, sandstone, and shale beds that lie on top of metamorphic and igneous crystalline basement rocks (DTE 2014d). Figure 3–11 identifies the major geologic units that make up this large sedimentary sequence of rocks. Regionally, the bedrock layers dip toward the northwest.

The major buildings are built into the bedrock and on fill that consists of gravel and cobble aggregate (NRC 2013a). The fill was excavated from the now water-filled quarries located in the southwest corner of the site property (Figure 3–10). The fill was also used to provide a structural base for several power plant auxiliary buildings and extends across most of the area containing plant structures (DTE 2014d). Other than fill, the unconsolidated material that overlies the bedrock is made up of glacial and lake sedimentary layers. Bedrock is encountered at about 30 ft (9.1 m) below the land surface. The Bass Islands Group forms the top of the bedrock. It consists of dolomite rock and is underlain by the Salina Group, which is made up of interbedded layers of dolomite, limestone, shale, claystone, sandstone, and anhydrite rock (DTE 2014d).

Mineral resources in Monroe County include active and inactive rock quarries, sand and gravel pits, and clay pits. The nearest pit to the Fermi property is a clay pit 6 mi (9.7 km) to the north. The nearest quarry is about 3 mi (5 km) north-northwest of the Fermi site (NRC 2013a). Other than the gravel and cobble aggregate deposits used to construct Fermi 2, significant economic mineral deposits have not been found at the site.

Figure 3–10. Topographic Map and Site Boundary



Source: Modified from DTE 2014d

1 **Figure 3–11. Fermi Site Geologic Column**

STRATIGRAPHIC NOMENCLATURE	AVERAGE THICKNESS (FEET)	LITHOLOGY
Unconsolidated Material	15-30	Plant Fill, Lake and Glacial Deposits
Bass Islands Group	99	Dolomite
Salina Group	>354	Interbedded Dolomite, Limestone, Shale, Claystone, and Anhydrite
Niagaran Group	425	Dolomite
Cataract Group	100	Shale and dolomite
Richmond Group	625	Shale and dolomite
Trenton-Black River Group	825-850	Dolomite and Shale
St. Croixian Series	475	Sandstone with some dolomite, thin shales
Crystalline Basement Rock		Metamorphic and Igneous Rock

2

3 Source: Modified from DTE 2014d

3.4.2 Soils

The soils around the site are very poorly drained to somewhat poorly drained. Within the site boundary, the soils are poorly drained loam to silty clay loams, with some beach sands located along the lake shore and stream channels. The soils around most of the plant structures were replaced with fill material when Fermi 2 was constructed.

The plant buildings and physical structures are located on land that is committed to industrial development and that has been previously disturbed by site activities. The rest of the land within the site boundary is poorly drained. Most undisturbed areas are either covered with water or subject to frequent flooding. These areas are classified as poorly drained and not prime farmland or prime farmland "if drained." A small parcel of land in the southwestern area of the site is designated as prime farmland and is currently used as such. Another smaller portion of land within the site boundary is also designated as prime farmland but is not farmed (DTE 2014d; NRC 2013a; USDA 2014a).

3.4.3 Seismic Setting

The Fermi site is located in one of the most seismically stable regions in the United States. Since the beginning of the 19th century, no recorded earthquake epicenter has been located closer than about 25 mi (40 km), and only seven earthquakes have been reported within 50 mi (80 km) of the site. Few reported earthquakes were of a high enough intensity to cause structural damage to reasonably well-built structures in the area (DTE 2014d). The NRC requires every nuclear plant to be designed for site-specific ground motions that are appropriate for its location.

3.5 Water Resources

3.5.1 Surface Water Resources

This section describes surface water resources within and near the Fermi 2 site.

3.5.1.1 Surface Water Hydrology

Fermi 2 is located on the western edge of Lake Erie. The site drains to Lake Erie to the east and to one of its tributaries to the north (Swan Creek) through the North Lagoon (see Figure 3–5 and Figure 3–12). The North Lagoon and South Lagoon are connected to Lake Erie through direct contiguous waterways. There are two manmade canals on the western side of the Fermi site. The North Canal (also known as the overflow canal) flows to the North Lagoon. It previously served as the cooling water discharge channel for Fermi 1 and now receives stormwater and other effluents from the Fermi site, as further discussed in Section 3.5.1.3 (DTE 2014d; NRC 2013a).

The South Canal (also known as the discharge canal) flows to the South Lagoon. A small pond (also called the Central Canal or pond) is located between the North and South Canals. Nearby wetlands are hydraulically connected to the canals through culverts, but the small pond is not directly connected to any other surface water features. The wetlands, North and South canals, and lagoons are all hydraulically connected to the western basin of Lake Erie and subject to lake level changes and weather conditions (NRC 2013a).

Other streams near the Fermi site (not shown in Figure 3–12) include Stony Creek, located approximately 3 mi (4.8 km) southwest of the site; the River Raisin, located about 6 mi (9.7 km) southwest of the site; the Huron River, located 6 mi (9.7 km) to the north of the site; and the mouth of the Detroit River, located approximately 6.5 mi (10 km) northeast of the site (DTE 2014d; NRC 2013a).

Lake Erie has an open water surface area of 9,910 mi^2 (25,700 km^2), which makes it the 12th largest freshwater lake on Earth. Lake Erie is the warmest of the Great Lakes, which also contributes to its high productivity and ecological sensitivity. The average depth of the entire lake is 62 ft (19 m), with a maximum depth of 210 ft (64 m). In all, Lake Erie holds an estimated 116 mi^3 (483 km^3) of water, or about 128 trillion gal (0.48 trillion m^3) (GLC 2014a). The lake retention (residence) time for water entering the lake is approximately 2.6 years. Although there is great uncertainty in calculating the lake's water balance and hydrologic flux over time, it is estimated that the Detroit River, which connects Lake Huron and Lake Erie, contributes about 80 percent of Lake Erie's total inflow. The other major inputs to Lake Erie are from precipitation (11 percent) and tributaries (9 percent) flowing through watersheds in Michigan, Ohio, Pennsylvania, New York, and Ontario (NRC 2013a). Specifically, based on estimated monthly contributions, inflow from the Detroit River system is estimated at 188,333 cfs (5,320 m^3/s). Annual average rainfall over Lake Erie is about 35 in. (89 cm) per year and contributes about 25,497 cfs (720 m^3/s) of water to the lake's water balance. Runoff from tributaries contributes another 21,189 cfs (599 m^3/s) of water. Groundwater contributions to the lake have not been quantified but have been assumed to be a relatively small component to the overall water balance. Losses from the lake due to evaporation are estimated to be 36 in. (91 cm) per year, equating to 26,027 cfs (735 m^3/s). Outflow from Lake Erie to Lake Ontario is estimated to be 206,202 cfs (5,825 m^3/s) (Neff and Nicholas 2005; NRC 2013a). This is equivalent to about 133,292 mgd (504.5 million m^3/d). For 2013, reported water withdrawals from the Lake Erie Basin totaled 51,623 mgd (195.4 million m^3/d), or about 79,861 cfs (2,256 m^3/s); less than about 4 percent of this water withdrawal was diverted out of the Lake Erie Basin or consumptively used (GLC 2014b).

The Fermi site is situated on the western drainage basin of Lake Erie, which is characterized as very shallow with an average water depth of 24 ft (7.3 m). This part of the lake basin is partially restricted from the rest of the lake by chains of barrier beaches and islands. Current patterns in the western basin are typically west to east. The current flow velocity averages 0.4 feet per second (0.12 meter per second), but it can vary due to winds and on a seasonal basis (DTE 2014d; NRC 2013a).

1 **Figure 3–12. Surface Water Features at the Fermi Site and Vicinity**

2

3 Source: Modified from DTE 2014d

Erosion and sediment transport in the western basin of Lake Erie near the Fermi site are dictated primarily by two major streams: (1) the Detroit River to the north and (2) the River Raisin to the south. However, the Maumee River farther south is the major sediment source to Lake Erie and contributes the highest amount of suspended solids per year of any other tributary to the Great Lakes (DTE 2014d; NRC 2013a).

The Lake Erie shoreline at the Fermi site has generally been stable since plant construction more than 30 years ago. A rock barrier exists along the shoreline that serves to stabilize the site and to protect against the high water levels of Lake Erie (DTE 2014d; NRC 2013a). The rock barrier and associated backfill across the Fermi site are comprised of bedrock excavated during plant construction to raise the entire plant grade approximately 10 ft (3 m) above the surrounding land area and lake surface (DECo 2012e). Thus, the top of the rock barrier and most existing Fermi 2 facilities are located at an elevation of 581.8 ft (177.3 m) above MSL (referenced to NAVD88). The average water elevation of Lake Erie at Fermi 2 is 571.6 ft (174.2 m) above MSL (DTE 2014d; NRC 2013a).

The National Oceanic and Atmospheric Administration (NOAA) operates a water level gauging station at the Fermi site (station number 9063090), located adjacent to the Fermi 2 GSW pump house and near the head of the intake channel (Figure 3–2). The gauge was established in 1963. For the 51-year period of record, the highest recorded lake level was 576.2 ft (175.6 m) on April 9, 1998, and the lowest was 563.65 ft (171.8 m) above MSL on February 16, 1967 (DTE 2014d; NOAA 2014). The highest water levels are generally in the spring and summer, with the lowest in the fall and winter (DTE 2014d).

In general, the potential for flooding at Fermi 2 exists from storms and winds on the lake that can cause a surge in lake levels and subsequent “seiches” (i.e., oscillations of the water surface due to atmospheric changes in pressure and winds). The U.S. Army Corps of Engineers (USACE) estimates that the maximum 100-year storm-induced surge on Lake Erie is 3.9 ft (1.2 m) at the Fermi site (NRC 2013a). Nevertheless, all seismic Category I (safety-related) structures at Fermi 2 are designed for the probable maximum meteorological event water level of 586.9 ft (178.9 m) plus the runup from small waves. The openings in the structures are watertight and designed for the high water levels. Otherwise, the Fermi site is not susceptible to flooding caused by surface runoff because of the shoreline location, the engineered grade and associated backfill across the site, and the distance to major streams (DECo 2012e).

Other surface water features on the Fermi site include two quarry lakes and several manmade impoundments (Figure 3–3). The NRC staff visited all of these features during the September 2014 environmental site audit. The two lakes are former rock quarries used during Fermi 2 construction and are located near the Fermi administrative and training buildings. Since the termination of quarrying in 1972, groundwater and runoff have filled the excavations (DECo 2012e).

The most notable impoundment is the 5.5-ac (2.2-ha) CWR, which is central to Fermi 2’s CWS (Section 3.1.3). The clay-lined CWR receives cooling tower blowdown and other plant effluents before they are discharged through Fermi 2’s primary permitted outfall (Outfall 001) in accordance with the plant’s Michigan-issued NPDES permit. Section 3.5.1.3 further discusses the site’s NPDES permit in detail.

Two other impoundments are the Chem Basin and Chem Waste Pond. The Chem Basin is a small, elevated clay-lined impoundment that temporarily stores wastewater from the plant’s auxiliary boiler blowdown sump, diesel fuel storage tank berm, and diesel fuel offloading station before it is discharged to the plant’s sanitary sewer system. The Chem Waste Pond is a chambered, clay-lined structure that receives plant low-volume wastes, metal cleaning wastes, and stormwater. It is also an active NPDES-permitted discharge point to the North Canal through Outfall 009 (DTE 2014d).

Finally, the dredge basin is an excavated basin with supporting embankments that is used for the discharge of dredge spoil associated with intake structure maintenance dredging. Dewatering flows from the dredged materials are discharged through NPDES Outfall 013 to the South Lagoon (DTE 2014d; NRC 2013a).

3.5.1.2 Surface Water Use

As previously detailed in Section 3.1.3, Fermi 2 withdraws surface water from Lake Erie for plant cooling and other uses through a dedicated intake structure. Cooling tower blowdown and other permitted effluent streams are discharged back to either Swan Creek or directly to Lake Erie through an on-shore discharge structure located just east of the CWR and designated as NPDES Outfall 001 (Figure 3–12).

The maximum (hypothetical) surface water withdrawal rate for Fermi 2 is 53,500 gpm (119 cfs or 3.36 m^3/s), which is equivalent to 77 mgd (291,500 m^3/d). This surface water withdrawal rate is based on all five GSW pumps in continuous operation plus one CWR makeup pump (Section 3.1.3). However, DTE reports that, based on four GSW pumps operating, Fermi 2's average daily (nominal) withdrawal rate is 31,000 gpm (69 cfs or 1.95 m^3/s) or about 44.6 mgd (169,000 m^3/d). On average, approximately 40 percent of the water withdrawn is consumptively used (DTE 2014d).

Table 3–7 summarizes Fermi 2's surface water withdrawals for the period 2009 to 2013. Based on the NRC staff's review of DTE's surface water withdrawal and use reports to the State of Michigan, Fermi 2's surface water withdrawals have averaged 19,086 million gallons per year (mgy) (72.2 million cubic meters per year (m^3/yr), which is equivalent to an average withdrawal rate of approximately 36,300 gpm (80.8 cfs (2.28 m^3/s)) or 52.3 mgd (198,000 m^3/d). Return discharges to Lake Erie have averaged 12,011 mgy (45.5 million m^3/y). This is equivalent to an average discharge rate of 22,850 gpm (50.9 cfs (1.44 m^3/s)), or 32.9 mgd (125,000 m^3/d). The values reflect a consumptive use rate averaging 37 percent or about 19 mgd (72,000 m^3/d).

Table 3–7. Annual Surface Water Withdrawals and Return Discharges to Lake Erie, Fermi 2

Year	Withdrawals (mgy)	mgd	Discharges (mgy)[(a)]	mgd
2009	18,192.6	49.8	11,003[(b)]	30.1
2010	19,244.7	52.7	12,165[(b)]	33.3
2011	21,111.3	57.8	14,006.2	38.4
2012	19,309.0	52.9	12,267.9	33.6
2013	17,575.1	48.1	10,613.7	29.1
Average	19,086.5	52.3	12,011.2	32.9

Note: Reported values are rounded. To convert million gallons per year (mgy) to million cubic meters (m^3), divide by 264.2.

(a) Reflects withdrawn water returned to Lake Erie and connecting waters as referenced in Michigan Water Use Reports.

(b) Value was calculated from information in the referenced report. All other values are as listed in the reports cited.

Sources: DECo 2010a, 2011c, 2012b, 2013a; DTE 2014a

Fermi 2's surface water withdrawals and consumptive water use are not currently subject to any water allocation or related permitting requirements. However, the State of Michigan is a party to the 2008 Great Lakes–St. Lawrence River Basin Water Resources Compact (the Compact) (451 MCL 324.34201), which also includes the States of Illinois, Indiana, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. The Compact is a legally binding interstate agreement that details how its member States will manage the use of the water supply of the Great Lakes Basin. The Compact explicitly provides a framework for each State to enact programs and laws protecting the Basin, and it is the formal mechanism for implementing the previous good-faith commitments made between the governors of the U.S. member States and the premiers of Ontario and Quebec under the 2005 Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement (Council of Great Lakes Governors 2015).

Following ratification of the Compact by all eight member States and the U.S. Congress, the Great Lakes–St. Lawrence River Basin Water Resources Council (Compact Council) was established on December 8, 2008, in accordance with Section 2.2 of the Compact. The Compact Council acts as the governing body under the Compact and comprises the governors and representatives from the eight member States. The Compact Council is responsible for conducting research, collecting data, and overseeing disputes related to the water management of the basin (Compact Council 2015). The Compact Council works in partnership with the Great Lakes Commission, which is an interstate compact agency originally established in 1955 that promotes the orderly, integrated, and comprehensive development, use, and conservation of the water and related natural resources of the Great Lakes Basin and St. Lawrence River. Its members likewise include the eight Great Lakes States with associate member status for the Canadian provinces of Ontario and Québec (GLC 2015).

Under the terms of the Compact, any water withdrawals within the Great Lakes Basin that would result in a new or increased consumptive use of 5 mgd (18,925 m^3/d) are subject to review by all States within the region. Central to the water use management provisions of the Compact is that withdrawals and consumptive uses will be managed to ensure that there will be no significant individual or cumulative adverse impacts to the quantity or quality of the waters of the Great Lakes. The consumptive use and water diversion requirements of the Compact are met by the State of Michigan under the MDEQ's water withdrawal permitting program (451 MCL 324.32723). DTE is subject to these requirements because its water withdrawals result in consumptive use greater than 5 mgd (18,925 m^3/d). DTE reports its surface water withdrawals and pays a water usage fee to the MDEQ in accordance with 451 MCL 324.32705.

3.5.1.3 Surface Water Quality and Effluents

The MDEQ is responsible for assessing the support of beneficial uses of surface water bodies in Michigan and it promulgates water quality standards applicable to the Great Lakes, connecting waters, and all other surface waters in Michigan in accordance with MAC Rule (R) 323.1041–1117. At a minimum, all surface waters of the State are designated and protected for all of the following uses: (1) agriculture, (2) navigation, (3) industrial water supply, (4) warm water fishery, (5) other indigenous aquatic life and wildlife, (6) partial body contact recreation, and (7) fish consumption under these standards. In addition, all Great Lakes and most connecting waters are designated and protected for cold water fisheries with specific numeric criteria for chemical parameters and temperature.

Lake Erie is extensively used for water supply (e.g., industrial and drinking water), recreation, navigation, and commercial fishing. Frenchtown Township withdraws water from Lake Erie through an intake, located south of the Fermi site at Pointe Aux Peaux, that it shares with the City of Monroe. However, Fermi 2's restricted area prohibits recreational activity and navigation near the site (NRC 2013a).

Section 303(d) of the Federal Clean Water Act of 1977, as amended (CWA) (33 U.S.C. 1251 et seq.), requires states to identify all “impaired” waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards in such waters. The Section 303(d) list includes those water quality limited stream segments that require the development of total maximum daily loads to ensure future compliance with water quality standards. Michigan prepares and submits its lists and associated report every 2 years.

As reaffirmed in Michigan’s current Section 303(d) report, the Michigan waters of the Great Lakes and their connecting channels continue to be listed as not supporting the fish consumption designated use because of elevated concentrations of polychlorinated biphenyls, dichlorodiphenyltrichloroethane, mercury, chlordane, and/or dioxin in the water. Atmospheric deposition is the major source of these persistent compounds (MDEQ 2014a).

Current water quality concerns with regard to Lake Erie include (1) increased phosphorus loading from regional agricultural activities, which is a factor that contributes to toxic algal blooms, and (2) elevated concentrations of three bioaccumulative contaminants (mostly from historical industrial activities), such as dioxin, polychlorinated biphenyls, and mercury, as indicated above (NRC 2013a). In 2005, the Detroit River–Western Lake Erie Basin Indicator Project was initiated. This joint U.S.-Canadian effort was led by the FWS and EPA along with their Canadian counterparts and other Governmental and non-Governmental partners. A primary objective of the study was to assess basin ecosystem status, quality, and trends and the factors that affect them (EPA 2009a). While the report identified a number of areas of substantial improvement in overall environmental quality, including water quality, the following challenges for the Detroit River–Western Lake Erie Basin were noted: (1) population growth and accompanied land use changes, (2) nonpoint source pollution, (3) toxic substances contamination, (4) habitat loss and degradation, (5) exotic species, and (6) greenhouse gases and global warming (Hartig et al. 2007; NRC 2013a).

To operate a nuclear power plant, NRC licensees must comply with the CWA, including associated requirements imposed by EPA or the state, as part of the NPDES permitting system under Section 402 of the CWA, as well as state water quality certification requirements under Section 401 of the CWA. The EPA or the state, not the NRC, sets the limits for effluents and operational parameters in plant-specific NPDES permits. Nuclear power plants cannot operate without a valid NPDES permit and a current Section 401 Water Quality Certification. In Michigan, EPA delegated its responsibility for administration of the NPDES program to the State in 1973. The NPDES permits are issued by the MDEQ on a 5-year cycle.

Under this approach, all of the permits in each individual watershed expire in the same year and are reviewed for reissuance, as applicable. This approach allows the MDEQ to consider cumulative impacts of all dischargers on water quality in the watershed. Discharges to lakes, streams, and wetlands must not cause a violation of Michigan water quality standards. As part of the permit issuance process, limits are developed for pollutants to avoid a violation of water quality standards and ensure compliance with the treatment technology regulations of the CWA (MDEQ 2014a). The State of Michigan’s regulations for administering its NPDES permit program are contained in MAC R 323.2101–2197.

Fermi 2 is currently operating under NPDES Permit No. MI0037028, issued on June 3, 2010 (MDNR 2010). It was last modified on April 23, 2012. The permit expired on October 1, 2014. However, DTE submitted a permit renewal application to the MDEQ on March 31, 2014, which the MDEQ subsequently accepted as administratively complete (DTE 2014c, 2014g). As a result, DTE’s NPDES permit for Fermi 2 operations remains in effect (i.e., administratively continued) because DTE submitted an application for renewal at least 180 days before the expiration of the current permit in accordance with MAC R 323.2151.

The permit specifies the discharge standards and monitoring requirements for effluent (wastewater) chemical and thermal quality and for stormwater discharges through the primary, internal, and secondary outfalls to Lake Erie and connected waters, as summarized in Table 3–8.

Table 3–8. NPDES-Permitted Outfalls, Fermi 2

Outfall	Max. Permitted Flow Rate (mgd)	Description
001 (001A)[a]	45.1	Cooling tower blowdown, processed Radioactive liquid (radwaste) wastewater, RHR system service water and metal cleaning wastes[b] through Outfall 001 to Lake Erie
001B[a]	1.44	RHR system service water (cooling water blowdown)
001D[a]	0.216	Processed radwaste wastewater[c]
001E[a]	0.5	Treated chemical and nonchemical metal cleaning wastes from the condenser water box
009 (009A)[a]	0.72	Chem Waste Pond discharge, low volume wastes, chemical metal-cleaning wastes,[b] and nonchemical metal-cleaning wastes and stormwater runoff to Swan Creek through the North Canal
011 (011A)[a]	0.216	Treated oily wastewater and an unspecified amount of General Service Water screen and pump strainer backwash to Swan Creek through the North Canal
011C[a]	0.216	Oily waste equalization basin, stormwater from oil-fired peaker units and associated fuel oil tank containment dike[d]
013 (013A)	Intermittent up to 450 mgy	Dredge basin, dredging dewatering water to Lake Erie

Note: To convert million gallons per day (mgd) or million gallons per year (mgy) to million cubic meters (m^3), divide by 264.2.

[a] This is an NPDES permit internal monitoring point(s) located upstream of the numbered point source outfall(s).

[b] Chemical metal cleaning wastes were originally permitted as a potential waste stream to support Fermi 2 construction. However, other than nonchemical metal-cleaning wastes comprising water used for the periodic washdown of the main unit transformers and discharged through Outfall 009, Fermi 2 does not anticipate discharging any chemical metal-cleaning wastes through Outfalls 001 and 009 in the future (DTE 2014d).

[c] Although permitted, Fermi 2 has not had a planned liquid effluent radioactive waste discharge since 1994 and plans to voluntarily continue to operate as a zero-discharge liquid radioactive waste release facility (DTE 2014d). DTE's NPDES permit renewal application to the MDEQ identifies its processed radioactive waste effluent stream to Outfall 001 as "inactive" (DTE 2014c).

[d] This basin takes stormwater inputs from the site's peaker power generating units and associated fuel oil tank containment dike. Although permitted, oily wastewater is no longer discharged through Outfall 011. Waste stream is now discharged to the sanitary sewer system (DTE 2014d). DTE's NPDES permit renewal application to the MDEQ identifies Outfall 011C as "inactive" (DTE 2014c).

Sources: DTE 2014d; MDNR 2010

For Fermi 2's primary outfall (Outfall 001), the NPDES permit requires DTE to monitor and report flow rate, pH, temperature of intake water and discharge, total residual chlorine, and the concentration of a cooling water biocide when used for zebra mussel control. For the other outfalls, other monitored parameters include total suspended solids, oil and grease, and various metals. Monitoring results are reported in monthly discharge monitoring reports submitted to the State.

Fermi 2's NPDES permit also governs stormwater discharges associated with industrial activity through six stormwater-only outfalls (i.e., Outfalls 002, 004, 005, 007, 012, and 014) (Figure 3–3). As specified in Part I, Section A.13 of Fermi 2's NPDES permit, DTE is required to develop, maintain, and implement a Storm Water Pollution Prevention Plan so that stormwater discharges do not violate State water quality standards (DTE 2013b). Based on the NRC staff's review, the plan identifies potential sources of pollution that could affect stormwater, groundwater, and/or offsite surface water quality, as well as the practices, controls, and inspections used to prevent or reduce pollutants in stormwater discharges.

The NRC staff's review of Discharge Monitoring Reports from 2009 through 2013 found no substantial or recurrent exceedances of NPDES permit requirements or unusual conditions of operations, with reported discharges in compliance with specified effluent limitations. Additionally, DTE reported that it has not received any Notices of Violation, nonconformance notifications, or related infractions associated with the site's NPDES permit within the past 5 years. However, DTE has identified a number of self-reported permit exceedances, permit noncompliances, and reportable releases (reported to responsible regulatory agencies) that have occurred over the last 5 years (DTE 2014g). Based on the NRC staff's review of the available information, all these self-reported events had little or no effect on offsite water quality.

Sanitary effluent from Fermi 2 is not discharged to surface water through a plant outfall but instead is discharged to a publicly owned treatment works (Monroe Metropolitan Wastewater Facility). This effluent stream includes domestic sewage, effluent from several oil-water separators, and effluent from the Chem Basin. These flows are first collected in an aboveground concrete-lined holding tank (i.e., the sewage forwarding station) where the streams are combined and forwarded to the offsite treatment facility. The effluent is subject to discharge (pretreatment) limits and monitoring requirements specified under Industrial/Non-Domestic User Discharge Permit No. 1020 issued to DTE by the City of Monroe (City of Monroe 2012).

Section 401 of the CWA requires an applicant for a Federal license to conduct activities that may cause a discharge of regulated pollutants into navigable waters to provide the licensing agency with water quality certification from the State. This certification implies that discharges from the project or facility to be licensed will comply with CWA requirements and will not cause or contribute to a violation of state water quality standards. If the applicant has not received Section 401 certification, the NRC cannot issue a license unless that state has waived the requirement. The NRC recognizes that some NPDES-delegated states explicitly integrate their Section 401 certification process with NPDES permit issuance. Fermi 2's NPDES permit does not explicitly convey water quality certification under CWA Section 401. Nevertheless, the MDNR previously issued a Section 401 Water Quality Certification for Fermi 2 on September 27, 1977. In it, the State noted that issuance of an NPDES permit, also by the State of Michigan, would ensure that applicable water quality provisions under the Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. 1251 et seq.) (i.e., referred to as the CWA), would be met in satisfaction of Section 401 requirements (DTE 2014d).

In response to the NRC staff's request for additional information for documentation of the status of Fermi 2's Section 401 Water Quality Certification, DTE cited a meeting between DTE and staff of the MDEQ's Water Bureau, which was held on January 31, 2013. At the meeting, the MDEQ informed DTE that Section 401 Water Quality Certification is implicitly granted by the State with Fermi 2's NPDES permit (DTE 2014g).

The surface water intake from Lake Erie for Fermi 2 is located between the two rock groins that extend into Lake Erie to minimize shoaling and to protect the Fermi 2 water intake (Figure 3–2). DTE periodically performs maintenance dredging in the area between the two groins constituting the intake channel. The current dredge cycle is 4 years (NRC 2013a). This maintenance dredging is conducted under permits issued by the USACE in accordance with Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403 et seq.) and Section 404 of the CWA and by the MDEQ under Act 451, NREPA, Part 325, “Great Lakes Submerged Lands” (451 MCL 324.32501–32515a).

Specifically, Fermi 2 possesses Department of the Army Permit No. 98-001040-9 (USACE 2004) and MDEQ Permit No. 11-58-0055-P (MDEQ 2012) that authorize the hydraulic dredging of up to 25,000 cubic yards (19,100 m^3) of material from the main intake channel and disposal of the dredge spoils in the dredge basin (Figure 3–12). In addition, dredging of up to 500 cubic yards (380 m^3) from the GSW intake canal adjacent to the intake channel (Figure 3–5) is separately permitted under U.S. Army letter of authorization LRE-1988-10408-L13 (USACE 2013) and MDEQ Permit No. 13-58-0013-P (MDEQ 2013a). These authorizations were sought by DTE and issued by the USACE and the MDEQ after DTE performed dredging of the intake canal, a location not explicitly authorized under U.S. Army Permit No. 98-001040-9 and MDEQ Permit No. 11-58-0055-P. Initially, DTE applied for after-the-fact permits as directed by the MDEQ to address the noncompliance. The MDEQ then issued an after-the-fact permit for the completed activity, and the USACE issued an after-the-fact Section 404 Nationwide Permit 3 (DTE 2014d).

Dredge spoils from the intake canal and channel are piped to the dredge basin to dewater. As previously noted, and indicated in Table 3–8, the dredge basin has an NPDES-permitted outfall for the discharge of dewater effluent. Dredge spoils are removed approximately every 10 years. The materials are sampled to ensure that the quality is acceptable to meet MDNR requirements for land application before they are placed on the Fermi site and are seeded to prevent erosion (DTE 2014d).

The dredge basin was visited by NRC personnel during the September 2014 environmental site audit, during which time DTE contractor personnel were performing grading and maintenance of the basin.

3.5.2 Groundwater Resources

This section describes the current groundwater resources within and near the Fermi site.

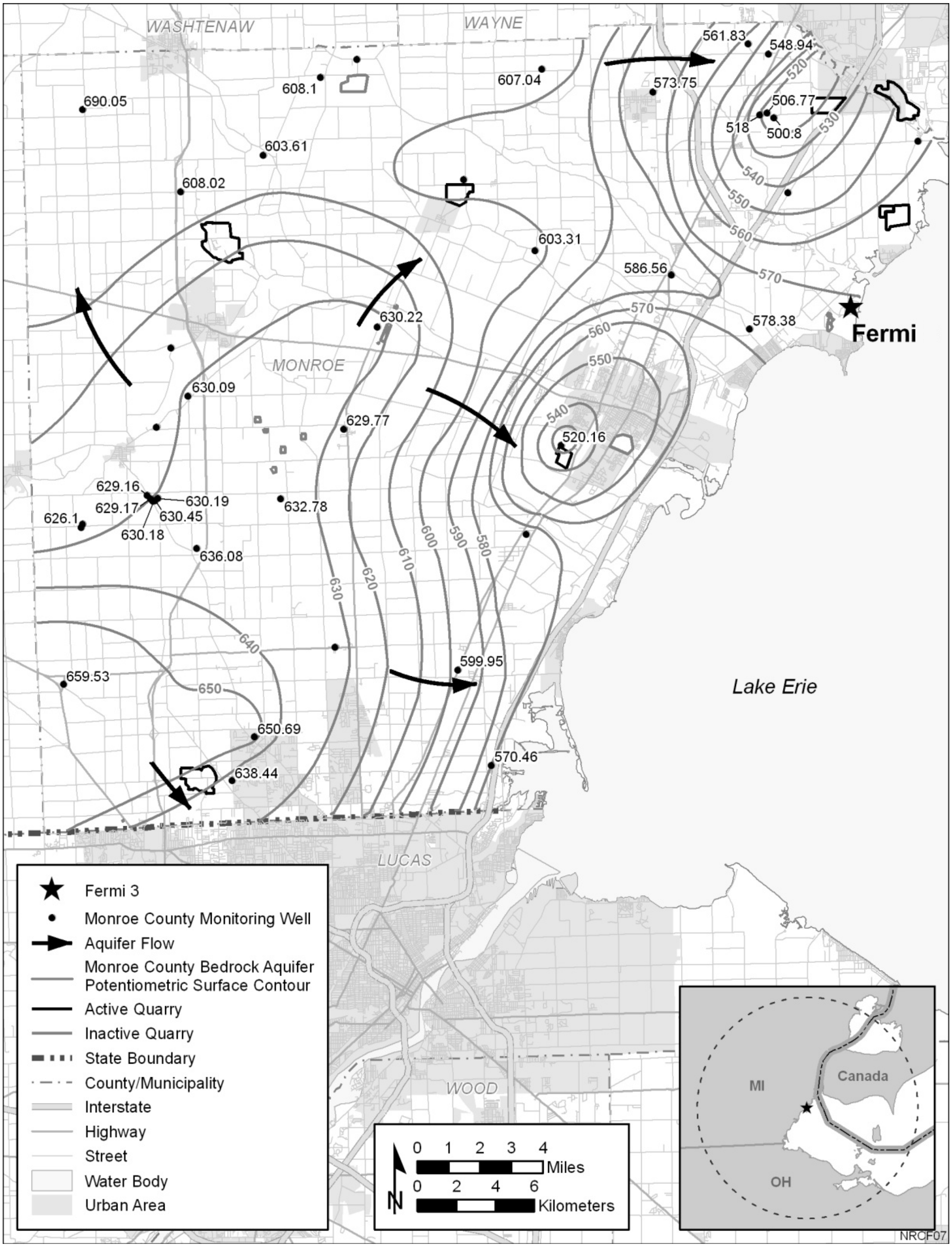
3.5.2.1 Site Description and Hydrogeology

Because of the low lying topography and the numerous water bodies around the site (Figure 3–10), the water table can often be found near the land surface. The depth to the water table within the site boundary generally ranges from the land surface to greater than 6.6 ft (2 m). Recharge to the water table is from local precipitation or, depending on the location, from occasional flooding or high lake levels. Around plant buildings, the depth to the water table is around 9 ft (2.7 m). Here the water table is in the construction fill and unconsolidated sediments (interbedded silt, clays, and sands). The unconsolidated material on top of the bedrock near the major buildings also contains vertical clay dikes that were installed during construction activities to limit the volume of groundwater flowing into building excavations. These dikes were left in place after construction activities stopped; they continue today to limit the lateral flow of water within the diked areas. Recharge to the water table in the plant area is primarily from precipitation, with some lateral infiltration from Lake Erie during high levels in Lake Erie (DTE 2014d; NRC 2013a; USDA 2014a).

Groundwater flow in the unconsolidated sediments is laterally to or away from surface water bodies and vertically downward into the underlying bedrock (DTE 2014d; NRC 2013a). Beneath the Fermi site, the Bass Islands Group forms the underlying bedrock. It is made up of approximately 50 to 100 ft (15.2 to 30.5 m) of dolomite rock. Groundwater flow is primarily through joints in the rock. Historically, the average lateral direction of groundwater flow in this group (and immediately underlying groups) was eastward toward the lake (DTE 2014d; NRC 2013a). However, the lateral direction of groundwater flow in the bedrock beneath the site is presently away from the lake toward quarry operations that are removing groundwater as part of their operations. These quarry operations are located to the north and southwest of the site (Figure 3–13) (DTE 2014d; NRC 2013a). At the site, recharge to the Bass Islands Group is from the overlying unconsolidated sediments or from the lake because the bedrock subcrops beneath Lake Erie and the water levels in this group are presently less than Lake Erie water levels (DECo 2011b).

The vertical flow of groundwater within the Bass Island Group is downward into the underlying Salina Group. The Salina Group is primarily composed of dolomite, shale, breccia, and limestone. As with the Bass Island Group, groundwater flow is mostly transmitted through joints in the rock. The thickness of the Salina Group is over 100 ft (30.5 m). Locally, it is recharged by the Bass Islands Group aquifer and Lake Erie. Regionally both the Bass Island and the Salina Groups are recharged by areas west of both the site and the two quarry operations (DTE 2014d). Both the Bass Island and Salina Groups are considered to be aquifers (Section 3.5.2.2).

1 **Figure 3–13. Bed Rock Water Levels and Lateral Groundwater Flow Directions**



2

3 Source: Modified from NRC 2013a

3.5.2.2 Groundwater Use

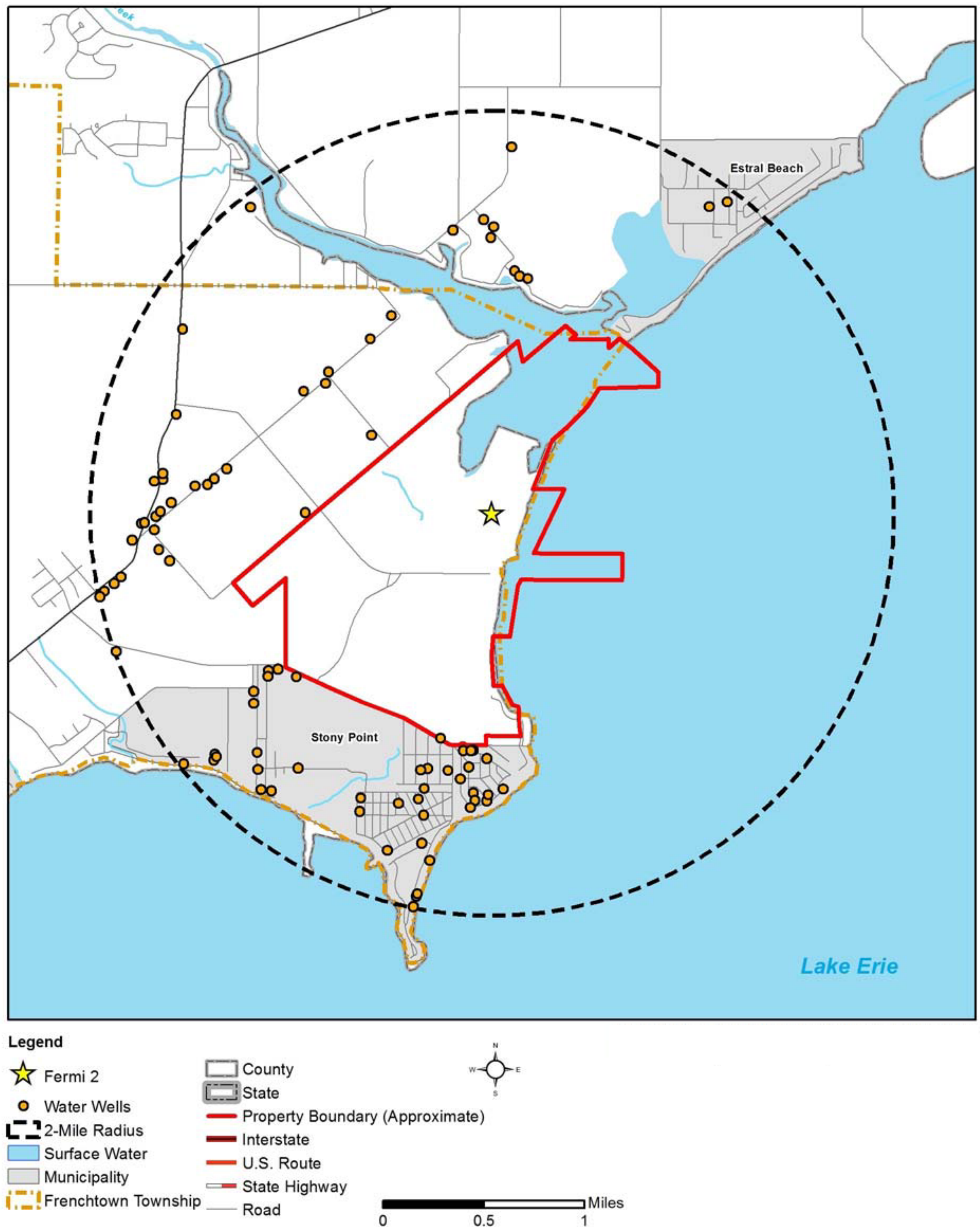
Groundwater use in the vicinity of the Fermi site is primarily limited to individual residences. Locally, the lake and glacially deposited material that lies on top of the bedrock is not considered to be an aquifer as they contain considerable amounts of clay and silt and do not readily transmit water (DECo 2011b). The Bass Islands and the Salina Groups are part of the regional bedrock aquifer that exists throughout Monroe County. In Monroe County, water from this aquifer is used by individual residences and quarries, with quarries being the largest consumer of groundwater (DECo 2011b) (Figure 3–14).

Groundwater is not used at the Fermi site and is not planned for use in the future. The primary cooling-water source for Fermi 2 is Lake Erie. Potable water used for drinking water and sanitary purposes comes from the Frenchtown Township Water Plant, which obtains its water from Lake Erie (DTE 2014d; NRC 2013a).

Although Fermi 2 does not consume groundwater for potable uses, the high groundwater table around plant buildings has caused some intermittent leakage of groundwater into the turbine building basement. The maximum quantity of groundwater that has been collected in a 24-hr period from this flow into the basement is 220 gal (833 L) (DTE 2014d).

In addition, water is pumped from site cable vaults to keep the cables dry. Some of the vaults are manually pumped periodically and some are pumped automatically. Typically, this water is from a mixture of groundwater inflow and stormwater runoff. Once the water is pumped from the vaults, it is discharged through stormwater outfalls to water bodies that are in communication with Lake Erie (DTE 2014d).

1 **Figure 3–14. Wells within 2 mi (3 km) of Fermi**



2

3 Source: Modified from DTE 2014d

3.5.2.3 Groundwater Quality

In the local area, naturally occurring concentrations in the groundwater of arsenic and some nonhazardous water quality constituents may exceed drinking water standards, but overall the groundwater quality in the bedrock aquifers is generally adequate for public consumption (DECo 2011b; DTE 2014d; NRC 2013a).

In wells within a 5-mi (8-km) radius of the Fermi site, elevated concentrations of arsenic above EPA's maximum contaminant level (0.010 mg/L) for drinking water were found in groundwater samples. Fermi site activities did not cause the arsenic concentrations in these wells (NRC 2013a). In the local area and in other areas of Michigan, natural earth materials, such as bedrock, sand, and gravel, may contain arsenic-bearing minerals. The arsenic in these naturally occurring materials may enter the groundwater as a dissolved constituent, which in turn would increase the concentration of arsenic in wells that withdraw this groundwater (MDEQ 2013c).

A few nonradiological spills of chemicals into the water table of the Fermi site have occurred. DTE reported all spills to the MDEQ and has remediated them (NRC 2013a; DTE 2014g). Spill incidences are as follows:

- In 1987, a leak of sodium hydroxide to groundwater was identified, and the pH of the groundwater in the area of the spill was measured to be 12.8. DTE excavated the soil in the area of the spill and pumped groundwater from the excavated area until the groundwater pH was reduced to 9.5.
- A diesel tank leak at the Fermi site was discovered on October 18, 2001. The investigation for this leak was closed on December 19, 2001.
- In 2002, 20 gal (76 L) of 15-percent sodium hypochlorite solution was accidentally spilled on soil. The contaminated soil was subsequently excavated and neutralized.
- Remedial action was taken to clean up a diesel spill to groundwater that was identified in 2002. Free phase diesel fuel was found in a dewatering sump within the Fermi 2 RHR complex in June 2002. A leak in the emergency fuel drain pipe was thought to be the source, and the leak was repaired. The diesel fuel contamination in the groundwater was monitored and remediated.
- Approximately 3,000 gal (11,365 L) of auxiliary boiler blowdown water was released to both the ground and to Outfall 002A on November 3, 2010. The release was determined to be the result of a leaking underground pipe that was subsequently repaired. No cleanup was required.
- Ten gallons (37 L) of raw sewage was discharged to the ground from a sanitary sewer line break on November 23, 2010. The line was immediately repaired.
- Thee gallons (11.4 L) of nonradioactive oily water from an oil/water separator tank spilled onto the ground surface on November 1, 2012. The contaminated soil and rock were removed.

Occasionally, low-level concentrations of tritium (hydrogen with an atomic weight of 3) have been detected above the laboratory lower limit of detection (500 picocuries per liter (pCi/L)) in a few onsite wells that monitor groundwater quality in the unconsolidated material. At the end of 2013, tritium was detected above the detection limit in two wells. These wells are located near the lake and the Fermi 2 air emissions stack. They are completed in unconsolidated material that contains fill. Tritium concentrations in these wells were 527 and 1,170 pCi/L, respectively. Tritium detected in these wells is believed to have originated from permitted (allowable) air releases of water vapor that contained tritium. The water vapor in the air condensed into liquid water and fell to the ground where it seeped into the ground and infiltrated down to the water table. Increasing trends in tritium concentration in the groundwater have not been observed, and all detected concentrations of tritium are well below EPA's drinking water standard of 20,000 pCi/L (NRC 2013a; DTE 2014e). Tritium has not been detected above the detection limit in wells that monitor the Bass Island Group. No other radionuclides have been detected in groundwater samples above their baseline values (DECo 2011b).

3.6 Terrestrial Resources

3.6.1 Fermi 2 Ecoregion

Fermi 2 lies in the Southern Lower Peninsula within the Maumee Lake Plain Level IV Ecoregion. The Southern Lower Peninsula encompasses 24,248 mi^2 (62,802 km^2) and is characterized by rolling moraines and flat lake prairies. The region is underlain by Paleozoic bedrock and was completely glaciated during the Late Wisconsinan Glacial period; typically 100 to 400 ft (30 to 120 m) of loamy glacial drift covers the bedrock (MDNR 2006a). This ecoregion experiences the warmest climate and longest growing season in the State. Historically, open fire-dependent oak savannas and prairies, oak-hickory forests, prairie fens, lakeplain prairies, southern wet meadows, southern swamps, and floodplain forests covered much of the region. The MDNR (2006a) reports that this region was the only region in Michigan to support large areas of tallgrass prairie. Today, agriculture and urban development constitute the major land uses. Remaining floodplain forests provide important habitat for migrating and breeding songbirds and other wildlife, especially as the region has become increasingly fragmented. Most of the oak savannahs have been eliminated or converted to closed-canopy forest due to fire suppression, and almost all of the original tallgrass and wet prairies have been converted to farmland. The MDNR (2006a) considers the remaining marshes and wetlands along Great Lakes shorelines to be critical for maintaining migratory waterfowl, shore birds, and the Great Lakes fisheries. Rare plant communities found within this region include coastal plain marshes, which occur in sandy depressions in outwash plains and glacial lake beds; inland salt marshes, which are limited to a handful of locations along the Maple River; and prairie fens, which are concentrated in the interlobate region (MDNR 2006a).

The MDNR maintains Michigan's Wildlife Action Plan (MDNR 2006a), which addresses native habitat and species decline and contains a Statewide conservation plan. In the plan, the MDNR identifies and prioritizes conservation actions, research and survey needs, and long-term monitoring initiatives. Within the Southern Lower Peninsula, the MDNR's (2006a) priority conservation actions include invasive species monitoring, prevention, and control programs; management of natural disturbance regimes, such as prescribed fires; and working with municipalities to develop planning and zoning ordinances that promote the conservation of native grasslands, shrublands, and forests. The MDNR (2006b) has also identified species of greatest conservation need within the area, the list of which includes 92 birds, 91 insects, 15 reptiles, 12 mammals, 11 amphibians, and 9 snails.

3.6.2 Fermi Site Surveys, Studies, and Reports

A number of vegetation and wildlife surveys have been conducted on the Fermi site beginning with preconstruction surveys in the early 1970s. This section summarizes these surveys in chronological order.

Final Environmental Statement for Construction (1972)

In July 1972, the U.S. Atomic Energy Commission (AEC), the predecessor agency to the NRC, issued a final environmental statement that evaluated the construction of Fermi 2 (FES-C) (AEC 1972). Although no specific studies were conducted to support the preparation of the FES-C, the report summarizes the terrestrial habitats and wildlife on the site.

Preconstruction Surveys (1973–1974)

From January 1973 through January 1974, NUS Corporation (1974) performed baseline preconstruction surveys of the Fermi site. The surveys included qualitative and quantitative surveys of woody vegetation, herbaceous plants, and wetland plants; bird censuses; mammal field studies and population estimates; and qualitative reptile and amphibian surveys. The final report also contains extensive tables of species present at the Fermi site.

Final Environmental Statement for Operation (1981)

In August 1981, the NRC issued a final environmental statement that evaluated the operation of Fermi 2 (FES-O) (NRC 1981). The report includes updates to the information provided on terrestrial habitats and wildlife in the FES-C.

Wildlife Habitat Council Vegetation and Wildlife Surveys (2000)

In July 2000, Wildlife Habitat Council (WHC) biologists performed a general habitat survey that identified wildlife and plant species common to the site and surrounding vicinity (DTE 2014d). The Fermi 2 Wildlife Management Plan (DECo 2000) documents the survey results.

Fermi 3 Reconnaissance Surveys (2006–2008)

Between November 2006 and May 2008, Black & Veatch Corporation (Black & Veatch) conducted reconnaissance surveys of the Fermi site to assess existing ecological conditions in support of Detroit Edison Company's (DECo) preparation of the Fermi 3 COL application. The surveys included both vegetation sampling and wildlife surveys. DECo's ER for the Fermi 3 COL application (DECo 2011b) documents the results of the surveys.

Ducks Unlimited Wetland Investigation Report (2008)

In 2008, DTE contracted with Ducks Unlimited, Inc. (Ducks Unlimited) to perform wetland delineation on 1,106 undeveloped acres (448 ha) on the Fermi site. Ducks Unlimited reviewed existing topographic and National Wetlands Inventory maps, soil surveys, and other existing information; conducted onsite investigations of soil, hydrology, flora, and fauna in May and June 2008; and delineated all wetlands on the site using USACE delineation guidance. A July 2008 Wetland Investigation Report (Ducks Unlimited 2008) delineates the results. In 2011, Ducks Unlimited updated the report to incorporate minor changes to the delineation provided by the MDEQ and the USACE (Ducks Unlimited 2011).

Fermi 3 Terrestrial Vegetation and Wildlife Surveys (2008–2009)

From July 2008 through June 2009, Black & Veatch conducted more detailed surveys of vegetation and wildlife on the Fermi site than that of the previous reconnaissance surveys.

Black & Veatch gathered quantitative data on the abundance, density, and cover of plant species on the site using line transects and plot sampling methods during 3-day periods in July 2008, October 2008, May 2009, and June 2009. Transects were positioned in areas that Fermi 3 construction was expected to affect and that generally represented the plant communities present, including emergent wetland, restored prairie, Lake Erie shoreline, and wooded lots. Black & Veatch issued a final report in November 2009 (Black & Veatch 2009c).

The wildlife surveys were conducted to systematically confirm data obtained from earlier surveys and to further characterize the terrestrial wildlife species that inhabit the site. General visual encounter surveys were conducted during 4-day periods in July 2008, October 2008, January 2009, and April 2009. Black & Veatch also conducted focused surveys for Federally and State-listed birds, mammals, reptiles, and amphibians. Black & Veatch issued a final report in November 2009 (Black & Veatch 2009d).

Transmission Line Corridor Prairie Planting Survey (2005 and 2007)

In July 2005 and September 2007, representatives from the Michigan State University Extension surveyed a 29-ac (12-ha) area of restored prairie within an onsite transmission line corridor (MNFI 2007h). Section 3.6.5.2 describes the survey results.

Threatened and Endangered Species Assessment (2013)

In July and August 2013, Cardno JFNew representatives conducted surveys for Federally and State-listed threatened and endangered species on the Fermi site (Kogge and Heslinga 2013). Frog and toad surveys were also conducted at several locations throughout the site. Section 3.6.3.2 discusses the State-listed species observed during this assessment in detail. No Federally listed species were observed during the assessment.

2014 Special Status Species Survey (2014)

In response to proposed rules to Federally list two species—the red knot (*Calidris canutus rufa*) and northern long-eared bat (*Myotis septentrionalis*)—DTE contracted with Cardno JFNew to perform a supplemental threatened and endangered species assessment in 2014 (Kogge 2014). Field surveys for the two species were conducted in September 2014. Although neither species was observed during the surveys, Cardno JFNew concludes, in the final report, that potential roosting and foraging habitat for the northern long-eared bat and potential migratory stopover or resting habitat for the red knot occurs on the site. Section 3.8 discusses this study in detail.

Annual Christmas Bird Count (1990–Present)

DTE has hosted an annual Christmas bird count on the Fermi site with the National Audubon Society since 1990. The Fermi site counts are reported with the Rockwood, Michigan (Christmas Bird Count Code MIRO), counts on the National Audubon Society's Christmas Bird Count web site.

Fermi 2 Wildlife Habitat Team Monitoring (Ongoing)

The Fermi 2 Wildlife Habitat Team conducts periodic wildlife surveys of the site four to five times per year to monitor changes in wildlife communities and to document any new species found on the site. The surveys are random and include the South Lagoon, dredge basin, quarry lakes, and several areas of wooded wetlands (DTE 2014g).

3.6.3 Fermi Site

The Fermi site encompasses 1,260 ac (510 ha) in Frenchtown Township, Monroe County, Michigan. Approximately 212 ac (86 ha) of the site are developed and in industrial use. DTE leases approximately 64 ac (26 ha) in the western-most portion of the site to private individuals for agricultural use. The remainder of the site consists of natural areas, including coastal emergent wetlands, forests, grasslands, shrublands, thickets, Lake Erie, and other various waterbodies. The FWS manages approximately 656 ac (265 ha) of the site's natural areas as part of the DRIWR under a cooperative agreement with DTE that was first established in 2003 (DECo and FWS 2003). DTE manages the remaining natural areas on the site in accordance with its WHC-certified Wildlife Management Plan (DECo 2000). The DRIWR cooperative agreement and Wildlife Management Plan are discussed in more detail in Sections 3.6.5.2 and 3.6.4, respectively.

Much of the site was disturbed before or during Fermi 2 construction through clearing or covering with fill materials, and some of the forested tracts along the southern edge of the site were also logged (DTE 2014d).

3.6.3.1 Vegetation

As described in Section 3.6.2, Black & Veatch conducted initial vegetation surveys of the Fermi site from November 2006 through May 2008 (DECo 2011b) and more detailed surveys from July 2008 through June 2009 (Black & Veatch 2009c). These surveys and the NRC's final environmental impact statement (FEIS) for the Fermi 3 COL (NRC 2013a), inform the description of the vegetative communities on the Fermi site. Table 3–9 lists the vegetative cover types, dominant species, and acreage for each of the nine terrestrial habitat types on the site.

Table 3–9. Vegetative Cover Types and Dominant Species on the Fermi Site by Area

Cover Type (Habitat)[(a)]	Dominant Species	Area (in acres)	Percent[(b)]
Coastal Emergent Wetland		**273**	**32.8**
Coastal Emergent Wetland	common reed (*Phragmites australis*), cattail species (*Typha* spp.), American lotus (*Nelumbo lutea*)	273	32.8
Forest		**256**	**30.6**
Coastal Shoreline	cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*)	47	5.6
Lowland Hardwood	cottonwood, peach-leafed willow, oak species (*Quercus* spp.), basswood (*Tilia americana*), hickory species (*Carya* spp.)	92	11.0
Woodlot	cottonwood, box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*)	117	14.0
Grassland		**168**	**20.2**
Right-of-way	big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*)	29	3.5
Idle, Old Field, or Planted	smooth brome (*Bromus inermis*), Canada goldenrod (*Solidago canadensis*)	75	9.0
Row Crop	corn (*Zea mays*), soybeans (*Glycine max*)	64	7.7
Shrubland		**113**	**13.6**
Shrubland	dogwood species (*Cornus* spp.), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), blackberry species (*Rubus* spp.)	113	13.6
Thicket		**23**	**2.8**
Thicket	hawthorn species (*Crataegus* spp.), box elder, dogwoods	23	2.8
Total		**833**	

Cover Type (Habitat)[a]	Dominant Species	Area (in acres)	Percent[b]

[(a)] Vegetative cover types are based on the MDNR's (2006a) Wildlife Action Plan.
[(b)] Percentages represent the percent of the undeveloped portion of the site (excluding water) that the cover type represents.

Source: DECo 2011b; NRC 2013a

Coastal Emergent Wetland

Coastal emergent wetland is the most prevalent terrestrial habitat on the Fermi site and accounts for approximately 32.8 percent of the site's undeveloped terrestrial land cover.

The largest area of coastal wetland on the site includes the North and South Lagoons and an unnamed drainage corridor that flows from the west. The hydrology of the coastal emergent wetlands is controlled almost entirely by variations in Lake Erie and Swan Creek surface water elevations (DECo 2011a). During the 2006 through 2008 study, Black & Veatch estimated that only about 238 ac (96 ha) of coastal emergent wetland is vegetated and that the remaining area that is so designated (approximately 35 ac (14 ha)) is actually open water (DECo 2011b). However, the extent of emergent vegetation appears to fluctuate annually depending on Lake Erie water levels with more open water in high-water years and less open water in low-water years. For example, water conditions were relatively high in 1981 and relatively low in 2005. Aerial photographs from 2005 show a marked increase in emergent vegetation in the lagoons (NRC 2013a).

Presently, site lagoons are dominated by dense and extensive stands of common reed (*Phragmites australis*) and cattail (*Typha* spp.). Purple loosestrife (*Lythrum salicaria*), an invasive non-native herbaceous wetland species, is present throughout most of the coastal emergent wetlands on the Fermi site. The west-side drainage corridor has virtually no open water because of the dense growth of common reed, cattails, and purple loosestrife. These dense stands of non-natives likely provide low-quality habitat for wildlife, especially waterfowl. However, some species of songbirds, including the red-winged blackbird (*Agelaius phoeniceus*), use the cattails and reeds for nesting. Moderately shallow areas of the South and North Lagoons and the South Canal contain stands of American lotus (*Nelumbo lutea*), which is a State-threatened species. Section 3.6.5.1 discusses the American lotus in detail. Most of the South Lagoon is shallow and contains fill deposits. Wading birds, such as egrets and other herons, use these shallow water areas for foraging.

Forest

Forest accounts for 30.6 percent of the undeveloped portion of the Fermi site and is the second most prevalent terrestrial habitat type. Three types of forested habitat occur on the site: (1) coastal shoreline, (2) lowland hardwood, and (3) woodlot.

Coastal Shoreline. Forested coastal shoreline consists of a narrow, interrupted band along Lake Erie. This cover type accounts for about 47 ac (19 ha) or 5.6 percent of undeveloped land cover. The area is dominated by large eastern cottonwoods (*Populus deltoides*), some of which are 2 ft (0.3 m) or more in diameter at breast height (DBH), and peachleaf willow (*Salix amygdaloides*). Box elder (*Acer negundo*) is also scattered in the area. Green ash (*Fraxinus pennsylvanica*) was formerly common in the area before the emerald ash borer (*Agrilus planipennis*), an invasive beetle, killed virtually all ash trees on the site. Shrub growth varies from dense to sparse depending on lake exposure and the extent of high-water ponding. Ground cover is sparse in heavily shaded areas, whereas the edges of the coastal shoreline habitat include dense stands of reed canarygrass (*Phalaris arundinacea*). Several forbs, including stinging nettle (*Urtica dioica*), are present as many forbs can grow in sandy soils and are capable of withstanding fluctuations in moisture availability. Several unexpected native and introduced species also occur in this habitat that have likely dispersed through water from other areas of Lake Erie. Examples of such species include jimson-weed (*Datura strumonium*) and clammy-weed (*Polanisia dodecandra*) (NRC 2013a).

Lowland Hardwood. Lowland hardwoods represent the most mature vegetation on the Fermi site. This cover type accounts for about 92 ac (37 ha) or 11.0 percent of undeveloped land cover and occurs immediately northeast of the quarry lakes and within the south-central portion of the site along the west side of the South Lagoon. Eastern cottonwood and peachleaf willow are present, but oaks (*Quercus* spp.), American basswood (*Tilia americana*), and hickories (*Carya* spp.) are more dominant. Overall, this habitat is drier and more stable than the coastal shoreline habitat, and the topsoil is organic or composed of clay rather than sand. The largest trees occur in the area northeast of the quarry lakes where many specimens range from 18 to 26 in. (0.46 to 0.66 m) DBH. In the south-central area, some trees reach this size, but most are less than 14 in. (0.36 m) DBH. Scattered stumps indicate that larger trees in this area were likely logged before the construction of Fermi 2. Shrubs are widely scattered in the understory. Ground cover is generally sparse but consists of a variety of woodland species, such as woodland bluegrass (*Poa sylvestris*), scattered sedges (*Carex* spp.), Enchanter's nightshade (*Circaea lutetiana*), false spikenard (*Smilacina racemosa*), and Virginia stickseed (*Hackelia virginiana*). Poison ivy (*Toxicodendron radicans*) and wild grapes (*Vitis* spp.) are also common (NRC 2013a).

Woodlot. Woodlots occur in the east-central and northwestern portions of the Fermi site and account for about 117 ac (47 ha) or 14.0 percent of the undeveloped land cover. These areas primarily lie above fill material from the construction of Fermi 1 and 2 or on land otherwise heavily disturbed by construction activities. Until the early 2000s, the tree canopy was well developed and composed mostly of eastern cottonwood, box elder (*Acer negundo*), and green ash. Since that time, the canopy has become more open because of the loss of almost all the site's green ash trees to the invasive emerald ash borer. As a result, the majority of the understory is composed of tree saplings of various species. Introduced tree species, such as the tree of heaven (*Ailanthus altissimus*), are also present. Poison ivy, wild grape, and trumpet creeper (*Campsis radicans*) vines form localized thickets, and the non-native invasive shrub species European privet (*Ligustrum vulgare*) and common buckthorn (*Rhamnus cathcartica*) are relatively common. Ground cover is generally sparse and composed mostly of aggressive native plant species and non-native invasive plant species. Some of the more common herbaceous species include burdock (*Arctium minus*) and heal-all (*Prunella vulgaris*), both of which are native, and the highly invasive garlic mustard (*Alliaria petiolata*) (NRC 2013a).

<u>Grassland</u>

Grassland accounts for 20.2 percent of the undeveloped portion of the Fermi site. Three types of grasslands occur on the site: right-of-way grasslands; idle, old field, or planted grasslands; and agricultural fields used for growing row crops.

Right-of-way. Right-of-way grasslands encompass 29 ac (12 ha) or 3.5 percent of the site's undeveloped land cover. Right-of-way grasslands may be associated with roadways, rail lines, transmission lines, pipelines, and other linear features. On the Fermi site, the onsite transmission line corridor accounts for the majority of this land cover type. DTE, in coordination with the NRCS, Ducks Unlimited, ITC Transmission, and the FWS, began restoring the corridor habitat to native prairie beginning in 2003. Section 3.6.5.2 discusses this effort in more detail in the subsection entitled, "Restored Prairie Habitat."

Idle, Old Field, or Planted. Idle, old field, or planted land comprises 75 ac (30 ha) or 9.0 percent of the site's undeveloped land cover and consists of land that had once been cleared for agriculture or other purposes and that has now been taken over in part by opportunistic plants. In some cases, these areas were initially planted with a cover grass, such as perennial brome (*Bromus* spp.) or fescues (*Fescue* spp.). Smooth brome grass (*Bromus ramosus* ssp. *ramosus*) often dominates these areas, but other opportunistic (weedy and invasive) native and introduced species, such as Canada thistle (*Cirsium arvense*), Canada goldenrod (*Solidago canadensis*), and flattop-fragrant goldenrod (*Euthamia graminifolia*), are also common. Native shrubs, such as blackberry (*Rubus* spp.), and non-native invasive shrubs, such as multiflora rose (*Rosa multiflora*), are also present but are not dominant (NRC 2013a).

Row Crop. Row crops represent agricultural fields that are planted with a single species, such as corn (*Zea mays*) or soybeans (*Glycine max*), and that are harvested annually (NRC 2013a). Approximately 64 ac (26 ha) or 7.7 percent of the undeveloped land consists of this cover type (NRC 2013a). DTE leases this land to private individuals (DECo 2011b). According to NRCS (1997) maps, a portion of the leased cropland contains prime farmland.

<u>Shrubland</u>

Shrublands include upland areas with relatively dry soils that are dominated by deciduous shrubs. Approximately 113 ac (45.7 ha) or 13.6 percent of the site's undeveloped land cover is shrubland. Most of the site's shrubland lies in areas that were filled or otherwise extensively disturbed by development of Fermi 1 and 2 with the possible exception of some shrubland in the extreme southeastern corner of the site. Dogwoods (*Cornus* spp.), common buckthorn, multiflora rose, and blackberries are among the dominant species. Tree saplings, such as honey locust (*Gleditsia triacanthos*), eastern cottonwood, and green ash, are common, and grasses and forbs generally form substantial ground cover. Many introduced or opportunistic species, including smooth brome grass, prickly lettuce (*Lactuca serriola*), Canada goldenrod, and Missouri ironweed (*Vernonia missurica*), are likely the result of past habitat disturbances (NRC 2013a).

<u>Thicket</u>

The 23 ac (9.3 ha) of thicket on the Fermi site are generally located in transitional areas between wetlands and uplands. This cover type occurs at lower elevations than the shrubland cover type does; however, like shrubland, it is in a successional stage that is likely to transition to forest conditions over time. The site's thickets are densely covered with saplings of eastern cottonwood, peachleaf willow, and green ash, as well as small trees, such as hawthorns (*Crataegus* spp.) and box elder. Common shrubs include European privet and dogwoods. Poison ivy is abundant, and ground cover is sparse except in a few open areas (NRC 2013a).

3.6.3.2 Animals

As described in Section 3.6.2, Black & Veatch conducted initial wildlife surveys of the Fermi site from November 2006 through May 2008 (DECo 2011b) and more detailed surveys from July 2008 through April 2009 (Black & Veatch 2009d). Black & Veatch (2009b) also conducted focused surveys for Federally and State-listed birds, mammals, reptiles, and amphibians. Cardno JFNew conducted surveys for Federally and State-listed threatened and endangered species on the Fermi site (Kogge and Heslinga 2013) in July and August 2013 and performed a supplemental assessment (Kogge 2014) in September 2014 in response to proposed rules to Federally list the red knot and northern long-eared bat. These surveys and the NRC's FEIS for the Fermi 3 COL (NRC 2013a) inform the description of the animals present on the Fermi site.

Birds

Birds in the Fermi 2 region include year-round residents, seasonal residents, and transients (birds stopping briefly during migration). Lake Erie, on which Fermi 2 lies, is within the Atlantic flyway, one of several major migratory flyways in North America.

In preconstruction surveys, NUS Corporation (1974) identified about 150 bird species that were known to occur or were likely to occur on or near the Fermi site. In its July 2008 through June 2009 wildlife survey, Black & Veatch (2009b) identified a total of 118 bird species on the Fermi site across four survey sessions (74 species in July, 57 in October, 29 in January, and 79 in April). The five most abundant species across all survey sessions were ring-billed gull (*Larus delawarensis*), European starling (*Sturnus vulgaris*), mallard (*Anas platyrhynchos*), red-winged blackbird, and double-crested cormorant (*Phalacrocorax auritus*), which together accounted for 60 percent of the total number of birds observed (Black & Veatch 2009b). These species were especially common in small flocks or large assemblages during migratory periods (October and April survey sessions) (Black & Veatch 2009b).

Black and Veatch (2009b) observed some habitat segregation among species. Generally, gulls, ducks, cormorants, and geese dominated the Lake Erie shoreline. Warblers, flycatchers, and other songbirds were most commonly observed or heard calling in wooded areas. Interior forest species, such as ovenbird (*Seiurus aurocapilla*) and veery (*Catharus fuscescens*), were absent, which Black & Veatch (2009b) attributed to past site disturbance and unsatisfactory forest size, structure, and maturity. Species that depend on large grassland tracts, such as Henslow's sparrow (*Ammodramus henslowii*) were also absent, whereas species tolerant of edge habitats, such as American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), Northern cardinal (*Cardinalis cardinalis*), European starling, American goldfinch (*Spinus tristis*), and several sparrow species, were found within the site's grassland and prairies. Red-tailed hawks (*Buteo jamaicensis*) were found to use transmission line towers as hunting perches in the right-of-way grasslands, and bald eagles (*Haliaeetus leucocephalus*) were observed along the Lake Erie waterfront. Black & Veatch (2009b) observed evidence of both red-tailed hawks and bald eagles nesting on the site. Other raptors, including the broad-winged hawk (*Buteo platypterus*), northern harrier (*Circus cyaneus*), osprey (*Pandion haliaetus*), and peregrine falcon (*Falco peregrinus*), were seen hunting or flying overhead, but no signs of nesting were observed. Herons, egrets, and other wading birds were usually present along the Lake Erie shoreline near the dredge disposal pond or within marshes throughout the site when water levels were low enough to create mud flats in these areas.

Mammals

The Fermi site is surrounded by high chain-linked fences, which likely inhibit larger mammals from entering the site (DTE 2014d). However, individuals can gain access to the site through the Lake Erie waterfront, North Lagoon area, and through entrance roadways.

During its 2008 through 2009 survey, Black & Veatch (2009b) recorded observations of mammals and any signs (scat, tracks, rubs, or discarded hair) that could be attributed to a particular species. The survey identifies 16 mammals that occur on the site (Table 3–10), many of which are small rodents. The most commonly observed mammal was the white-tailed deer (*Odocoileus virginianus*). Coyote (*Canis latrans*), eastern cottontail (*Sylvilagus floridanus*), eastern fox squirrel (*Sciurus niger*), groundhog (*Marmota monax*), muskrat (*Ondatra zibethica*), and raccoon (*Procyon lotor*) were also common. The least encountered species were nocturnal species, such as the striped skunk (*Mephitis mephitis*) and Virginia opossum (*Didelphis virginianus*); shrews; and other small rodents.

Black & Veatch (2009b) found most mammals to be relatively nonselective in their habitat preferences (i.e., occurring in both remote locations and locations near human activity). Distinct white-tailed deer trails were generally present in wooded areas, thickets, and other areas of dense vegetative cover. Eastern fox squirrels were only observed in distant wooded areas of the site.

Table 3–10. Mammals Observed on the Fermi Site, 2008–2009

Common Name	Species Name	Abundance[a]
coyote	*Canis latrans*	Common
deer mouse	*Peromyscus maniculatus*	Infrequent
domestic cat	*Felis catus*	Obscure
eastern cottontail	*Sylvilagus floridanus*	Common
eastern fox squirrel	*Sciurus niger*	Common
eastern gray squirrel	*Sciurus carolinensis*	Obscure
groundhog	*Marmota monax*	Common
meadow vole	*Microtus pennsylvanicus*	Obscure
muskrat	*Ondatra zibethica*	Common
northern short-tailed shrew	*Blarina brevicauda*	Obscure
raccoon	*Procyon lotor*	Common
red fox	*Vulpes vulpes*	Obscure
striped skunk	*Mephitis mephitis*	Infrequent
Virginia opossum	*Didelphis virginianus*	Obscure
white-footed mouse	*Peromyscus leucopus*	Obscure
white-tailed deer	*Odocoileus virginianus*	Common

(a) Black & Veatch (2009b) defined abundance classes for mammals as follows:

- Common = appears in three or more (out of four total) survey sessions.
- Occasional = appears in two survey sessions or in one session with more than 10 individuals.
- Infrequent = appears in only two survey sessions.
- Obscure = observed in only one survey session with less than 10 individuals.

Source: Black & Veatch 2009b

Reptiles and Amphibians

The lagoons, other wetlands areas, and adjacent habitats on the Fermi site provide substantial areas of potential habitat for amphibians and reptiles. However, direct and indirect observations have been infrequent both in recent and past studies (NRC 2013a).

During the 2008 through 2009 wildlife survey, Black & Veatch (2009b) observed four reptile species and six amphibians (Table 3–11). All of the observed amphibians were frogs and were observed in or near wetlands. Black & Veatch (2009b) conducted call surveys to identify these species. Wetlands near roads were selected for listening based on the audible presence of singing or calling frogs or toads, and listening was conducted for at least 5 minutes at 13 locations representing approximately 40 percent of the wetlands on the Fermi site. During the April survey session, the western chorus frog (*Pseudacris triseriata triseriata*) and American toad (*Bufo americanus*) were heard. In July 2008, the American toad, bullfrog (*Rana catesbeiana*), and green frog (*Rana clamitans melanota*) were heard. Additional incidental observances included one road-killed and one live pickerel frog (*Rana palustris*) in October 2008 and a northern leopard frog (*Rana pipiens*) during the May 2009 vegetation sampling.

Reptiles were most closely associated with vegetation bordering wetlands and other wet areas. The midland painted turtle (*Chrysemys picta marginata*) was the most commonly observed reptile and was present in three out of the four survey sessions. Black & Veatch (2009b) notes that both reptiles and amphibians are likely underrepresented in the survey because occurrence and abundance was determined based on encounter rates during the survey.

Black & Veatch (2009b) did not observe any salamanders, although the study notes that the site potentially provides habitat for seven species, including the blue-spotted salamander (*Ambystoma laterale*), eastern newt (*Notophthalmus viridescens*), eastern tiger salamander (*Ambystoma tigrinum tigrinum*), and spotted salamander (*Ambystoma maculatum*). The wooded portion of the site includes scattered pools that appear suitable for use by salamanders, but most of the pools do not have substantial invertebrate populations other than mosquitoes and may not represent usable salamander forage or breeding habitat (Black & Veatch 2009b).

Table 3–11. Reptiles and Amphibians Observed on the Fermi Site, 2008–2009

Common Name	Species Name	Abundance[(a)]
Reptiles		
Blanding's turtle	*Emydoidea blandingii*	Obscure
eastern garter snake	*Thamnophis sirtalis sirtalis*	Occasional
midland painted turtle	*Chrysemys picta marginata*	Common
queen snake	*Regina septemvittata*	Obscure
Amphibians		
American toad	*Bufo americanus*	Infrequent
bull frog	*Rana catesbeiana*	Obscure
green frog	*Rana clamitans*	Obscure
northern leopard frog	*Rana pipiens*	Obscure
pickerel frog	*Rana palustris*	Obscure
western chorus frog	*Pseudacris triseriata triseriata*	Obscure

(a) Black & Veatch (2009b) defined abundance classes for mammals as follows:

- Common = appears in three or more (out of four total) survey sessions.
- Occasional = appears in two survey sessions or in one session with more than 10 individuals.
- Infrequent = appears in only two survey sessions.
- Obscure = observed in only one survey session with less than 10 individuals.

Source: Black & Veatch 2009b

3.6.4 Fermi 2 Wildlife Management Plan

The Fermi 2 Wildlife Management Plan (DECo 2000) outlines the goals and projects of DTE's Wildlife at Work program. Some of the plan's goals include conducting regular site inventories of native plant and animal species, providing nesting structures for select native birds on the site, enhancing wildflower habitat on the site, and monitoring and removing problematic invasive species. DTE first received WHC certification for its plan in 2000 (DTE 2014g), and it most recently received recertification in October 2014 (WHC 2014). WHC certification lasts for 2-year periods. DTE intends to seek WHC recertification and to continue to implement wildlife protection programs during the proposed license renewal term (DTE 2014g).

3.6.5 Important Species and Habitats

3.6.5.1 Important Species

Michigan's Natural Resources and Environmental Protection Act 451 of 1994, as amended (NREPA), Part 365, "Endangered Species Protection," contains provisions for the protection of species deemed to be endangered or threatened at the State level. The NREPA designates the MDNR as the agency responsible for determining which species should be listed as State-endangered or State-threatened and for managing protection and recovery programs. The act also prohibits the take of State-listed species unless a person or party first receives an Endangered Species Permit from the MDNR Wildlife Division.

Within Monroe County, the Michigan Natural Features Inventory (MNFI) natural heritage database indicates that 87 State-listed terrestrial species (49 flowering plants, 13 insects, 11 birds, 8 snails, 4 reptiles, and 2 amphibians) occur in Monroe County (MSUE 2014). In September 2013, the Michigan State University Extension (MSUE), on behalf of the MDNR, provided DTE with records from the MNFI's natural heritage database on known occurrences and localities of rare species and unique natural features near the Fermi site. Of the 87 State-listed terrestrial species in Monroe County, MSUE (2013) identified 7 species with known occurrences within 1.5 mi (2.4 km) of the Fermi site. Table 3–12 lists these species, and each species is discussed in detail in this section.

Table 3–12. Rare Species with Known Occurrences within 1.5 mi (2.4 km) of the Fermi Site

Species	Common Name	Status[a]	Recorded Occurrence on Fermi site? (Y/N)
Birds			
Haliaeetus leucocephalus	bald eagle	SSC	Y
Sterna hirundo	common tern	ST	Y
Tyto alba	barn owl	SE	N
Flowering Plants			
Nelumbo lutea	American lotus	ST	Y
Sagittaria montevidensis	giant arrowhead	ST	N
Strophostyles helvula	trailing wild bean	SSC	N
Reptiles			
Pantherophis gloydi	eastern fox snake	ST	Y

[a] SE = State-endangered; ST = State-threatened; and SSC = State species of concern.

Sources: MSUE 2013, 2014

Bald Eagle

The bald eagle is a large, blackish-brown eagle with a white head and tail and heavy yellow bill. The species typically inhabits lakes, rivers, marshes, and seacoasts and nests in tall trees or on top of buildings or cliffs. The bald eagle regularly occurs on and in the vicinity of the Fermi site, and DTE has observed nests on site property in recent years. In late 2007, DTE (2014d) personnel observed three bald eagle nests in large trees along the shoreline of Lake Erie. Only two nests remained following a series of winter storms in 2007 through 2008; by spring 2008, eagles continued to occupy only one of the two nests (DTE 2014d). In late May 2012, DTE (2014d) personnel observed a new nest with chicks near the site's firing range, and an additional active nest was identified near the dredge basin along the Lake Erie shoreline in early spring 2013. As of August 2014, DTE (2014g) personnel had identified an additional nest near the firing range. In addition to the nests, Black & Veatch (2009b) observed individuals during all of its 2008 through 2009 survey sessions. Black & Veatch (2009b) observed three fledglings in October 2008, several fledglings and subadults in January 2009, and one subadult in April 2009. Black & Veatch (2009b) noted that the successful fledging of eaglets indicates that bald eagles do not appear to be affected by ongoing site activity. Kogge and Heslinga (2013) observed several bald eagles in flight in July and August 2013.

In addition to being a Michigan species of special concern, bald eagles are protected under the Bald and Golden Eagle Protection Act of 1940, as amended (BGEPA) (16 U.S.C. 668 et seq.). This Federal act prohibits anyone from taking or disturbing bald eagles or golden eagles (*Aquila chrysaetos*), including their nests or eggs, without an FWS-issued permit. The BGEPA defines the term "take" to mean to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb" (50 CFR 22.3). "Disturb" means to take action that causes, or is likely to cause, (1) injury to an eagle, (2) decreases its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment (50 CFR 22.3). DTE maintains site procedures that ensure that personnel consider any potential environmental impacts before performing work on site (Section 4.6.1.2). Such impacts include those that may require a bald eagle take permit. Although DTE has initiated communications with the FWS pursuant to the BGEPA on several occasions, no site activities have required DTE to obtain a bald eagle take permit to date (DTE 2012, 2014g; FWS 2012).

Common Tern

The common tern (*Sterna hirundo*) is a medium-sized tern that is grayish-white in color with a black cap and wingtips. Common terns typically inhabit sand and gravel beaches and nest in shallow scrapes of bare sand between mid-May and early July (MNFI 2014d). Individuals often nest on islands to avoid human disturbance and terrestrial predators (MNFI 2014d). The MSUE (2013) reports that common terns have been observed nesting near the Fermi site. The MNFI (2014d) and the Audubon Society's Michigan Bird Records Committee (Audubon 2013) has not documented the species in Monroe County since the mid-1980s. However, Black & Veatch observed the species on the Fermi site during the November 2006 through 2008 reconnaissance surveys documented in the Fermi 3 COL application ER (DECo 2011b). Black & Veatch (2009b) also observed two individuals during the 2008 through 2009 survey. However, given the large resident population of gulls that inhabit the Fermi 2 intake area, Black & Veatch (2009b) concluded that common terns were unlikely to use the available coastal habitat on site for nesting. Kogge and Heslinga (2013) considered the species to have a "moderate or high potential to occur within the assessment area" based on previous site studies but did not observe the common tern during its 2013 threatened and endangered species assessment and did not find the site to contain optimal habitat for the species.

Barn Owl

The barn owl (*Tyto alba*) is a crow-sized owl with a buff to brown back and white face and underside. Its heart-shaped face distinguishes it from other owls. The species uses a wide variety of open habitats, including wet prairie, coastal plain marshes, emergent marshes, and oak barrens, but it is less common where intensive agriculture dominates the landscape (MNFI 2014f). The MSUE (2013) reports that barn owls have been known to nest along Post Road to the north of the Fermi site. Barn owls nest in hollow trees, buildings, or nest boxes between early April and late July (MNFI 2014f). According to MNFI (2014f) and the Audubon Society's Michigan Bird Records Committee (Audubon 2013), the species has not been documented in Monroe County since the early 1980s. Additionally, none of the Fermi site surveys or reports (AEC 1972; Black & Veatch 2009b; Kogge and Heslinga 2013; NRC 1981; NUS 1974) have documented this species. Specifically, in the 2008-2009 Black & Veatch study, particular emphasis was placed on surveying suitable habitat for barn owls. The survey identified no suitable nesting or roosting habitat due to the absence of large mature trees (Black & Veatch 2009b). Black & Veatch (2009b) also conducted night call surveys that included barn owl calls. However, none of the survey sessions resulted in a response by a barn owl.

American Lotus

The American lotus is a marsh-dwelling perennial emergent plant that grows from thick tubers and flowers in mid-summer (DTE 2014d). It is often associated with water-plaintain (*Alisma* spp.), sedges (*Carex* spp.), spike-rush (*Eleocharis palustris*), cattail, water-milfoil (*Myriophyllum* spp.), pondweed (*Potamogeton nodosus*), and other emergent marsh plants (MNFI 2014a). The species occurs in aquatic beds throughout the Fermi 2 property and is particularly abundant in the site's north and south lagoons (DTE 2014d). Kogge and Heslinga (2013) estimate that the total area of American lotus on the site is approximately 65 ac (26 ha), which represents a regionally significant population. In most areas where it occurs on site, American lotus is the dominant species and forms a significant aquatic/deepwater wetland community together with other submergent and aquatic plant species (Kogge and Heslinga 2013).

Giant Arrowhead

The giant arrowhead (*Sagittaria montevidensis*) is an emergent wetland plant with broad arrow-shaped leaves, white flowers, and sepals closely cupped around the flower and fruit (MNFI 2014c). It grows on wet to shallowly inundated mud flats, lagoons, and estuaries that are exposed to fluctuating water levels (MSUE 2013). Southeastern Michigan represents the species' northern distribution limit (Black & Veatch 2009a). Although MSUE (2013) indicates that the species has been known to occur on the Fermi site, the available site surveys and reports (Black & Veatch 2009a; DeCo 2000; Kogge and Heslinga 2013; NRC 1981; NUS 1974) did not identify this species on the site. The FES-C (AEC 1972) indicates that arrowhead occurs within site marshes, but the AEC only provides the genus (*Sagittaria*); therefore, it is unclear whether the report is referring to the presence of the State-threatened giant arrowhead or another unprotected arrowhead species. The MNFI (2014c) reports this species as occurring in Monroe County as recently as 2001.

Trailing Wild Bean

The trailing wild bean (*Strophostyles helvula*) is a twining to trailing annual vine that inhabits open, moist, sandy soil on disturbed roadsides, ditch banks, beaches, and dunes in or near emergent marsh or mesic sand prairie habitats. It produces pinkish, pea-like flowers and greenish pods that coil after seed dispersal. As a special concern species, the trailing wild bean is not legally protected under Michigan's endangered species legislation, but the MDNR considers the remaining population to be small enough that continued decline could necessitate its reclassification as a State-threatened or -endangered species (MSUE 2013). The MNFI (2014e) indicates that the species was last observed in Monroe County in 1985. None of the available site surveys or reports (AEC 1972; Black & Veatch 2009a; DeCo 2000; Kogge and Heslinga 2013; NRC 1981; NUS 1974; DeCo 2000) have recorded this species as occurring on the site.

<u>Eastern Fox Snake</u>

The eastern fox snake (*Pantherophis gloydi*) is a large snake with dark brown to black blotches down the middle of the back and smaller, alternating blotches along the sides of its yellowish body. The species inhabits emergent wetlands along Great Lakes shorelines, as well as drier habitats, including vegetated dunes, beaches, old fields, and open woodlands (MNFI 2014b). Individuals may also use disturbed areas, such as pastures, woodlots, vacant urban lots, rock riprap, ditches, dikes, and residential properties (Black & Veatch 2009b). Eastern fox snakes inhabit marsh and wetland on the Fermi site. The species was first observed within site wetlands west of Doxy Road in May and June 2008 during the Ducks Unlimited wetland delineation effort (Black & Veatch 2009b). The species was not observed during the 2008 through 2009 Black & Veatch (2009b) wildlife surveys but was again observed on a sand/gravel beach on the northern edge of the site during the Kogge and Heslinga 2013 survey.

As part of the preparation for construction and operation of the proposed Fermi 3, DTE developed a Habitat and Species Conservation Plan for the eastern fox snake (DECo 2012a). The plan includes measures to minimize or mitigate impacts to the eastern fox snake. Such measures include educating employees through use of a fox snake manual, adding the eastern fox snake to pre-job brief checklists to reinforce the issue before work begins each day, having a biologist capture and release snakes observed in developed areas before the commencement of work in those areas, and reporting of eastern fox snake sightings on the site.

For Fermi 2, DTE uses some similar measures to minimize impacts to the eastern fox snake. For instance, in accordance with Site Procedure MCE06, "Non-Radiological Environmental Protection," DTE personnel must include a Protected Species Protection Plan in the work package for any activities planned in undeveloped areas of the site unless the environmental engineer's work package review determines that such a plan is not needed (DTE 2014g). The pre-job brief for such work would include an explanation of the plan and the responsibilities of workers to prevent harm to protected species. If a protected species were to be harmed during the work, DTE personnel would prepare a Corrective Action Resolution Document (CARD), which would require followup action (DTE 2014g). For instance, in 2013, two eastern fox snakes were killed on site roadways; in response to these events, the site Wildlife Habitat Committee placed eastern fox snake signs on site roads to increase awareness following these events, and DTE implemented an awareness campaign through the site's daily update meetings (DTE 2014g). Because DTE maintains these administrative controls and because DTE does not anticipate any impact to habitat occupied by the snake as a result of continued operation of Fermi 2 during the proposed license renewal term, DTE has not implemented a specific mitigation plan for eastern fox snakes, and it has not found reason to seek a take permit from the MDNR (DTE 2014g).

3.6.5.2 Important Habitats

<u>Detroit River International Wildlife Refuge</u>

The DRIWR consists of nearly 6,000 ac (2,400 ha) of coastal wetlands, marshes, shoals, waterfront lands, and islands along 48 mi (77 km) of shoreline on the lower Detroit River and western shore of Lake Erie (FWS 2014f). Congress established the DRIWR in 2001, and it is the only International Wildlife Refuge in North America. The refuge contains bottomland hardwoods, glacial lakeplain prairie, coastal plain pond communities, and a variety of wetland types (FWS 2005). The refuge's coastal marshes are used by as many as 17 species of raptors, including eagles, hawks, owls, and falcons, as feeding and resting habitat, and by as many as 48 species of nonraptors, including waterfowl, loons, herons, egrets, terns, and neotropical migrant songbirds that migrate through the Detroit River area each year (FWS 2005). The FWS (2005) maintains a Comprehensive Management Plan for the refuge that includes plans for restoration of the Lake Erie shoreline, control of exotic species, and development of private land partnerships to enable restoration of wetlands, grasslands, stream channels, and riparian corridors used by Federal trust resources (migratory birds, Federally listed species, and interjurisdictional fish).

Since September 2003, DTE has maintained a cooperative agreement with the FWS to allow the FWS to manage 62.6 percent (656 ac (265 ha)) of the site's natural areas as part of the DRIWR (DECo 2011b; DECo and FWS 2003). The DRIWR lands on the Fermi site constitute the DRIWR Lagoona Beach Unit, and the general public does not have access to this unit (DTE 2014d; DECo 2011b). The Lagoona Beach Unit consists of the following four sections (Figure 3–8):

(1) DRIWR-1 lies in the northern portion of the Fermi site and consists of coastal wetlands and palustrine systems, including freshwater emergent wetlands and semi-permanently flooded lake areas (DTE 2014d).

(2) DRIWR-2 lies south of DRIWR-1 in the northwestern portion of the site. It includes coastal wetlands, upland forests, wet meadows, and coastal prairies, as well as palustrine scrub-shrub systems. This unit is seasonally inundated (DTE 2014d).

(3) DRIWR-3 lies in the southwest portion of the site and includes upland forests and palustrine forests with broad-leaved deciduous vegetation. It is seasonally inundated or partially drained throughout the year (DTE 2014d).

(4) DRIWR-4 lies in the south-southeast portion of the site and includes coastal wetlands and upland forest composed on palustrine forested and seasonally inundated areas (DTE 2014d).

DTE intends to maintain the cooperative agreement with the FWS for management of the DRIWR Lagoona Beach Unit throughout the proposed license renewal term. However, if Fermi 3 is built, small modifications to the refuge acres would be required for temporary construction buildings and laydown, and some small permanent impacts would occur due to a new site access road and meteorological tower (DTE 2014g). Section 4.15.4 discusses these cumulative impacts in more detail.

<u>Delineated Wetlands</u>

The National Wetlands Inventory indicates that 31 types of wetlands totaling approximately 1,508 ac (610 ha) lie within a 6-mi (10-km) radius of the Fermi site (DTE 2014d). Within Michigan, the MDEQ administers Section 404 of the Federal Water Pollution Control Act of 1972, as amended (referred to as the CWA). The MDEQ issues Section 404 permits, which are required for actions that result in the discharge of dredge or fill material into wetlands that are considered waters of the United States. Within Michigan, some wetlands in coastal areas, including those on the Fermi site, are further protected under Act 451, NREPA, Part 323, "Shorelands Protection and Management."

As previously described, Ducks Unlimited performed wetland delineation on 1,106 undeveloped acres (448 ha) on the Fermi site in 2008 and updated its Wetland Investigation Report in 2011 to incorporate minor changes to the delineations provided by the MDEQ and the USACE. During its wetland assessment, Ducks Unlimited (2011) identified 37 wetlands comprising 52.8 percent (553.35 ac (223.74 ha)) of the undeveloped land on the Fermi site. The majority of the site's wetlands are palustrine emergent marsh and palustrine forested. With the exception of a few wetlands isolated by roads or berms, most of the wetlands are hydrologically connected and are therefore part of one wetland system (DTE 2014d). Ducks Unlimited (2011) found the principal functions of the Fermi 2 wetland system to be (1) flood flow alteration, (2) sediment or toxicant retention, (3) nutrient removal, and (4) fish and wildlife habitat. Table 3–13 lists the total area of delineated wetlands on the site by wetland type. Figure 3–15 depicts the location of each of the 37 delineated wetlands on the Fermi site.

Table 3–13. Delineated Wetlands on the Fermi Site by Area

	Area	
Wetland Type	**Acres**	**Hectares**
Palustrine Emergent Marsh (PEM)	318.03	128.70
Palustrine Forested (PFO)	166.73	67.47
Palustrine Scrub-Shrub (PSS)	16.15	6.54
PEM/Wooded Marsh (WM)	6.47	2.62
Open Water (OW)	45.04	18.03
PFO/PSS/PEM	0.93	0.38
Total	**553.35**	**223.74**

Source: Ducks Unlimited 2011

The site's palustrine emergent marshes (PEM) are characterized by reed canarygrass, common reed, sedges, narrow-leaf cattail (*Typha angustifolia*), water lily (*Nymphaea* spp.), and coontail (*Ceratophyllum demersum*). These areas range from inundated wet meadows to deep water marsh systems, and herbaceous or small woody vegetation covers more than 50 percent of the ground surfaces (Ducks Unlimited 2011).

The palustrine forested (PFO) wetlands contain hydric soils with pockets of standing water. Dominant species include silver maple (*Acer saccharinum*), shellbark hickory (*Carya laciniosa*), swamp white oak (*Quercus bicolor*), American elm (*Ulmus americana*), and eastern cottonwood, and the shrub layer is dominated by American elm saplings, silky dogwood (*Comus amomum*), and green ash saplings. Herbaceous vegetation is sparse and includes black raspberry (*Rubus* spp.), mayapple (*Podophyllum peltatum*), reed canarygrass, poison ivy, and Virginia creeper (*Parthenocissus quinquefolia*) (Ducks Unlimited 2011).

Palustrine scrub-shrub (PSS) wetlands are characterized by herbaceous or woody vegetation constituting less than 50 percent of ground cover. On the Fermi site, these wetlands largely consist of early successional woody communities dominated by silky dogwood, green ash, and hawthorn (Ducks Unlimited 2011).

Open water areas are characterized by inundation to a depth of greater than 4 ft (1.2 m) with no emergent vegetation present (Ducks Unlimited 2011).

Figure 3–15. Delineated Wetlands on the Fermi Site

Source: NRC 2013a, Figure 2-11

Restored Prairie Habitat

DTE has undertaken two prairie restoration projects on the Fermi site. DTE planted the first prairie in 2003 in coordination with the NRCS, Ducks Unlimited, ITC Transmission, and the FWS with the assistance of a grant under the North American Wetlands Conservation Act of 1989 (16 U.S.C. 4401–4412) (DTE 2014d; NRC 2013a). The prairie occupies about 29 ac (12 ha) within the existing onsite transmission line corridor (NRC 2013a). The prairie is dominated by big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*). Broomsedge (*Andropogon virginicus*), a less desirable native grass, is also relatively common in dense localized patches. Undesirable plants include purple loosestrife, common reed, and teasel (*Dipsacus sylvestris*) (NRC 2013a).

DTE, in conjunction with the FWS, restored a second area of tall-grass prairie of about 5 ac (2 ha) in the southeastern corner of the Fermi site. The prairie was planted in 2010 with a purchased tall grass seed mix. A July 2011 survey (DTE 2011) of the area revealed 38 native species within the prairie. Winged lythrum (*Lythrum alatum*), white blue-eyed grass (*Sisyrinchium albidum*), Indiangrass, dense blazing star (*Liatris spicata*), Canada wildrye (*Elymus canadensis*), and swamp milkweed (*Asclepias incarnata*) are among the dominant species (DTE 2011).

3.6.6 Bird Collisions and Strikes

Erickson et al. (2001) estimates that millions of birds are killed each year in the United States when they collide with manmade objects, including cooling towers, radio and television towers, buildings, vehicles, wind generation facilities, transmission lines, and numerous other objects. Bird mortality resulting from collisions with manmade structures is of concern if the stability of the local or migratory population of any bird species is threatened or if the reduction in numbers within any bird population significantly impairs its function within the ecosystem. Bird collision monitoring has been conducted at several nuclear power plants. Section 4.6.1.1 of NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 2013b), summarizes the results of these monitoring efforts. In the GEIS, the NRC (2013b) found that nuclear power plant operation does not represent a significant threat to overall bird populations and that there are no known instances in which bird collisions with plant structures or transmission lines have resulted in noticeable effects on local bird populations.

The FES-O for Fermi 2 (NRC 1981) notes that in September 1973, 50 dead birds of unspecified species were observed near the Fermi 2 cooling towers. In the FES-O, the NRC (1981) stated that only a few dead birds were observed near the cooling tower following this event and until the issuance of the FES-O.

As part of the license renewal application review, DTE (2014g) provided data on the last 10 years of bird strike occurrences (2005 through 2014), which is summarized in Table 3–14. Of particular note is DTE's observation of 45 dead birds in a one-week period in October 2007 near the Fermi 2 south cooling tower. DTE (2014g) reports that the species is unknown, but that individuals may have been American goldfinches. Following this occurrence, DTE undertook a two-year surveillance effort during migration periods to determine the number and species of birds that were colliding with the cooling tower and other plant structures. During the surveillance period, the most bird mortalities identified in any given week was four individuals, and no Federally or State-listed bird species were identified. Following this effort, DTE developed Nuclear Licensing Work Instruction 11801, "Unusual or Important Environmental Events Reporting Guidelines," that details reporting thresholds for "excessive bird impacts" and other unusual or important environmental events reportable to the NRC under Section 4.1 of Appendix B to the Fermi 2 operating license (DTE 2014g; NRC 1985). Table 3–14 lists the bird strike occurrences in the last 10 years (2005 through 2014), and Table 3–15 lists the results of the bird strike surveillance data from 2008 and 2009.

Since DTE's completion of its 2-year surveillance effort, DTE personnel have reported only two bird strikes, one of which was a bald eagle in October 2011. The bald eagle is a Michigan species of special concern and Federally protected under the BGEPA. Following this event, it was determined, after contacting the FWS, that no further followup action was necessary (DTE 2014g).

DTE's bird strike records do not indicate that any Federally or State-listed species have collided with plant structures or transmission lines.

Table 3–14. Bird Strike Occurrences, 2005–2014

Date	Species and Number	Description
May 31, 2005	unknown species (1 individual)	Mortality was due to collision with condenser fan. The individual likely entered through an opening in fan louvered cover.
October 2007	unknown (possibly American goldfinch) (45)	The birds were found near Fermi 2 south cooling tower over a 1-week period.
May 5, 2009	unknown species (1)	Mortality was due to a bird striking a ceiling fan inside of warehouse.
October 21, 2011	bald eagle (1)	A dead eagle was found near the 120-kV switchyard. DTE communications with the FWS determined that further followup action was unnecessary.
August 28, 2012	goose (1)	A dead goose was found with a singed wing beneath transmission line.

Source: DTE 2014g

Table 3–15. Bird Strike Monitoring Data, 2008–2009

Date	Species and Number	Description
2008		
March 27	European starling (4)	The birds were found on the south cooling tower in an advanced state of decay.
April 18	house sparrow (*Passer domesticus*) (1) grackle (family Icterid) (2)	The birds were found on ground around the meteorological tower.
April 29	yellow-rumped warbler (*Setophaga coronata*) (1)	The bird was found between cooling towers.
May 6	American goldfinch (1) American robin (1)	The goldfinch was found on the deck of the south cooling tower. The robin was found in a parking lot.
May 7	Baltimore oriole (*Icterus galbula*) (1) yellow-rumped warbler (1)	The birds were found on the ground around the meteorological tower.
May 22	ovenbird (1) yellow-rumped warbler (1)	The birds were found on the south cooling tower deck.

Date	Species and Number	Description
May 28	American redstart (*Setophaga ruticilla*) (1) eastern wood pewee (*Contopus virens*) (1) magnolia warbler (*Setophaga magnolia*) (1) unspecified warbler (1)	The American redstart and eastern wood pewee were found on the south cooling tower deck. The magnolia warbler was found on the ground near the meteorological tower. The unspecified warbler was found partially eaten on the ground near the south cooling tower deck.
2009		
April 3	golden crowned kinglet (*Regulus satrapa*) (1)	The bird was found on the southeast side of the south cooling tower.
September 3	pigeon (1) golden crowned kinglet (1)	The pigeon was found on the north cooling tower. The kinglet was found on the south cooling tower.
September 18	Philadelphia vireo (*Vireo philadelphicus*) (2)	One bird was found on the south cooling tower, and the other was found on the north cooling tower.
September 25	golden crowned kinglet (3) unspecified warbler (possibly cerulean) (1)	The kinglets were found on the south cooling tower. The warbler was found on the north cooling tower.
October 2	unspecified birds (possibly kinglets) (4)	The birds were found on the south cooling tower.

Source: DTE 2014g

3.7 Aquatic Resources

This section describes the aquatic environment and aquatic biota in the vicinity of the Fermi site and other areas that could be affected by operation or maintenance of Fermi 2. This description of the aquatic environment is largely taken from the NRC's Environmental Impact Statement for the COL application for the proposed Enrico Fermi Unit 3 (NRC 2013a) and has been updated as appropriate.

The Fermi site is located on 1,260 ac (510 ha) of developed and undeveloped land on the shoreline of the western basin of Lake Erie between Swan Creek and Stony Creek (Figure 3–3). Approximately 656 ac (265 ha) of this land (called the Lagoona Beach Unit) is managed as part of the DRIWR. As in many areas bordering the Great Lakes, coastal freshwater marshes are common in the vicinity of the Fermi site. These freshwater marshes play a pivotal role in the aquatic ecosystem of the Great Lakes, including storing and cycling nutrients and organic material from the land into the aquatic food web (Bouchard 2007). Most of the fish species in the Great Lakes depend on freshwater marshes during at least some portion of their life cycles (Wei et al. 2004). Freshwater marshes associated with the Great Lakes typically contain aspects of both riverine and lacustrine (standing water) habitats, are usually found in the vicinity of river mouths, and are influenced by both the level of the adjacent lake and riverine inflows. The Fermi site is located near the mouth of Swan Creek, which borders the site to the north, and it is surrounded by coastal freshwater marsh habitat. The largest water body near the site is Lake Erie, which borders the site to the east. Lake Erie provides cooling water and the Fermi site's cooling lake discharges back to Lake Erie (Section 3.1.3).

3.7.1 Aquatic Resources—Site and Vicinity

The aquatic resources on the Fermi site and vicinity occur in a variety of natural and constructed freshwater habitats (Figure 3–12). The discussion of aquatic resources present within the potentially affected area is divided among the prominent surface water features associated with the site, including the following:

- circulating water reservoir,
- overflow and discharge canals,
- drainage ditches,
- quarry lakes,
- wetland ponds and marshes managed as part of the DRIWR,
- Swan Creek,
- Stony Creek, and
- Lake Erie.

3.7.1.1 Circulating Water Reservoir (Cooling Water Pond and Circulation Pond)

The CWR, a component of the heat dissipation system associated with the operation of Fermi 2, provides the cooling water for the CWS. The CWR is located east of the Fermi 2 cooling towers in the northern portion of the developed part of the Fermi site (Figure 3–12). This manmade reservoir encompasses an area of approximately 5 ac (2 ha), is approximately 20 ft (1.5 m) deep, and is clay-lined. Although the CWR is periodically treated with chemicals to inhibit excessive growth of vegetation and the production of aquatic organisms, some benthic organisms and aquatic vegetation do occur in the reservoir. Overall, the habitat provided by the CWR is not suitable for supporting significant populations of aquatic species.

3.7.1.2 Overflow and Discharge Canals

One clay-lined canal, approximately 5 to 10 ft (1.5 to 3 m) deep and 70 ft (21 m) wide, originates in the central portion of the Fermi site (along the western edge of the developed portion of the site) and extends northward where it connects with Swan Creek after passing through a marshy area known as the North Lagoon. This constructed canal is referred to as the overflow canal or the North Canal (Figure 3–12). The overflow canal was historically used as a cooling water discharge and overflow canal for operation of Fermi 1 but ceased being used when Fermi 1 was temporarily shut down in the mid-1960s. The overflow canal is hydraulically connected to the wetlands to the west and provides the hydraulic connection between Lake Erie and the wetland area. Currently, the Fermi site uses the overflow canal as a permitted wastewater discharge (Outfall 009) (Figure 3–12). Section 3.1.3 further discusses the outfall and discharge points of the Fermi site. Thirty fish species were captured in the overflow canal during surveys conducted in 2008; the most abundant species were bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), emerald shiner (*Notropis atherinoides*), and gizzard shad (*Dorosoma cepedianum*) (AECOM 2009).

A second manmade canal, referred to as the discharge canal or the South Canal, originates in the central portion of the Fermi site and extends southward where it flows into the South Lagoon (Figure 3–12). This canal is approximately 5 to 10 ft (1.5 to 3 m) deep and 70 ft (21 m) wide and serves as the hydraulic connection between Lake Erie and the wetland areas located west of the developed portion of the Fermi site. Twenty-eight fish species were collected in the discharge canal during surveys conducted in 2008; the most abundant species were goldfish

(*Carrasius auratus*), common carp (*Cyprinus carpio*), bluegill, pumpkinseed, and golden shiner (*Notemigonus crysoleucas*) (AECOM 2009).

A third small water body is located between the overflow and discharge canals. This manmade feature, referred to as the Central Canal, is stagnant and has no connections to the overflow canal or the discharge canal (Figure 3–12). Thirteen fish species were collected in the Central Canal during surveys conducted in 2008; the most abundant species were bluegill, gizzard shad, largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), green sunfish (*L. cyanellus*), and bluntnose minnow (*Pimephales notatus*) (AECOM 2009).

3.7.1.3 Drainage Ditches

Several ditches located throughout the Fermi site drain surface water runoff to Swan Creek and the nearby wetlands. The drainage ditches are regularly maintained and equipped with concrete culverts to divert runoff from the surface roads. The drainage ditches are periodically dry, and the habitat provided by the ditches is not suitable for supporting significant populations of aquatic species.

3.7.1.4 Quarry Lakes

The North and South Quarry Lakes are located in the southwestern portion of the Fermi site. The two lakes are approximately 50 ft (15 m) deep and, in total, cover an area of approximately 100 ac (40 ha). The quarry lakes were created when water filled abandoned rock quarries that were used for site development and for construction of Fermi 2 (DECo 1977).

The quarry lakes support a limited variety of aquatic species common to Lake Erie coastal marsh habitats. Nine fish species were collected in the quarry lakes during surveys conducted in 2008; the most abundant species were bluegill, gizzard shad, green sunfish, goldfish, and common carp (AECOM 2009).

3.7.1.5 Wetland Ponds and Marshes Managed as Part of the DRIWR

The acreage managed as part of the DRIWR surrounds the developed portion of the Fermi site on the northern, western, and southern borders. This area encompasses approximately 656 ac (265 ha) that includes coastal wetlands and palustrine wetlands, such as freshwater emergent wetlands and small lakes that are semipermanently or seasonally inundated. These types of coastal wetlands are essential to many aquatic species because of the spawning, nursery, and feeding grounds they provide (Kelleys Island Birds and Natural History 2006).

A fisheries survey of coastal marshes managed as part of the DRIWR was conducted in September 2005 as a joint venture by the MDNR and the FWS to document fish communities associated with the Michigan waters of Lake Erie and to inventory the fishery resources of the refuge. This survey used electrofishing and seining to sample four marsh complexes within the refuge, one of which was the Swan Creek Estuary located near the northern extent of the Fermi site. A total of 38 species of fish from 13 families were collected at this sampling site. Species most common in the catch included gizzard shad, bluntnose minnow, mimic shiner (*Notropis volucellus*), bluegill, pumpkinseed, goldfish, and largemouth bass. Thirty-three fish species were collected during fishery surveys conducted near the mouth of Swan Creek in 2008. The most abundant species in those collections were gizzard shad, emerald shiner, bluegill, brook silverside (*Labidesthes sicculus*), pumpkinseed, and golden shiner (AECOM 2009).

3.7.1.6 Swan Creek

Swan Creek is located on the northern boundary of the Fermi site. It originates approximately 12 mi (19 km) to the northwest of the Fermi site as small streams and then flows south and east where it enters Lake Erie. Land use adjacent to the Swan Creek drainage includes small residential communities and agricultural development.

Swan Creek forms a freshwater estuary where it flows into Lake Erie. The aquatic habitat in this area is shallow, with large stands of submerged aquatic vegetation. Many areas along the shoreline support water lilies, cattails, common reed, and other emergent vegetation (Francis and Boase 2007; AECOM 2009). The benthic habitat associated with this area of Swan Creek consists of sandy sediment interspersed with small pockets of gravel and flat stone (AECOM 2009).

Benthic macroinvertebrates were collected during eight sampling events from July 2008 through June 2009 near the location where water from the North Lagoon area enters Swan Creek (AECOM 2009). These collections were dominated by aquatic worms (*Haplotaxida,* 31 percent); small crustaceans (*Amphipoda,* 23 percent); and midge larvae (*Diptera,* 19 percent), among others (AECOM 2009).

A fisheries survey of the Swan Creek estuary was conducted in September 2005 by the MDNR and the FWS using electrofishing and seining to sample nine sites along Swan Creek ranging from approximately 0.5 to 2.5 mi (0.8 to 4 km) from the Fermi site (Francis and Boase 2007). A total of 38 species from 13 families were collected at these sampling sites. Frequently encountered species included gizzard shad, bluntnose minnow, emerald shiner, mimic shiner, bluegill, pumpkinseed, goldfish, and largemouth bass (Francis and Boase 2007).

Fish were also collected from Swan Creek monthly from July 2008 to June 2009 (excluding winter months) near the location where water from the North Lagoon area enters Swan Creek (AECOM 2009). Overall, the fish species encountered during these surveys were similar to those observed in the survey by Francis and Boase (2007) described above. A total of 1,790 fish (33 species) were represented in the samples; dominant species included gizzard shad, emerald shiner, bluegill, brook silverside, and pumpkinseed (AECOM 2009).

Swan Creek is popular with recreational anglers, and several species common to Michigan are frequent catches in Swan Creek, including smallmouth bass (*Micropterus dolomieu*), largemouth bass, and bluegill.

3.7.1.7 Stony Creek

Stony Creek is located generally to the west of the Fermi site in Washtenaw and Monroe Counties, Michigan, and drains directly into the western basin of Lake Erie at a location approximately 3 mi (5 km) southwest of the Fermi site boundary. Stony Creek is about 35 mi (56 km) long. Land cover within the watershed includes forested areas, agricultural lands, and residential developments (Gustavson and Ohren 2005).

Some biological data were collected from Stony Creek and its tributaries. The Stony Creek Watershed Project performed studies focusing on water quality, nutrients, and indicator species, although the majority of the data from these studies were not collected near the Fermi site. A macroinvertebrate survey was conducted in 2004 at several sampling sites along Stony Creek to assess water quality. The nearest sampling site was located approximately 2.5 mi (4 km) south-southwest of the Fermi site. Data on various hydrological parameters were collected in addition to the macroinvertebrate samples. Results from the survey indicated an increase in the number of insect families with respect to previous studies of Stony Creek. There was also an abundance and diversity of mayflies (*Ephemeroptera*); stoneflies (*Plecoptera*); and caddisflies (*Trichoptera*), which are three orders of insects that are considered sensitive to poor water quality. Together, the abundance of taxa in these three orders are used to calculate the *Ephemeroptera-Plecoptera-Trichoptera* (EPT) index, which is a measure of water quality, with a higher number of taxa from each of these orders generally indicating better water quality. The downstream sites (located nearest to the Fermi site) had a higher EPT index than did the upstream survey sites (Gustavson and Ohren 2005).

Fish surveys conducted in portions of Stony Creek located in Monroe County during 1997 indicated that the fish community in Stony Creek was dominated by taxa that are tolerant of degraded water quality conditions, although the fish community was rated as acceptable (MDEQ 1998). Dominant species found to be present included green sunfish, rock bass, (*Ambloplites rupestris*), common carp, and blackside darter (*Percina maculata*) (MDEQ 1998).

3.7.1.8 Lake Erie

The Fermi site is situated along the shoreline of Lake Erie. Lake Erie provides the source of cooling water and receives cooling water discharge from Fermi 2. Consequently, aquatic habitats and organisms in Lake Erie in the vicinity of the Fermi site have the potential to be affected by operation of Fermi 2. This section describes the ecological setting and recent ecological history of Lake Erie, with a focus on the vicinity of the Fermi site.

Lake Erie is one of the five lakes included in the Great Lakes system and is the smallest of the group in volume (116 mi^3) (484 km^3). Measuring 241 mi (388 km) across and 57 mi (92 km) from north to south, Lake Erie has a surface area of nearly 10,000 mi^2 (2,600 km^2) with 871 mi (1,400 km) of shoreline. The average depth of Lake Erie is approximately 62 ft (19 m) and is 210 ft (64 m) deep at its maximum depth (EPA 2008).

Lake Erie is divided into three basins on the basis of the bathymetry of the lake: (1) eastern basin, (2) central basin, and (3) western basin. Because the Fermi site is located on the shoreline of the western basin, this portion of Lake Erie is of the greatest concern with regard to operation of Fermi 2. The western basin receives 95 percent of the water that drains into Lake Erie, including several major river drainages (e.g., Maumee River, River Raisin, Huron River, and Detroit River), as well as numerous smaller streams that discharge directly into the western basin. Depth generally increases from west to east in Lake Erie. The western basin is the shallowest basin in the lake, averaging approximately 24 ft (7.3 m) in depth (LaMP Work Group 2008). Although thermal stratification is a frequent and persistent condition during summer months for the central basin, stratification events are relatively rare and brief in the western basin (LaMP Work Group 2008; Bolsenga and Herdendorf 1993). As a consequence, the western basin is less likely to experience severe or prolonged episodes of oxygen depletion in deeper waters, which can result in large mortality events for aquatic species that are physiologically restricted to cooler water conditions.

The drainage basin of Lake Erie includes portions of Indiana, Michigan, Ohio, Pennsylvania, New York, and Ontario, and it is the most densely populated of the five Great Lakes basins (LaMP Work Group 2008). The fertile soils associated with the Lake Erie watershed support intense agricultural production throughout the entire drainage basin. Greater urbanization, industrialization, agricultural development, and the smaller volume of water make the Lake Erie ecosystem more susceptible to external stressors than the ecosystems of the other Great Lakes. This became apparent by the 1960s when decades of nutrient enrichment (eutrophication) and chemical contamination resulted in severe degradation of the Lake Erie ecosystem. By the 1980s, positive recovery of Lake Erie’s water quality was observed as a result of the implementation of remediation plans through the NPDES that helped meet targets for nutrient levels (especially phosphorus) established under the Great Lakes Water Quality Agreement (LaMP Work Group 2008). In addition to pollution abatement programs, colonization of Lake Erie by invasive zebra mussels (*Dreissena polymorpha*) and quagga mussels (*D. rostriformi)* during this same period helped return the lake to more mesotrophic (i.e., less nutrient-rich) conditions.

There are indications, however, that total phosphorus concentrations in Lake Erie waters have again started to increase over the past decade; this trend has been hypothesized to be related to changes in lakewide nutrient dynamics and more frequent storm events (LaMP Work Group 2008). Coincident with (and perhaps attributable to) these increasing dissolved phosphorus loads, blooms of some undesirable algal taxa (e.g., *Cladophora* spp. and *Microcystis spp.*) have increased. In recent years, *Lyngbya wollei*, an invasive filamentous cyanobacterial (also called blue-green algae) species, has become a nuisance in some areas of the western basin, such as Maumee Bay (approximately 18 mi (29 km) south-southeast of the Fermi site), that continue to experience higher levels of nutrient enrichment through riverine inputs (LaMP Work Group 2008).

The following sections summarize information for major ecological groups of aquatic organisms, including plankton, benthic invertebrates, and fish, that are present in the waters of Lake Erie.

<u>Plankton</u>

Plankton are very small aquatic organisms that drift in the water column and are unable to move or are too small or too weak to swim against water currents. Some plankton serve as the base of the aquatic food chain in Lake Erie, providing food for larger aquatic organisms. The plants of the plankton community are called phytoplankton, and the animals are called zooplankton. Most phytoplankton serve as food for benthos and zooplankton, which is directly eaten by many species of fish (at least during early fish life stages) and other zooplankton. Zooplankton includes animals that spend their entire lives in the plankton community (holoplankton) and the larval forms of many species of invertebrates and fish that are planktonic during early life stages. Fish eggs, larvae, and juveniles (called ichthyoplankton) are also part of the overall zooplankton community.

Phytoplankton studies conducted in the 1980s and 1990s in nearshore waters of the western basin of Lake Erie demonstrated that phytoplankton biomass fluctuates seasonally, with the highest overall phytoplankton densities occurring in the spring. Phytoplankton density also varies spatially throughout the western basin, with increased phytoplankton abundance along the entire southern shore and decreased abundance offshore and throughout deeper waters. The types of phytoplankton typically documented in greatest abundance during those earlier studies were diatoms (*Bacillariophyceae*) and green algae (*Chlorophyceae*). Millie et al. (2009) found that the phytoplankton community in the western basin during the late summer from 2003 to 2005 was dominated by various species of green algae, diatoms, and cyanobacteria (blue-green algae).

Periodically, there can be a rapid increase in the population of particular species of planktonic algae that results in unusually high densities. Such events are referred to as algal blooms. Sometimes algal blooms can discolor water or produce other undesirable conditions. Decomposition of dead cells from algal blooms (regardless of the species involved) can sometimes lower the concentration of dissolved oxygen in the water, causing hypoxic (low oxygen) or anoxic (no oxygen) conditions that can result in fish kills. Of particular concern in Lake Erie is a phytoplanktonic genus of blue-green alga (*Microcystis* spp.) that can produce a substance (microcystin) that is toxic to fish and other organisms when concentrations are high enough (EPA 2009c). Under certain conditions (such as high nutrient concentrations, increased light levels, and calm weather (usually in the summer)), *Microcystis* spp. can form dense aggregations of cells that form a thick layer (mat) on the surface of the water. At higher concentrations, *Microcystis* spp. blooms can resemble bright green paint. *Mycrocystis* spp. blooms can affect water quality, as well as the health of human and natural resources. The NOAA (2012) has been conducting research in Lake Erie to develop methods to identify the presence of cyanobacterial (blue-green algae) blooms from satellite imagery and to determine the factors controlling production of toxins associated with *Microcystis* spp. blooms. Results of this research indicate that cyanobacterial blooms tend to occur primarily in the southwestern portion of the western basin, especially in the vicinity of Maumee Bay, during summer months (NOAA 2012).

Dominant zooplankton taxa in Lake Erie include various species of crustaceans, such as copepods (e.g., *Cyclops* spp. and *Diaptomus* spp.); cladocerans (e.g., *Daphnia* spp., *Bosmina* spp., and *Leptodora* spp.); rotifers (e.g., *Keratella* spp. and *Asplanchna* spp.); and other taxonomic groups. The early life stages of some fish species can be part of the zooplankton. Zooplankton populations are typically lowest during winter months and most abundant during summer months. Two species of zooplankton, the spiny water flea (*Bythotrephes* spp.) and the fishhook water flea (*Cercopagis pengoi*), are invasive species throughout Lake Erie (Bolsenga and Herdendorf 1993).

Because plankton responds quickly to changes in nutrient inputs, phytoplankton and zooplankton are important indicators of nutrient pollution. One measure that has been developed to assess the biological health and diversity of offshore waters of Lake Erie is the Planktonic Index of Biotic Integrity (P-IBI) (Kane et al. 2009). This indicator, which is based on the abundance and number of different species groups of phytoplankton and zooplankton present in water samples, is used to evaluate the productivity level of the lake. Plankton productivity in formerly oligotrophic lakes is related to the anthropogenic introduction of phosphorus into lake waters from point sources (e.g., permitted discharge sites) or nonpoint sources (e.g., surface water runoff). Low productivity (oligotrophic condition) is associated with low phosphorus enrichment, moderate productivity (mesotrophic condition) is associated with moderate phosphorus levels, and high productivity (eutrophic condition) is associated with high phosphorus levels. Application of the P-IBI to the waters of the western basin of Lake Erie suggests that the overall condition of the western basin was mesotrophic during 1995 and became more eutrophic during the period from 2000 to 2003 (EPA 2009d).

Benthic Invertebrates

Benthic species inhabit the bottom of aquatic environments and serve as valuable indicators of the surrounding ecosystem. Benthic species include epifauna, which live on substrate surfaces, and infauna, which burrow into bottom sediments. Benthic communities consist of many different types of organisms and many different species. Examples of benthic invertebrates present in Lake Erie include mollusks (i.e., snails, mussels, and clams); larvae of various insects (such as midges, mosquitoes, mayflies, and stoneflies); and worms. The distribution and density of benthic organisms can be quite variable and are especially affected by the type of substrate (e.g., mud, sand, gravel, or cobble) and the water conditions present at a particular location. As are plankton, benthic organisms are important members of the aquatic food web, and the presence, absence, and abundance of some species or species groups can serve as indicators of local water conditions.

As part of the COL process for the proposed Fermi 3 unit, benthic invertebrates were sampled by DTE from two locations in Lake Erie just offshore from the Fermi site during 2008 and 2009 (AECOM 2009) to determine those species that could be present in areas potentially affected by building and operating Fermi 3. One site (Lake Erie intake), located in water approximately 3 to 5 ft (1 to 1.5 m) deep near the existing cooling water intake for Fermi 2 and the proposed intake location for Fermi 3, had a substrate that consisted of mud and sand. The benthic organisms collected at this site consisted primarily of various species of amphipods (62 percent of the organisms collected); dipterans (fly and midge larvae, 18 percent); and tubificid worms (10 percent) (AECOM 2009). The second site, located in water approximately 1 to 4 ft (0.3 to 1.2 m) deep at the southern end of the Fermi site near the South Lagoon, had a rocky substrate.

Dominant taxa collected from this site included various species of ephemeropterans (mayflies, 19 percent); amphipods (18 percent); dipterans (14 percent); tubificid worms (13 percent); mollusks (13 percent); and water mites (11 percent) (AECOM 2009).

The four families of bivalve mollusks that live in the streams and lakes of Michigan are freshwater unionid mussels (*Unionidae*), fingernail and pea clams (*Sphaeriidae*), Asian clams (*Corbiculidae*), and zebra and quagga mussels (*Dreissenidae*). Unionid mussels and sphaeriid clams are native to North America, whereas Asian clams and zebra and quagga mussels are not native to this continent. The Asian clam (*Corbicula fluminea*) was introduced to North America in 1938 as a food species and has since spread throughout the United States. The Asian clam is present in Lake Erie. Pea clams and fingernail clams are fairly widespread and common in Michigan. Unionid mussels are of particular interest because of their unique life history, importance to aquatic ecosystems, and use as indicators of change in water and habitat quality. They have also undergone significant declines in range and abundance over the past century.

Unionid mussels require a fish host to complete their life cycle, whereas other bivalve families produce free-swimming larvae that develop into the adult form without a host. Eggs of unionid mussels are fertilized and develop into larvae within the gills of the female mussel. These larvae, called glochidia, are released into the water and must attach to the gills or fins of a suitable fish or amphibian host to survive and transform into the adult form. Glochidia are very small (approximately 0.1 mm (0.004 in.) in length) and do not significantly harm their hosts. Some unionids are known to have only one or two suitable host species, whereas others are generalists and use several fish species as hosts. Without the presence of healthy fish host populations, unionid mussels are unable to reproduce.

Although they were once widely distributed and common in the western basin of Lake Erie, declines in the abundance of unionid mussels have been documented since 1961 (Schloesser and Nalepa 1994). Although earlier declines were largely attributable to declines in water quality, the introduction and subsequent proliferation of zebra and quagga mussels in the late 1980s is believed to have been a primary factor in the large declines in (i.e., near extirpation of) unionid mussel populations in a large portion of western Lake Erie between 1989 and 1991 (Schloesser and Nalepa 1994).

Lake Erie was one of the first North American water bodies to be colonized by zebra mussels and quagga mussels in the late 1980s. Believed to have been introduced in ballast water of ocean-going vessels entering the Great Lakes, these non-native, invasive mussels have caused extensive economic and environmental impacts on Lake Erie and on many other freshwater systems in the United States. Many power plants, including Fermi 2 (Section 3.1.3), have implemented control programs specifically to address these species, which can accumulate on intake and discharge structures, potentially affecting the efficiency of cooling water operations. Populations of native mussel species have also been affected by the introduction and proliferation of zebra and quagga mussels (USGS 2008; Schloesser and Nalepa 1994).

<u>Fish</u>

Human activities have resulted in considerable changes in the nature of the Lake Erie fish community during the past century. These changes have resulted from many causes, including overfishing, introduction and expansion of invasive exotic species, nutrient enrichment (and reversal of nutrient enrichment), deterioration of tributaries and other habitat features, and introduction of contaminants (Regier and Hartman 1973).

Van Meter and Troutman (1970) listed 138 species of fish documented to occur in Lake Erie or its tributaries. Since then, additional non-native fish species have been introduced into

Lake Erie, including ghost shiner (*Notropis buchanani*) and round goby (*Neogobius melanostomus*). Prior to 1900, lake trout (*Salvelinus namaycush*) was the dominant predator in the eastern basin of Lake Erie, with walleye (*Sander vitreus*) and burbot (*Lota lota*) as subdominants. Before 1950, the dominant predatory fish species in the western and central basins included walleye and blue pike (*S. vitreus glaucus*). The forage fish community in the western and central basins was dominated by emerald shiner, spottail shiner (*Notropis hudsonius*), and gizzard shad. In the eastern basin, the prey fish community was dominated by cisco (formerly called lake herring, *Coregonus artedi*). Changes in the structure of the fish community began to occur in the early 1900s, and the fish community structure was very different by 1960 (Tyson et al. 2009). These changes were primarily attributed to invasions of fish, such as sea lamprey (*Petromyzon marinus*), alewife (*Alosa pseudoharengus*), and rainbow smelt (*Osmerus mordax*); over-exploitation of important species, including the extinction of the blue pike; and declines in water quality and habitat degradation in nearshore areas and tributaries (Tyson et al. 2009). By the 1980s, Lake Erie's water quality started to improve as a result of reductions in nutrient inputs caused by remediation programs and as a result of the colonization of Lake Erie by invasive zebra mussels and quagga mussels. These changes in the nutrient status of the lake in conjunction with additional invasions by non-native species, such as the round goby, have resulted in further changes in the structure of the fish community.

The western basin contains important fish spawning and nursery areas and is also important to commercial and recreational fisheries. Although movements of fish among basins make it difficult to explicitly define a fish community by basin, examples of dominant fish species in the western basin include yellow perch *(Perca flavescens*), walleye, smallmouth bass, channel catfish (*Ictalurus punctatus*), alewife, gizzard shad, carp, freshwater drum (*Aplodinotus grunniens*), and emerald shiner.

The U.S. Geological Survey (USGS) has conducted assessments of fish populations throughout the western basin of Lake Erie for a number of years to estimate density and biomass of key forage and predator species in Michigan and Ontario waters. These data are maintained in an interagency database that is used to assess seasonal and spatial distributions of fish and year class strength of key forage and predator species. Based on sampling conducted in the western basin during 2011 (Kocovsky et al. 2012), populations of several ecologically and economically important native fish species remained low in abundance or appeared to be declining in numbers compared to previous years. There was an indication of recent increases in the abundance of walleye and freshwater drum, but both of these species, as well as yellow perch, remained at depressed levels of abundance. Alewife, an introduced species that is an important prey species in Lake Erie, has drastically declined in abundance and was not captured during surveys for four consecutive years (Kocovsky et al. 2012). Most of the 15 species examined had poor or moderate year classes in 2011; only gizzard shad, freshwater drum, and rainbow smelt had catch levels above the 8-year mean. Yearling and older silver chub (*Machrybopsis storeriana*) increased in abundance compared to 2010 and remains much more abundant than in the 1990s (Kocovsky et al. 2012).

As part of the COL application process, fish were collected monthly from July 2008 to June 2009 (excluding winter months) at two sampling locations in Lake Erie just offshore from the Fermi site (AECOM 2009) to determine those species that could be present in areas potentially affected by building and operating Fermi 3. The intake location was near the existing cooling water bay for Fermi 2 and the proposed intake location for Fermi 3, whereas the other sampling location was along the Lake Erie shoreline near the South Lagoon. The two locations differed in the types of aquatic habitat that were present and had comparatively different species richness and abundance. The intake location was located along a sand and gravel beach in the open waters of Lake Erie and had little or no structure that would provide cover or spawning features. The South Lagoon location was near sand and gravel shoreline areas and vegetated shoreline areas that could provide cover and spawning areas for some fish species. In addition, the South Lagoon location was near the mouth of the drainage area for the South Lagoon, which has extensive aquatic vegetation; fish within that drainage can move freely from the lagoon out into the main body of the lake.

Overall, 5,765 individual fish, composed of 40 species, were collected from the two Lake Erie sampling locations (Table 3–16). The most abundant species encountered in those collections were gizzard shad, goldfish, white perch (*Morone americana*), emerald shiner, spottail shiner, and bigmouth buffalo (*Ictiobus cyprinellus*) (AECOM 2009).

Table 3–16. Percent Abundance of Fish Species Collected in Lake Erie near the Fermi Site during 2008 and 2009(a)

Common Name	Scientific Name	Intake Location	South Lagoon	Overall
alewife	*Alosa pseudoharengus*	0.1	0.0	<0.1
banded killifish	*Fundulus diaphanus*	0.5	0.5	0.4
bigmouth buffalo	*Ictiobus cyprinellus*	2.7	4.8	4.1
black bullhead	*Ameiurus melas*	0.0	2.9	1.9
bluegill	*Lepomis macrochirus*	0.6	0.9	0.8
bluntnose minnow	*Pimephales notatus*	0.3	5.5	3.8
bowfin	*Amia calva*	0.0	0.1	0.1
brook silverside	*Labidesthes sicculus*	0.0	2.6	1.7
brown bullhead	*Ameiurus nebulosus*	0.0	0.3	<0.1
channel catfish	*Ictalurus punctatus*	0.4	0.3	0.1
common carp	*Cyprinus carpio*	0.5	5.6	3.8
common shiner	*Luxilus cornutus*	0.0	0.3	<0.1
emerald shiner	*Notropis atherinoides*	6.8	13.6	11.3
freshwater drum	*Aplodinotus grunniens*	0.0	0.1	0.1
gizzard shad	*Dorosoma cepedianum*	44.9	15.8	25.4
golden redhorse	*Moxostoma erythrurum*	0.0	0.1	0.1
golden shiner	*Notemigonus crysoleucas*	0.0	2.2	1.4
goldfish	*Carassius auratus*	4.0	28.0	19.7
green sunfish	*Lepomis cyanellus*	0.0	0.2	0.2
largemouth bass	*Micropterus salmoides*	0.1	2.5	1.7
longnose gar	*Lepisosteus osseus*	0.2	0.0	0.1
logperch	*Percina caprodes*	0.0	0.5	<0.1
longear sunfish	*Lepomis megalotis*	0.0	0.2	<0.1
northern pike	*Esox lucius*	0.0	0.3	0.2
pumpkinseed	*Lepomis gibbosus*	0.0	3.2	2.1
quillback	*Carpiodes cyprinus*	0.1	0.7	0.5
rock bass	*Ambloplites rupestris*	0.3	0.4	0.3

Common Name	Scientific Name	Intake Location	South Lagoon	Overall
round goby	*Neogobius melanostomus*	0.0	0.6	0.4
sand shiner	*Notropis stramineus*	0.3	0.2	0.2
smallmouth bass	*Micropterus dolomieu*	0.0	0.3	<0.1
spotfin shiner	*Cyprinella spiloptera*	0.8	1.9	1.5
spottail shiner	*Notropis hudsonius*	5.8	3.2	4.1
spotted gar	*Lepisosteus oculatus*	0.0	0.3	<0.1
spotted sucker	*Minytrema melanops*	0.0	0.3	<0.1
tadpole madtom	*Noturus gyrinus*	0.0	0.5	<0.1
western mosquitofish	*Gambusia affinis*	0.0	0.3	<0.1
white perch	*Morone americana*	33.5	1.9	12.4
white sucker	*Catostomus commersonii*	0.3	0.2	0.2
yellow bullhead	*Ameiurus natalis*	0.0	0.3	0.0
yellow perch	*Perca flavescens*	0.0	1.8	1.2

[a] Percent of the individuals collected at site location.

Source: AECOM 2009

Entrainment and impingement studies provide additional data on fish from the waters of Lake Erie near the Fermi site.

The rates at which fish eggs and fish larvae were entrained by the existing cooling water intake of Fermi 2 were measured from July 2008 through July 2009, excluding the months of December through February when ice cover was present and spawning by fish would most likely be at minimum levels (AECOM 2009). Entrainment rates (fish eggs plus larvae per unit volume of water) ranged from 4.82 /m^3 (0.14 /ft^3) in July 2009 to 0.00 /m^3 (0.00/ft^3) in November 2008 and March 2009. The average annual entrainment rate for all species collected from July 2008 through July 2009 was 0.98/m^3 (0.028/ft^3). Of the 12 fish species identified in entrainment samples, the species with the highest annual entrainment rates included gizzard shad, emerald shiner, bluntnose minnow, and yellow perch (AECOM 2009). Table 3–17 presents the overall estimates of the total numbers of fish eggs and larvae entrained during the study period. These estimates were calculated by multiplying monthly entrainment estimates by the volume of water drawn into the cooling system during each period.

Table 3–17. Estimated Numbers of Fish Eggs and Larvae Entrained by the Fermi 2 Cooling Water Intake from July 2008–July 2009[a]

Common Name	2008					2009					Annual Total[b]
	Jul	Aug	Sep	Oct	Nov	Mar	Apr	May	Jun	Jul	
gizzard shad	62,048							1,452,781	1,191,501	27,531,802	30,238,132
emerald shiner	1,054,814	1,897,015					109,500	2,994,507	911,148	3,933,115	10,900,099
bluntnose minnow		72,962					15,643	4,892,017	560,707		5,541,329
yellow perch							140,786	4,121,154	560,707		4,822,647
unidentified spp.				4,298,465							4,298,465
freshwater drum										2,317,728	2,317,728
round goby	62,048	510,735	141,109					770,863	210,265	70,234	1,765,254
bigmouth buffalo								1,274,889	420,530		1,695,419
channel catfish	434,335										434,335
largemouth bass							62,571	88,946			151,517
sunfish sp.								148,243			148,243
white perch	124,096										124,096
unknown centrarchidae									70,088		70,088
brook silverside								59,297			59,297
Total	**1,737,341**	**2,480,712**	**141,109**	**4,298,465**	**0**	**0**	**328,500**	**15,802,697**	**3,924,946**	**33,852,879**	**62,566,649**

[a] Estimates are based on measured entrainment rates and actual operational flow volume reported by DECo from July 2008 through July 2009.

[b] The annual estimate does not include data from December through February. The numbers of eggs and larvae are expected to be low during these months because it is outside the normal spawning period for most Lake Erie fish species.

Source: AECOM 2009

In general, fish species entrained during the 2008 to 2009 study (AECOM 2009) were similar to those captured during a previous entrainment study (Lawler, Matusky, and Skelly Engineers 1993) conducted at the Fermi site from October 1991 to September 1992. The most abundant larval fish taxa entrained during the earlier study included Cyprinids (22.9 percent), *Morone* spp. (20.0 percent), gizzard shad (19.5 percent), Clupeids (8.8 percent), and white perch (6.2 percent); the taxa for which fish eggs were most abundant in entrainment samples included Cyprinidae (42.1 percent of eggs) and Percidae (22.4 percent of eggs).

Impingement data collected from 1991 to 1992 from the Fermi 2 intake indicated that the dominant species impinged was the gizzard shad, which accounted for 71.5 percent of the estimated total number of individual fish impinged during the study period. White perch was the second most abundant species impinged (6.8 percent of the estimated total). Third, fourth, and fifth species ranked by the estimated number of individuals affected were the rock bass, freshwater drum, and emerald shiner, respectively. Table 3–18 presents the estimated numbers of fish impinged (by species) in 2008 through 2009 from Fermi 2. During that period, gizzard shad accounted for approximately 39 percent, emerald shiner accounted for approximately 29 percent, and white perch accounted for approximately 10 percent of the total estimated numbers of fish impinged at the plant (AECOM 2009). Overall, an estimated 3,102 individual fish were impinged by the Fermi 2 cooling water intake during the 2008 through 2009 sampling period (Table 3–18). Most of the fish species identified in impingement samples are considered forage species for other fish. On the basis of an analysis conducted by the Lake Erie Forage Task Group (2010), the long-term average density of forage fish in size classes capable of being captured in nets and trawls is approximately 1,384,680 fish per square mile in the western basin. Assuming an estimate of approximately 1,200 mi^2 (3,100 km^2) for the western basin as a whole, the long-term average number of forage fish within the basin is estimated to be approximately 1.7 billion.

Table 3–18. Estimated Numbers of Fish Impinged by the Fermi 2 Cooling Water Intake from August 2008–July 2009[a]

	2008					2009								
Common Name	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr[b]**	**May**	**Jun**	**Jul**	**Annual Total**	**% of Total**
gizzard shad			62	150	930	62							1,204	38.8
emerald shiner	31	30	31		62	93	84	558					889	28.7
white perch	62	30	31	30	31		28	93					305	9.8
bluegill					31	31	28	124					214	6.9
round goby	31	30				31				31			123	4.0
smallmouth bass	31							31					62	2.0
spottail shiner										31		31	62	2.0
banded killifish			31										31	1.0
brook silverside	31												31	1.0
largemouth bass			31										31	1.0
bluntnose minnow		30											30	1.0
channel catfish		30											30	1.0
freshwater drum											30		30	1.0
green sunfish		30											30	1.0
rock bass		30											30	1.0
Total	**186**	**210**	**186**	**180**	**1054**	**217**	**140**	**806**		**62**	**30**	**31**	**3102**	**100.0**

[a] Estimates are based on measured impingement rates and actual operational flow volume reported by DECo from August 2008 through July 2009.
[b] Annual estimates do not include data from April 2009 because heavy debris prevented sample collection.

Source: AECOM 2009

3.7.2 Aquatic Habitats—Transmission Lines

The in-scope transmission lines that connect Fermi 2 to the transmission grid for purposes of power transmission are located within the property boundary, are aboveground, and are limited to the developed portion of the site. The in-scope transmission lines do not pass over aquatic habitat.

3.7.3 Important Aquatic Species and Habitats—Site and Vicinity

Important aquatic species include commercially or recreationally important fishery species, species considered to have vital roles in ecosystem dynamics, and Federally and State-listed species. Although tabulated here for completeness, Federally protected species are discussed in Section 3.8. On the basis of these criteria, 37 species that inhabit the freshwater habitats near the Fermi site were identified as important species (Table 3–19).

Brief summaries of distribution and life history information for important species are also provided; these summaries were developed from information provided by NatureServe (2009) unless otherwise indicated. Where applicable, information about impingement and entrainment during Fermi 2 operations is presented for each species based on recently collected impingement and entrainment data for the Fermi site (AECOM 2009).

Table 3–19. Important Aquatic Species That Have Been Observed in the Vicinity of the Fermi Site[a]

Common Name	Scientific Name	Category[b,c]
Mollusks		
elktoe	*Alasmidonta marginata*	ESA-NL, MI-SC
northern riffleshell	*Epioblasma torulosa rangiana*	ESA-E, MI-T
purple lilliput	*Toxolasma lividus*	ESA-NL, MI-T
purple wartyback	*Cyclonaias tuberculata*	ESA-NL, MI-T
rayed bean	*Villosa fabalis*	ESA-E, MI-E
round hickorynut	*Obovaria subrotunda*	ESA-NL, MI-T
round pigtoe	*Pleurobema sintoxia*	ESA-NL, MI-SC
salamander mussel	*Simpsonaias ambigua*	ESA-NL, MI-T
slippershell	*Alasmidonta viridis*	ESA-NL, MI-T
snuffbox mussel	*Epioblasma triquetra*	ESA-E, MI-E
wavyrayed lampmussel	*Lampsilis fasciola*	ESA-NL, MI-T
white catspaw	*Epioblasma obliquata perobliqua*	ESA-E, MI (presumed extirpated in Michigan)
Fish		
bigmouth buffalo	*Ictiobus cyprinellus*	Commercial fishery
brindled madtom	*Noturus miurus*	ESA-NL, MI-SC
channel catfish	*Ictalurus punctatus*	Commercial fishery, recreational fishery
channel darter	*Percina copelandi*	ESA-NL, MI-E
common carp	*Cyprinus carpio*	Commercial fishery
creek chubsucker	*Erimyzon claviformis*	ESA-NL, MI-E
eastern sand darter	*Ammocrypta pellucida*	ESA-NL, MI-T

Common Name	Scientific Name	Category[b,c]
freshwater drum	*Aplodinotus grunniens*	Commercial fishery
gizzard shad	*Dorosoma cepedianum*	Commercial fishery
goldfish	*Carassius auratus*	Commercial fishery
lake whitefish	*Coregonus clupeaformis*	Commercial fishery
largemouth bass	*Micropterus salmoides*	Recreational fishery
orangethroat darter	*Etheostoma spectabile*	ESA-NL, MI-SC
pugnose minnow	*Opsopoedus emiliae*	ESA-NL, MI-E
quillback	*Carpiodes cyprinus*	Commercial fishery
river darter	*Percina shumardi*	ESA-NL, MI-E
sauger	*Sander canadensis*	ESA-NL, MI-T
silver chub	*Macrhybopsis storeriana*	ESA-NL, MI-SC
silver shiner	*Notropis photogenis*	ESA-NL, MI-E
smallmouth bass	*Micropterus dolomieu*	Recreational fishery
southern redbelly dace	*Phoxinus erythrogaster*	ESA-NL, MI-E
walleye	*Sander vitreus*	Commercial fishery, recreational fishery
white bass	*Morone chrysops*	Commercial fishery, recreational fishery
white perch	*Morone Americana*	Commercial fishery
yellow perch	*Perca flavescens*	Commercial fishery, recreational fishery

[a] These are commercial and recreationally important species and Federally and State-listed species that could occur in the waters of the western basin of Lake Erie near the Fermi site and freshwater habitats of Monroe County, Michigan.

[b] ESA-E = Federally listed under ESA as endangered, ESA-NL = not listed under ESA, MI-E = listed by the State as endangered, MI-SC = listed by the State as a species of concern, and MI-T = listed by the State as threatened.

[c] Section 3.8 discusses Federally listed species, but they are included in this table for completeness.

3.7.3.1 Commercially Important Species

Although other waters in the vicinity of the Fermi site do not support commercial fisheries, Lake Erie supports one of the largest freshwater commercial fisheries in the world, with the majority of commercial fishing occurring along the Canadian border. Commercial landings in Lake Erie are dominated by yellow perch, walleye, rainbow smelt (*Osmerus mordax*), and white bass (*Morone chrysops*). In the western basin of Lake Erie, management of commercial fisheries falls under the jurisdiction of the MDNR; the Ohio Department of Natural Resources (ODNR); or the Ontario Ministry of Natural Resources, depending upon where the fishing occurs. The Great Lakes Fisheries Commission coordinates fisheries research and facilitates cooperative fishery management among the state, provincial, tribal, and Federal agencies that manage fishery resources within the Great Lakes and has established a Lake Erie Committee that considers issues pertinent to Lake Erie waters.

Michigan's commercial landings from Lake Erie for 2010 (the year for which the most recent report is available) was 752,956 lb (341,535 (kilograms (kg)) (Table 3–20) (NMFS 2014). Twelve fish species are included in the landings for an estimated value of $288,563. Three species comprised over half (57 percent) of the landings: carp, freshwater drum, and quillback.

Table 3–20. Commercial Fishery Statistics for Michigan from Lake Erie during 2010

Species	Landings (lb)[a]	Percent of Total Landings	Reported Market Value ($)	Percent of Total Value
carp	191,321	25.4	47,844	16.6
freshwater drum	130,533	17.3	27,411	9.5
quillback	107,037	14.2	24,619	8.5
goldfish	77,550	10.3	62,819	21.8
bigmouth buffalo	68,511	9.1	32,888	11.4
channel catfish	64,913	8.6	30,519	10.6
brown bullhead	47,612	6.3	20,948	7.3
white bass	37,021	4.9	27,398	9.5
white perch	19,524	2.6	11,522	4.0
suckers	7,919	1.1	1,346	0.5
lake whitefish	963	0.1	1,232	0.4
gar	52	0.0	17	0.0
Total	752,956	100	288,563	100

[a] To convert pounds to kilograms, 1 lb = 0.45 kg.

Source: NMFS 2014

Ohio's commercial landings from Lake Erie for 2010 (the year for which the most recent report is available) were 4,133,417 lb (1,874,886 kg) (Table 3–21) (NMFS 2014). Thirteen fish species are included in the landings, for an estimated value of $4,115,982. The three species that comprised over half (56 percent) of the landings were yellow perch, white perch, and freshwater drum. Although yellow perch has historically been a significant component of the commercial fishery in the Ohio waters of the western basin, this area was closed to commercial yellow perch harvest in 2008 and 2009.

Table 3–21. Commercial Fishery Statistics for Ohio from Lake Erie during 2010

Species	Landings (lb)[a]	Percent of Total Landings	Reported Market Value ($)	Percent of Total Value
yellow perch	1,284,404	31.1	3,006,787	73.1
white perch	551,042	13.3	232,480	5.6
freshwater drum	491,999	11.9	85,002	2.1
channel catfish	452,637	11.0	154,887	3.8
white bass	357,083	8.6	285,156	6.9
bigmouth buffalo	343,962	8.3	138,818	3.4
carp	255,991	6.2	51,192	1.2
quillback	183,093	4.4	33,305	0.8
lake whitefish	83,303	2.0	83,303	2.0
goldfish	59,681	1.4	35,817	0.9
brown bullhead	33,401	0.8	6,676	0.2
suckers	22,076	0.5	2,411	0.1
gizzard shad	14,745	0.4	148	0.0
Total	**4,133,417**	**100**	**4,115,982**	**100**

[a] To convert pounds to kilograms, 1 lb = 0.45 kg.

Source: NMFS 2014

Additional information about the distribution and life history for selected commercially important species that could be present in Lake Erie in the vicinity of the Fermi site is presented below.

Bigmouth Buffalo (*Ictiobus cyprinellus*)

The bigmouth buffalo is fairly common throughout North America from the Mississippi River Basin stretching from Louisiana to Ohio to southern Michigan, Wisconsin, Minnesota, North Dakota, Montana, the lower Great Lakes Basin, the Hudson Bay Basin (Nelson River drainage) and Saskatchewan. This species makes up a portion of the commercial fishery in the western basin of Lake Erie.

The preferred habitat for bigmouth buffalo consists of the main channels, pools, and backwaters of small to large sluggish rivers, oxbows, bayous, reservoirs, and lakes. The bigmouth buffalo is tolerant of low oxygen levels and high temperatures. These fish prefer to spawn after spring floods, doing so in flooded marshes and river bottoms or in tributary streams. Both juvenile and adult members of this species rely mainly on planktonic and bottom-dwelling invertebrates as food sources.

AECOM (2009) estimates that approximately 1.7 million bigmouth buffalo eggs and larvae were entrained at the Fermi site during 2008, primarily during the months of May and June (Table 3–17). No bigmouth buffalo juveniles or adults were observed during impingement studies conducted at the Fermi site during 2008 and 2009 (AECOM 2009).

Channel Catfish (*Ictalurus punctatus*)

Channel catfish occur mostly in the central drainages of North America from southern Canada to northern Mexico. This species has been widely distributed throughout the United States and other countries. Channel catfish prefer clean, well-oxygenated water of rivers and streams but also inhabit ponds and lakes. They occur in locations ranging from clear, rapid-flowing waters over firm bottoms to turbid, slow-moving water over mud substrates.

Channel catfish have been known to migrate hundreds of miles throughout their lifetime. They generally spawn between April and July, and females lay up to 20,000 eggs in nests dug in sandy substrates. Males then guard and fan water across the nest during the 3- to 8-day incubation period. Larval development lasts about 2 weeks, and schools of larvae may persist for weeks after leaving the nest. Sexual maturity is reached anywhere from 2 to 8 years, and adults may reach over 130 cm (51 in.) and live up to 16 years.

Juvenile channel catfish eat mainly small invertebrates and insects and prey increasingly on crayfish and fish as they grow. Adults eat mainly fish but will also feed on insects, small mammals, and vegetation.

The potentially large size and food quality of channel catfish make it a highly sought after sport fish, and this species also has a significant commercial value in Lake St. Clair and Lake Erie. It was estimated (Table 3–17 and Table 3–18) that approximately 435,000 channel catfish eggs and larvae were entrained and 30 individual fish were impinged by the Fermi 2 cooling water intake during studies conducted in 2008 and 2009.

<u>Common Carp (*Cyprinus carpio*)</u>

The common carp is native to temperate Eurasia where it has been domesticated and bred for human food for several centuries. Common carp were first introduced into the United States around 1872, and the species was subsequently stocked throughout the United States. Carp are now found in every state except Hawaii and Alaska, in five Canadian provinces, and on every continent except Antarctica.

This species is typically found in rivers, lakes, ponds, reservoirs, swamps, or low-salinity estuaries, usually in shallow water with abundant vegetation and little or no current. The species is tolerant of a wide range of oxygen, salinity, turbidity, and bottom conditions. Common carp usually spawn in shallows and flooded areas, although deeper water may also be used. Eggs are dispersed and stick to submerged objects. Fry remain attached to the vegetation for about 2 days before dropping to the bottom and inhabit shallow, warm, and slow-moving water during their first summer.

Common carp are omnivorous, and adults eat primarily invertebrates, detritus, fish eggs, and plant material. Fry feed on zooplankton but will also eat phytoplankton if zooplankton densities are low.

Common carp make up a relatively large portion of the commercial fishery within the western basin of Lake Erie, as described above. No common carp were identified in impingement or entrainment samples collected at the Fermi site during 2008 and 2009 (AECOM 2009).

<u>Freshwater Drum (*Aplodinotus grunniens*)</u>

The freshwater drum occurs throughout North and Central America. The species ranges from the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River Basins to Gulf Coast drainages, south through eastern Mexico, and down to Guatemala.

Freshwater drum occur in a variety of habitats but are usually found in large, silty lakes and large rivers. They generally occur over mud bottoms in open water. Freshwater drum spawn from spring to late summer as water temperatures reach 51 to 72 °F (10.5 to 22 °C). They broadcast eggs in shallow water, which float on the surface and hatch in about 1 day. Males generally reach sexual maturity in 2 to 4 years, whereas females take 4 to 6 years. Maximum life expectancy for this species is 10 years. Juvenile drum feed primarily on small crustaceans and insect larvae. Adults are mostly benthic foragers, and prey items include insect larvae; crustaceans; fish; and mollusks, such as clams and snails.

Freshwater drum are harvested commercially in Lake Erie, although there is not a significant recreational fishery for this species. It was estimated that approximately 2.3 million freshwater drum eggs and larvae were entrained by the Fermi 2 cooling water intake during a study conducted in 2008 and 2009; entrainment was observed only in July 2009 (AECOM 2009)(Table 3–17). Approximately 30 individual freshwater drum were impinged during studies conducted at the Fermi 2 cooling water intake in 2008 and 2009 (AECOM 2009) (Table 3–18).

Gizzard Shad (*Dorosoma cepedianum*)

The gizzard shad is distributed widely in the continental United States from Utah and Arizona eastward to the Atlantic seaboard. This species occurs throughout the Great Lakes region within both the United States and Canada and is common within the western basin of Lake Erie.

As an adult, the gizzard shad can reach 9 to 14 in. (23 to 35 cm) in length and can weigh up to 2 lb (0.9 kg). This fish can thrive in a wide variety of habitats, including large rivers, reservoirs, lakes, swamps, bays, sloughs, and similar quiet open waters. Young and juveniles live in relatively clear and shallow waters, whereas adult gizzard shad tend to stay in deeper waters or near the bottom. Although gizzard shad are capable of withstanding temperatures from approximately 43 to 91 °F (6 to 33 °C), they are very sensitive to cold water temperatures, and large numbers are often found dead in the spring when the ice melts off of reservoirs and lakes.

Female gizzard shad can produce as many as 500,000 eggs, which are spawned by scattering them over sandy or rocky substrates. The eggs adhere to objects on the bottom until hatching 2 to 4 days later. Sexual maturity is generally reached in 2 to 3 years. A few individuals will survive beyond 3 years of age, with their maximum lifespan approximately 4 to 6 years. Because of the large numbers of eggs produced, gizzard shad populations are often capable of rebounding quickly following overwinter die-offs.

Juvenile gizzard shad are planktivores, feeding on both zooplankton and phytoplankton. Adults are primarily bottom filter-feeding detritivores, mostly eating plants and animals that live attached to hard substrates, such as sand and rocks.

Gizzard shad often travel in large schools, and young gizzard shad are ecologically significant because they serve as prey for many species of commercially and recreationally important fish. Because of their rapid growth rates, many individuals are too large to be eaten by most other fish by the end of their first year of life. Recreational anglers commonly use gizzard shad as a bait fish, and the species makes up a substantial portion of the commercial harvest in the Michigan waters of Lake Erie.

Gizzard shad was the most commonly entrained species during studies conducted at the Fermi 2 cooling water intake in 2008 and 2009, and it is estimated that approximately 30.2 million gizzard shad eggs and larvae were entrained during the 1-year study period (AECOM 2009) (Table 3–17). In addition, gizzard shad was the most commonly impinged species during studies conducted at the Fermi 2 cooling water intake in 2008 and 2009, with approximately 1,200 individuals impinged during the year (AECOM 2009) (Table 3–18).

Goldfish (*Carrasius auratus*)

Goldfish are native to Eurasia and have been introduced throughout the United States and in parts of southern Canada. They were first introduced in the Great Lakes around 1885 and have since become well established in the region. They are abundant in the shallow bays and marshes of western Lake Erie and can also be found in slow-moving tributaries.

Goldfish can grow to be 12 in. (30 cm) or larger, although most individuals are considerably smaller. Goldfish spawn during the spring and summer in shallow water, and the eggs adhere to vegetation and substrates. A single female can produce several lots of eggs within a season. Hatching occurs in 2 to 14 days, depending on water temperature.

Goldfish feed on a variety of small aquatic invertebrates and vegetation. Because of their abundance within shallow habitats, including marsh habitats, of the western basin and because of their relatively small size, goldfish are a potentially important prey species for fish-eating fish and birds. Goldfish also have some commercial importance within the western basin, making up approximately 10 percent of the commercial harvest in Michigan waters of the basin. Although goldfish were relatively abundant in collections made during fish surveys on and near the Fermi site, no goldfish were identified in impingement or entrainment samples during 2008 and 2009 (AECOM 2009).

<u>Lake Whitefish (*Coregonus clupeaformis*)</u>

Lake whitefish occur throughout most of Canada and Alaska, in south to northern New England, in the Great Lakes region, and in central Minnesota. Lake Erie is considered to be at the southern extent of the range for this species. Lake whitefish have also been introduced as forage and food fish in other areas, including the States of Montana, Idaho, and Washington.

The lake whitefish is a cool-water species that has a narrow temperature tolerance and requires cold, well-oxygenated bottom waters throughout the summer to survive. Optimum temperature for the lake whitefish ranges from 50 to 57 °F (10 to 14 °C) for adults and 60 to 67 °F (15.5 to 19 °F) for juveniles. This species usually spawns during late fall or early winter over rocky or sandy substrates in water less than 25 ft (7.5 m) deep. Eggs hatch in the early spring, and sexual maturity is generally reached in 5 to 7 years. Young lake whitefish subsist primarily on zooplankton, whereas adults usually eat bottom-dwelling invertebrates and small fish.

Lake whitefish are an indicator of ecosystem health and an important component of the Great Lakes food web. During the late 19th and early 20th centuries, large numbers of lake whitefish entered the Detroit River each year to spawn (EPA 2009e). Reports indicate that the lower Detroit River was a prolific spawning area before the construction of the Livingstone Shipping Channel. The timing of this construction coincides with the degradation of whitefish populations in the river and western Lake Erie (EPA 2009e). Recently, populations of lake whitefish were once again discovered in the Detroit River, but further studies are necessary to ascertain their presence in other tributaries of western Lake Erie (EPA 2009e).

Lake whitefish historically made up a large proportion of the commercial fishery in the western basin of Lake Erie. In the late 1800s and early 1900s, more than 500,000 lb (225,000 kg) of lake whitefish were commercially harvested each year, but catches declined drastically after that period. There have been improvements in the fishery more recently, and the commercial lake whitefish landings in all of Lake Erie exceeded 1 million lb (450,000 kg) in 2000 (EPA 2009e). In the western basin, the commercial harvest of lake whitefish was only 8,800 lb (4,000 kg) in Michigan waters during 2007, and it was more than 287,000 lb (130,000 kg) in Ohio waters during 2009 (Table 3–20 and Table 3–21). Lake whitefish were not observed in collections made during fish surveys on and near the Fermi site, and no lake whitefish were identified in impingement or entrainment samples during 2008 and 2009 (AECOM 2009).

<u>Quillback (*Carpiodes cyprinus*)</u>

The quillback has a wide distribution in North America, with inhabited areas encompassing an area with a northward boundary from the Alberta to Quebec Provinces in Canada, southward to the Gulf Slope, and eastward to the Atlantic slope drainages. The species is relatively common in the Great Lakes, including Lake Erie.

These fish are suited to a variety of aquatic habitat conditions, including pools, backwaters, and main channels and clear to turbid waters of creeks, rivers, and lakes. Spawning usually occurs in April through May over sand and mud bottoms in quiet waters of streams, overflow areas in bends of rivers, or the bays of lakes. Quillbacks sometimes migrate up small streams and creeks during the spring and summer to find suitable spawning habitat. Both adults and juveniles are omnivorous, feeding on organic matter in bottom sediments, insect larvae, and plant material.

The quillback is a small component of the commercial fisheries in the Michigan and Ohio waters of the western basin (Table 3–20 and Table 3–21). In Ohio, commercial harvest of quillback averaged more than 200,000 lb (90,000 kg) per year from 2000 through 2009 (ODNR 2010). Although small numbers of quillback were collected during fish surveys on and near the Fermi site, no quillback were present in impingement or entrainment samples during 2008 and 2009 (AECOM 2009).

Walleye (*Sander vitreus*)

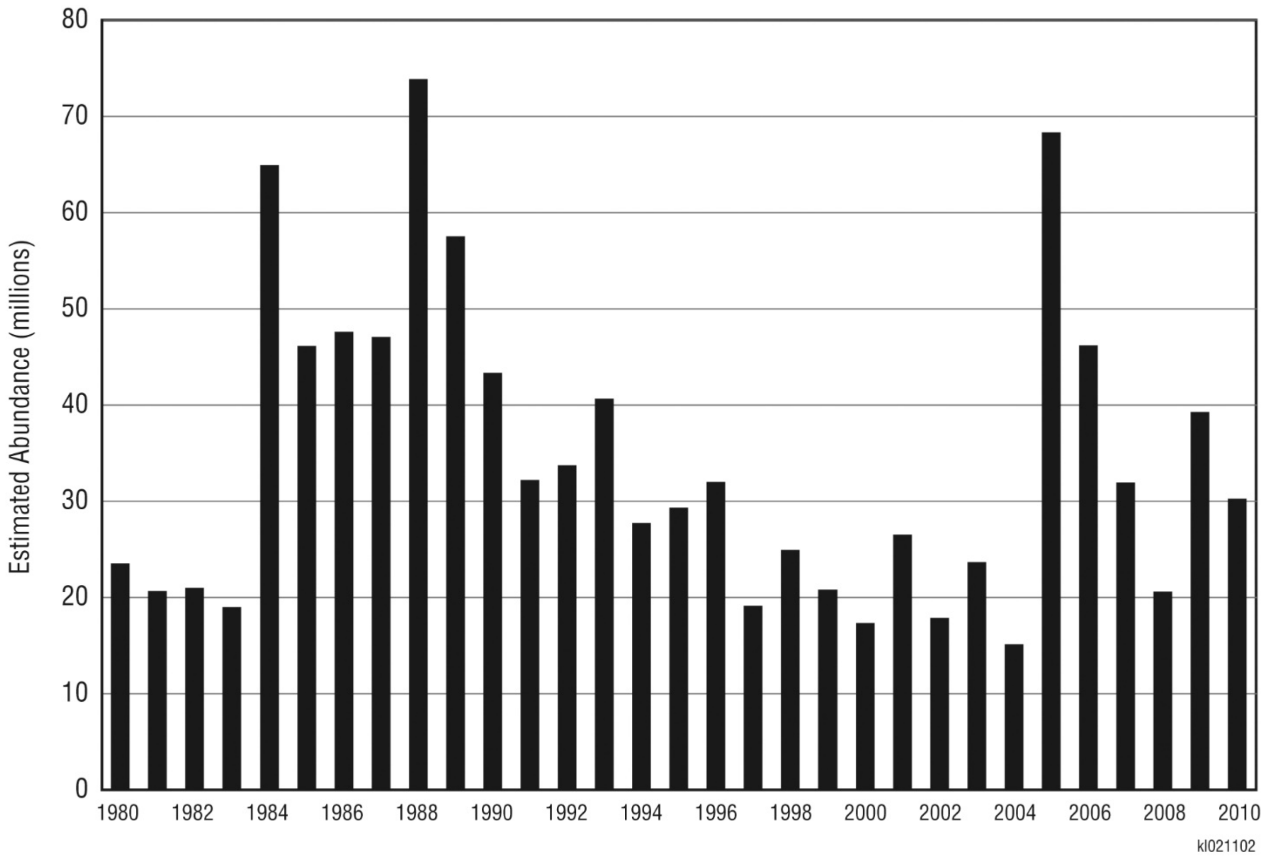
The walleye is the largest member of the perch family and can be found in all of the Great Lakes where it is a native species. Walleye have been introduced and are stocked widely in the United States; the distribution for the species now extends across most of the continental United States and Canada.

The walleye can be found in a variety of large bodies of freshwater, including lakes, pools, backwaters, rivers, and flooded marshes. It prefers deep waters and avoids bright light. This species spawns in late spring or early summer in turbulent rocky areas in rivers, coarse gravel shoals in lakes, or flooded marshes. Eggs hatch in approximately 26 days. Adults may migrate up to 100 mi (160 km) between spawning habitat and nonspawning habitat. Sexual maturity is reached in 2 to 4 years for males and in 3 to 8 years for females. Young walleye up to 6 weeks of age primarily eat zooplankton and small fishes, whereas adults feed upon fishes and larger invertebrates. Adults typically range in length from 13 to 25 in. (33 to 64 cm) and weigh 1 to 5 lb (0.5 to 2.3 kg).

The walleye is considered an extremely important commercial and recreational fishery resource in Lake Erie. Although the commercial fisheries for walleye in the Michigan and Ohio waters of Lake Erie have been closed for many years, commercial fishing for walleye in the western basin waters of Ontario has continued, and the annual harvest since 1976 has averaged approximately 1.5 million fish per year (the range is approximately 113,000 to approximately 2.8 million fish) (Lake Erie Walleye Task Group 2010). The western basin also supports a popular recreation fishery, with average harvests of approximately 1.6 million; 293,000; and 39,000 fish in the western basin waters of Ohio, Michigan, and Ontario, respectively, since 1975 (Lake Erie Walleye Task Group 2010).

Because of the importance of walleye to the commercial and recreational fisheries in Lake Erie, the status of walleye populations in the lake are closely monitored by various agencies. The Lake Erie Committee of the Great Lakes Fishery Commission has formed the Walleye Task Group to bring together information from various agencies so that the population status of walleye in Lake Erie can be monitored each year. This task group maintains and updates centralized datasets, improves population models so that scientifically defensible abundance estimates and forecasts can be produced, makes recommendations regarding allowable harvest levels, and helps identify studies that need to be conducted to address data gaps (Lake Erie Walleye Task Group 2010). Modeled abundance estimates of walleye in Lake Erie for the period from 1980 to 2010 indicate that the overall numbers of walleye aged 2 and older have varied considerably, ranging from a low of approximately 15 million individuals in 2004 to a high of approximately 74 million individuals in 1988 (Figure 3–16). Estimated abundance for 2010 was approximately 30 million fish (Lake Erie Walleye Task Group 2010).

Figure 3–16. Estimated Abundance of Walleye Aged 2 and Older in Lake Erie, 1980–2010 (Lake Erie Walleye Task Group 2010)



Source: NRC 2013a, Figure 2-13

No walleye were observed in collections made during fish surveys in aquatic habitats on and near the Fermi site, and no walleye were present in impingement or entrainment samples collected at the Fermi 2 cooling water intake during 2008 and 2009 (AECOM 2009).

White Bass (*Morone chrysops*)

The white bass is distributed across the United States and eastern Canada. It is a relatively common species in the Great Lakes, including Lake Erie. White bass typically inhabit open waters of large lakes and reservoirs and pools of slow-moving rivers. Often traveling in schools, white bass tend to occur in offshore waters during the day and in inshore waters at night.

Tributary streams appear to be the preferred spawning habitat, but white bass may also spawn along lake shores with high wave action. Spawning occurs during the spring, usually over rock or gravel substrate in water up to 10 ft (3 m) deep. After hatching, the young fish generally remain in shallow water for a period of time before migrating to deeper areas. White bass become sexually mature at 1 to 3 years of age and usually do not live past 4 years of age. As adults, they can reach up to 16 in. (40 cm) in length and can weigh up to 4 lb (1.8 kg). White bass are carnivores that eat zooplankton, insect larvae, and other fish.

White bass can be a notable component of the commercial fisheries in the Michigan and Ohio waters of the western basin. By weight, white bass accounted for approximately 7 percent of the fish commercially harvested from Michigan waters of Lake Erie in 2007 and for 25 percent of the fish commercially harvested from Ohio waters of the western basin in 2009.

White bass are also an important recreational fishing species in each of these States. In general, it is reported that very few angler boat trips specifically target white bass, and the majority of white bass are harvested as incidental catch from anglers targeting other species (ODNR 2010). However, when adult fish are moving into major tributaries to spawn during the spring, the aggregations of fish can attract many anglers, especially in major spawning tributaries, such as the Maumee River (Bolsenga and Herdendorf 1993). The recreational noncharter boat harvest of white bass from Michigan waters in the western basin during 2007 was estimated to be 7,911 individual fish (Thomas and Haas 2008). From 2000 to 2009, the recreational white bass harvest in the Ohio waters of the western basin averaged over 72,000 individual fish per year, with a peak of 121,000 fish caught in 2009 (ODNR 2010).

Although small numbers of white bass were collected on and near the Fermi site, no white bass were present in impingement or entrainment samples during 2008 and 2009 (AECOM 2009).

<u>White Perch (*Morone americana*)</u>

White perch are native to the east coast of the United States and Canada but can be found in the Great Lakes area where they are considered an introduced species. This species was first observed in Lake Erie in 1954 and has been abundant in the lake since the 1980s (Bolsenga and Herdendorf 1993). On the Atlantic coast, they are typically found in brackish waters, but they have adapted to inland freshwater lakes and tributaries.

White perch spawn in the spring by releasing their eggs in the shallow waters of tributaries. The eggs sink and stick to the bottom until hatching approximately 4 days later. After hatching, the young feed initially on small planktonic organisms; as they grow larger, their diet changes to include aquatic insects, invertebrates, other fish, and the eggs of other fish species.

White perch make up a component of the commercial fish harvest in the western basin of Lake Erie. In 2007, approximately 36,000 lb (16,000 kg) (3.4 percent of the commercial harvest) of white perch were reported in Michigan waters of the western basin (Table 3–20). In Ohio waters of the western basin, white perch was the second most dominant species in the commercial catch during 2009, with more than 535,000 lb (243,000 kg) (23.4 percent of the commercial catch by weight) reported (Table 3–21). Although white perch is generally regarded as an undesirable sport fish in the Great Lakes, it is considered an excellent sport fish in the eastern United States.

White perch was one of the dominant fish species collected during fish surveys on and near the Fermi site during 2008 and 2009. Overall, white perch accounted for more than 12 percent of the individual fish collected during the surveys and more than 33 percent of the individuals collected in areas near the existing Fermi 2 cooling water intake location (Table 3–16). It is estimated that more than 124,000 white perch eggs and larvae were entrained during studies conducted at the Fermi 2 cooling water intake in 2008 and 2009 (AECOM 2009) (Table 3–17). In addition, white perch was the third most commonly impinged species during studies conducted at the Fermi 2 cooling water intake in 2008 and 2009, with approximately 305 individuals being impinged during the year (AECOM 2009) (Table 3–18).

<u>Yellow Perch (*Perca flavescens*)</u>

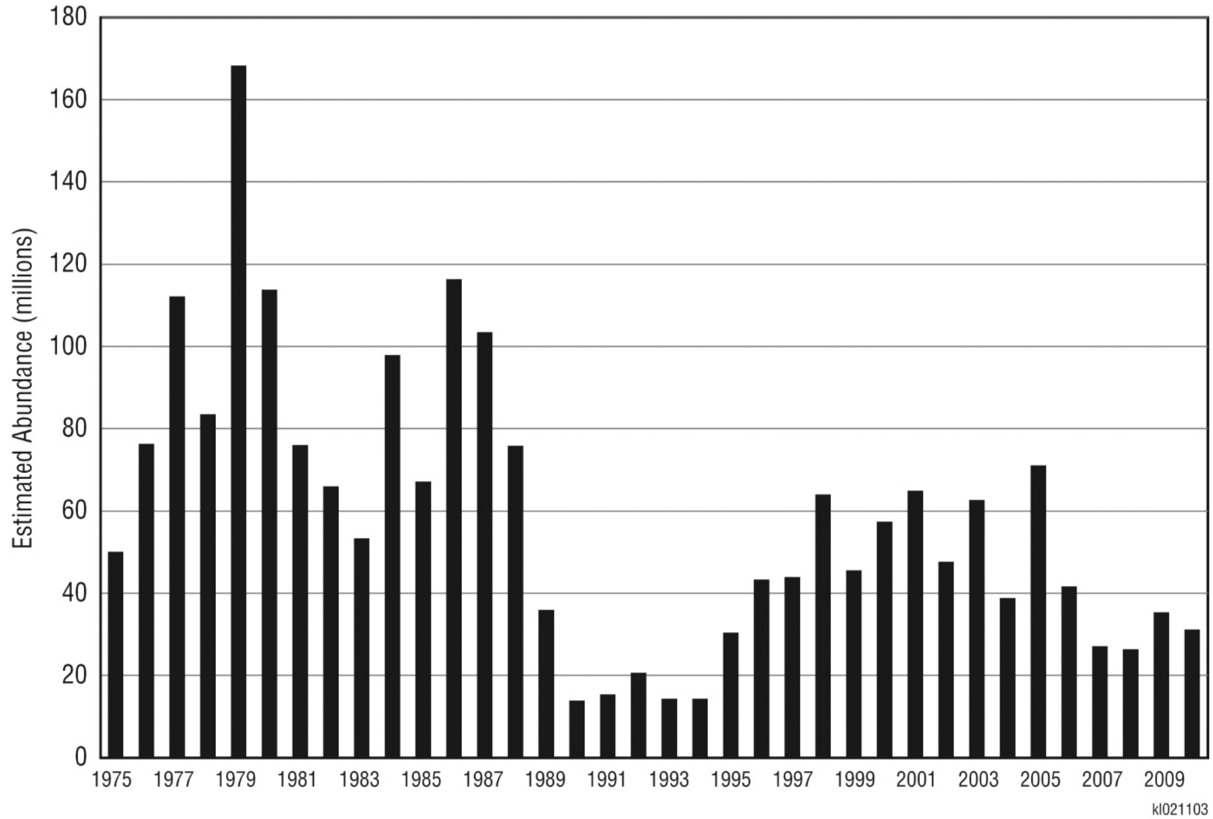
The yellow perch is native to the Great Lakes region but can be found in almost all 50 states and most of Canada. This species is one of the most common fish in Michigan waters; is commonly found in Lake Erie; and is assumed to occur throughout the Detroit River, Swan Creek, Stony Creek, and other surface water habitats on the Fermi site.

Yellow perch usually travel in schools and are generally associated with the clear, shallower waters of lakes or weedy backwaters of creeks and rivers. Yellow perch usually grow to be 6 to 10 in. (15 to 25 cm) long and weigh between 6 and 16 ounces (0.17 to 0.45 kg). Yellow perch spawn in the spring in shallower waters over submerged beds of aquatic vegetation or over sand, gravel, or rubble. The eggs, which are laid in gelatinous strands that can be several feet long, usually hatch in 10 to 20 days. Sexual maturity is reached in 2 to 3 years for males and in 3 to 4 years for females; the maximum lifespan is about 10 years. Larval and young yellow perch feed primarily on zooplankton, whereas adults feed on larger invertebrates and small fish.

Yellow perch is one of the most popular and economically valuable sport and commercial fish in Lake Erie and is considered an indicator of the ecological condition of Lake Erie (EPA 2009f). Because of the importance of yellow perch in Lake Erie, various agencies closely monitor the status of yellow perch populations in the lake. The Lake Erie Committee of the Great Lakes Fishery Commission has formed the Yellow Perch Task Group to bring together information from various agencies so that the population status of yellow perch in Lake Erie can be monitored each year. This task group maintains and updates centralized datasets of information needed to evaluate population status and to support population and harvest modeling efforts and makes recommendations regarding sustainable harvest levels (Lake Erie Yellow Perch Task Group 2010).

After peaking in the late 1800s, commercial catches of yellow perch in the Detroit River and the western basin of Lake Erie decreased substantially through the 1960s. These decreases are attributed primarily to a combination of high levels of fishing pressure and deteriorating water quality. Improvement in yellow perch population levels occurred during the 1970s as fishing pressure declined and as water quality improved as a result of lakewide pollution control programs that were implemented (EPA 2009f). The numbers of yellow perch in Lake Erie dropped again to very low levels during the early 1990s, possibly because of the combined effects of a lakewide invasion of zebra and quagga mussels, fishing pressure, and unsuitable weather conditions (EPA 2009f). Yellow perch populations increased again beginning in the latter portion of the 1990s; although they are not at the levels observed during the 1970s and 1980s, they have remained relatively stable since that time (Figure 3–17) (EPA 2009f; Lake Erie Yellow Perch Task Group 2010). In addition to potentially being affected by water quality, fishing pressure, and invasive species, yellow perch are one of the principal prey items for walleye. As a consequence, as walleye populations increase, there is often a corresponding decrease in yellow perch populations (EPA 2009f).

Figure 3–17. Estimated Abundance of Yellow Perch Aged 2 and Older in the Western Basin of Lake Erie, 1975–2010 (Lake Erie Yellow Perch Task Group 2010)



Source: NRC 2013a, Figure 2-14

Although yellow perch historically made up a large portion of commercial fishery in the western basin of Lake Erie, the commercial perch fishery in Michigan waters has been closed since 1970, and the commercial perch fishery in the western basin waters of Ohio has been closed since 2008. From 1999 to 2008, the annual commercial harvest of yellow perch in Ohio waters of the western basin ranged from approximately 179,000 to 357,000 lb (81,000 to 162,000 kg) (with a mean of approximately 255,000 lb (116,000 kg)). Commercial fishing for yellow perch also occurs in the western basin waters of Ontario, Canada, with a mean landing of approximately 1.1 million lb (500,000 kg) from 1999 to 2009 (Lake Erie Yellow Perch Task Group 2010).

Yellow perch is present in at least low numbers in most of the surface water habitats on the Fermi site based on fish surveys conducted in 2008 and 2009 (AECOM 2009). Yellow perch was among the most common species observed during entrainment studies conducted at the Fermi 2 cooling water intake in 2008 and 2009, and it is estimated that more than 4.8 million yellow perch eggs and larvae were entrained during the year-long study (AECOM 2009) (Table 3–17). No yellow perch adults or juveniles were observed during impingement studies conducted at the Fermi 2 cooling water intake during the same period (AECOM 2009) (Table 3–18).

3.7.3.2 Recreationally Important Species

Lake Erie is the warmest and most biologically productive of the Great Lakes, producing more fish each year than any of the other Great Lakes (Bolsenga and Herdendorf 1993). Walleye and yellow perch are the most popular recreational species in the western basin of Lake Erie.

The total noncharter sport harvest from the Michigan waters of Lake Erie for 2009, based on creel surveys, was estimated at 460,425 fish (Thomas and Haas 2010). Walleye and yellow perch together accounted for 93 percent of the reported recreational fishing harvest. Walleye harvest rates had declined since the previous estimate obtained in 2007, while yellow perch harvest rates were at the highest levels observed since 1998. It is estimated that noncharter boat anglers harvested 85,348 walleye and 344,811 yellow perch during 2009, whereas charter boat anglers harvested 10,258 walleye and 9,989 yellow perch (Thomas and Haas 2010). Reported recreational harvests of other species from the Michigan waters of Lake Erie were considerably lower than those of walleye and yellow perch; they included white perch, channel catfish, freshwater drum, largemouth bass, smallmouth bass, and rainbow trout (Thomas and Haas 2010).

In 2009, sport anglers made more than 300,000 trips to fish in the Ohio waters of the western basin of Lake Erie, and the private sport boat fishing effort within the Ohio waters of the basin totaled more than 1.6 million hours (ODNR 2010). Charter boat fishing effort within the Ohio waters of the western basin in 2009 totaled approximately 158,000 hours (ODNR 2010). Estimates of angler hours indicate that most of the private boat angling effort was directed toward walleye (56 percent of angler hours) and yellow perch (35 percent). Smallmouth bass (4 percent), white bass (2 percent), and largemouth bass (2 percent) were less commonly targeted by private boat anglers (ODNR 2010). Charter boat anglers mainly targeted walleye (95 percent of angler hours), followed by yellow perch (4 percent) and smallmouth bass (less than 1 percent). The total (combined private and charter boat) recreational harvest of fish from the Ohio waters of the western basin in 2009 was estimated at approximately 2.6 million fish and was made up primarily of walleye (21 percent of harvest), yellow perch (72 percent of harvest), and white bass (5 percent of harvest). Smallmouth bass, white perch, freshwater drum, channel catfish, and other species accounted for less than 2 percent of the recreational harvest within the Ohio waters of the western basin of Lake Erie (ODNR 2010). On the basis of fish surveys conducted in 2008 and 2009, each of these recreationally important species, with the exception of walleye, is present in Lake Erie adjacent to the Fermi site and/or in onsite surface water habitats (AECOM 2009).

Sport fish landings are managed by using State-implemented fishing regulations, such as harvest quota systems and requirements that fish must be within certain length limits to be harvested. Typical goals of such regulations are to maintain the numbers of catchable-sized and reproductive-sized individuals at desired levels and to maintain sustainable population levels. For example, walleye fisheries throughout Lake Erie were affected by reduced spawning, which resulted in a lower adult abundance during the 1990s. Harvest quotas and other fishing regulations for walleye became more restrictive because of this reduced adult population, and the result was a rebound in the adult walleye population. Subsequently, less restrictive fishing regulations for the walleye have been implemented in more recent years. The States of Michigan and Ohio have implemented other species-specific fishing regulations.

Recreational angling also occurs in other waters within the vicinity of the Fermi site, such as ponds and tributary drainages of Lake Erie. Swan Creek supports a recreational fishery for common game fish, including largemouth bass and bluegill. Portions of the creek located near recreational areas, such as public parks, receive the largest share of fishing pressure. There are no significant recreational fisheries within the boundaries of Stony Creek, the area managed as part of the DRIWR, or other water bodies located at the Fermi site.

Because many of the recreationally important aquatic species that occur in the vicinity of the Fermi site are also commercially important, the distribution and life history information for those species was summarized above. The distribution and life history information for other recreationally important species that may occur in the vicinity of the site is summarized below.

Bluegill (*Lepomis macrochirus*)

The bluegill is popular with many recreational anglers and is important ecologically because it can affect the composition of aquatic communities by controlling zooplankton populations and by serving as an important prey item for many larger fish, including largemouth bass and northern pike.

The bluegill is native to the Great Lakes and Mississippi River Basins from Quebec and New York to Minnesota and south to the Gulf of Mexico. It is also native to the Atlantic and Gulf Slope drainages from the Cape Fear River, which flows through North Carolina, to the Rio Grande River, which flows through Texas, New Mexico, and northern Mexico (Page and Burr 1991). It has been introduced throughout North America and is now found in many other parts of the world. This sunfish species most commonly inhabits shallow lakes, ponds, reservoirs, sloughs, and slow-flowing streams. It is often associated with rooted aquatic vegetation and silt, sand, or gravel substrates.

Bluegills lay eggs in a nest excavated in shallow water by the male on bottoms of gravel, sand, or mud that contain pieces of debris. Adult bluegills can reach sizes of between 10 and 16 in. (25 and 40 cm) and may live longer than 10 years. Young bluegill feed primarily on planktonic crustaceans, insect larvae, and worms. Adults eat mainly aquatic insects, small crayfish, and small fishes; in some bodies of water, adults may primarily consume zooplankton.

The bluegill is very common in the immediate vicinity of the Fermi site, according to recent fish surveys. Francis and Boase (2007) found that bluegills made up approximately 9 percent of the individual fish collected during surveys in Swan Creek. Bluegills were also found in most aquatic habitats associated with the Fermi site during surveys conducted in the 2008–2009 period; overall, they accounted for 13 percent of the individual fish collected (AECOM 2009). Impingement rates measured at the cooling water intake indicate that an estimated 214 bluegills were impinged at the Fermi 2 cooling water intake from August 2008 through July 2009 (Table 3–18) (AECOM 2009), accounting for approximately 7 percent of the fishes impinged by Fermi 2 during the sampling period. No bluegill eggs or larvae were specifically identified in entrainment samples collected at the Fermi 2 cooling water intake from August 2008 through July 2009 (AECOM 2009). However, it was estimated that approximately 70,000 eggs or larval stages of fish in the same fish family (*Centrarchidae*) would be entrained annually on the basis of the presence of eggs and larvae not identifiable to the species level (AECOM 2009). Some portion or all of these unidentified eggs and larvae could have been those of bluegill.

Largemouth Bass (*Micropterus salmoides*)

The largemouth bass is native to the Great Lakes, Hudson Bay (Red River), and Mississippi River Basins from southern Quebec to Minnesota and south to Texas, throughout the Gulf Coast and southern Florida, and in Atlantic coast drainages from North Carolina to Florida. Because of its popularity as a sport fish, this species has been introduced throughout the United States, southern Canada, and much of the world. Largemouth bass occur in a variety of habitats, including clear and turbid waters of lakes, ponds, reservoirs, and swamps and pools or in backwater areas of creeks and rivers. They are often found in areas containing aquatic vegetation.

Largemouth bass spawn primarily in the spring and summer in water temperatures of 60 °F (15.5 °C) or higher. Males excavate nests in shallow water. After a female deposits eggs in the nest, the male guards the eggs, which hatch within a few days. Largemouth bass reach sexual maturity in 2 to 5 years and can attain sizes as large as 38 in. (96 cm), although approximately 28 in. (70 cm) is a typical size for older adult fish. This species feeds mainly upon zooplankton as fry. As the juvenile grows, it begins to prey on larger organisms, including insect larvae, crustaceans, and small fish. Adults prey mainly on fish but are also known to eat other organisms, including crayfish and frogs.

The largemouth bass is a popular sport fish in the Great Lakes region, including Lake Erie and its tributaries. This species is present, at least in low numbers, in most of the surface water habitats on the Fermi site, according to fish surveys conducted in 2008 and 2009 (AECOM 2009). Largemouth bass was among the species observed during entrainment studies conducted at the Fermi 2 cooling water intake in 2008 and 2009, and it is estimated that approximately 152,000 largemouth bass eggs and larvae were entrained during the year-long study (AECOM 2009) (Table 3–17). On the basis of species-specific impingement rates measured at the Fermi 2 cooling water intake, it is estimated that a total of 31 largemouth bass individuals were impinged at the Fermi 2 cooling water intake during the period from August 2008 through July 2009 (AECOM 2009) (Table 3–18).

<u>Smallmouth Bass (*Micropterus dolomieu*)</u>

The smallmouth bass is native to the St. Lawrence–Great Lakes, Hudson Bay (Red River), and Mississippi River Basins from southern Quebec to North Dakota and south to northern Alabama and eastern Oklahoma. It has been widely introduced throughout the United States, southern Canada, and other countries. Smallmouth bass prefer large, clear lakes (especially in the northern part of the range) and clear, intermediate-sized streams that contain large pools and abundant cover (e.g., rocks, shelves, and logs), and they prefer cool summer temperatures. Adults typically seek the shelter of pools or deep water during the day.

Spawning habitat includes shallow water in lakes or quiet areas of streams, often fairly close to shore. In lakes, spawning adults sometimes move a short distance up a stream to spawn. Spawning generally occurs in late spring or early summer. Females deposit eggs in nests that are constructed by the males; nests usually occur near cover on gravel or sand bottoms. Eggs typically hatch in 2 to 10 days, and males guard eggs and hatchlings for a period of 4 weeks or longer. Individuals usually attain sexual maturity at 2 to 6 years of age, depending on local conditions. Young smallmouth bass eat primarily small crustaceans and aquatic insects (e.g., midge larvae and pupae) until the fish are about 2 in. (5 cm) in length, after which they primarily eat fish. Crayfish, amphibians, and larger insects often become the dominant or seasonal foods of local smallmouth bass populations.

In addition to being a species that has recreational importance, smallmouth bass have ecological importance as being one of the top-level predators in aquatic habitats in the Great Lakes region. Smallmouth bass make up a small component of the aquatic community in the immediate vicinity of the Fermi site, according to recent fish surveys. Francis and Boase (2007) captured low numbers of smallmouth bass in collections from Swan Creek. Smallmouth bass were not found in most aquatic habitats on the Fermi site during surveys conducted in the 2008–2009 period (AECOM 2009), perhaps because many of these habitats have conditions (e.g., warm summer water temperatures and high turbidity) that are not optimal for smallmouth bass. Based on impingement rates measured at the cooling water intake, it is estimated that 62 smallmouth bass were impinged at the Fermi 2 cooling water intake from August 2008 through July 2009 (AECOM 2009) (Table 3–18), accounting for approximately 2 percent of the fishes impinged by Fermi 2. No smallmouth eggs or larvae were identified in entrainment samples collected at the Fermi 2 cooling water intake from August 2008 through July 2009 (AECOM 2009). However, it was estimated that approximately 70,000 eggs or larval stages of fish in the same fish family (*Centrarchidae*) would be entrained annually based on the presence of eggs and larvae not identifiable to the species level (AECOM 2009). Some portion or all of these unidentified eggs and larvae could have been those of smallmouth bass.

3.7.3.3 State-Listed Aquatic Species

This section presents information about Michigan State-listed aquatic species near the Fermi site. Section 3.8 discusses aquatic species that are either Federally or both Federally and Michigan State listed. Table 3–22 indicates State-listed aquatic species that may occur on or near the Fermi site or in Monroe County.

Table 3–22. Exclusively State-Listed Aquatic Species[(a)] That Have Been Observed in Monroe County[(b)] and Their Potential to Occur on the Fermi Site

Common Name	Scientific Name	State Status[(c)]	Fermi Site[(d)]
Mollusks			
hickorynut	*Obovaria olivaria*	E	U
purple lilliput	*Toxolasma lividus*	E	U
purple wartyback	*Cyclonaias tuberculata*	T	U
round hickorynut	*Obovaria subrotunda*	E	U
salamander mussel	*Simpsonaias ambigua*	E	P
slippershell	*Alasmidonta viridis*	T	U
wavyrayed lampmussel	*Lampsilis fasciola*	T	U
Fish			
channel darter	*Percina copelandi*	E	U
creek chubsucker	*Erimyzon claviformis*	E	U
eastern sand darter	*Ammocrypta pellucida*	T	U
pugnose minnow	*Opsopoedus emiliae*	E	P
river darter	*Percina shumardi*	E	U
sauger	*Sander canadensis*	T	P
silver shiner	*Notropis photogenis*	E	U
southern redbelly dace	*Phoxinus erythrogaster*	E	U

(a) This list contains those species that are listed for protection only by the State of Michigan. Section 3.8 discusses species that are both State and Federally listed.

(b) County-level occurrence based on information provided by MNFI (MNFI 2014g).

(c) State species information provided by MNFI (MNFI 2014g) is as follows: E = endangered and T = threatened.

(d) P = possible occurrence on Fermi site due to presence of potentially suitable habitat and nearby populations, but it has not been reported on or adjacent to the Fermi site. U = unlikely to occur due to absence of nearby populations and/or lack of suitable habitat on or adjacent to the Fermi site. Species for which there was no record of occurrence reported by MNFI (MNFI 2014g) for Monroe County were considered unlikely to occur on the Fermi site.

Excluding Federally listed species, the State of Michigan has listed 15 aquatic species as endangered (10 species) or threatened (5 species) in Monroe County (Table 3–22) (MNFI 2014g). Of these, 8 species are fish and 8 species are mollusks (all freshwater mussels). Additional information about the distribution, life history, population status, and potential for occurrence of exclusively State-listed threatened and endangered aquatic species that could be present in the vicinity of the Fermi site is provided below. MNFI (2014g) presents additional information about distribution, life history, and ecology of species of special concern to the State of Michigan.

Hickorynut (*Obovaria olivaria*)

The hickorynut is a freshwater unionid mussel that is listed as endangered by the State of Michigan (MNFI 2014g). The historic range for the hickorynut includes eastern North America from western Pennsylvania and New York to Missouri, Iowa, and Kansas, and from Michigan and the St. Lawrence drainage southward to Alabama and Arkansas (Badra 2004a). In Michigan, the historic range for this species included the Kalamazoo, Grand, Menominee, Saginaw, and Detroit Rivers, as well as Lake Erie and Lake St. Clair (Badra 2004a). Habitat for the hickorynut consists of sand or mixed sand and gravel substrates in large rivers and lakes (Badra 2004a).

Section 3.7.1 describes the general life history of unionid mussels. Gravid individuals of the hickorynut retain larvae internally over the winter and release glochidia in the spring (Badra 2004a). The shovelnose sturgeon (*Scaphirhynchus platorynchus*) and freshwater drum have been shown to be suitable hosts, and it possibly uses additional species as hosts in natural environments (Badra 2004a). Like all freshwater mussels, the hickorynut is a filter feeder.

Principal threats to the hickorynut include siltation and runoff from human activities, damming and dredging of rivers, and the spread of introduced invasive species. Zebra mussels pose a threat for freshwater mussels because they compete for food and benthic habitat and because they attach to the shells of native mussels, making it difficult for the mussels to move and feed properly. The hickorynut has not been reported from Monroe County (MNFI 2014g). Although streams with conditions suitable for the hickorynut are not present on the Fermi site, some nearshore areas in Lake Erie in the vicinity of the site could potentially provide suitable substrate.

Purple Lilliput (*Toxolasma lividus*)

The purple lilliput is a freshwater unionid mussel listed as endangered by the State of Michigan (MNFI 2014g). The historic range for the purple lilliput extends from Michigan south to Alabama and from Missouri and Arkansas eastward to Virginia (Carman 2002a). In Michigan, the purple lilliput is generally restricted to the southeastern portion of the State, and spent shells have been found from sites in the River Raisin in Monroe Country (Carman 2002a). The purple lilliput occurs in small- to medium-sized streams and occasionally in large rivers and lakes; the preferred substrate for this species is well-packed sand or gravel and a water depth of less than 1 m (3 ft) (MNFI 2014g).

Section 3.7.1 describes the general life history of unionid mussels. Gravid purple lilliputs have been known to retain the larvae internally for about a year, although populations in Michigan reportedly produce multiple broods in a single year (Carman 2002a). Fish hosts for the purple lilliput include green sunfish and longear sunfish (*Lepomis megalotis*) (Carman 2002a); both species have been observed in aquatic habitats associated with the Fermi site (AECOM 2009). Like all freshwater mussels, the purple lilliput is a filter feeder.

Principal threats to survival of the species are similar to those described previously for the hickorynut. The purple lilliput was last reported from Monroe County in 1977 (MNFI 2014g). Streams with conditions suitable for the purple lilliput are not present on the Fermi site. The portions of Lake Erie adjacent to the Fermi site do not offer suitable habitat for this species.

Purple Wartyback (*Cyclonaias tuberculata*)

The purple wartyback is a freshwater unionid mussel listed as threatened by the State of Michigan (MNFI 2014g). The historic range for the purple wartyback includes eastern North America from Ontario, Canada, south to Alabama, west to Oklahoma, and east to Pennsylvania (Badra 2004b). It is present in the Mississippi River, Ohio River, Lake Michigan, Lake St. Clair, and Lake Erie drainages (Badra 2004b). The purple wartyback is found in medium to large rivers with gravel or mixed sand and gravel substrates in areas with relatively fast current (Badra 2004b).

Section 3.7.1 describes the general life history of unionid mussels. Gravid individuals of the purple wartyback release glochidia during the same summer that they are fertilized (Badra 2004b). The yellow bullhead and channel catfish have been shown to be suitable hosts for the purple wartyback, and it possibly uses additional species as hosts in natural environments (Badra 2004b). Like all freshwater mussels, the purple wartyback is a filter feeder.

Principal threats to survival of the species are similar to those described previously for the hickorynut. The purple wartyback was last reported from Monroe County in 2000 (MNFI 2014g). Streams with conditions suitable for the purple wartyback are not present on the Fermi site, and Lake Erie adjacent to the Fermi site does not offer suitable habitat for this species.

Round Hickorynut (*Obovaria subrotunda*)

The round hickorynut is a freshwater unionid mussel listed as endangered by the State of Michigan (MNFI 2014g). The historic range for the round hickorynut includes much of eastern North America from Ontario and New York southward to Arkansas, Mississippi, Alabama, and Georgia. It has historically been present in the Ohio, Tennessee, Cumberland, and Mississippi River systems, as well as the St. Lawrence and Lake Erie/Lake St. Clair drainages (Carman 2001f). In Michigan, the round hickorynut occurs in the Lake St. Clair and Lake Erie drainages, and it has historically been observed in Sanilac, St. Clair, Macomb, Wayne, Monroe, and Lenawee Counties (Carman 2001f). The round hickorynut is found in sand and gravel substrates of moderately flowing medium to large rivers and along the shores of Lake Erie and Lake St. Clair near river mouths (Carman 2001f).

Section 3.7.1 describes the general life history of unionid mussels. Gravid individuals of the round hickorynut retain fertilized larvae over the winter and release glochidia during the early summer (Carman 2001f). The host fish species for the round hickorynut is unknown (Carman 2001f). Like all freshwater mussels, the round hickorynut is a filter feeder.

Principal threats to survival of the species are similar to those described previously for the hickorynut. The round hickorynut was last reported from Monroe County in 1977 (MNFI 2014g). Streams with conditions suitable for the round hickorynut are not present on the Fermi site, although areas in Lake Erie near the mouths of Swan Creek or Stony Creek could contain suitable substrates.

Salamander Mussel (*Simpsonaias ambigua*)

The salamander mussel is a freshwater unionid mussel listed as endangered by the State of Michigan (MNFI 2014g). The historic range for the salamander mussel includes North America from Ontario southward to Tennessee, where it is found in the Great Lakes Basin in the Lake St. Clair, Lake Huron, and Lake Erie drainages. The salamander mussel is also found in the Ohio River, Cumberland River, and upper Mississippi River drainages (Carman 2002b). The salamander mussel is found in medium to large rivers and in lakes. It is usually found in silt or sand substrates under flat stones (MNFI 2014g).

Section 3.7.1 describes the general life history of unionid mussels. The biology of the salamander mussel is poorly understood. Gravid females release glochidia in the spring or summer (Carman 2002b). The host for the salamander mussel is the mudpuppy (*Necturus maculosus*) (Carman 2002b), a large (8- to 15-in.-long) salamander species that inhabits many water bodies in Michigan. Like all freshwater mussels, the salamander mussel is a filter feeder.

Principal threats to survival of the salamander mussel are similar to those described previously for the hickorynut. The salamander mussel was last reported from Monroe County in 1977 (MNFI 2014g). Streams with conditions suitable for the salamander mussel are not present on the Fermi site. However, areas in Lake Erie near the site could contain suitable substrates and the mudpuppy host. Although the exact locations of the salamander mussel's occurrence are unknown, its nearest reported occurrence is from Macon Creek, a medium-sized tributary of Lake Erie, and La Plaisance Bay, which is located 6 to 9 mi (10 to 15 km) southwest of the Fermi site (Carman 2002b).

Slippershell (*Alasmidonta viridis*)

The slippershell is a freshwater unionid mussel listed as threatened by the State of Michigan (MNFI 2014g). The historic range for this species extends from southern Ontario south to Alabama and from South Dakota and Kansas east to New York, Virginia, and North Carolina (Carman 2002c). It is found in the Lake Michigan, Lake Huron, Lake St. Clair, and Lake Erie drainages of the Great Lakes Basin and is also present in the Mississippi River system from the Ohio River drainage to the Tennessee River drainage (Carman 2002c). In Michigan, this species has been observed in a number of counties, including Monroe and Washtenaw Counties. The slippershell typically occurs in creeks and headwaters of rivers in sand or gravel substrates, although it can also be present in larger rivers and lakes and has occasionally been found in mud substrates (MNFI 2014g).

Section 3.7.1 describes the general life history of unionid mussels. The biology of the slippershell is poorly understood. The slippershell retains larvae internally for about a year. Fish species that are hosts for the slippershell include the johnny darter (*Etheostoma nigrum*) and mottled sculpin (Carman 2002c). Like all freshwater mussels, the slippershell is a filter feeder.

Principal threats to survival of the slippershell are similar to those described previously for the hickorynut (Carman 2002c). The slippershell was last reported from Monroe County in 2000 (MNFI 2014g). Streams with conditions suitable for the slippershell are not present on the Fermi site, and Lake Erie adjacent to the Fermi site does not offer suitable habitat for this species

Wavyrayed Lampmussel (*Lampsilis fasciola*)

The wavyrayed lampmussel is a freshwater unionid mussel listed as threatened by the State of Michigan (MNFI 2014g). The historic range for this species extended from Ontario to Alabama and Illinois to New York, and it is now discontinuously distributed in the Great Lakes tributaries of Lake Michigan, Lake Erie, Lake Huron, and Lake St. Clair, and in the Ohio, Mississippi, and Tennessee River drainages (Stagliano 2001c). Historically, the wavyrayed lampmussel was found throughout the streams and rivers of southeastern Michigan, but the current distribution is more limited (Stagliano 2001c). It is currently known to occur in the Clinton River drainage in Macomb and Oakland Counties; the St. Joseph River in Hillsdale County; the Belle River in St. Clair County; the Huron River drainage in Washtenaw County; and the River Raisin drainage in Jackson, Lenawee, and Washtenaw Counties. It has also been reported in the past from the River Raisin in Monroe County, although the status of populations in that area is not known. The wavyrayed lampmussel occurs in small to medium-sized shallow streams, in and near riffles, with good current; it rarely occurs in medium or larger rivers (Stagliano 2001c). The preferred substrate is sand and gravel (Stagliano 2001c).

Section 3.7.1 describes the general life history of unionid mussels. The wavyrayed lampmussel breeding season extends from August of one year through July of the following year (Stagliano 2001c). Following fertilization, gravid females retain larvae over the winter and release glochidia during spring and summer (Stagliano 2001c; Carman and Goforth 2000c). The smallmouth bass is the only known fish host (Stagliano 2001c). After dropping off the fish host, this species reportedly does not move more than approximately 300 yards (300 m) throughout its life (Stagliano 2001c). The life span of the wavyrayed lampmussel is unknown (Stagliano 2001c). Like all freshwater mussels, the wavyrayed lampmussel is a filter feeder.

Principal threats to survival of this species are similar to those described previously for the hickorynut. The wavyrayed lampmussel was last reported from Monroe County in 2000 (MNFI 2014g). Streams with conditions suitable for the wavyrayed lampmussel are not present on the Fermi site, and Lake Erie adjacent to the Fermi site does not offer suitable habitat for this species.

<u>Channel Darter (*Percina copelandi*)</u>

The channel darter is a small fish listed as endangered by the State of Michigan (MNFI 2014g). Its distribution extends from the upper St. Lawrence drainages through the Great Lakes Basin and into the Ohio River Basin. The darter is found primarily in the Ohio River Basin, but isolated populations occur southward to Louisiana (Carman and Goforth 2000c). In Michigan, the darter's range historically included nearshore areas of Lake Erie and Lake Huron, including some tributaries (Carman and Goforth 2000c). Since 1994, it has been recorded only in the Au Sable, Pine, and St. Clair Rivers in Michigan (Carman and Goforth 2000c). The channel darter's habitat includes rivers and large creeks with moderate current over sand and gravel substrate. It has also been recorded in wave-swept areas of Lake Huron and Lake Erie that have coarse-sand, fine-gravel beach and sandbar substrates (Carman and Goforth 2000c). The darter is usually found in deeper water but will move into shallow water (less than 3 ft) (less than 1 m) at night (Carman and Goforth 2000c).

The channel darter spawns in July in Michigan and requires flowing water conditions for successful spawning (Carman and Goforth 2000c). Spawning males maintain a territory with a radius of approximately 1.6 ft (0.5 m) around a large rock as a spawning female partially buries herself in gravel downstream of the rock and deposits her eggs (Carman and Goforth 2000c). Adults grow to be approximately 2 in. (5 cm) long. Channel darters are benthic feeders whose diet consists of small invertebrates, including mayfly and midge larvae, small crustaceans, algae, and organic debris (Carman and Goforth 2000c).

In Michigan, the range of the channel darter was severely reduced during the past century. Before 1957, this species was reported from 11 counties along Lake Huron, Lake St. Clair, the St. Clair River, and Lake Erie (Carman and Goforth 2000c). Declines in abundance and distribution have been attributed primarily to loss of suitable habitat (Carman and Goforth 2000c). The channel darter was last observed in Monroe County in 1941 (MNFI 2014g). No suitable stream habitat for the channel darter is present on the Fermi site, although the potential exists for this species to inhabit wave-swept shorelines in Lake Erie, such as that located along the eastern edge of the Fermi site. However, no channel darter individuals were collected during recent surveys of aquatic habitats on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No channel darter eggs or larvae were observed during entrainment and impingement studies conducted at the Fermi 2 intake in 2008 and 2009 (AECOM 2009).

Creek Chubsucker (*Erimyzon oblongus claviformis*)

The creek chubsucker is listed as endangered by the State of Michigan and has been reported from Monroe County (MNFI 2014g). This fish occurs throughout most of the eastern United States but is becoming increasingly rare at the edges of its historic distribution. The northern extent of the range for the creek chubsucker terminates in Michigan where it has been found in the Kalamazoo River, St. Joseph River, and River Raisin and their tributaries. For the last two decades, it has been reported only in the Kalamazoo River, located west of Monroe County. The creek chubsucker inhabits headwaters and clear creeks with moderate currents over sand-gravel substrate. In Michigan, the creek chubsucker has been reported primarily from streams that are 3 to 5 ft (1 to 1.5 m) deep with moderately swift currents and muddy bottoms (Carman 2001b).

The creek chubsucker migrates upstream to spawn in early spring. Eggs are usually scattered over substrates, although males have been observed building nests. Adults may produce up to 9,000 eggs per year. Juveniles of this species often form schools in vegetated headwater areas with less current but migrate to deeper downstream areas as they become adults. Life expectancy of the creek chubsucker is approximately 5 years. The diet of the creek chubsucker is mostly small benthic invertebrates (Carman 2001b).

The preferred habitat type for this species (clear creeks with sandy substrates and moderate current) does not occur on the Fermi site. No creek chubsuckers were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) in the vicinity of the Fermi site.

Eastern Sand Darter (*Ammocrypta pellucida*)

The eastern sand darter is listed as threatened by the State of Michigan (MNFI 2014g). This fish occurs in the St. Lawrence River drainage and the Lake Champlain drainage in Vermont and occurs south to West Virginia and Kentucky and west through Ontario and Michigan (Derosier 2004a). Within Michigan, this darter was found historically in the Huron, Detroit, St. Joseph, River Raisin, and Rouge Rivers and in Lake St. Clair. However, in the past 2 decades, it has been recorded in the Lake St. Clair and Huron River drainages (Derosier 2004a). The preferred habitats of the eastern sand darter are streams and rivers with sandy substrates and lakes with sandy shoals. They frequently occur in slow-moving streams with deposits of fine sand, often just downstream of a bend (Derosier 2004a).

The spawning period for the eastern sand darter occurs from April through June. Eggs are buried singly in sandy sediments. These darters reach sexual maturity at age one and have a life expectancy of 2 to 3 years. The eastern sand darter feeds mostly on chironomid larvae but will also prey upon aquatic worms and small crustaceans (Derosier 2004a).

Declines in Michigan populations of eastern sand darters have been attributed to siltation, modification of riparian areas, channel and flow alterations, and nutrient enrichment (Derosier 2004a). In the vicinity of the Fermi site, the eastern sand darter was last observed in Monroe County in 1929 (MNFI 2014g). Although suitable habitat for this species could be present in Stony Creek, no eastern sand darters were collected during recent surveys of aquatic habitats on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No eastern sand darter eggs or larvae were collected during entrainment or impingement studies in 2008 and 2009 (AECOM 2009).

Pugnose Minnow (*Opsopoeodus emiliae*)

The pugnose minnow is listed as endangered by the State of Michigan (MNFI 2014g). This fish species has been documented from the southern Great Lakes Basin through the Mississippi River valley to the Gulf of Mexico (Carman 2001c). Although common in the southeastern portion of its range, it is becoming rare at the northern edge of its range (Carman 2001c). Historically, the pugnose minnow occurred in Michigan tributaries and nearshore areas of Lake Erie and Lake St. Clair, located approximately 15 mi (24 km) northeast of the Fermi site, although there is no recent record of occurrence (Carman 2001c). The pugnose minnow inhabits slow, clear waters of rivers and shallow regions of lakes and is found in greatest abundance in weedy areas over sand or organic substrate (Carman 2001c). Historically, it occurred in turbid areas of the Huron River that lacked aquatic vegetation, although it is believed that such conditions are not preferred (Carman 2001c).

The life history of the pugnose minnow is not well documented. Spawning occurs in June and July (MNFI 2014g). After hatching, it reaches its adult length of 2 in. (5 cm) within 2 years (Carman 2001c). The pugnose minnow feeds on small crustaceans, dipteran larvae, and other aquatic invertebrates, as well as algae and plants (Carman 2001c).

In Michigan, the pugnose minnow has been observed in Monroe County within the past 15 years (MNFI 2014g). Declines in Michigan populations have been attributed primarily to increased siltation and loss of weedy aquatic habitats (Carman 2001c). Although there is a potential for suitable habitat for the pugnose minnow to be present in the vicinity of the Fermi site, no individuals were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No pugnose minnow eggs or larvae were collected during entrainment or impingement studies in 2008 and 2009 (AECOM 2009).

Pugnose Shiner (*Notropis anogenus*)

The pugnose shiner is listed as endangered by the State of Michigan (MNFI 2014g). The distribution of this fish species historically ranged from the Lake Ontario drainage of eastern Ontario and western New York to southeastern North Dakota and central Illinois (Derosier 2004b). The species is rare and declining in much of its former range (Derosier 2004b). Within Michigan, the pugnose shiner was historically found within at least 18 watersheds (MNFI 2014g). The pugnose shiner usually inhabits clear vegetated lakes and vegetated pools and runs of low-gradient streams and rivers and appears to be extremely intolerant of increased levels of turbidity (MNFI 2014g). The species feeds on filamentous green algae, plant material, and small crustaceans (Derosier 2004b). There is little other information available about the life history of this species.

In Michigan, the pugnose shiner was last reported from Washtenaw County in 1938 and from Wayne County in 1894; it has not been reported from Monroe County (MNFI 2014g). No individuals were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No pugnose shiner eggs or larvae were collected during entrainment or impingement studies in 2008 and 2009 (AECOM 2009). Suitable habitat for this species does not occur on the Fermi site.

River Darter (*Percina shumardi*)

The river darter is listed as endangered by the State of Michigan (MNFI 2014g). The distribution of this fish species ranges from southern Canada to the Gulf of Mexico, including the Great Lakes Basin (Carman 2001d). The river darter is found in rivers and large streams with deep, fast-flowing riffles and cobble and boulder substrates. This species has also been observed at depths below 15 ft (5 m) in nearshore areas of the Great Lakes and is tolerant of elevated levels of turbidity (Carman 2001d).

The river darter is believed to move upstream to spawn. Spawning occurs in late winter to early spring in southern areas from April through May in the Midwest and as late as June or July in Canada. The female river darter buries eggs in loose gravel or sand substrates during spawning, and neither males nor females provide parental care to the young. River darters grow to be about 3 in. (7.5 cm) long, mostly within the first year of development, and sexual maturity is usually reached after 1 year. As juveniles, river darters primarily feed on small zooplankton; adults prey upon midge and caddisfly larvae, as well as some snail species (Carman 2001d).

Even though the river darter is relatively tolerant of elevated turbidity and other water quality changes, the species generally requires deep and swiftly flowing waters as habitat. Such habitats are becoming more limited as a result of flood control efforts and riverine impoundments. The river darter was last observed in Monroe County in 1941 (MNFI 2014g). No suitable stream habitat for the river darter is present on the Fermi site. No river darters were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No river darter eggs or larvae were collected during entrainment and impingement studies in 2008 and 2009 (AECOM 2009).

Sauger (*Sander canadensis*)

The sauger is listed as threatened by the State of Michigan (MNFI 2014g). The native range for this fish species includes the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River Basins and the Tennessee River in Alabama and Louisiana; the sauger has also been introduced into the Atlantic, Gulf, and southern Mississippi River drainages (Derosier 2004c). This species was historically abundant in Lake Erie.

The sauger, which is closely related to the walleye, prefers turbid areas of lakes, reservoirs, and large rivers (MNFI 2014g). This species spawns over shallow areas with gravel and rubble substrates in May or June when temperatures range from 4 to 6 °C (39 to 43 °F) (Derosier 2004c). The sauger broadcasts demersal, adhesive eggs over shoals during the night. After hatching, young sauger spend up to 9 days on the bottom, absorbing yolk from their egg sacs. Males reach sexual maturity within 3 years, while females take 4 to 6 years to mature (Derosier 2004c). The life expectancy for the sauger is up to 13 years (Derosier 2004c), and it can attain lengths up to approximately 18 in. (45 cm) (NatureServe 2009). Saugers have a specialized structure in their eyes that makes them very sensitive to light, and they prefer to feed at night in clearer waters or during the day in turbid areas (Derosier 2004c). Juvenile sauger prey on zooplankton and aquatic insect larvae, whereas adults feed on fish and larger invertebrates, including gizzard shad, emerald shiner, crappie, bass, freshwater drum, leeches, crayfish, and insects (Derosier 2004c).

The sauger was last reported from Monroe County in 1996 (MNFI 2014g). Although there is no riverine habitat suitable for sauger on or adjacent to the Fermi site, suitable habitat could be present in Lake Erie near the Fermi site. However, no sauger individuals were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No sauger eggs or larvae were collected during entrainment and impingement studies in 2008 and 2009 (AECOM 2009).

<u>Silver Shiner (*Notropis photogenis*)</u>

The silver shiner is listed as endangered by the State of Michigan (MNFI 2014g). The distribution for this fish species ranges from the Great Lakes and their tributaries through the Ohio River Basin and Tennessee drainage to northern Alabama and Georgia. This shiner is fairly common within most of the Ohio River Basin but occurs more rarely in tributaries of the Great Lakes. Within Michigan, it is locally abundant in the St. Joseph River (Hillsdale County) and in the River Raisin (Washtenaw County). Historically, the silver shiner was also found in the River Raisin in Monroe County (Carman 2001e).

Preferred habitat for the silver shiner is medium to large streams with moderate to high gradients. This species is usually found in deeper water, such as pools or eddies directly below riffles. The species has been documented to prefer a variety of substrates, including gravel and boulder; pebble and cobble; and sand, mud, and clay and is believed to avoid areas with dense vegetation and substantial siltation. In Michigan, the shiner has been found to inhabit areas of strong current with wooded banks (Carman 2001e).

Reproduction of the silver shiners is not well documented, but it is believed to spawn in June. Juvenile silver shiners exhibit rapid growth, reaching sexual maturity at age 2 and maximum size by age 3. Although the silver shiner primarily feeds at the surface, it will take mid-water prey as well. The majority of the silver shiner's prey are aquatic stages of insects, especially flies (Carman 2001e).

The silver shiner is relatively rare in Michigan, but populations appear to be stable (Carman 2001e). The species is fairly tolerant of human impact and poor water quality (Carman 2001e). The silver shiner prefers stream habitats with moderate to high gradient; this type of habitat is not present on the Fermi site. No silver shiners were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) in the vicinity of the Fermi site. No silver shiner eggs or larvae were observed during entrainment or impingement studies in 2008 and 2009 (AECOM 2009). Suitable habitat for this species does not occur on the Fermi site.

<u>Southern Redbelly Dace (*Phoxinus erythrogaster*)</u>

The southern redbelly dace is listed as endangered by the State of Michigan (MNFI 2014g). The distribution for this fish species ranges from the Lake Erie and Lake Michigan drainages through the Mississippi River Basin south to Alabama, Arkansas, and Oklahoma. The northern limit of this species' range is in southeastern Michigan in the Huron River and River Raisin drainages that feed Lake Erie (Stagliano 2001b). The southern redbelly dace generally occurs in the clear and cool permanent headwaters of river systems, especially small, moderate-gradient, spring-fed, and wooded streams that contain pools and are shaded (Stagliano 2001b). Preferred substrates include mud bottoms of pools and clean gravel of riffles (Stagliano 2001b).

In the northern portion of its range, the southern redbelly dace usually spawns in May and June. Spawning fish migrate from pools to riffles where they use nests built by other fish in the same family (*Cyprinidae*). Females generally release 700 to 1,000 eggs during each spawning event. Southern redbelly dace reach sexual maturity within 1 year and a length of less than 2 in. (5 cm). This species is generally herbivorous, feeding on filamentous algae, diatoms, and drifting or benthic detritus. Larger fish reportedly feed on chironomid and mayfly larvae and other small invertebrates (Stagliano 2001b).

Near the Fermi site, the southern redbelly dace was last reported from Monroe County in 1930 and from Washtenaw County in 1973; there are no reports of this species from Wayne County

(MNFI 2014g). Although there is a potential for suitable habitat to be present in some of the small streams adjacent to the Fermi site, the areas of Lake Erie near the Fermi site are not suitable habitat for this species. No southern redbelly dace were collected during recent surveys on the Fermi site (AECOM 2009), and none were reported in past biological surveys of Stony Creek (MDEQ 1996, 1998) or the Swan Creek estuary (Francis and Boase 2007) near the Fermi site. No southern redbelly dace eggs or larvae were collected during entrainment and impingement studies in 2008 and 2009 (AECOM 2009).

3.7.3.4 Non-Native Nuisance Species

Aquatic non-native nuisance species have the ability to cause large-scale ecological and economic problems when they have been introduced into an ecosystem that does not have the natural controls to keep them in check, such as pathogens, predators, and parasites. When new species are introduced into an area, the lack of natural controls may cause the populations to grow at or near maximum exponential rates. If a nuisance species becomes established, it may disrupt the balance of the existing ecosystem. As a nuisance species proliferates, it may prey upon, out-compete, or cause disease in the existing inhabitants. Some aquatic non-native nuisance species known to occur on or near the Fermi site are discussed below.

<u>Asian Clam (*Corbicula fluminea*)</u>

The Asian clam was imported in the northwestern United States in 1938 as a food source and subsequently released to the environment. The species has since become widely distributed throughout the United States (Foster et al. 2011). Native to Asia and Africa, the first report of this species from Lake Erie was in 1981, and it has now become established in the Great Lakes. Cold water temperatures limit the potential for survival and reproduction of this species in the Great Lakes Region where it is often found in areas influenced by the heated water discharged from power plants (French and Schloesser 1991). Asian clams can attach to intake pipes and other manmade structures, causing problems related to the operation and maintenance of power plants and industrial water systems. The cost of removing them from intake systems is estimated at about a billion dollars each year (Foster et al. 2011). Asian clams compete with other species, especially native freshwater mussels, by occupying benthic habitat and filtering phytoplankton and suspended matter from the water column. This species is also eaten by some aquatic species, such as some fish and crayfish (Foster et al. 2011).

<u>Fishhook Water Flea (*Cercopagis pengoi*)</u>

The fishhook water flea is an invasive planktonic crustacean that is native to the Caspian Basin in southwest Asia. It is believed to have been introduced to the Great Lakes from the ballast water of a transoceanic ship in the late 1990s. It is now considered established in Lake Ontario and has substantial populations in all of the Great Lakes except Lake Superior and Lake Huron. The fishhook water flea consumes zooplankton and competes with other planktivores for food. Similar to the spiny water flea (described below), this species has a long spine that makes it less palatable to planktivorous fish, and it has a high reproductive rate. As a consequence, it is feared that the establishment of this species could result in substantial changes to plankton communities and could affect survival of planktivorous fish in affected lakes. The current distribution of this species in the vicinity of the Fermi site is unknown, although it was found in Lake Erie in 2002 (Benson et al. 2010a).

<u>Lyngbya (*Lyngbya wollei*)</u>

Lyngbya is an invasive filamentous cyanobacterial (blue-green algal) species that has become established in some areas of the western basin of Lake Erie. Lyngbya, which is common in some areas of the southeastern United States, was first observed in Maumee Bay (approximately 18 mi (30 km) south-southwest of the Fermi site) in 2006. This species has been observed to form dense benthic and floating mats that can interfere with boating and other lake activities and may negatively affect other aquatic organisms. In addition, when the algal mats wash ashore, they can blanket extensive shoreline areas and become a nuisance as they decompose.

Bridgeman and Penamon (2010) conducted surveys of the western basin in 2008 and found that lyngbya was most prevalent along shorelines in the vicinity of Maumee Bay, becoming less prevalent with increasing distance from Maumee Bay. In addition, the biomass of benthic mats of lyngbya was found to be greatest in Maumee Bay and Bolles Harbor at water depths of 5 to 11 ft (1.5 to 3.3 m) on substrates that contained mixtures of sand and fragmented shells from dreissenid mussels (i.e., zebra and quagga mussels). The closest record of occurrence of lyngbya is in the vicinity of Sterling State Park, approximately 5 mi (8 km) south-southwest of the Fermi site (Bridgeman and Penamon 2010). Bridgeman and Penamon (2010) found no lyngbya in samples collected at Stony Point (approximately 2 mi (3 km) southwest of the Fermi site) in 2008, and lyngbya has not been documented at the Fermi site. Overall, it appears that the potential for excessive growth of lyngbya is related to the amount of light penetration into the water column (a function of water turbidity), water depth, nutrient availability, and type of substrate that is present (Bridgeman and Penamon 2010; LaMP Work Group 2008). Bridgeman and Penamon (2010) found that lyngbya in the vicinity of Maumee Bay usually occurred at depths between 6.6 and 9.2 ft (2 to 3 m). Nutrient concentrations of nitrate, orthophosphate, and total phosphorus reported from Maumee Bay (Moorhead et al. 2008) were higher than those reported by DTE in Lake Erie near the Fermi site (AECOM 2009a).

A report prepared by DECo (2012d) documented visual inspections for algae recorded in ship and dive logs during surveys conducted as part of the Fermi 2 Radiological Environmental Monitoring Program. DECo (2012d) also performed microscopic analyses of algal samples collected near the Fermi 2 discharge and the proposed location for the Fermi 3 discharge in 2011. Information from the logs indicated that no mats or stands of algae were observed in the vicinity of the Fermi site. The microscopic analyses confirmed that *Lyngbya wollei* was not present in samples from the Fermi site.

<u>Quagga Mussel (*Dreissena rostriformis bugensis*)</u>

The quagga mussel is a nuisance species believed to have been introduced to the United States through the ballast water discharge of transatlantic shipping vessels. Native to Ukraine, this species was first discovered in the Great Lakes region in 1989 and has now become well established in Lake Erie. It has been reported in Lake Erie near the mouths of Swan and Stony Creeks (near the Fermi site), and it is most likely present in parts of the Detroit River as well. Very similar to the zebra mussel (described below), the quagga mussel attaches to a wide variety of living and nonliving things, including intake pipes and structures, causing problems related to the operation and maintenance of these structures. By filtering phytoplankton and suspended matter from the water column, the quagga mussel consumes a large portion of the zooplankton food source, thus affecting the entire food chain. By clarifying the water, the species augments the natural success of aquatic vegetation and, in turn, alters the entire lake ecosystem (Benson et al. 2010b).

<u>Round Goby (*Neogobius melanostomus*)</u>

The round goby is an invasive species abundant throughout the Great Lakes region, with origins in the Black and Caspian Seas. It is commonly believed that the round goby was introduced to the Great Lakes through ballast water. First encountered in the vicinity of the St. Clair River in 1990, the round goby has now spread to all of the Great Lakes. The largest populations are believed to be in Lake Erie and Lake Ontario. This small fish feeds primarily on bivalves (including zebra mussels), amphipods, small fish, and fish eggs. Thermal tolerance for this species ranges from 39 to 68 °F (4 to 20 °C). Known to compete with other fish for food and to consume eggs and juvenile fish, the round goby is seen as a detriment to the Lake Erie ecosystem (Fuller et al. 2010a).

The round goby is present in habitats near the Fermi site and is likely present in Swan Creek and Stony Creek. During aquatic surveys conducted at the Fermi site in 2008 and 2009, a total of 22 round gobys were collected along the Lake Erie shoreline near the South Lagoon (AECOM 2009). Round gobys were also observed in samples collected during impingement and entrainment studies during 2008 and 2009; it was estimated that 123 individuals would be impinged and that more than 1.7 million eggs and larvae would be entrained annually during normal operations of the water intake (AECOM 2009).

Sea Lamprey (*Petromyzon marinus*)

The sea lamprey is a primitive jawless fish originating in the Atlantic Ocean. The sea lamprey is an invasive species and is larger and far more predacious than the lamprey species that are native to Lake Erie. During the adult stage, sea lampreys parasitize other fish by attaching to them with their suckerlike mouth and penetrate the body wall with sharp teeth in order to feed on body fluids; this often results in the death of the host fish (Great Lakes Fishery Commission 2000). A single sea lamprey can kill as much as 40 lb (18 kg) of fish in its lifetime, and it is estimated that only one in seven fish survive an attack by a sea lamprey (Great Lakes Fishery Commission 2000). They have a strong advantage over the many species of fish native to Lake Erie because they have no natural predators in the lake. The sea lamprey has no economic value, and during its peak abundance, it is estimated that 85 percent of lake trout encountered that have not been killed by the lamprey will have scarring from their attacks (Great Lakes Fishery Commission 2000). Sea lampreys were first observed in Lake Erie in 1921 (Great Lakes Fishery Commission 2000). This species typically moves into tributaries to spawn, and many tributaries of Lake Erie are treated with chemicals, called lampricides, that kill the larval stages of sea lampreys to prevent further expansion of the species. Although Lake Erie and Swan Creek are the only waterways in the vicinity of the Fermi site where sea lampreys have been found, Stony Creek and the Detroit River could have individuals present during spawning runs.

Spiny Water Flea (*Bythotrephes longimanus*)

The spiny water flea is an invasive planktonic crustacean (cladoceran) that is native to Europe and northern Asia and is believed to have arrived in the Great Lakes region through ballast water in the mid-1980s. Because of a preference for cooler waters, the spiny water flea is more abundant in the central basin of Lake Erie than it is in the western basin; however, it can be found throughout the lake (Berg 1992). There are populations found in inland lakes of the Great Lakes region, and it is presumed that the spiny water flea could also occur in tributaries of Lake Erie, such as Swan Creek, Stony Creek, and the Detroit River, as well.

This is a large plankton species, about 0.5 in. (1.25 cm) long, that has a very high reproductive rate. The spiny water flea consumes small zooplankton, such as small cladocerans, copepods, and rotifers, and the introduction of this species could result in changes to the zooplankton community structure in affected lakes. The spiny water flea also competes with juvenile fish since they share many similar food sources, such as zooplankton, fish larvae, and eggs. This species is not an attractive prey to the native inhabitants of Lake Erie because of the sharp spines located on its tail; therefore, there are few deterrents to the success of its rapidly growing population (Liebig and Benson 2010).

<u>Tubenose Goby (*Proterorhinus semilunaris*)</u>

The tubenose goby is a small fish that was introduced into the St. Clair River, in Michigan in 1990 and probably originated in ballast water discharged from a foreign tanker that took on water somewhere in the Black Sea (Jude et al. 1992). This species is believed to be established but rare in the St. Clair River and in Lake St. Clair in Michigan (Fuller et al. 2012). Since its establishment, the distribution of the species has expanded, and it now also occurs in the Detroit River and the western basin of Lake Erie (Kocovsky et al. 2011). This species was also found to be present in Swan Creek in 2001 within approximately 2.5 mi (4 km) of Lake Erie and the Fermi site (Fuller et al. 2012).

In the western basin of Lake Erie, maximum densities of tubenose gobies occurred in sheltered areas with abundant growth of aquatic vegetation, which also is the preferred habitat for the native northern Black Sea populations (Kocovsky et al. 2011). Tubenose gobies were generally absent from sampled areas of the western basin that were dominated by cobble along windswept shores or that lacked vegetation (Kocovsky et al. 2011). The diet of tubenose gobies in the western basin consisted almost exclusively of invertebrates, especially midge larvae and amphipods, suggesting that it may compete for food with other bottom-dwelling fish, such as darters (*Etheostoma* spp. and *Percina* sp.), madtoms (*Noturus* spp.), and sculpins (*Cottus* spp.), and could displace some of these native species (Kocovsky et al. 2011).

<u>Zebra Mussel (*Dreissena polymorpha*)</u>

The zebra mussel is considered a nuisance species throughout the entire Great Lakes region and is known to inhabit the western basin of Lake Erie near the Fermi site. Zebra mussels have been reported in Swan Creek, Stony Creek, and the Detroit River. Originally found primarily in Russia, it is believed that this species was transported to the Great Lakes region in the ballast water of a transatlantic freighter in 1988. Since that time, it has spread to more than 100 lakes and several major river systems, including the Mississippi River (USGS 2008).

Zebra mussels are very successful invaders because they live and feed in many different aquatic habitats, breed prolifically, and have both a planktonic larval stage and an attached adult stage. Adult zebra mussels attach to a wide variety of living and nonliving things from boats, docks, piers, and water intake pipes to plants and even slow-moving animals. They can also attach to each other, creating dense blankets of mussels up to 1 ft (1/3 m) thick. In 1989, the City of Monroe lost its water supply for 3 days when large amounts of zebra mussels clogged the city’s water intake pipeline. The FWS estimates the economic impact of zebra mussels to be in the billions of dollars (over the next 10 years) in the Great Lakes region alone (USGS 2008).

In addition to the economic damage caused by this species, the invasion of the Great Lakes and other areas by this species has had important ecological effects. As identified in previous sections, zebra mussels have contributed to the decline of native freshwater mussels by competing for food and space and by preventing burrowing and other activities when they attach to the shells of freshwater mussels. In addition, the collective water-filtering ability of quagga and zebra mussels is believed to have had lakewide effects on nutrient levels; the abundance and composition of phytoplankton and zooplankton communities; and water clarity, thus resulting in large-scale ecological changes (USGS 2008).

3.7.4 Aquatic Species and Habitats in the Transmission Line Corridor

Aquatic habitats within or adjacent to the in-scope transmission line corridor include only small streams and drainage ditches. The in-scope transmission line corridor does not cross any lakes, ponds, or reservoirs.

3.7.5 Aquatic Monitoring

No formal monitoring of the aquatic environment on the Fermi site has been conducted or is planned. The current NPDES permit for the Fermi site does not require monitoring of aquatic ecological resources, and the operating license for Fermi 2 does not require monitoring of aquatic resources, including specific aquatic ecological monitoring of the algal community, benthic invertebrates, or fish.

3.8 Special Status Species and Habitats

This section addresses species and habitats that are Federally protected under the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) and the Magnuson–Stevens Fishery Conservation and Management Act of 2006, as amended (MSA) (16 U.S.C. 1801–1884). The ESA and the MSA placed requirements on Federal agencies, such as the NRC. The terrestrial and aquatic resource sections (Sections 3.6 and 3.7, respectively) discuss other species and habitats protected by other Federal acts and the State of Michigan that do not place requirements on the NRC.

3.8.1 Species and Habitats Protected under the Endangered Species Act

The FWS and the National Marine Fisheries Service (NMFS) jointly administer the ESA. The FWS manages the protection of, and recovery effort for, listed terrestrial and freshwater species, and the NMFS manages the protection of, and recovery effort for, listed marine and anadromous species. This section describes the action area and considers those species that could occur in the action area under both the FWS's and the NMFS's jurisdictions.

3.8.1.1 Action Area

The implementing regulations for Section 7(a)(2) of the ESA define "action area" as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area effectively bounds the analysis of ESA-protected species and habitats because only species that occur within the action area may be affected by the Federal action.

For the purposes of the ESA analysis in this SEIS, the NRC staff considers the action area to be the Fermi site (described in Sections 3.1 and 3.6) and the portion of Lake Erie that would be affected by water withdrawal and discharge effluent (described in Section 3.7). The NRC staff expects all direct and indirect effects of the proposed action to be contained within these areas.

The NRC staff recognizes that, although the action area is stationary, Federally listed species can move in and out of the action area. For instance, a migratory fish species could occur in the action area periodically and then travel to freshwater streams to spawn. Similarly, a flowering plant known to occur near, but outside of, the action area could appear within the action area over time if its seeds are carried into the action area by wind, water, or animals. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area but also those species that may passively or actively move into the action area. The NRC staff then considers whether the life history of each species makes the species likely to move into the action area where it could be affected by the proposed Fermi 2 license renewal.

Within the action area, Federally listed terrestrial species could experience impacts, such as habitat disturbance associated with ground-disturbing activities; cooling tower drift; collisions with cooling towers and in-scope transmission lines; exposure to radionuclides; and other direct and indirect impacts associated with station, cooling system, and in-scope transmission line operation and maintenance (NRC 2013b). The proposed action has the potential to affect

Federally listed aquatic species in several ways: impingement or entrainment of individuals into the cooling system; alteration of the lake environment through water level reductions; changes in dissolved oxygen, gas supersaturation, eutrophication, and thermal discharges from cooling system operation; habitat loss or alteration from dredging; and exposure to radionuclides (NRC 2013b).

3.8.1.2 Species and Habitats under the FWS's Jurisdiction

Table 3-23 identifies the species under the FWS's jurisdiction that occur within Monroe County, Michigan. Monroe County includes approximately 680 mi^2 (1,761 km^2) of varying land uses and habitat types. Thus, a Federally listed species that occurs within Monroe County does not necessarily occur within the action area. The NRC staff uses this geographical range as a starting point for its analysis because Federally listed species distribution and critical habitat information is readily available at the County level. Additionally, the action area is a small area of land wholly contained within the geographical boundaries of the County. Following the table, descriptions of each species include a determination of whether each species occurs in the action area based on the species' habitat requirements, life history, and available occurrence information.

The NRC compiled the list of species in Table 3–23 from the FWS's Endangered Species Program online databases (FWS 2014a, 2014b); correspondence between the NRC and the FWS (FWS 2014c; NRC 2014c); information from DTE's ER (DTE 2014d); and available scientific studies, surveys, and literature. The NRC staff did not identify any candidate species or designated critical habitats within the action area.

Table 3–23. Federally Listed Species in Monroe County, Michigan

Species	Common Name	Federal Status	Habitat
Birds			
Calidris canutus	red knot	T	The Lake Erie shoreline is part of the red knot's migratory route and potential resting grounds when it migrates to and from the Canadian Artic and Argentina.
Charadrius melodus	piping plover	E	When the piping plover inhabits the Great Lakes during spring and summer, its nest sites include open, sparsely vegetated, sandy areas along the Great Lakes.
Mammals			
Myotis septentrionalis	northern long-eared bat	T	During late spring and summer, the northern long-eared bat roosts and forages in upland forests. It uses caves and mines as hibernacula in winter.
Myotis sodalis	Indiana bat	E	The Indiana bat inhabits hardwood forests; hardwood pine forests; and old-growth forests, especially near stream and river corridors; agricultural lands; and old fields. It uses caves and mines as hibernacula during winter.

Species	Common Name	Federal Status	Habitat
Insects			
Lycaeides melissa samuelis	Karner blue butterfly	E	The Karner blue butterfly inhabits pine barrens and oak savannas that contain wild lupines (*Lupinus perennis*), the only known food plant of larvae.
Plants			
Platanthera leucophaea	Eastern prairie fringed orchid	T	The eastern prairie fringed orchid inhabits mesic to wet prairies and meadows.
Mussels			
Epioblasma torulosa rangiana	northern riffleshell	E	The northern riffleshell inhabits Lake Erie, large streams, and small rivers in areas of firm sand and where riffles occur.
Epioblasma triquetra	snuffbox mussel	E	The snuffbox mussel inhabits Lake Erie, small- to medium-sized creeks, and some larger rivers in areas with a swift current.
Villosa fabalis	rayed bean	E	The rayed beam inhabits Lake Erie and smaller headwater creeks or sometimes in large rivers.

Key: E = endangered; T = threatened

Sources: 80 FR 17973; DTE 2014d, 2014g; FWS 2014a, 2014b, 2014c

Red Knot (*Calidris canutus rufa*). The FWS published a final rule to list the red knot as threatened throughout its range on December 11, 2014 (Volume 79 of the *Federal Register* (FR), page 73706). The FWS (2014d) expects to issue a proposal to designate critical habitat for the red knot in 2015. Loss of breeding and nonbreeding habitat, reduced prey availability, and increasing frequency and severity of asynchronies in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions are factors that have contributed to the decline of this species. Unless otherwise cited, the information in this section is derived from the FWS's listing document (79 FR 73706).

The red knot is a medium-sized (9 to 11 in. (23 to 28 cm) in length) shorebird. It migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeastern United States, Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego off the coast of the southern tip of South America. Between both its spring and fall migrations, the red knot uses key staging and stopover areas to rest and feed.

Red knots live up to 7 years (Niles et al. 2008) and likely begin breeding at 2 years (Harrington 2001). The species breeds in June in inland areas near arctic coasts and nests in dry, slightly elevated tundra areas. Breeding success can vary dramatically from year to year based on weather, food availability (insects and other terrestrial invertebrates), and abundance of predators (the arctic lemmings *Dicrostonyx torquatus* and *Lemmus sibericus*). Little information is available on mating fidelity, but the species is known to return to the same breeding grounds each year, and pairs seem to form monogamous bonds throughout the breeding season (Niles et al. 2008). Females lay one clutch of three to four eggs per season. Males and females participate in egg incubation, which lasts for approximately 22 days (Niles et al. 2008). Chicks are born in early July, and the fledgling period lasts 18 days (Niles et al. 2008).

Red knots migrate up to 19,000 mi (30,000 km)—one of the longest migrations known in the animal kingdom—each year, and individuals can undertake flights of several thousand miles without stopping. Stopover habitat most often includes muddy or sandy coastal areas near mouths of bays and estuaries (Niles et al. 2008). In the spring, stopover areas include the Atlantic coast of Argentina, eastern and northern Brazil, the Virginia barrier islands, and the Delaware Bay. Important fall stopover sites include southwest Hudson Bay, James Bay, the St. Lawrence River, the Mingan Archipelago in Canada, the Bay of Fundy, the coasts of Massachusetts and New Jersey, the mouth of the Altamaha River in Georgia, the Caribbean, and the northern coast of South America from Brazil to Guyana. During both migrations, red knots may stopover along the coast of the Great Lakes. During migration, red knots eat bivalves, gastropods, amphipods, and occasionally polychaetes (Niles et al. 2008).

Occasional observations of red knots have been recorded within the 6-mi (10-km) vicinity surrounding the Fermi site, including at Estral Beach, Sterling State Park, and Pointe Mouillee State Game Area (eBird 2014). DTE's contractor, Kogge, conducted a field survey for the red knot on September 3, 2014, and September 4, 2014, which consisted of visual searches for the presence of this species and its preferred or suitable habitat. The focus of the visual surveys occurred on the coastal shoreline and wetland areas adjacent to the existing Fermi 2 facilities and undeveloped shoreline areas along the Lake Erie coastline of the Fermi site. Kogge (2014) did not observe this species or optimal feeding or overwintering habitats, such as areas with horseshoe crabs or other preferred foods. However, Kogge (2014) concluded that the coastal areas on the Fermi site could provide suitable resting or foraging habitat for the red knot. The last time that DTE recorded an observation of this species on the Fermi site was in 1973 (NUS 1974, DTE 2015). Thus, shoreline within the Fermi site may provide suitable habitat for migrating red knots that stop to rest or feed, but the occurrence of this species within the action area would be occasional or rare.

Piping Plover (*Charadrius melodus*)—Great Lakes Watershed Population. The FWS listed the Great Lakes watershed population of piping plover as endangered in 1985 (50 FR 50726). The species occurs through much of the Northern Great Plains, Great Lakes region, Atlantic coast, and Gulf Coast region. Miller et al. (2009) conducted a recent study of the taxonomy of the species and confirmed the genetic uniqueness of only two subspecies—Atlantic (*C.m. melodus*) and Interior (*C.m. circumcinctus*), although the FWS (2009a) recognizes three distinct population segments in its ESA rulemakings—the Atlantic Coast, the Great Lakes, and the Northern Great Plains populations. The Atlantic Coast population is *C.m. melodus*, while the Great Lakes and Northern Great Plains populations are *C.m. circumcinctus*.

Piping plovers inhabit open, sandy, sparsely vegetated beaches and barrier islands along the Great Lakes' shorelines. They avoid high bluffs or areas where the beach has been severely eroded. Historically, the Great Lakes watershed population bred throughout the Great Lakes' shorelines within eight states, including Michigan, and Ontario. Currently, breeding is restricted to several beaches along Lake Superior and Lake Michigan in northern Michigan. The population winters along the Gulf coasts of Texas, Louisiana, Alabama, and Florida (Haig 1992).

Piping plovers have not nested on Lake Erie since 1942 (ODNR 2014). Suitable breeding habitat for plovers occurs along Lake Erie in Ohio and Ontario (FWS 2003). The MNFI did not contain any records of piping plovers within Monroe County (MNFI 2007a). Occasional observations of piping plovers have been recorded within the vicinity surrounding the Fermi site, including in Sterling State Park and Pointe Mouillee State Game Area (eBird 2014). At the Fermi site, Black & Veatch, DTE's contractor, observed several transient piping plovers on the sandy beach south of the Fermi 2 intake in July 2008 (Black & Veatch 2009a). DTE (2014d) reported that no piping plovers have been observed on site since 2008. Most recently, Kogge and Heslinga (2013), another DTE contractor, conducted surveys in 2013 and did not observe piping plovers nor did they find suitable nesting habitat onsite. Thus, DTE (2014d) finds that the shoreline within the Fermi site may provide marginal habitat for migrating piping plovers that stop to rest or feed, but the occurrence of this species within the action area would be rare.

The FWS designated critical habitat for the Great Lakes breeding population in May 2001 (66 FR 22938). However, designated critical habitat does not occur within the action area.

Northern Long-Eared Bat (*Myotis septentrionalis*). The FWS published a final rule to list the northern long-eared bat as threatened throughout its range on April 2, 2015 (80 FR 17973). The FWS did not propose to designate critical habitat for the species because it found that such habitat is "not determinable at this time" (80 FR 17973). White-nose syndrome, wind energy development, and loss of habitat specifically linked to surface coal mining in prime summer habitat are factors that have contributed to the decline of this species. White-nose syndrome was first confirmed in Michigan in the winter of 2014 through 2015 (80 FR 17973).

The northern long-eared bat is a medium-sized bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. This bat inhabits 39 states in the eastern and north central United States and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia. Populations are typically composed of small numbers and tend to be patchily distributed across the species' range. More than 780 winter hibernacula have been recorded in the United States (94 in Michigan), most of which contain only a few (one to three) individuals. The FWS recognizes four U.S. populations. Northern long-eared bats inhabiting Michigan are considered part of the Midwest population (78 FR 61046; 80 FR 17973).

In the Midwest, the northern long-eared bat is fairly common during summer mist-net surveys and is found infrequently in winter hibernacula surveys (80 FR 17973). In summer, bats roost alone or in small colonies under the bark of live or dead trees; in caves or mines; or in manmade structures, such as barns, sheds, and other buildings. The species opportunistically roosts in a variety of trees, including several species of oak, maple, beech, and pine (80 FR 17973). In southern Michigan, northern long-eared bats use cavities within roost trees, living trees, and roosts with greater canopy cover more often than does the Indiana bat, which occurs in the same area (Foster and Kurta 1999). Northern long-eared bats forage both in flight and on the ground and eat a variety of moths, flies, leafhoppers, caddisflies, and beetles. The species breeds from late July to early October, after which time it will migrate to winter hibernacula. Northern long-eared bats are short-distance migrators and will travel 35 to 55 mi (56 to 89 km) from summer roosts to winter hibernacula (80 FR 17973). Hibernating females store sperm until spring and give birth to one pup approximately 60 days after fertilization (80 FR 17973). Females raise young in maternity colonies of up to 30 individuals (80 FR 17973).

In Michigan, the northern long-eared bat is known to occur within 36 counties, including Monroe County. The northern long-eared bat is most common in the northern Lower Peninsula and portions of the Upper Peninsula. Similarly, the majority of hibernacula in Michigan are in the far northern and western Upper Peninsula. Therefore, few bats occur in the southern half of the Lower Peninsula during the summer because of the long distance to hibernacula in the northern portion of the State. The few bats that spend summer in the southern half of the Lower Peninsula may hibernate during the winter in caves or mines in neighboring States (80 FR 17973).

DTE's contractor, Kogge (2014), conducted a field survey for the northern long-eared bat on September 3, 2014, and September 4, 2014, which consisted of visual searches for the presence of this species and its preferred or suitable habitat. Kogge (2014) analyzed the suitability of individual trees and woodland areas by following the protocols set forth by the FWS guidelines for northern long-eared bat (FWS 2014e) and previous bat surveys on the Fermi site (Black & Veatch 2009a). These protocols included methods for measuring the tree's DBH and assessing overhead canopy cover, understory density, and proximity to flowing or standing water. Kogge (2014) did not observe this species during the surveys, but the NRC staff notes that the surveys occurred at a time when northern long-eared bats are migrating north to winter hibernacula (FWS 2014e). Kogge (2014) determined that the site provides potential roosting and foraging habitat for the northern long-eared bat. For example, woodlots and several individual trees could provide suitable roosting habitat due to the presence of trees with a DBH of greater than 3 in. (8 cm) and with exfoliating, peeling, or scaling bark. This species has not been observed on or near the Fermi site since wildlife studies began in 1973 (NUS 1974; Black & Veatch 2009a; DECo 2011b; NRC 2013a; Kogge and Heslinga 2013; Kogge 2014; DTE 2014d, 2014g). However, DTE has not conducted onsite mist-net surveys for northern long-eared bats that follow protocols recommended by the FWS.

Indiana Bat (*Myotis sodalis*). The FWS listed the Indiana bat as endangered in 1967 (32 FR 4001). The FWS designated critical habitat for the Indiana bat in 1976 (41 FR 41914) to include 11 caves and 2 mines in 6 states, none of which are located in Michigan.

The Indiana bat is an insectivorous, migratory bat that inhabits the central portion of the Eastern United States and hibernates colonially in caves and mines. The decline of Indiana bats is attributed to urban expansion, habitat loss and degradation, human-caused disturbance of caves or mines, insecticide poisoning, and white-nose syndrome (FWS 2011; Pruitt and TeWinkel 2007).

During summer months, reproductive female bats tend to roost in colonies under slabs of peeling tree bark or cracks within trees in forest fragments, often near agricultural areas (Pruitt and TeWinkel 2007). Colonies may also inhabit closed-canopy, bottomland deciduous forest; riparian habitats; wooded wetlands and floodplains; and upland communities (Pruitt and TeWinkel 2007). Maternity colonies typically consist of 60 to 80 adult females (Whitaker and Brack 2002). Colonies occupy multiple trees for roosting and rearing young (Watrous et al. 2006), and once these colonies are established, the Indiana bats usually return to the same areas each year (Pruitt and TeWinkel 2007). Nonreproductive females and males do not roost in colonies during the summer; they may remain near the hibernacula or migrate to summer habitat (Pruitt and TeWinkel 2007). High-quality summer habitat includes mature forest stands containing open subcanopies, multiple moderate- to high-quality snags, and trees with exfoliating bark (Farmer et al. 2002). In summer, bats forage for insects along forest edges, riparian areas, and in semi-open forested habitats. In the winter, Indiana bats rely on caves for hibernation. The species prefers hibernacula in areas with karst (limestone, dolomite, and gypsum), although it may also use other cave-like locations, such as mines.

The FWS's Indiana bat recovery plan (Pruitt and TeWinkel 2007) indicates that one winter hibernaculum occurs within Michigan, approximately 200 mi (322 km) from the Fermi site. Additionally, 11 extant maternity colonies occur in Michigan. None of these records identify Monroe County as containing hibernacula or maternity colonies. For 2007, the FWS (2009b) estimated that Michigan's total population of Indiana bats was 20 individuals. According to more recent estimates based on FWS winter surveys conducted in January and February 2013, the Michigan population of Indiana bats remained the same with 20 individuals (King 2013).

The Fermi site could provide habitat for the Indiana bat. Although portions of the Fermi site are forested, large live trees with loose bark that would provide roosting habitat for the Indiana bat are not common there. The death of many green ash (*Fraxinus pennsylvanica*) trees in the action area caused by the emerald ash borer (*Agrilus planipennis*) has made some dead tree suitable for summer roosting habitat.

On August 2, 2011, DTE's contractor, Black & Veatch (2011) conducted a field visit to the Fermi site to look for potential roost trees for Indiana bats within areas that would be affected by building the proposed Fermi 3 facilities. Black & Veatch evaluated potential roost trees as low, moderate, or high potential based on criteria drawn from the FWS's Indiana bat recovery plan (Pruitt and TeWinkel 2007). Black & Veatch (2011) determined that six trees were potentially suitable for summer roosts by the Indiana bat, including one tree that was considered high potential for roosting. The study indicated that most trees in the area were either too small or otherwise unsuitable for Indiana bat summer roosts (Black & Veatch 2011). In addition, other habitat features usually preferred by Indiana bat were generally lacking at the Fermi site (Black & Veatch 2011).

The MNFI (2007b) does not include any reported occurrences of the Indiana bat in Monroe County, although this species has been observed in counties north and west of the Fermi site. This species has not been observed on or near the Fermi site since wildlife studies began in 1973 (NUS 1974; Black & Veatch 2009a; Black & Veatch 2011; DECo 2011b; NRC 2013a; Kogge and Heslinga 2013; DTE 2014d). However, the NRC staff notes that DTE has not conducted onsite mist-net surveys for Indiana bats that follow FWS protocols.

<u>Karner blue butterfly (*Lycaeides melissa samuelis*).</u> The FWS listed the Karner blue butterfly as endangered in 1992 (57 FR 59236). No critical habitat has been designated for this species.

The Karner blue butterfly is a small silvery butterfly with a 0.9- to 1.3-in. (2.2- to 2.3-cm) wingspan. These butterflies typically occur with landscapes composed of sandy soils, which supported oak or oak-pine savanna or barrens before European settlement. Given that its historical habitat suffers from fire suppression efforts, the butterfly often occurs in openings, old fields, and utility right of ways (ROWs) surrounded by close-canopied oak forest. Karner blue larvae feed exclusively on wild lupine (*Lupinus perennis*), but adults visit a wide variety of flowering plants for nectar (MNFI 2007c).

MNFI surveys (MDNR 2015) have not recorded the occurrence of any Karner blue butterflies in Monroe County within the past 5 years. The most recent observations of a Karner blue butterfly in Monroe County occurred in 2008 and 1986 (MNFI 2007c; NRC 2013a). This species has not been observed on site since wildlife studies began in 1973 (Black & Veatch 2009a; DECo 2011b; DTE 2014d; Kogge and Heslinga 2013; NRC 2013a; NUS 1974).

During interactions with the FWS and the MDNR for the proposed construction and operation of Fermi, Unit 3, the MDNR and the FWS concluded that Karner blue butterflies are not likely to occur on the Fermi site (NRC 2013a). As described above, DTE and its contractors have conducted several terrestrial ecology surveys on site. Based on these surveys (DECo 2009, 2011b), the NRC staff concludes that suitable habitat for this species, which consists of dry forest openings with wild lupine, does not exist on the Fermi site or in the immediate vicinity. Given that this species has not been observed on site and that no suitable habitat occurs within the action area, the NRC staff concludes that the Karner blue butterfly is unlikely to occur within the action area.

<u>Eastern Prairie Fringed Orchid (*Platanthera leucophaea*).</u> The FWS listed the eastern prairie fringed orchid as threatened in 1989 (54 FR 39857). No critical habitat has been designated for this species.

The eastern prairie fringed orchid is a perennial herb that grows 8 to 40 in. (20 to 102 cm) tall and produces long clusters of up to 40 white flowers in early July (NatureServe 2014). It inhabits mesic prairie, wetlands, sedge meadows, marsh edges, and bogs with full sun and little to no woody encroachments (FWS 2013). These orchids require hawkmoths (family *Sphingidae*) for successful pollination, and seedling establishment requires a mycorrhizal relationship with soil fungus (Bowles 1999). Eastern prairie fringed orchids occur in the Eastern United States and Great Lakes States and in Nova Scotia and Ontario, Canada.

The eastern prairie fringed orchid historically occurred within 21 counties in Michigan (Case 1987). Today, about 12 populations are thought to exist within nine counties mostly in southeastern lower Michigan. A cluster of these flowers occurs on degraded prairie and wetland habitat bordering western Lake Erie. The total number of flowering plants contained in this cluster has fluctuated from an estimated 900 plants in 1984 (Chapman and Crispin 1985) to an estimated 314 plants in 1990 (Case and Case 1990).

The most recent observations of eastern prairie fringed orchid in Monroe County occurred in 2006 (MNFI 2007d). This species has not been observed on or near the Fermi site in any onsite vegetation study since 1973 (NUS 1974; Black & Veatch 2009b; DECo 2011b; NRC 2013a; Kogge and Heslinga 2013; DTE 2014d). In the NRC staff's review of the proposed construction and operation of Fermi 3, the NRC staff concluded that this species could occur on the site because the plant is known to occur in lakeplain prairies around western Lake Erie (NRC 2013a). The NRC (2013a) noted that, although emergent wetlands exist on the Fermi site, large portions of these emergent wetlands have been severely degraded by the common reed, an invasive plant.

<u>Northern Riffleshell (*Epioblasma torulosa rangiana*).</u> The FWS listed the northern riffleshell as endangered in 1993 (58 FR 5638). No critical habitat has been designated for this species.

The northern riffleshell is a freshwater unionid mussel. The habitat for the northern riffleshell is fine to coarse gravel in riffles and runs of streams with swift currents (MNFI 2007e). The northern riffleshell holds larvae over the winter and releases glochidia in the spring (Carman and Goforth 2000a). In the laboratory, glochidia developed with brown trout (*Salmo trutta*), bluebreast darter (*Etheostoma camurum*), banded darter (*Etheostoma zonale*), and banded sculpin (*Cottus carolinae*) as hosts; however, these fish species do not occur in the areas of Michigan that could harbor northern riffleshell populations, suggesting that there are also other hosts (Carman and Goforth 2000a). The age at maturity for northern riffleshell is not known, but this species may reach 15 years of age (Carman and Goforth 2000a). Like all freshwater mussels, the northern riffleshell is a filter feeder.

The historic range for the northern riffleshell includes Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, West Virginia, and western Ontario (Carman and Goforth 2000a). It was once widespread in the Ohio and Maumee River Basins and in tributaries of western Lake Erie (Carman and Goforth 2000a). In Michigan, the northern riffleshell is known to currently occur only in the Black River in Sanilac County and the Detroit River in Wayne County (Carman and Goforth 2000a). More than 100 individuals from the Detroit River population were relocated to the St. Clair River in 1992 as part of an effort to establish a new population, but the success of that effort is not known (Carman and Goforth 2000a).

The survival of this species depends on the protection and preservation of suitable habitat and host fish species. The MNFI includes two recorded observations of this species in Monroe

County, the most recent of which was in 1977 (MNFI 2007e). This species has not been observed on or near the Fermi site in any aquatic study conducted on the site (AECOM 2009; DECo 2011b; NRC 2013a; DTE 2014d). Streams with conditions suitable for the northern riffleshell are not present on the Fermi site (NRC 2013a). Therefore, no suitable habitat occurs within the Fermi site or adjacent waters on Lake Erie. Given that the MNFI most recently observed this species in Monroe County in 1977, that the species has never been observed on or near the Fermi site, and that no suitable habitat occurs within the action area, the NRC staff concludes that the northern riffleshell is unlikely to occur within the action area.

Snuffbox (*Epioblasma triquetra*). Snuffbox is a freshwater mussel belonging to the family *Unionidae* that the FWS designated as endangered through its range in 2012 (77 FR 8632). No critical habitat has been designated for this species. Unless otherwise cited, information for the present summary is from the FWS's listing document (77 FR 8632).

Adults are small- to medium-sized mussels; males attain lengths up to 7.0 cm (2.8 in.), and females attain lengths up to 4.5 cm (1.8 in.). The shells are somewhat triangular in females and oblong or ovate in males, with the anterior of the shell being rounded and the posterior truncated. The shells are solid and thick and typically smooth and yellowish or yellowish-green in young individuals and become darker with age. Snuffbox reproductive and maximum ages are unknown, but unionids are generally long-lived, and maximum ages can exceed that of humans. The adults are suspension feeders that consume algae, bacteria, microscopic animals, and detritus. They may also deposit-feed on particles in the sediment.

Snuffbox has separate male and female individuals. Like other unionids, snuffbox has an unusual life cycle, although all the details are not known for snuffbox. After fertilization, the eggs live in special gill chambers of the females and develop into microscopic larvae called glochidia. Females may brood the glochidia from September to May. When the glochidia are ready, female snuffbox move to the surface and may attract host fish, whereupon the female expels the glochidia, which then must attach to the host fish's gills or fins to complete development by enclosing themselves in a cyst (encysting). They drop off the host fish as newly transformed juveniles.

Different unionid species require different host fish. In the laboratory, juvenile snuffbox have successfully transformed on logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter (*Etheostoma caeruleum*), Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceous*), mottled sculpin (*Cottus bairdii*), banded sculpin, Ozark sculpin (*C. hypselurus*), largemouth bass (*Micropterus salmoides*), and brook stickleback (*Culaea inconstans*).

The snuffbox was once widespread and occurred in 210 lakes and streams in 18 states and one Canadian province. The historic range of the snuffbox mussel extended from Ontario southward to Mississippi and Alabama and eastward to New York and Virginia; extant populations are still present in Wisconsin, Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, Tennessee, and West Virginia (NatureServe 2009). In Michigan, this species is found primarily in eastern and southeastern rivers, including Otter Creek in Monroe County and the Detroit River in Wayne County (Carman and Goforth 2000b). The snuffbox mussel primarily inhabits small- and medium-sized rivers, although specimens have also been collected from Lake Erie and large rivers, such as the St. Clair River. Preferred habitat usually has clear water and a sand, gravel, or cobble substrate with a swift current; individuals are often buried deep in the sediment (Carman and Goforth 2000b).

The MNFI includes three recorded observations of this species in Monroe County, the most recent of which was in 1933 (MNFI 2007f). This species has not been observed on or near the Fermi site in any aquatic study conducted on the site (AECOM 2009; DECo 2011b; NRC 2013a;

DTE 2014d). Streams with conditions suitable for the snuffbox mussel are not present on the Fermi site, although shoreline areas of Lake Erie near the site possibly could contain suitable substrates (NRC 2013a). Given that the MNFI most recently observed this species in Monroe County in 1933 and that the species has never been observed on or near the Fermi site, the NRC staff concludes that the snuffbox is unlikely to occur within the action area.

Rayed Bean (*Villosa fabalis*). The rayed bean is a freshwater unionid mussel that was Federally listed as endangered in 2012 (77 FR 8632). No critical habitat has been designated for this species.

The rayed bean reportedly holds glochidia internally over the winter for release in the spring; female rayed beans bearing eggs have been found in May (Carman 2001a). Fish hosts for the glochidia could include the Tippecanoe darter (*Etheostoma tippecanoe*), greenside darter (*Etheostoma blennioides*), rainbow darter, mottled sculpin, and largemouth bass (FWS 2002). The limited data available suggest that the lifespan for the rayed bean is less than 20 years (FWS 2002). Like all freshwater mussels, the rayed bean is a filter feeder.

The rayed bean is patchily distributed in the St. Lawrence, Ohio, and Tennessee River drainages (Carman 2001a). Although it was historically widespread from Ontario to Alabama and from Illinois to New York, only a few populations are currently known to exist, and it is assumed to be extirpated throughout much of its former range (Carman 2001a). As of November 2010, extant populations were known from 28 streams in Indiana, Michigan, New York, Ohio, Pennsylvania, West Virginia, and the province of Ontario in Canada. In Michigan, existing rayed bean populations occur in the Black, Pine, Belle, and Clinton River systems.

The rayed bean is generally found in smaller headwater creeks, although it has also been found in larger rivers (FWS 2002). Individuals are usually found in or near shoal or riffle areas; rayed bean specimens were also recorded to occur in shallow, wave-washed areas of Lake Erie, generally associated with islands in the western portion of the lake (FWS 2002). Preferred substrates are gravel and sand, and it is oftentimes found among the roots of vegetation growing in riffles and shoals (FWS 2002).

The MNFI includes six recorded observations of this species in Monroe County, the most recent of which is in 1984 (MNFI 2007g; NRC 2013a). However, these observations were based on the presence of shells rather than live specimens (Carman 2001a). Although there are records of rayed bean shells from shallow, wave-washed areas of western Lake Erie, it is unlikely that the species occurs in the vicinity of the Fermi site for a number of reasons: (1) this species has not been observed on or near the Fermi site in any aquatic study conducted on or adjacent to the site (AECOM 2009; DTE 2010; DECo 2011b; NRC 2013a; DTE 2014d), (2) DTE reviewed approximately 30 years of mussel surveys in the western basin of Lake Erie (including in the vicinity of the Fermi site), none of which identified rayed bean specimens (Napela et al. 1991; Shackelford et al. 2009; DTE 2009, 2010), (3) the USACE conducted mussel surveys in Lake Erie approximately 2 mi (3.2 km) south of the Fermi site and found no live specimens or shells of the rayed bean (Clarke 1980, 1981), (4) observations made by DTE divers during sediment sampling for Fermi 2's REMP program and buoy maintenance indicated that the sediment and other habitat characteristics are not suitable for the rayed bean (DTE 2009, 2010), and (5) no streams occur on the Fermi site with conditions suitable for the rayed bean (NRC 2013a). Given that the MNFI most recently observed this species in Monroe County in 1984, that it has never been observed on or near the Fermi site, and that no suitable habitat occurs within the action area, the NRC staff concludes that the rayed bean is unlikely to occur within the action area.

3.8.1.3 Species and Habitats under the NMFS's Jurisdiction

As discussed in Section 3.7, Lake Erie does not contain marine or anadromous fish species. Therefore, no Federally listed species or habitats under the NMFS's jurisdiction occur within the action area.

3.8.2 Species and Habitats Protected under the Magnuson–Stevens Act

The NMFS has not designated essential fish habitat in Lake Erie. Therefore, this section does not contain a discussion of any species or habitats protected under the MSA.

3.9 Historic and Cultural Resources

This section discusses the cultural background and the known historic and cultural resources found on and in the vicinity of Fermi 2. The discussion is based on a review of historic and cultural resource surveys and other background information on the region surrounding Fermi 2. In addition, a records search was performed through the Michigan State Historic Preservation Office (SHPO) to obtain the most up-to-date information about historic and cultural resources in the region.

The area of potential effect is the area at the Fermi site, the transmission lines up to the first substation, and the immediate environs that may be affected by the license renewal decision and land-disturbing activities associated with continued reactor operations. For this analysis, the first substation (the 345-kV Fermi switchyard) is located on the Fermi site (DTE 2014d). The area of potential effect may extend beyond the immediate environs in instances where land-disturbing maintenance and operations activities during the license renewal term or refurbishment activities could potentially have an effect (Figure 3–3).

3.9.1 Cultural Background

Human occupation in the vicinity of the Fermi site is generally characterized according to the following chronological sequence (MI SHPO undated):

- Paleo-Indian Period (12,000–10,000 years before present (BP)),
- Archaic Period (10,000–2,500 BP),
- Woodland Period (2,500–400 BP (ca. A.D. 1600)), and
- Historical Period (400 BP–Present (ca. A.D. 1600 to present)).

Fermi 2 and the surrounding region show evidence of both prehistoric and historic occupation and/or settlement by Native Americans and Euroamericans that has continued through to the present. Archaeological records suggest that the area has had the potential for occupation from the Paleo-Indian Period, the Archaic Period, and the Woodland Period (NRC 2013a).

<u>Paleo-Indian Period (12,000–10,000 BP)</u>

The earliest evidence of people living in Michigan dates to the Paleo-Indian Period. Paleo-Indian sites are generally found upland or on river terraces and are characterized by specific types of projectile points (i.e., fluted Clovis and Folsom points) and stone tools, such as gravers, scrapers, or large blades. These artifacts often occur in association with mastodon remains, suggesting a reliance on megafauna (e.g., mammoth, ground sloth, and saber-toothed tiger) for subsistence, along with plants, small game, birds, and amphibians. Social organization consisted of small, highly nomadic bands of hunter-gatherers, leaving Paleo-Indian sites with little detailed archaeological information (Neusius and Gross 2007). Evidence of

Paleo-Indian sites is sparse in southeast Michigan and in the immediate vicinity of the Fermi site (DTE 2014d).

Archaic Period (10,000–2,500 BP)

The Archaic Period was a time of major climatic shifts as colder environments transitioned to warmer environments similar to modern conditions. In response to this shift, new technologies and subsistence strategies were developed during this time. The Archaic Period is often divided into early, middle, and late subperiods. The Early Archaic Period is characterized by a shift from nomadic to sedentary settlement patterns, with central base camps located on river terraces and smaller hunting camps located in upland areas. This subperiod also shows an increased reliance on wild plant foods, small game, and aquatic resources. The Middle Archaic Period is characterized by an increased number of settlement sites on high stream terraces, which may reflect population increases. Although subsistence and settlement patterns remained fairly similar to the Early Archaic Period, artifact assemblages suggest increased exploitation of aquatic resources and new artifacts, such as pecked and ground stone tools used for intensive processing of nuts, banner stones that signaled the innovation of a new projectile technology called the atlatl or spear-thrower, and grooved axes. The Late Archaic Period is characterized by an increase in the number and size of settlement sites, which indicates an increase in population and a more sedentary lifestyle. New features of Late Archaic artifact assemblages, such as crude ceramic vessels, represent a shift toward increased reliance on horticulture as a subsistence strategy, although hunting and gathering would have continued (Fagan 2005; Neusius and Gross 2007).

Woodland Period (2,500–400 BP)

The Woodland Period is also often divided into early, middle, and late periods. However, the distinction between the early and middle period is not fixed. The Woodland Period is marked by an increase in more permanent settlements; changes in burial practices; increased cultivation of plants, such as sunflowers and cucurbits (e.g., squashes, gourds, and melons); and a rise in the manufacture and use of pottery (Fagan 2005). During the Middle Woodland Period, the large and complex Hopewell Culture emerged in the northeastern and midwestern United States. This culture is characterized by settlement in villages, increased reliance on intensive horticulture, burial mounds, and long-distance trade networks. These long-distance networks allowed the trade of exotic materials from far outside their immediate locations, such as marine shells from the Gulf Coast, obsidian from the Rocky Mountains, copper from Lake Superior, and mica from the Appalachian Mountains. The burial mounds of this period often included central features, lined with logs, and filled with grave goods (Neusius and Gross 2007). The Middle Woodland period in Michigan is characterized as exhibiting a definite Hopewell cultural influence in terms of its ceramic styles and elaborate burial procedures (DTE 2014d). The Late Woodland Period is characterized by an increase in settlement sites, which suggests a rise in population and/or a change in settlement patterns from large, centralized village sites to smaller, dispersed habitation sites. Late Woodland Period artifact assemblages are characterized by an increase in thin-walled plain ceramic types and stemmed and side-notched projectile points. The sudden appearance of very small, thin triangular projectile points between 1,300 and 1,400 BP indicates the invention of bow and arrow technology and suggests a corresponding change in hunting techniques (Fagan 2005).

Historical Period (A.D. 1600–Present)

The end of the Woodland Period is characterized by severe social, political, and demographic changes that resulted from indirect and direct contact with Europeans. In particular, it is believed that the introduction of European infectious diseases, such as smallpox, yellow fever, typhoid, and influenza, severely decimated Native American populations, which had no immunity to these diseases. The spread of these diseases, which were fatal to large numbers of Native Americans, resulted in the widespread abandonment of villages and a concurrent collapse of Native American socioeconomic networks (Fagan 2005). Native American groups that lived in the region of the Fermi site at the time of contact with early European explorers and settlers were identified from historic written accounts, which indicated that these contact-period Native American groups were associated with the Erie, an Iroquoian group, and with the Wendat/Huron, Ottawa, Miami, and allied Fox and Mascouten, which are all Algonquian groups (NRC 2013a).

According to the Michigan Department of Human Services (MDHS) and the U.S. Bureau of Indian Affairs, there are currently 12 Federally recognized tribes in the State of Michigan, all primarily associated with the Chippewa, Ottawa, and Potawatomi. None of these 12 Federally recognized tribes are currently located within the Fermi 2 region or its surrounding region in southeastern Michigan (MDHS 2015, undated). However, the closest of these 12 Federally recognized tribes are three groups of Potawatomi Indians in southwestern Michigan and one group of Chippewa Indians in central Michigan: the Nottawaseppi Huron Band of Potawatomi Indians in Calhoun County, the Pokagon Band of Potawatomi Indians in Cass County, the Gun Lake Potawatomi Tribe (also known as the Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan) in Allegan County, and the Saginaw Chippewa Indian Tribe on the Isabella Indian Reservation in Isabella County (NRC 2013a).

The National Park Service's (NPS) Native American Consultation Database, developed as part of NPS's national program for compliance with the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.), identified three Federally recognized Indian tribes with judicially established land claims within Monroe County, Michigan. One is the Hannahville Indian Community in Menominee County (northern Michigan). The other two are outside the State of Michigan: the Forest County Potawatomi Community in Forest County, Wisconsin (northeastern Wisconsin), and the Ottawa Tribe of Oklahoma in Ottawa County, Oklahoma (northeastern Oklahoma). Because judicially established land claims are based on proven ancestral or historic ties to lands, these three Federally recognized Indian tribes may also have been prehistorically or historically associated with the Fermi 2 property or its surrounding region (NRC 2013a).

The regional historic cultural background begins with European exploration and settlement by the French in the 17th century, followed by British control of the area in the mid- to late-18th century. After the War of 1812, the region came under American control and was reorganized into counties, including the establishment of Monroe County and the Village of Monroe in 1817. With the opening of a Federal Land Office in the area in 1824, increasing settlement occurred in the region through the remainder of the 19th century. However, because the Fermi site was historically a wetland environment, little settlement occurred in the area in the 19th century, although the shoreline areas were used for commercial fishing purposes and upland areas were used for vineyards and silica sand mining. The local commercial fishing industry was replaced in the early 20th century by the development of summer cottage communities and resorts northeast and southwest of the Fermi site along the Lake Erie shoreline. In the mid-20th century, these seasonal communities subsequently transitioned into year-round communities that are still occupied today (NRC 2013a).

3.9.2 Historic and Cultural Resources

Historic and cultural resources include prehistoric era and historic era archaeological sites; historic districts; buildings; and any site, structure, or object that may be considered eligible for listing on the National Register of Historic Places (NRHP). Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture. "Historic property" is the legal term for a historic and/or cultural resource that is eligible for listing on the NRHP.

A review of databases maintained by the NPS indicates that there are 12 historic properties listed on the NRHP within Monroe County and that none of these historic properties are located at the Fermi site (NPS 2015a, 2015b). These historic properties consist of historic buildings, structures, and districts dating from the mid-18th through mid-20th centuries. Located approximately 7 mi (11 km) southwest of Fermi is the River Raisin Battlefield Site, a component of the River Raisin National Battlefield Park, which commemorates two key battles fought during the War of 1812 (NPS 2015c; DTE 2014d). There are no National Historic Landmarks located within Monroe County (NPS 2015d).

The NRHP-eligible Enrico Fermi Atomic Power Plant Unit 1 (Fermi 1) is located adjacent to Fermi 2 (DTE 2014d, 2014g). Fermi 1 was the Nation's first commercial liquid-metal-cooled fast breeder reactor and, for a time, was the world's largest reactor of this type. Construction of Fermi 1 began in 1956, and initial criticality was achieved in 1963. Fermi 1 operated until 1972, and it was permanently shut down in 1975 (Kuranda et al. 2009). In 2012, NRC entered into a Memorandum of Agreement with the Michigan SHPO regarding mitigation measures to take into account with regard to the proposed demolition of Fermi 1 (NRC 2012; DTE 2014g). The Joseph Fix Farmstead, located approximately 0.5 mi (0.8 km) northwest of the Fermi property boundary, is the nearest offsite NRHP-eligible property. A 2012 windshield survey identified this site to be the only offsite historic property to have the Fermi 2 cooling towers within its viewshed (DTE 2014d).

As described in DTE's ER (DTE 2014d), several cultural resource investigations have been conducted at the Fermi site and nearby areas. Much of the land involving Fermi 2 was previously disturbed by the construction of Fermi 1. No surveys were conducted at the Fermi site before the construction of Fermi 1. Subsequent cultural resource investigations for Fermi 2 noted that there were no known historical or archeological resources on the Fermi site. A more comprehensive series of cultural resource surveys (including literature reviews, pedestrian surveys, and shovel tests) were conducted from 2007 to 2010 in support of the Fermi 3 COL application. These surveys focused on historic sites within a 10-mi (16-km) radius of Fermi and on archeological sites located within a 1.5-mi (2.4-km) radius (NRC 2013a). In 2012, additional file searches and archeological field surveys were conducted on the Fermi site in association with the Fermi 2 license renewal effort (DTE 2014d, 2014g).

Based on these surveys, a total of 17 historic and archaeological sites have been identified at the Fermi site. Table 3–24 lists these sites. One of these, Fermi 1, is a NRHP-eligible site. The other archaeological sites have either been determined by the Michigan SHPO as ineligible or have been recommended not eligible for listing on the NRHP. The location of Site 20MR207 is based entirely on literature sources that have never been verified in the field. The reported site area was revisited during 2012 field investigations and was found to be visibly eroded, and no evidence of the site was found. Therefore, the site (at its reported location) is recommended not eligible for listing on the NRHP (DTE 2014d; OSA 2014). A search of the Michigan Archaeological Site Files conducted in 2014 by the Michigan SHPO updated the status of these 17 cultural resources.

Table 3–24. Cultural Resources Located within the Fermi Site

Site	On Fermi Site	Description	NRHP Status
Enrico Fermi Atomic Power Plant (Fermi 1)	Yes	Decommissioned Nuclear Power Plant	Eligible
20MR207	Yes	Prehistoric/historic literature reference	Recommended not eligible
20MR702	Yes	Prehistoric/lithic scatter on beach; presumed destroyed	Not eligible
20MR818	Yes	Prehistoric/isolated flake; early 20th century/artifact scatter	Not eligible
20MR819	Yes	Prehistoric/isolated flake	Not eligible
20MR820	Yes	Prehistoric/isolated flake	Not eligible
20MR821	Yes	Prehistoric/isolated flake	Not eligible
20MR822	Yes	Prehistoric/isolated flake	Not eligible
20MR823	Yes	20th century/building foundation, concrete pad, box cistern, and artifact scatter	Not eligible
20MR825	Yes	20th century/artifact scatter and wooden markers (crosses and possible pet burials)	Not eligible
20MR828	Yes	Late 19th century–early 20th century/structural remains (former foundation)	Not eligible
20MR829	Yes	20th century/structural remains (former foundation), artifact scatter	Not eligible
20MR830	Yes	20th century/structural remains (former foundation), cisterns, and artifact scatter	Not eligible
20MR831	Yes	20th century/structural remains (poured concrete pads) and artifact scatter	Not eligible
20MR832	Yes	20th century/structural remains (former foundation) and artifact scatter	Not eligible
20MR833	Yes	20th century/structural remains (former foundation) and cistern	Not eligible
20MR834	Yes	20th century/structural remains (former foundation and poured concrete pad) and well pipe	Not eligible

Sources: DTE 2014d, 2014g; NRC 2013a; OSA 2014

3.10 Socioeconomics

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Fermi 2. Fermi 2 and the communities that support it can be described as a dynamic socioeconomic system. The communities supply the people, goods, and services required to operate the nuclear power plant. Power plant operations, in turn, supply wages and benefits for people and dollar expenditures for goods and services. The measure of a community's ability to support Fermi 2 operations depends on its ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Power Plant Employment and Expenditures

The socioeconomic region of influence (ROI) is defined by the areas where Fermi 2 employees and their families reside; spend their income; and use their benefits, thus affecting the economic conditions of the region. DTE employs a permanent workforce of approximately 870 employees and 20 long-term contract employees (DTE 2014d). Approximately 78 percent of Fermi 2 employees reside in a two-County area in southern Michigan in Monroe and Wayne Counties. Most of the remaining 22 percent of the workforce are spread among 16 other counties in Michigan and Ohio and in one Canadian province, with numbers ranging from 1 to 9 employees per County (DTE 2014d). Given the residential locations of Fermi 2 employees, the most significant effects of plant operations are likely to occur in Monroe and Wayne Counties. Table 3–25 summarizes the Fermi 2 workforce geographic distribution. Therefore, the focus of the socioeconomic impact analysis in this SEIS is on the impacts of continued Fermi 2 operations on these two Counties, also termed the ROI.

Table 3–25. Fermi 2 Employees Residence by County

County	Number of Employees	Percentage of Total
Michigan		
Lenawee	17	2
Monroe	526	59
Oakland	30	3
Washtenaw	25	3
Wayne	167	19
Ohio		
Lucas	74	8
Wood	15	2
Other counties	35	4
Total	**867**	**100**

Source: DTE 2014d

DTE purchases goods and services to facilitate Fermi 2 operations. Although specialized equipment and services are procured from a wider region, some proportion of the goods and services used in plant operations are acquired from within the ROI. These transactions fuel a portion of the local economy, creating jobs and generating purchases by suppliers.

Refueling outages occur on an 18-month cycle and historically have lasted approximately 42 days on average. During refueling outages, site employment typically increases by an additional 1,400 to 1,500 temporary workers (DTE 2014d). Outage workers are drawn from all regions of the country and Canada; however, the majority would be expected to come from Michigan, Ohio, and other Midwestern states.

3.10.2 Regional Economic Characteristics

This section presents information on employment and income in the Fermi 2 socioeconomic ROI. Monroe County is predominantly rural with agricultural and forested land comprising the majority of the land use in the County. Conversely, Wayne County is predominantly urban with developed land comprising about 80 percent of total land area in the County (USDA 2014c).

3.10.2.1 Employment and Income

From 2010 to 2013, the labor force in the Fermi 2 ROI decreased approximately 2.4 percent to just over 889,000. However, the number of employed persons increased by the same percentage, about 2.4 percent, to approximately 798,000. Consequently, the number of unemployed people in the ROI decreased by nearly 31 percent, by approximately 41,000 persons to over 91,000, or about 10.3 percent of the current workforce, down from 14.6 percent in 2010 (BLS 2014).

According to the U.S. Census Bureau's (USCB's) 2013 American Community Survey estimates, the educational, health, and social services industry represented the largest employment sector in the socioeconomic ROI (23.5 percent) followed by manufacturing (17 percent) and retail (10.5 percent). A list of employment by industry in each County of the ROI is provided in Table 3–26.

Table 3–26. Employment by Industry in the Fermi 2 ROI (2013 Estimates)

Industry	Monroe	Wayne	Total	Percent
Total employed civilian workers	65,527	696,644	762,171	–
Agriculture, forestry, fishing, hunting, and mining	747	2,348	3,095	0.4
Construction	3,257	26,981	30,238	4.0
Manufacturing	14,981	115,587	130,568	17.1
Wholesale Trade	1,260	16,082	17,342	2.3
Retail Trade	6,682	73,640	80,322	10.5
Transportation, warehousing, and utilities	3,844	43,478	47,322	6.2
Information	957	13,897	14,854	1.9
Finance, insurance, real estate, rental, and leasing	2,295	39,082	41,377	5.4
Professional, scientific, management, administrative, and waste management services	4,394	78,914	83,308	10.9
Educational, health, and social services	16,066	163,197	179,263	23.5
Arts, entertainment, recreation, accommodation, and food services	6,529	64,443	70,972	9.3
Other services (except public administration)	2,725	34,323	37,048	4.9
Public administration	1,790	24,672	26,462	3.5

Source: USCB 2014a

Major employers in Monroe County, the County in which Fermi 2 is located, are listed in Table 3–27. Mercy Memorial Hospital is shown as the largest employer in the County.

Table 3–27. Major Employers in Monroe County in 2013

Employer	Number of Employees
Mercy Memorial Hospital	1,738
DECo	1,251
Johnson Controls (Plastech)	815
Dundee Engine Plant	519
Monroe Public Schools	549
Gerdau Specialty Steel	510
La-Z-Boy, Inc.	491
Meijer, Inc.	475
Tenneco, Inc.	456
Monroe Bank and Trust	450

Source: MCFD 2014

Table 3–28 presents the estimated income information for the Fermi 2 ROI. According to the USCB's 2013 American Community Survey estimates, 12.3 percent of families and 17 percent of individuals in Michigan were living below the Federal poverty threshold, and the median household income for Michigan was $48,273 (USCB 2013a). In the socioeconomic ROI, people living in Monroe County had median household and per capita incomes above the State average. The median household income average in Monroe County was $53,561 with 10.4 percent of families and 12.9 percent of individuals living below the poverty level. Conversely, Wayne County had a lower median household income average ($40,487) and a higher percentage of families (19.6 percent) and individuals (24.9 percent) living below the official poverty level (USCB 2014a).

Table 3–28. Estimated Income Information for the Fermi 2 ROI (2013 Estimates)

	Monroe	Wayne	Michigan
Median household income (dollars)[a]	53,561	40,487	48,273
Per capita income (dollars)[a]	26,825	22,538	25,918
Individuals living below the poverty level (percent)	12.9	24.9	17.0
Families living below the poverty level (percent)	10.4	19.6	12.3

[a] In 2012 inflation adjusted dollars.

Source: USCB 2014a

3.10.2.2 Unemployment

According to the USCB's 2013 American Community Survey estimates, the unemployment rates in Monroe County and in the State of Michigan as a whole were both 9.8 percent. Comparatively, the Wayne County unemployment rate during this same time period was 14.8 percent (USCB 2014a).

3.10.3 Demographic Characteristics

According to the 2010 Census, an estimated 434,209 people lived within 20 mi (32 km) of Fermi 2, which equates to a population density of 346 persons per square mile (DTE 2014d).

This translates to a Category 4 "least sparse" population density using the GEIS measure of sparseness (greater than or equal to 120 persons per square mile within 20 mi (32 km). An estimated 5,176,563 people live within 50 mi (80 km) of Fermi 2 with a population density of 659 persons per square mile (DTE 2014d). This translates to a Category 4 density, using the GEIS measure of proximity (greater than or equal to 190 persons per square mile within 50 mi (80 km)). Therefore, Fermi 2 is located in a high population area based on the GEIS sparseness and proximity matrix.

Table 3–29 shows population projections and percent growth from 1970 to 2060 in the two-County Fermi 2 ROI. The population in Monroe County has increased while the population in Wayne County has decreased over the previous two decades (2000 and 2010). Based on forecasts, the population is expected to continue these trends at a moderate to low rate. Population projections for years 2020 and 2040 shown in the table were developed by the SEMCOG.

Table 3–29. Population and Percent Growth in Fermi 2 ROI Counties, 1970–2010, 2013 (Estimated), and Projected for 2020–2060

	Monroe County		Wayne County	
Year	Population	Percent Change	Population	Percent Change
1970	118,479	–	2,666,751	–
1980	134,659	13.7	2,337,891	-12.3
1990	133,600	-0.8	2,111,687	-9.7
2000	145,945	9.2	2,061,162	-2.4
2010	152,021	4.2	1,820,584	-11.7
2013	150,376	-1.1	1,775,273	-2.5
2020	156,592	3.0	1,700,779	-6.6
2030	160,841	2.7	1,664,635	-2.1
2040	164,720	2.4	1,656,931	-0.5
2050	168,846	2.5	1,630,267	-1.6
2060	172,910	2.4	1,608,343	-1.3

Source: Decennial population data for 1970–2010 and estimated for 2013 (USCB 2014b); projections for 2020–2040 by the SEMCOG (SEMCOG 2012); and 2050-2060 calculated.

Table 3–30 presents the 2010 Census demographic profile of the two-County ROI population. According to the 2010 Census, minorities (race and ethnicity combined) comprised 47.1 percent of the total two-County population. The largest minority populations in the ROI were Black or African American (37.3 percent) and Hispanic or Latino (5.1 percent).

Table 3–30. Demographic Profile of the Population in the Fermi 2 ROI in 2010

	Monroe	Wayne	ROI
Total Population	**152,021**	**1,820,584**	**1,972,605**
Race (percent of total population, Not-Hispanic or Latino)			
White	92.5	49.6	52.9
Black or African American	2.1	40.3	37.3

	Monroe	Wayne	ROI
American Indian and Alaska Native	0.3	0.3	0.3
Asian	0.6	2.5	2.4
Native Hawaiian and Other Pacific Islander	0.0	0.0	0.0
Some other race	0.1	0.1	0.1
Two or more races	1.5	2.0	2.0
Ethnicity			
Hispanic or Latino	4,667	95,260	99,927
Percent of total population	3.1	5.2	5.1
Minority population (including Hispanic or Latino ethnicity)			
Total minority population	11,412	918,404	929,816
Percent minority	7.5	50.4	47.1

Source: USCB 2014b

The USCB's 2013 American Community Survey 1-Year Estimates (USCB 2014c) shows that, since 2010, minority populations in the ROI have decreased by approximately 28,600 persons and now comprise 46.8 percent of the ROI population (Table 3–31). The largest decline occurred in the Black or African American population (nearly 38,000 persons since 2010, a decrease of 5.2 percent). This corresponds with the overall decline in regional population (nearly 47,000 persons since 2010, a decrease of 2.4 percent). However, some of this decrease was partially offset by an increase in the Asian population (over 6,700 persons), an increase of over 14.5 percent from 2010. The next largest increase in minority population was Hispanic or Latino, an increase of approximately 3,600 persons or 3.6 percent from 2010 (USCB 2014g).

Table 3–31. Demographic Profile of the Population in the Fermi 2 ROI in 2013

	Monroe	Wayne	ROI
Total Population	**150,376**	**1,775,273**	**1,925,649**
Race (percent of total population, Not-Hispanic or Latino)			
White	91.9	49.9	53.2
Black or African American	2.3	39.1	36.2
American Indian and Alaska Native	0.5	0.3	0.3
Asian	0.6	2.9	2.8
Native Hawaiian and Other Pacific Islander	0.0	0.0	0.0
Some other race	0.1	0.2	0.2
Two or more races	1.3	2.0	2.0
Ethnicity			
Hispanic or Latino	4,981	98,590	103,571
Percent of total population	3.3	5.6	5.4
Minority population (including Hispanic or Latino ethnicity)			
Total minority population	12,112	889,109	901,221
Percent minority	8.1	50.1	46.8

Source: USCB 2014c

3.10.3.1 Transient Population

Within 50 mi (80 km) of Fermi 2, colleges and recreational opportunities attract daily and seasonal visitors who create a demand for temporary housing and services. In 2013, approximately 211,000 students attended colleges and universities within 50 mi (80 km) of Fermi 2 (NCES 2014a).

Based on the USCB's 2011–2013 American Community Survey 3-Year Estimates (USCB 2014d), approximately 34,300 seasonal housing units are located within 50 mi (80 km) of Fermi 2. Of those, 4,409 were located in the Fermi 2 ROI. Table 3–32 presents information about seasonal housing for the counties located all or partly within 50 mi (80 km) of Fermi 2.

Table 3–32. 2013 Estimated Seasonal Housing in Counties Located within 50 mi (80 km) of Fermi 2

County[a]	Total Housing Units	Vacant Housing Units for Seasonal, Recreational, or Occasional Use	Percent
Michigan			
Jackson	69,042	1,464	2.1
Lenawee	43,317	2,643	6.1
Livingston	73,190	2,167	3.0
Macomb	358,565	1,720	0.5
Monroe	***63,077***	***233***	***0.4***
Oakland	529,279	5,052	1.0
St. Clair	71,764	2,445	3.4
Washtenaw	148,202	1,345	0.9
Wayne	***818,113***	***4,176***	***0.5***
County Subtotal	**2,174,549**	**21,245**	**1.0**
Ohio			
Erie	37,669	2,746	7.3
Fulton	17,352	45	0.3
Henry	11,905	20	0.2
Lucas	201,884	920	0.5
Ottawa	27,877	8,679	31.1
Sandusky	26,256	443	1.7
Seneca	23,942	97	0.4
Wood	53,472	99	0.2
County Subtotal	**400,357**	**13,049**	**3.3**
Total	**2,574,906**	**34,294**	**1.3**

[a] Counties within 50 mi (80 km) of Fermi 2 with at least one block group located within the 50-mi (80-km) radius.

Note: ROI Counties are in bold italics.

Source: USCB 2014d

3.10.3.2 Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Others may be permanent residents living near Fermi 2 and travel from farm to farm harvesting crops.

Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these minority and low-income workers would be "underrepresented" in the decennial Census population counts.

In the 2002 Census of Agriculture, farm operators were asked for the first time whether or not they hired migrant workers—defined as farm workers whose employment required travel—to do work that prevented the migrant workers from returning to their permanent place of residence the same day. The Census is conducted every 5 years and results in a comprehensive compilation of agricultural production data for every county in the Nation.

Information about migrant and temporary labor (working less than 150 days) was collected in the 2012 Census of Agriculture. Table 3–33 supplies information about migrant and temporary farm labor within 50 mi (80 km) of Fermi 2. According to the 2012 Census, approximately 11,000 farm workers were hired to work for less than 150 days and were employed on 2,623 farms within 50 mi (80 km) of Fermi 2. The County with the highest number of temporary farm workers (984) on 281 farms was Lenawee County, Michigan (NASS 2014).

Table 3–33. Migrant Farm Workers and Temporary Farm Labor in Counties Located within 50 mi (80 km) of Fermi 2 (2012)

County[(a)]	Number of Farms with Hired Farm Labor[(b)]	Number of Farms Hiring Workers for Less than 150 Days [(b)]	Number of Farm Workers Working for Less than 150 Days[(b)]	Number of Farms Reporting Migrant Farm Labor[(b)]
Michigan				
Jackson	260	209	546	4
Lenawee	376	281	984	8
Livingston	164	131	508	3
Macomb	165	130	934	19
Monroe	***246***	***188***	***934***	***16***
Oakland	210	152	555	7
St. Clair	254	190	522	4
Washtenaw	310	242	937	7
Wayne	***87***	***66***	***577***	***1***
County Subtotal	**2,072**	**1,589**	**6,497**	**69**
Ohio				
Erie	102	65	445	8
Fulton	229	199	637	3
Henry	156	128	480	5
Lucas	113	94	454	6
Ottawa	102	74	811	9
Sandusky	165	133	655	13

County[(a)]	Number of Farms with Hired Farm Labor[(b)]	Number of Farms Hiring Workers for Less than 150 Days [(b)]	Number of Farm Workers Working for Less than 150 Days[(b)]	Number of Farms Reporting Migrant Farm Labor[(b)]
Seneca	225	166	495	4
Wood	240	175	512	6
County Subtotal	**1,332**	**1,034**	**4,489**	**54**
Total	**3,404**	**2,623**	**10,986**	**123**

(a) Counties within 50 mil (80 km)of Fermi 2 with at least one block group located within the 50-mi (80-km) radius.

(b) Table 7: Hired Farm Labor—Workers and Payroll: 2012.

Note: ROI Counties are in bold italics.

Source: 2012 Census of Agriculture—County Data (NASS 2014)

A total of 123 farms in the 50-mi (80-km) radius of the Fermi 2 reported hiring migrant workers in the 2012 Census. Macomb County, Michigan, reported the most farms with migrant farm labor (19 farms) (NASS 2014).

3.10.4 Housing and Community Services

This section presents information on housing and local public services, including education and water supply.

3.10.4.1 Housing

Table 3–34 lists the total number of occupied and vacant housing units, vacancy rates, and median value in the ROI. Based on the USCB's 2013 American Community Survey Estimates (USCB 2014e), there were nearly 880,000 housing units in the ROI, nearly 723,000 of which were occupied. The median values of owner-occupied housing units in the ROI range from $78,100 in Wayne County to $132,100 in Monroe County. The vacancy rate also varied considerably between the two Counties, from 7.5 percent in Monroe County to 18.6 percent in Wayne County (USCB 2014e).

Table 3–34. Housing in the Fermi 2 ROI (2013 estimate)

	Monroe	Wayne	ROI
Total housing units	63,191	816,539	879,730
Occupied housing units	58,479	664,415	722,894
Total vacant housing units	4,712	152,124	156,836
Percent total vacant	7.5	18.6	17.8
Owner occupied units	46,015	416,280	462,295
Median value (dollars)	132,100	78,100	83,475
Owner vacancy rate (percent)	2.8	2.7	2.7
Renter occupied units	12,464	248,135	260,599
Median rent (dollars/month)	754	783	782
Rental vacancy rate (percent)	12.6	8.0	8.2

Source: USCB 2014e

3.10.4.2 Education

Wayne County has 33 public school districts with approximately 600 public schools and 290,000 students (RESA 2014). In Monroe County, the County in which Fermi 2 is located, there are 13 public school districts with 55 public schools and over 25,700 students (NCES 2014b).

3.10.4.3 Public Water Supply

The City of Monroe pumps and treats water from Lake Erie and operates a joint intake and pumping facility with Frenchtown Charter Township. The city's water treatment and distribution system serves the City of Monroe and portions of the surrounding townships, including Monroe Charter, Raisinville, Exeter, Ida, and London. In addition, the City of Monroe supplies water in bulk to the village of Dundee and the City of Petersburg, serving an estimated population of 53,000 residents. The City of Monroe treatment plant has a treatment capacity of approximately 18 mgd. Frenchtown Charter Township shares the water intake with the City of Monroe and operates a water treatment plant that services approximately 20,000 residents and other nonresidential customers within the township.

Northern portions of Monroe County, including Ash Township, Berlin Township, and the villages of Carleton, Estral Beach, and South Rockwood receive water supplies directly through the Detroit Water and Sewage District, which maintains three intake facilities that draw water from Lake Huron and the Detroit River and five water treatment plants.

Wastewater treatment services are provided by a number of townships and municipalities in Monroe County that service residential, commercial, and industrial customers in the City of Monroe; in Frenchtown Charter, Monroe Charter, Raisinville, Bedford, Berlin, Ida, York, LaSalle and Ash townships; in the Cities of Milan, Petersburg, and Luna Pier; and in the villages of Dundee, Carleton, and Maybee. Other residents within the County are served by private onsite wastewater disposal systems. The Monroe Metropolitan Water Pollution Control System serves approximately 52,000 residents within the City of Monroe, large portions of Monroe Charter and Frenchtown Charter townships, and a small portion of Raisinville Township.

Table 3–35 lists the largest public water suppliers in Monroe and Wayne Counties and provides water source and population served for those suppliers. The discussion of public water supply systems is limited to major municipal water systems. All major public water suppliers in Monroe and Wayne Counties obtain their supplies from surface water. Currently, there is excess capacity in every major public water system in the two Counties. Fermi 2 gets potable water from Frenchtown Charter Township.

Table 3–35. Local Public Water Supply Systems

Public Water System	Source	Population Served[(a)]
Monroe County		
Ash Township	Surface water purchased	5,304
Berlin Township	Surface water purchased	9,700
Dundee	Surface water purchased	3,975
Frenchtown Township	Surface water	16,481
Monroe	Surface water	48,726
Monroe South County	Surface water purchased	33,816
Wayne County		
Allen Park	Surface water purchased	28,210

Public Water System	Source	Population Served[a]
Brownstown Township	Surface water purchased	30,627
Canton Township	Surface water purchased	90,173
Dearborn	Surface water purchased	98,153
Dearborn Heights	Surface water purchased	57,774
City of Detroit	Surface water	713,777
Garden City	Surface water purchased	27,692
Grosse Ile Township	Surface water purchased	10,371
Grosse Pointe Farms	Surface water	9,479
Grosse Pointe Park	Surface water purchased	11,555
Grosse Pointe Woods	Surface water purchased	16,135
Hamtramck	Surface water purchased	22,423
Harper Woods	Surface water purchased	14,236
Highland Park	Surface water	11,776
Huron Township	Surface water purchased	15,879
Inkster	Surface water purchased	25,369
Lincoln Park	Surface water purchased	38,144
Livonia	Surface water purchased	96,942
Melvindale	Surface water purchased	10,715
Northville Township	Surface water purchased	26,655
Plymouth	Surface water purchased	9,132
Plymouth Township	Surface water purchased	27,524
Redford Township	Surface water purchased	48,362
Riverview	Surface water purchased	12,486
Romulus	Surface water purchased	23,989
Southgate	Surface water purchased	30,047
Sumpter Township	Surface water purchased	9,549
Taylor	Surface water purchased	63,131
Trenton	Surface water purchased	18,853
Van Buren Township	Surface water purchased	27,359
Wayne	Surface water purchased	17,593
Westland	Surface water purchased	84,094
Woodhaven	Surface water purchased	12,875
Wyandotte	Surface water	25,883

[a] Safe Drinking Water Search for the State of Michigan (EPA 2014c).

Source: EPA 2014c

3.10.5 Tax Revenues

Fermi 2 property taxes are paid to Frenchtown Township, Monroe County, Michigan. Table 3–36 lists the property taxes paid for Fermi 2 for the years of 2009 through 2013. As shown in the table, total property tax payment amounts for the reported years fluctuated from year to year because, in part, of an order issued by the Michigan State Tax Commission in

December 2008 that changed the classification of nuclear fuel from real property to industrial personal property. This classification change meant that nuclear fuel was no longer subject to the school millage rate (i.e., 24 mills), which resulted in a refund for the 2008 tax year. This refund was provided to DTE in the form of three equal installments from 2009 to 2011. Additionally, the value of nuclear fuel decreases each year, and because there were no additions in nuclear fuel in 2009, the taxes for that year decreased from the previous year. However, the tax payments in 2010 increased due to a refueling that increased the value subject to the new Michigan State Tax Commission order (DTE 2014d).

Table 3–36. Fermi 2 Property Tax Distribution 2009–2013 (in Dollars)

Year	Plant Property Tax[(a)]	Nuclear Fuel Property Taxes[(b)]	Total Property Taxes
2009	18,205,402	182,717	18,388,119
2010	18,717,489	1,595,989	20,313,478
2011	18,402,570	1,386,006	19,788,576
2012	19,508,133	1,024,198	20,532,331
2013	19,047,062	597,092	19,644,154

[(a)] Plant property tax for 2013 includes a refund of $155,604 received for a land parcel reclassification.
[(b)] $801,192 settlement refund (2013 refund of $665,532 included above; 2014 refund of $67,830; and 2015 refund of $67,830 from Frenchtown Township).

Source: DTE 2014g

Fermi 2 property tax payments for 2013 were distributed in accordance with the Frenchtown Charter Township millage spread (tax rates per $1,000 of taxable value) detailed in Table 3–37. Monroe and Airport schools do not receive revenue directly from property taxes paid for Fermi 2.

Table 3–37. Property Taxes Paid for Fermi 2 by Millage Type, 2013 Tax Year

Millage Type	Millage		Amount Paid (dollars)
	Rate	Dollars	
State Education	**6**		**2,312,816**
County Operating	**4.7952**		**2,162,592**
County Winter	**0.802**		**361,695**
Senior Citizens	0.5	225,496	
Veterans	0.002	902	
Fairview	0.2	90,198	
Tourism	0.1	45,099	
Monroe School District	**4.7541**		**2,144,057**
Technology Enhancement	0.9866	444,948	
Allocated	0.2897	130,652	
Voted Operating	3.4778	1,568,457	
Monroe Community College	**2.1794**		**982,890**
Monroe County Library	**1**		**450,991**
Frenchtown Allocations	**7.909**		**3,566,888**
Operating	2.7166	1,225,162	
Water Bond Debt	1.5	676,487	
Fire Department	3	1,352,973	

Millage Type	Millage		Amount Paid
Lake Erie Transportation	0.6924	312,266	
Monroe Schools	**19**		[(a)]
Voted Operating	18	–	
Voted Sinking Fund	1	–	
Airport Schools	**19.9**		[(a)]
Voted Operating	18	–	
Voted Bonded Debt	1.9	–	
Jefferson Schools	**18.5**		**7,163,251**
Voted Operating	18	6,937,755	
Voted Recreation	0.5	225,496	
Resort District Authority	**2.9274**		**1,320,110**
Total, Including Adjustments			**20,465,290**
Adjustments			(821,136)
Total Frenchtown Township Mills/Tax—47.8428			**19,644,154**

[(a)] These school districts do not receive revenue directly from property taxes paid for Fermi 2.

Source: DTE 2014g

Table 3–38 lists 2013 millage totals by district. The Frenchtown Charter Township prepares tax bills by July 1 and December 1. The summer tax bill includes State education tax millage and Monroe County allocated operating millage. The winter tax bill includes revenues for the Monroe County Community College; Monroe County Intermediate Schools; Monroe County seniors; Lake Erie Transportation; additional voted school millage; local township operations and, when applicable, the Resort Authority. At the end of the winter tax season, the Frenchtown Charter Township reaches a settlement with the Monroe County Treasurer and provides their appropriate apportionment (DTE 2014d).

Table 3–38. 2013 Frenchtown Charter Township Millage Totals by District

District	Winter PRE[(a)]	Winter Non-PRE[(a)]	Summer All	Annual PRE[(a)]	Annual Non-PRE [(a)]	Annual Industrial Personal [(b)]	Annual Commercial Personal[(c)]
Monroe Schools	17.6445	35.6445	10.7952	28.4397	46.4397	22.4397	34.4397
Airport Schools	18.5446	36.5445	10.7952	29.3397	47.3397	23.3397	35.3397
Jefferson Schools	17.1445	35.1445	10.7952	27.9397	45.9397	21.9397	33.9397
Jefferson Schools in Resort District Authority	20.0719	38.0719	10.7952	30.8671	48.8671	24.8671	36.8671

[(a)] PRE = principal residence exemption.

[(b)] Industrial personal exempt from 18 school operating mills and 6 State education mills.

[(c)] Commercial personal exempt from 12 school operating mills.

Source: DTE 2014g

Fermi 2 is located within the Jefferson Resort School District; in 2013, it paid approximately 48.8671 mills in total property tax payments (Table 3–39). Of that amount, 7.9090 mills (16 percent of the total) went to Frenchtown Township and 13.5307 mills (28 percent of the total) went to Monroe County (Monroe Intermediate School District, Monroe County Library, and Monroe County Community College). Approximately 18.5 mills (38 percent of the total) went to the school district, approximately 3 mills (6 percent of the total) went to the Resort Authority, and 6 mills (12 percent of the total) went to the State of Michigan State education tax fund (DTE 2014d).

Table 3–39. 2013 Fermi 2 Property Tax Distribution in Millage

Jurisdiction	Total (Mills)	Percent of Total
State Education Tax	6.0000	12
Frenchtown Charter Township	7.9090	16
Monroe County	13.5307	28
Jefferson Schools in Resort District Authority	18.5000	38
Resort Authority	2.9274	6
Total	**48.8671**	**100**

Source: DTE 2014g

Table 3–40 presents Fermi 2 total property tax distribution as a percentage of the total amount of property taxes collected by selected jurisdictions in Frenchtown Township for 2013. The amount of property tax revenue attributable to Fermi 2 ranges from 34 to 53 percent of the total property tax revenues.

Table 3–40. 2013 Fermi 2 Property Tax Distribution as a Percentage of Total Property Taxes Collected by Frenchtown Township

Jurisdiction	Total Mills[(a)]	Total Property Taxes Collected by Frenchtown Township[(b)]	Fermi 2 Property Tax Payment	Percent of Total Property Taxes Collected	Mills Included in Total
State Education Tax	6.0000	6,795,216	2,312,816	34	State Education
Frenchtown Township	9.9500	11,264,062	4,886,998	43	Frenchtown Allocations and Resort District Authority
Monroe County	6.6000	7,471,567	3,958,168	53	County Operating, County Winter, Monroe Community College, and Monroe County Library
School Taxes[(c)]	18.7900	21,281,376	9,307,308	44	Monroe School District and Jefferson Schools

Jurisdiction	Total Mills[(a)]	Total Property Taxes Collected by Frenchtown Township[(b)]	Fermi 2 Property Tax Payment	Percent of Total Property Taxes Collected	Mills Included in Total

[(a)] Total mills is a weighted average from page 30 of the Michigan Department of Treasury's "Taxable Valuations, Tax Levies, and Tax Rates for the Year 2013 in Michigan Townships."

[(b)] Due to different classifications and tax abatements, the amount of property taxes paid may not equal the amount owed.

[(c)] Millage rate attributable to the Monroe School District is included within the Jefferson Schools weighted average millage.

Source: DTE 2014g

In addition, DTE makes annual payments to the State of Michigan, Monroe County, and Wayne County and to Amherstburg, Canada, in support of the radiological emergency response plan. The annual payments are as follows:

- State of Michigan—$877,000
- Monroe County—$97,200
- Wayne County—$67,200
- Amherstburg, Canada—$30,000

3.10.6 Local Transportation

The region surrounding Fermi 2 has a highly developed roadway network. I-75 running north and south through Monroe County and Frenchtown Charter Township is located 2 mi (3 km) west of Fermi 2. I-75 provides access to the Fermi site from Detroit to the north and Toledo to the south. North of the Fermi site, I-275 connects with I-75 connecting the western Detroit metropolitan area, Wayne County Airport, western Wayne County, and Oakland County. It also connects to I-94 and I-96, which are the primary Michigan east-west interstates.

Enrico Fermi Drive is the primary road entrance and connects the Fermi site to North Dixie Highway after crossing Toll Road and Leroux Road. North Dixie Highway runs north and south through Monroe County and Frenchtown Charter Township and provides access to regional highways. To the north, North Dixie Highway intersects Swan Creek Road, which connects to I-75 approximately 6 mi (9.7 km) to the northwest of Fermi 2. To the south, North Dixie Highway provides direct access to I-75 at an interchange located approximately 6.2 mi (10 km) southwest of Fermi 2. North Dixie Highway also intersects Nadeau Road south of Fermi 2 with additional access to I-75 at an interchange approximately 6 mi (9.7 km) west of Fermi 2.

Table 3–41 lists commuting routes to the Fermi site and average annual daily traffic volume values. The average annual daily traffic values represent traffic volumes for a 24-hour period factored by both the day of the week and the month of the year.

Table 3–41. Major Commuting Routes in the Vicinity of Fermi 2: 2013 Average Annual Daily Traffic Count

Roadway and Location	Average Annual Daily Traffic
I-75, I-275 to Newport/Swan Creek Road	49,700
I-75, North Dixie Highway to Nadeau Road	65,200
North Dixie Highway, I-75 to Nadeau Road	12,700

Roadway and Location	Average Annual Daily Traffic
North Dixie Highway, Stony Creek to Williams	8,310
North Dixie Highway, Enrico Fermi to Post Road	4,140
Nadeau Road	5,300
Enrico Fermi Drive	2,378
Post Road, west of North Dixie Highway	275

Source: MDOT 2014

3.11 Human Health

3.11.1 Radiological Exposure and Risk

The regulations at 10 CFR 20.1101 require Fermi 2 to have a radiation protection program designed to protect onsite personnel, including employees, contractor employees, visitors, and offsite members of the public from radiation and radioactive material generated at Fermi 2.

The radiation protection program is extensive and includes, but is not limited to, the following:

- organization and administration (i.e., a Radiation Protection Manager who is responsible for implementing the program and for ensuring that workers are trained and qualified);
- implementing procedures;
- an ALARA program to minimize dose to workers and members of the public;
- a dosimetry program (i.e., measure radiation dose of plant workers);
- Radiological Controls (i.e., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements);
- radiation area entry and exit controls (i.e., locked or barricaded doors, interlocks, local and remote alarms, and personnel contamination monitoring stations);
- posting of radiation hazards (i.e., signs and notices alerting plant personnel of potential hazards);
- record keeping and reporting (i.e., documentation of worker dose and radiation survey data);
- radiation safety training (i.e., classroom training and use of mockups to simulate complex work assignments);
- radioactive effluent monitoring management (i.e., control and monitor radioactive liquid and gaseous effluents released into the environment);
- radioactive environmental monitoring (i.e., sampling and analysis of environmental media, such as air, water, vegetation, food crops, direct radiation, and milk to measure the levels of radioactive material in the environmental that may impact human health); and
- radiological waste management (i.e., control, monitor, process, and dispose of radioactive solid waste).

In regard to the radiation exposure to Fermi 2 personnel, the NRC staff reviewed the data in NUREG–0713, *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2012: Forty-Fifth Annual Report (Volume 34*) (NRC 2014b). This report was the most recent available at the time of this review; it summarizes the occupational exposure data through 2012 that are maintained in the NRC's Radiation Exposure Information and Reporting System database. The regulations at 10 CFR 20.2206 require nuclear power plants to report their occupational exposure data to the NRC annually.

NUREG–0713 calculates a 3-year average collective dose per reactor for all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the applicant's ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material over a 1-year time period. There are no NRC or EPA standards for collective dose. Based on the data for operating BWRs like those at Fermi 2, the 3-year average annual collective dose per reactor was 131.18 person-rem. In comparison, Fermi 2 had a 3-year average annual collective dose of 105.18 person-rem, which is better than the national average for BWRs.

In addition, as reported in NUREG–0713, no worker at Fermi 2 in 2012 received an annual dose greater than 1.0 rem (0.01 sievert (Sv)), which is well below the NRC occupational dose limit of 5.0 rem (0.05 Sv) in 10 CFR 20.1201.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes and minor chemical spills. Chemical hazards to plant workers resulting from continued operations associated with license renewal are expected to be minimized by the licensee implementing good industrial hygiene practices as required by permits and Federal and state regulations. Plant discharges of these chemical and sanitary wastes are monitored and controlled as part of the plant's NPDES permit process to minimize impacts to the public and the environment. In addition, proposed changes in the use of cooling water treatment chemicals would require review by the plant's NPDES permit-issuing authority and possible modification of the existing NPDES permit, including examination of the human health effects of the change.

DTE controls the use, storage, and discharge of chemicals and sanitary wastes at Fermi 2 in accordance with its chemical control procedures and site-specific chemical spill prevention plans. As part of the chemical control procedures, DTE minimizes onsite chemical inventory by requiring personnel, before they can procure new chemical stocks, to check DTE's existing stock system to ensure that requested chemicals are not already available elsewhere in the facility (DTE 2014g). Chemical wastes are controlled and managed in accordance with DTE's waste management procedure. These plant procedures and plans are designed to prevent and minimize the potential for a chemical or hazardous waste release that could impact workers, members of the public, and the environment (DTE 2014d).

3.11.3 Microbiological Hazards

Typical microbiological hazards associated with nuclear plant cooling operations and thermal discharge include thermophilic microorganisms, such as enteric pathogens (*Salmonella* spp., *Shigella* spp., and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (*Legionella* spp.), and the free-living amoeba (*Naegleria fowleri*). The presence of these microorganisms could result in adverse effects to the health of nuclear power plant workers in plants that use cooling towers and to the health of the public where thermal effluents discharge into cooling ponds, lakes, canals, or rivers. Section 4.14 addresses harmful algal blooms, such as those observed in recent years in Lake Erie.

3.11.3.1 Background Information on Microorganisms of Concern

Salmonella typhimurium and *S. enteritidis* are two species of enteric bacteria that cause salmonellosis, a disease more common in summer than winter (CDC 2012). Salmonellosis is transmitted through contact with contaminated human or animal feces and may be spread through water transmission or contact with food or infected animals (CDC 2014). The bacteria grow at temperatures ranging from 77 to 113 °F (25 to 45 °C), have an optimal growth temperature around human body temperature (98.6 °F (37 °C)), and can survive extreme temperatures as low as 41 °F (5 °C) and as high as 122 °F (50 °C) (Oscar 2009). Research studies examining the persistence of *Salmonella* spp. outside of a host found that the bacteria can survive for several months in water and in aquatic sediments (Moore et al. 2003).

Shigellosis infections are caused by the transmission of *Shigella* spp. from person to person through contaminated feces and unhygienic handling of food. Like salmonellosis, infections are more common in summer than in winter (CDC 2014). The bacteria grow at temperatures between 77 and 99 °F (25 and 37 °C) and can survive temperatures as low as 41 °F (5 °C) (PHAC 2011).

Pseudomonas aeruginosa can be found in soil, hospital respirators, water, and sewage and on the skin of healthy individuals. It is most commonly linked to infections transmitted in healthcare settings. It is a waterborne pathogen, and infections from exposure to *P. aeruginosa* in water can lead to development of mild respiratory illness (CDC 2013c). These bacteria have an optimal growth temperature of 98.6 °F (37 °C) and can survive in temperatures as high as 107.6 °F (42 °C) (Todar 2004).

Legionella spp. infections result in legionellosis (e.g., Legionnaires' disease), which manifests as a dangerous form of pneumonia or an influenza-like illness. Legionellosis occurrences vary by season and geographic location; Mid-Atlantic states report the highest numbers of cases during summer and early fall (CDC 2011). *Legionella* spp. thrive in aquatic environments as intracellular parasites of protozoa and are only infectious in humans through inhalation contact from an environmental source (CDC 2013a). Conditions that favor *Legionella* spp. growth are stagnant water between 95 and 115 °F (35 and 46 °C), although the bacteria can grow at temperatures as low as 68 °F (20 °C) and as high as 122 °F (50 °C) (OSHA 1999).

The free-living amoeba *Naegleria fowleri* prefers warm freshwater habitats and is the causative agent of human primary amoebic meningoencephalitis. Infections occur when *N. fowleri* penetrate the nasal tissue through direct contact with water in warm lakes, rivers, or hot springs and migrate to the brain tissues (CDC 2013b). This free-swimming amoeba species is rarely found in water temperatures below 95 °F (35 °C), and infections rarely occur at those temperatures (Tyndall et al. 1989).

3.11.3.2 Studies of Microorganisms in Cooling Towers

A 1981 study (Tyndall 1982) found pathogenic *Naegleria fowleri* in heated cooling water at 2 of 11 nuclear power plant sites and infectious *Legionella* spp. at 7 of the 11 sites. The concentrations of these organisms at these sites increased less than 10 fold in heated waters relative to source water. Tyndall's (1982) recommendations for disease prevention include the use of protective devices for plant personnel in close contact with cooling water sources known to contain infectious microorganisms.

In another study, Tyndall (1983) examined the distribution and abundance of *Legionella* spp. and *N. fowleri* near large industrial cooling towers. *Legionella* spp. were detected at low abundances in air discharged from cooling towers and in some upwind and downwind air samples. *N. fowleri* were detected but were not pathogenic. Tyndall (1983) concludes that industrial hygiene measures to limit plant worker exposure during maintenance of cooling water systems may be appropriate.

A more recent study (Berk et al. 2006) examined 40 natural aquatic environments and 40 cooling towers to determine the relative abundance of amoebae that may harbor infectious bacteria due to cooling tower operations from industries, hospitals, and public buildings. Those authors found that infected amoebae are 16 times more likely to occur in cooling towers than in natural environments and that cooling towers may be possible “hot spots” for emerging pathogenic bacteria.

3.11.3.3 Microbiological Hazards to Plant Workers

Plant workers are most likely to be exposed to pathogenic microorganisms from power plant operations when cleaning or providing other maintenance services that involve the cooling water system, including cooling towers and condensers. Diseases (e.g., legionellosis and primary amoebic meningoencephalitis) that involve respiratory or nasal infectivity routes are of primary concern, and workers should wear appropriate respiratory protection. Workers performing underwater activities should wear protective gear to prevent oral or nasal exposure to amoebae or other pathogenic bacteria. Plant operators should continue using proven industrial hygiene principles to minimize workforce exposures to microbiological organisms that may occur in the cooling water system (NRC 2013b).

3.11.3.4 Microbiological Hazards to the Public

Thermal effluents produced during nuclear power plant operations discharge to lakes, ponds, canals, or rivers and, therefore, may enhance the growth of naturally occurring thermophilic microorganisms. The public may come into contact with these water bodies through swimming and boating activities. Although the NPDES permit for Fermi 2 has no discharge temperature limits, DTE (2014d) reports that the heated effluent from Fermi 2 discharges into a restricted industrial area along the Lake Erie shoreline that is not used for recreation activities, such as boating, swimming, diving, and other water sports, which limits exposure to people on the shoreline or those engaging in water sports to warm water that might support thermophilic microorganisms.

3.11.4 Electromagnetic Fields

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is not expected to be a problem during the license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS.

In the GEIS, the NRC found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code® (NESC®) criteria, determining the significance of the electric shock potential (IEEE 2002) was not possible. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC® for preventing electric shock from induced currents. The NRC uses the NESC® criteria and the applicant's adherence to those criteria during the current operating license as its baseline to assess the potential human health impact of the induced current from an applicant's transmission lines. As discussed in the GEIS, the issue of electric shock is of small significance for transmission lines that are operated in adherence with the NESC® criteria.

As stated by DTE in its ER, the transmission lines that currently connect Fermi 2 to the regional electrical distribution grid and that would remain energized only if the plant's operating license were renewed are in-scope for evaluation in this SEIS. These in-scope transmission lines are entirely within the Fermi 2 owner-controlled area and span industrial areas within the Fermi site. Therefore, the public does not have access to this area and could not come into contact with these energized lines. Therefore, there is no potential shock hazard to members of the public from these transmission lines.

The Michigan Occupational Safety and Health Administration (MIOSHA) safety standards govern the nonradiological occupational safety and health of Fermi 2 workers. Operational safety requirements associated with MIOSHA are incorporated into Fermi 2's occupational health and safety program. Fermi 2 has implemented the following practices to limit the potential hazards from acute and induced electric shock to its workers:

- A risk analysis is performed to determine the probability of a shock hazard based on the task, tools, accessibility of equipment, proximity to live parts, and energy level.
- During work on overhead lines, employees standing on the ground cannot come in contact with a vehicle or mechanical equipment unless the transmission line is de-energized and properly grounded, the employee is using proper protective equipment, and the vehicle or equipment is located so that no energized conductive path is within the limited approach distance.
- Vehicles or mechanical equipment are properly grounded before approaching the limited approach distance.
- Materials to be stored near the 345-kV energized lines must be stored at a distance of 19 ft 10 in. (6 m), plus an amount that provides for maximum sag and swing of the line (DTE 2014d).

DTE manages electric shock hazards, including those from induced current shock, in compliance with the MIOSHA's requirements to protect its workers.

3.11.5 Other Hazards

Two additional human health issues are addressed in this section: (1) physical occupational hazards and (2) electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation utility. Workers at or around nuclear power plants would be involved in some electrical work, electric power line maintenance, repair work, and maintenance activities and exposed to some potentially hazardous physical conditions (e.g., falls, excessive heat, cold, noise, electric shock, and pressure).

The Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. OSHA was created by the Occupational Safety and Health Act of 1970, as amended (29 U.S.C. 651 et seq.), which was enacted to safeguard the health of workers. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC as set forth in a Memorandum of Understanding (53 FR 43950) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur.

Fermi 2 maintains an occupational safety program in accordance with MIOSHA's regulations for its workers (DTE 2014d). MIOSHA is an OSHA-approved State plan and, as such, operates a job safety and health program that is at least as effective as the Federal OSHA program (OSHA 2014).

3.12 Environmental Justice

Under Executive Order (EO) 12898 (59 FR 7629), U.S. Federal agencies are responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental impacts on U.S. minority and low-income populations. Independent U.S. agencies, such as the NRC, are not bound by the terms of EO 12898 but are, as stated in paragraph 6-604 of the EO, "requested to comply with the provisions of [the] order." In 2004, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040), which states, "The Commission is committed to the general goals set forth in EO 12898, and strives to meet those goals as part of its NEPA review process."

The U.S. Council on Environmental Quality (CEQ) provides the following information in a report entitled, "Environmental Justice: Guidance Under the National Environmental Policy Act" (CEQ 1997):

- **Disproportionately High and Adverse Human Health Effects.**

  Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997).

- **Disproportionately High and Adverse Environmental Effects.**

  A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ 1997).

The environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on U.S. minority and low-income populations that could result from the operation of Fermi 2 during the renewal term. In assessing the impacts, the following definitions of minority individuals and populations and low-income population were used (CEQ 1997):

Minority Individuals

Individuals living in the U.S. who identify themselves as members of the following population groups: Hispanic or Latino; American Indian or Alaska Native; Asian; Black or African American; Native Hawaiian or Other Pacific Islander; or two or more races, meaning individuals who identified themselves on a Census form as being a member of two or more races (e.g., White and Asian).

Minority Populations

Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-Income Population

Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the USCB's Current Population Reports, Series P60, on Income and Poverty.

3.12.1 Minority Population

According to 2010 U.S. Census data, 33 percent of the U.S. population residing within a 50-mi (80-km) radius of Fermi 2 identified themselves as minority individuals. The largest minority group was Black or African American (22.6 percent), followed by Hispanic or Latino (of any race) (4.4 percent) (USCB 2014b).

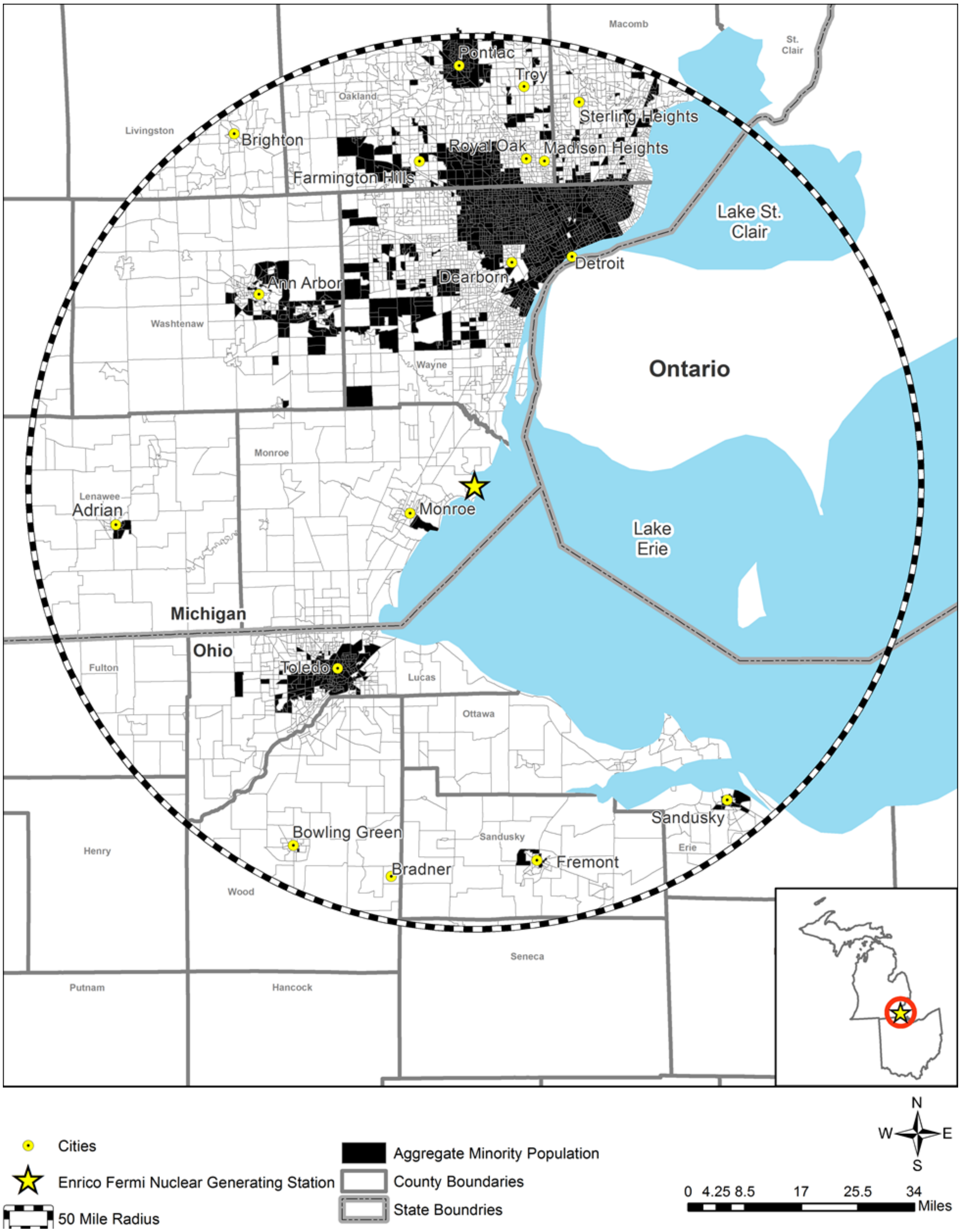
According to USCB's 2010 Census data, minority populations in the socioeconomic ROI (Monroe and Wayne Counties) comprised 47.1 percent of the total two-County population (Table 3–30). Figure 3–18 shows predominantly minority population U.S. Census block groups, using 2010 U.S. Census data for race and ethnicity, within a 50-mi (80-km) radius of Fermi 2 (USCB 2014b).

According to the USCB's 2013 American Community Survey 1-Year Estimates (USCB 2014c), since 2010, minority populations in the socioeconomic ROI decreased by approximately 28,600 persons and now comprise 46.8 percent of the population (Table 3–31). The largest decline occurred in the Black or African American population (a decrease of 5.2 percent). This corresponds with the overall decline in the regional U.S. population. However, some of this decrease was partially offset by increases in the Asian and Hispanic or Latino U.S. populations (USCB 2014g).

U.S. Census block groups were considered minority population block groups if the percentage of the minority population within any block group exceeded 33 percent (the percent of the minority population within the 50-mi (80-km) radius of Fermi 2). A minority population exists if the percentage of the minority population within the U.S. Census block group is meaningfully greater than the minority population percentage in the 50-mi (80-km) radius. Approximately 1,700 of the 4,300 U.S. census block groups located within the 50-mi (80-km) radius of Fermi 2 have meaningfully greater minority populations (USCB 2014b).

As shown in Figure 3–18, minority population U.S. Census block groups (race and ethnicity) are mostly clustered near Detroit, Michigan, and Toledo, Ohio. The nearest minority population U.S. Census block group to Fermi 2 is located south of River Raisin in Monroe, Michigan. None of the U.S. Census block groups nearest to Fermi 2 have meaningfully greater minority populations.

Figure 3–18. 2010 U.S. Census Minority Block Groups within a 50-mi (80-km) Radius of Fermi 2



Source: USCB 2014b

3.12.2 Low-Income Population

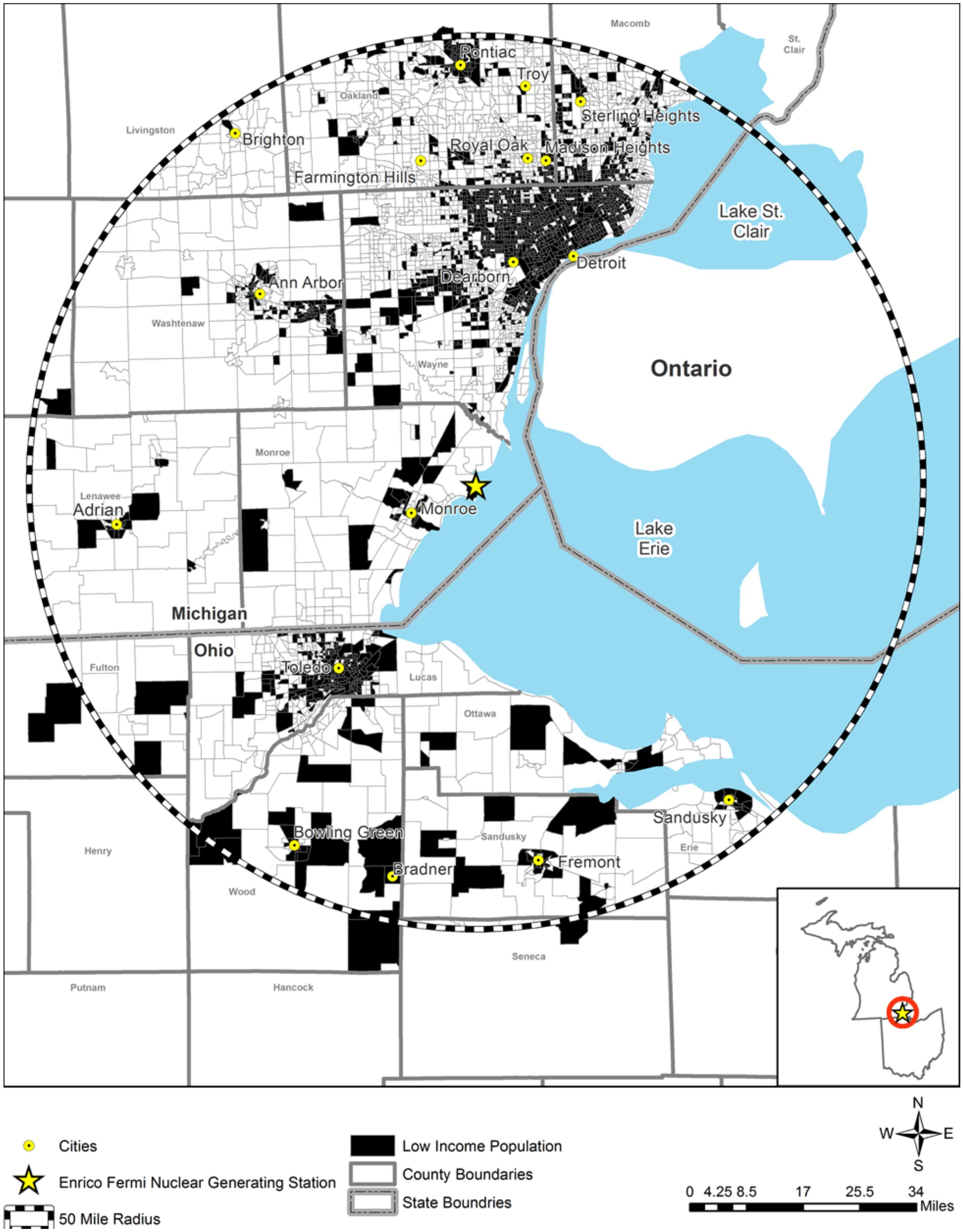
The USCB's 2013 American Community Survey 5-Year Estimates for 2009 through 2013 identifies 17 percent of U.S. individuals residing within a 50-mi (80-km) radius of FERMI 2 as living below the U.S. Federal poverty threshold in 2010 (USCB 2015). The 2010 U.S. Federal poverty threshold was $22,113 for a family of four.

According to the USCB's 2013 American Community Survey 1-Year Estimates (USCB 2014g), 12.3 percent of families and 17 percent of individuals residing in Michigan were living below the U.S. Federal poverty threshold, and the median household income for Michigan was $48,273 (USCB 2014g). In the socioeconomic ROI, people living in Monroe County had median household and per capita incomes above the State average. The median household income average in Monroe County was $53,561 with 12.9 percent of individuals and 10.4 percent of families living below the poverty level. Wayne County had a lower median household income average ($40,487) and a higher percentage of individuals (24.9 percent) and 19.6 percent of families living below the poverty level (USCB 2014g).

Figure 3–19 shows the location of predominantly low-income population U.S. Census block groups within a 50-mi (80 km) radius of Fermi 2. U.S. Census block groups were considered low-income population block groups if the percentage of individuals living below the U.S. Federal poverty threshold within any U.S. Census block group exceeded the percent of the individuals living below the U.S. Federal poverty threshold within the 50-mi (80-km) radius of Fermi 2. Approximately 1,600 of the 4,300 U.S. Census block groups located within the 50-mi (80-km) radius of Fermi 2 have meaningfully greater low-income populations.

As shown in Figure 3–19, low-income population U.S. Census block groups are mostly clustered near Detroit, Michigan, and Toledo, Ohio. The Fermi 2 site is located in a low-income population U.S. Census block group. This U.S. Census block group is considered a low-income population block group because the percentage of people living in poverty in the block group was higher than the percentage of all U.S. people living in poverty within the 50-mi (80-km) radius of Fermi 2.

Figure 3–19. U.S. Census Low-Income Block Groups within a 50-mi (80-km) Radius of Fermi 2



Source: USCB 2015

3.13 Waste Management and Pollution Prevention

3.13.1 Radioactive Waste

As discussed in Section 3.1.4 of this SEIS, Fermi 2 uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of plant operations. Radioactive materials in radioactive gaseous effluents are reduced before being released into the environment so that the resultant dose to members of the public from these effluents is well within NRC and EPA dose standards. As discussed in Section 3.1.4 of this SEIS, Fermi 2 has not had any planned radioactive liquid effluent releases into Lake Erie since 1994 and plans to continue this practice in the future. Radionuclides that can be efficiently removed from the radioactive liquid and gaseous wastes are converted to a solid waste form for disposal in a licensed disposal facility.

3.13.2 Nonradioactive Waste

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. The licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq.) and the RCRA (NRC 2013b).

As described in Section 3.1.5, Fermi 2 has a nonradioactive waste management program to handle this nonradioactive waste. In addition to managing its nonradioactive waste, DTE has programs in place to minimize the generation of this waste. Fermi 2 implements a waste minimization plan to reduce, to the extent feasible, waste generated, treated, accumulated, or disposed. In addition to a focus on recycling operations, DTE's waste minimization plan focuses on identifying waste reduction opportunities and on preventing waste before it happens. DTE implements best management practices for solid, special, hazardous, mixed waste, and chemicals to control and minimize waste generation to the maximum extent practicable (DTE 2014d).

Fermi 2 has a stormwater pollution prevention plan that identifies potential sources of pollution that may affect the quality of stormwater discharges from each permitted outfall. The stormwater pollution prevention plan also describes practices that are used to reduce pollutants in stormwater discharges to ensure compliance with the site's NPDES permit. As part of Fermi 2's chemical control procedure and site-specific spill prevention plans, measures are in place to monitor areas within the site that have the potential for spills of regulated substances, such as oil (DTE 2014d).

3.14 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 71. *Code of Federal Regulations*, Title 10, *Energy*, Part 71, "Packaging and transportation of radioactive material."

10 CFR Part 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, "Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related Greater than Class C waste."

40 CFR Part 50. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 51, "Requirements for Preparation, Adoptions, and Submittal of Implementation Plans."

40 CFR Part 81. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 81, "Designation of areas for air quality planning purposes."

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental radiation protection standards for nuclear power operations."

49 CFR Parts 171–178. *Code of Federal Regulations*, Title 49, *Transportation*, Subchapter C, "Hazardous Materials Regulation."

50 CFR Part 22. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 22, "Eagle permits."

50 CFR Part 402. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 402, "Interagency cooperation—Endangered Species Act of 1973, as amended."

32 FR 4001. U.S. Fish and Wildlife Service. "Endangered species." *Federal Register* 32(48):4001. March 11, 1967.

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4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

4.1 Introduction

In license renewal environmental reviews, the U.S. Nuclear Regulatory Commission (NRC) considers the environmental consequences of the proposed action (i.e., continued reactor operations), the no-action alternative (i.e., not renewing the operating license), and the environmental consequences of various alternatives for replacing the nuclear power plant's generating capacity. In plant-specific environmental reviews, the NRC compares the environmental impacts of license renewal with those of the no-action alternative and replacement power alternatives to determine whether the adverse environmental impacts of license renewal are great that it would be unreasonable to preserve the option of license renewal for energy-planning decisionmakers.

In this chapter, the NRC evaluates the environmental consequences of the proposed action (i.e., license renewal of Fermi 2), including the (1) impacts associated with continued operations similar to those that have occurred during the current license term, (2) impacts of various alternatives to the proposed action, (3) impacts from the termination of nuclear power plant operations and decommissioning after the license renewal term (with emphasis on the incremental effect caused by an additional 20 years of reactor operation), (4) impacts associated with the uranium fuel cycle, (5) impacts of postulated accidents (design-basis accidents (DBAs) and severe accidents), (6) cumulative impacts of the proposed action, and (7) resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources. The NRC also considers new and potentially significant information on environmental issues related to the impacts of operation during the renewal term.

NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999, 2013d), identifies 78 issues to be evaluated in the license renewal environmental review process. This supplemental environmental impact statement (SEIS) supplements the information provided in the GEIS. Generic issues (Category 1) rely on the analysis presented in the GEIS, unless otherwise noted. Applicable site-specific issues (Category 2) have been analyzed for Fermi 2 and assigned a significance level of SMALL, MODERATE, or LARGE. Section 1.4 of this SEIS provides an explanation of the criteria for Category 1 and Category 2 issues, as well as the definitions of SMALL, MODERATE, and LARGE. Resource-specific impact significance level definitions are provided where applicable.

4.2 Land Use and Visual Resources

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on land use and visual resources.

4.2.1 Proposed Action

Section 3.2 of this SEIS describes land use and visual resources in the vicinity of the Fermi site. The four generic (Category 1) issues that apply to land use and visual resources during the proposed license renewal period appear in Table 4–1. The GEIS (NRC 2013d) discusses these issues in Section 4.2.1. The GEIS does not identify any site-specific (Category 2) land use or visual resource issues.

The NRC staff did not identify any new and significant information related to the generic (Category 1) land use and visual resource issues during the review of the applicant's Environmental Report (ER) (DTE 2014a), the site audit, or the scoping process. Therefore, the NRC expects no impacts associated with these issues beyond those discussed in the GEIS. The GEIS concludes that the impact level for each of these issues is SMALL.

Table 4–1. Land Use and Visual Resource Issues

Issue	GEIS Section	Category
Land Use		
Onsite land use	4.2.1.1	1
Offsite land use	4.2.1.1	1
Offsite land use in transmission line right-of-ways (ROWs)[a]	4.2.1.1	N/A
Visual Resources		
Aesthetic impacts	4.2.1.2	1

[a] This issue applies only to the in-scope portion of electric power transmission lines, which are defined as transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid. As described in Section 3.1.6, all in-scope transmission lines subject to an environmental impact evaluation for license renewal are located within the Fermi site property.

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51, NRC 2013d

4.2.2 No-Action Alternative

4.2.2.1 Land Use

If Fermi 2 were to shut down, the impacts to land use would remain similar to those during operations until the plant is fully decommissioned. Temporary buildings and staging or laydown areas may be required during large component and structure dismantling. Fermi 2 is likely to have sufficient space within previously disturbed areas for these needs; therefore, no additional land would need to be disturbed that would result in changes to current land uses. In Volumes 1 and 2 of NUREG–0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1: Regarding the Decommissioning of Nuclear Power Reactors,* the NRC (2002) concludes generically that land use during decommissioning activities would be SMALL. The NRC staff concludes that the no-action alternative could, but may not necessarily, noticeably alter land use. Thus, the NRC staff concludes that the impacts of the no-action alternative on land use during the proposed license renewal term would be SMALL to MODERATE.

4.2.2.2 Visual Resources

If Fermi 2 were to shut down, visual resource impacts would remain similar to those experienced during operations until the site is fully decommissioned. The cooling towers, which create the largest visual impact, may eventually be dismantled, which would reduce the already SMALL impacts to visual resources that would occur during the proposed license renewal term. Thus, the NRC staff concludes that the impacts of the no-action alternative on visual resources would be SMALL.

4.2.3 Natural Gas Combined-Cycle Alternative

4.2.3.1 Land Use

The natural gas combined-cycle (NGCC) alternative assumes that a new NGCC facility would be built at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. The facility would require an estimated 24 acres (ac) (9.7 hectares (ha)) of land for the plant with the possibility of additional land required for gas pipeline ROWs. Additional offsite land would be required for gas extraction and collection, although this impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Fermi 2.

During construction, the use of the existing site would maximize availability of existing infrastructure. However, construction would likely require the conversion of natural areas because the new facility would be built outside the existing industrial footprint. This could affect 656 ac (265 ha) of wetlands managed as part of the Detroit River International Wildlife Refuge (DRIWR) under the cooperative agreement with the U.S. Fish and Wildlife Service (FWS). Currently, 62.6 percent of the site's natural areas are part of the DRIWR. The site has 64 ac (26 ha) of leased farmland that could be affected. The Natural Resources Conservation Service considers a portion of this area to be prime farmland. Other land uses on the site would likely be affected as well. Although construction of an NGCC facility would likely alter current land uses, it would be unlikely to destabilize important attributes of sensitive lands, such as DRIWR wetlands, because of the NGCC facility's small footprint. Accordingly, the NRC staff concludes that construction impacts would be MODERATE.

Operation of an NGCC facility would likely not incur additional land use changes; therefore, operational impacts would be SMALL.

Overall, impacts of the NGCC alternative on land use would be MODERATE during construction and would be SMALL during operation.

4.2.3.2 Visual Resources

Because the NGCC facility would be located on an industrial existing site, additional visual resource impacts would be minimal. The mechanical draft cooling towers would likely not be taller than other buildings on site and would be significantly less visible than Fermi 2's natural-draft cooling towers. Some temporary visual impacts may occur during construction from cranes and other construction equipment that may be visible off site. During operation, cooling tower plumes could create noticeable visual impacts. However, these impacts would be no different than those assessed in Section 4.2.1 for the proposed license renewal, which were determined to be SMALL. The NRC staff concludes that the impacts from the construction and operation of an NGCC alternative on visual resources would be SMALL.

4.2.4 Integrated Gasification Combined-Cycle Alternative

4.2.4.1 Land Use

Like the NGCC alternative, the integrated gasification combined-cycle (IGCC) alternative assumes that a new facility would be built at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. However, an IGCC facility would require significantly more land (an estimated 1,000 ac (405 ha)) than that of the NGCC alternative, which would only require 24 ac (9.7 ha). The larger footprint of the IGCC facility would require DTE Electric Company (DTE) to obtain additional parcels of land adjacent to the existing site. Additional offsite land would be required for coal mining, although this impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Fermi 2.

During construction, the use of the existing site would maximize availability of existing infrastructure. However, construction would likely significantly affect surrounding natural areas on the site and within purchased adjacent land parcels because it would require the clearing and grading of these areas for industrial use. This alternative would likely intensify the effects to the DRIWR lands, prime farmland, wetlands, and other natural areas described for the NGCC alternative in Section 4.2.3.1. Construction would likely noticeably alter land uses, and the large area of land required for the IGCC facility could destabilize important attributes of sensitive lands, such as DRIWR wetlands or other onsite and nearby wetlands. Accordingly, the NRC staff concludes that construction impacts would be MODERATE to LARGE.
Operation of an IGCC facility would likely not incur additional land use changes; therefore, operational impacts would be SMALL.

Overall, impacts of an IGCC alternative on land use would be MODERATE to LARGE during construction and would be SMALL during operation.

4.2.4.2 Visual Resources

Visual resource impacts for an IGCC facility would be similar in type and magnitude to those discussed for the NGCC alternative in Section 4.2.3.2 and would include temporary impacts during construction from tall pieces of construction equipment and visual impacts during operation from cooling tower plumes. The NRC staff concludes that these impacts on visual resources would be SMALL during both construction and operation of an IGCC alternative.

4.2.5 New Nuclear Alternative

4.2.5.1 Land Use

Like the NGCC and IGCC alternatives, this alternative assumes that DTE would build a new nuclear facility at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. The facility would require an estimated 301 ac (122 ha) of land. Although the land requirement for the new nuclear alternative is not as large as that for the IGCC facility, this alternative would still require DTE to obtain additional parcels of land adjacent to the existing site. Additional offsite land would be required for uranium mining, although this impact would result in no net change in land use impacts from those that would be associated with the proposed license renewal of Fermi 2.

During construction, the use of the existing site would maximize availability of existing infrastructure. However, as with the IGCC alternative, construction of this alternative would likely significantly affect surrounding natural areas on the site and within purchased land parcels. Although the NRC (2013a) has previously determined that construction of a new nuclear plant on the Fermi site (the proposed Fermi 3) would result in SMALL impacts to land use, the new nuclear alternative considered here represents an additional disturbance to the Fermi site because the footprints of the proposed Fermi 3 and this new nuclear alternative are assumed not to overlap. This alternative would likely intensify the effects to the DRIWR lands, prime farmland, wetlands, and other natural areas described for the NGCC alternative in Section 4.2.3.1. Construction would likely noticeably alter land uses, and the large area of land required for the new nuclear facility could destabilize important attributes of sensitive lands, such as DRIWR wetlands or other onsite and nearby wetlands. Accordingly, the NRC staff concludes that construction impacts would be MODERATE to LARGE.

Operation of a new nuclear facility would incur impacts similar to those assessed for the proposed Fermi 2 license renewal, which the NRC concludes, in Section 4.2.1, would be SMALL.

Overall, impacts of a new nuclear alternative on land use would be MODERATE to LARGE during construction and would be SMALL during operation.

4.2.5.2 Visual Resources

Visual resource impacts for a new nuclear facility would be similar in type and magnitude to those discussed for the proposed Fermi 2 license renewal, which the NRC staff concludes, in Section 4.2.1, would be SMALL. Additional temporary visual impacts would occur during construction from tall pieces of construction equipment. These impacts would also be SMALL.

4.2.6 Combination Alternative (NGCC, Wind, and Solar)

4.2.6.1 Land Use

The NGCC component of the combination alternative would have the same land requirements as discussed for the NGCC alternative in Section 4.2.3.1. Accordingly, the impacts to land use would be similar to those concluded for the NGCC alternative and, therefore, would be MODERATE during construction and would be SMALL during operation.

The wind component of this alternative would require an estimated 1,117 to 3,351 ac (452 to 1,356 ha) of land at onshore wind farm sites across the region of influence (ROI). However, the majority of this land would only be temporarily disturbed during construction. Permanently disturbed land would hold the wind turbines, access roads, and transmission lines. Land used for equipment laydown and turbine component assembly and erection could be returned to its original state. Given the large footprint of the wind component, land use could be affected, although some land uses, such as agriculture, could continue once the wind turbines are operational. Land use impacts for the wind component would range from SMALL to MODERATE depending on the amount and types of land that would be affected by wind turbine construction.

The solar component would require an estimated 3,577 ac (1,448 ha) of land across the ROI. The majority of solar installations could be installed on building roofs at existing residential, commercial, or industrial sites or at larger standalone solar facilities; therefore, only a little land would possibly be required for construction. However, the exact magnitude of impacts on land use would depend on the amount of land that must be converted for construction of solar installations. Unlike wind power, solar-powered installations often cannot be collocated with existing land uses (such as in crop-producing agricultural fields). The impacts of the solar component of this alternative on land use would range from SMALL to MODERATE depending on the amount and types of land that would be affected by construction of the solar installations.

The NRC staff concludes that the overall impacts of the combination alternative on land use would be SMALL to MODERATE. This range is primarily the result of the NGCC construction impacts on sensitive natural areas and the variability in land required for the wind and solar components.

4.2.6.2 Visual Resources

Visual resource impacts for the NGCC component of this alternative would be similar to those described in Section 4.2.3.2 for the NGCC alternative and, therefore, would be SMALL. Visual resources would be significantly affected by construction of the wind component. Although specific effects would vary based on the topography and remoteness of the wind turbine locations, the visual impact of wind energy is often one of the most significant energy-granting visual impacts and could range from MODERATE to LARGE. The visual impacts of the solar component would also vary based on the topography of the area, but the NRC expects these impacts to be minimal because individual solar installations are not tall or expansive, and many of the installations could be constructed on building roofs at existing residential, commercial, or industrial sites. Larger standalone solar facilities could have a greater visual impact depending on the location, but the impacts of the solar component would likely be SMALL overall. The NRC concludes that the impacts of the combination alternative on visual resources would be SMALL to LARGE. This range is primarily the result of the potential visual impacts from the wind component of the alternative.

4.3 Air Quality and Noise

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on air quality and noise conditions.

4.3.1 Proposed Action

4.3.1.1 Air Quality

Section 3.3 describes the meteorological, air quality, and noise conditions in the vicinity of Fermi 2. Two Category 1 air quality issues are applicable to Fermi 2: (1) air quality impacts (all plants) and (2) air quality effects of transmission lines (Table 4–2). There are no Category 2 issues for air quality. The Category 1 issue, air quality effects of transmission lines, considers the production of ozone and oxides of nitrogen; the GEIS found that minute and insignificant amounts of ozone and nitrogen oxides (NO_x) are generated during the transmission of power to the nuclear plant from the grid. The Category 1 issue, air quality impacts (all plants), considers the air quality impacts from continued operation and refurbishment associated with license renewal.

Table 4–2. Air Quality and Noise

Issue	GEIS Section	Category
Air quality impacts (all plants)	4.3.1.1	1
Air quality effects of transmission lines	4.3.1.1	1
Noise impacts	4.3.1.2	1

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d

The NRC staff did not identify any new and significant information during the review of DTE's ER (DTE 2014a), the site audit, or the scoping process. As a result, the NRC did not identify any information or impacts related to these issues that would change the conclusions presented in the GEIS. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. The GEIS concludes that the impact level for each of these issues is SMALL.

4.3.1.2 Noise

One Category 1 noise issue is applicable to Fermi 2: noise impacts (Table 4-2). The 1996 GEIS (NRC 1996) concluded that noise was not a problem at operating plants and was not expected to be a problem at any nuclear plant during the license renewal term. The GEIS (NRC 2013d) did not identify new information that would alter this conclusion; therefore, impacts are expected to be SMALL. The NRC staff did not identify any new and significant information during the review of DTE's ER (DTE 2014a), the site audit, or the scoping process. As a result, the NRC did not identify any information or impacts related to this issue that would change the conclusions presented in the GEIS. Therefore, there are no impacts related to this issue beyond those discussed in the GEIS. The GEIS concludes that the impact level for this issue is SMALL.

4.3.2 No-Action Alternative

4.3.2.1 Air Quality

When the plant stops operating, there would be a reduction in emissions from activities related to plant operation, such as cooling towers, use of stationary combustion sources (e.g., such as diesel generators, auxiliary boilers, or combustion turbines), and vehicle traffic (e.g., workers and delivery). Activity from these air emission sources would not cease, but emissions would be lower. Therefore, if emissions decrease, the impact on air quality from shutdown of the Fermi 2 would be SMALL.

4.3.2.2 Noise

As discussed in Section 3.3.3 of this SEIS, the NRC staff found that the noise levels at nearby receptors from plant operation were a little higher than the U.S. Environmental Protection Agency's (EPA) guideline of 55 decibels on the A-weighted scale (dBA) day-night average sound intensity level (L_{DN}) but below the acceptable U.S. Department of Housing and Urban Development L_{DN} guideline of 65 dBA. When the plant stops operating, there will be a substantial reduction in noise from activities related to plant operation, such as the use of cooling towers, switchyard/transformers, stationary combustion sources (e.g., diesel generators, and auxiliary boilers), the firing range, and vehicle traffic (e.g., workers and deliveries). In other words, noise levels around the Fermi site would approach the background levels that existed before Fermi 2 was built. As activity from noise sources is reduced, the impact on ambient noise levels is not expected to be greater than that from operation of Fermi 2; therefore, impacts would be SMALL.

4.3.3 NGCC Alternative

4.3.3.1 Air Quality

As discussed in Section 2.3.1, the NRC staff evaluated an NGCC alternative that consists of three 400-megawatt (MW) units for a total of 1,200 MW. The NGCC alternative would be located at the Fermi site in Monroe County, Michigan. Some infrastructure upgrades may be necessary and would require construction of a new or upgraded pipeline to deliver natural gas. Section 3.3 characterizes air quality environment surrounding the Fermi site. Monroe County is designated a maintenance area for the 1997 8-hour ozone standard and 1997 and 2006 $PM_{2.5}$ standard for particulate matter (PM) with a diameter of less than 2.5 micrometers (μm).

Construction

Construction of the NGCC plant would result in short-term impacts on local air quality. Construction-related activities, including earthmoving and vehicular traffic, will generate fugitive dust that will result in localized suspended particulate matter.[13] The operation of internal combustion engines in construction vehicles and equipment, delivery vehicles, and vehicles used by the commuting construction workforce will release various criteria pollutants, including carbon monoxide (CO), nitrogen oxides, sulfur oxides (SO_x), PM, volatile organic compounds (VOCs), and various greenhouse gases (GHGs). Air emissions would be intermittent and would vary based on the level and duration of a specific activity throughout the construction phase. Gas-fired power plants are constructed relatively quickly; construction lead times for NGCC

[13] PM_{10} refers to particulate matter with a diameter of less than 10 μm. $PM_{2.5}$ refers to particulate matter with a diameter of less than 2.5 μm.

plants are approximately 2 to 3 years (OECD/NEA 2005; EIA 2011). Various mitigation techniques could be used to minimize air emissions and to reduce fugitive dust. Because air emissions from construction activities would be limited, local, and temporary (short construction lead time), the NRC staff concludes that the associated air quality impacts from construction would be SMALL.

Operation

Operation of the NGCC plant would result in emissions of criteria pollutants, including carbon dioxide (CO_2), nitrogen oxides, sulfur oxides, and PM. The sources of air emissions during operation include gas turbines through heat recovery steam generator (HRSG) stacks and mechanical-draft cooling towers.

Emissions for the NGCC alternative were estimated using emission factors developed by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) NGCC analysis (NETL 2010). Assuming a total gross capacity of 1,200 MW and capacity factor of 0.85, the NRC staff estimates the following air emissions for an NGCC alternative plant:

- sulfur oxides—4 tons (13 metric tons (MT)) per year,
- nitrogen oxides—300 tons (272 MT) per year,
- carbon monoxide—30 tons (28 MT) per year,
- PM_{10}—21 tons (20 MT) per year, and
- carbon dioxide equivalents[14] (CO_{2eq})—3.9 million tons (3.5 million MT) per year.

Operation of the mechanical-draft cooling tower will also result in additional particulate matter emissions above those presented above. Additional emissions will also be associated with worker vehicles commuting to and from the plant.

A new NGCC plant would qualify as a major-emitting industrial facility and would be subject to a New Source Review (NSR) under the Clean Air Act of 1970, as amended (CAA) (42 U.S.C. 7651 et seq.), to ensure that air emissions are minimized and that the local air quality is not substantially degraded (EPA undated(a)). The NGCC plant would need to comply with the standards of performance for stationary combustion turbines set forth in Subpart KKKK of Title 40 of the *Code of Federal Regulations* (40 CFR) Part 60. Subpart P of 40 CFR Part 51.307 contains the visibility protection regulatory requirements, including review of the new sources that may affect visibility in any Federal Class I area. As discussed in Section 3.3.2, the nearest Class I Federal area for visibility protection is the Otter Creek Wilderness, which is about 269 miles (mi) (432.9 kilometers (km)) from the Fermi site. The EPA recommends that sources located within 62 mi (100 km) of a Class I area be modeled to consider adverse impacts (EPA 1992). Considering the distance to the nearest Class I area, operation of the NGCC alternative at the Fermi site is not likely to adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) at the nearest Class I area.

A new NGCC plant would also have to comply with Title IV of the CAA's reduction requirements for sulfur oxides and nitrogen oxides, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum sulfur oxide and nitrogen oxide

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[14] CO2eq is a metric used to compare the emissions of GHG based on their global warming potential (GWP), which is a measure used to compare how much heat a GHG traps in the atmosphere. GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_{2eq} is obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of methane (CH_4) is estimated to be 21; therefore, 1 ton (0.9 MT) of methane emission is equivalent to 21 tons (19 MT) of carbon dioxide emissions.

emission rates from existing plants and a system of sulfur oxide emission allowances that can be used, sold, or saved for future use by new plants.

More recently, EPA has issued additional rules and requirements that apply to certain fossil fuel-based power plants, such as NGCC generation. The new plant would be subjected to the continuous monitoring requirements of sulfur dioxide and nitrogen oxides as specified in 40 CFR Part 75. The Cross-State Air Pollution Rule (CSAPR) requires states (including Michigan) to significantly improve air quality by reducing power plant emissions that contribute to ozone and particulate matter in other states. CSAPR requires states to reduce annual sulfur dioxide emissions and nitrogen oxide emissions to attain the 1997 ozone and fine particle and 2006 fine particle National Ambient Air Quality Standards (NAAQS). A new NGCC plant would be subject to these additional rules and regulations.

The NGCC alternative would emit approximately 3.9 million tons (approximately 3.5 million MT) of CO_{2eq} per year. The carbon capture and storage (CCS) method would be used to reduce carbon dioxide by up to 90 percent; however, it would also decrease the power production capacity of an NGCC plant by up to 15 percent (NETL 2013). The plant would be subjected to the continuous monitoring requirements for carbon dioxide, as specified in 40 CFR Part 75. In May 2010, EPA issued the GHG Tailoring Rule establishing a process to permit GHG emission under Prevention of Significant Deterioration (PSD) and Title V Programs (75 FR 31514). On July 12, 2012, EPA[15] issued the third step of the final rule tailoring the criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V Programs of the CAA (Volume 77 of the *Federal Register*, page 41051 (77 FR 41051)). Operating permits issued to major sources of GHGs under the PSD or Title V Programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons of CO_{2eq} per year. If the NGCC alternative meets PSD or Title V permitting requirements for non-GHG pollutant emissions and the GHG emission thresholds established in the rule, GHG emissions from this alternative would be regulated under the PSD and Title V Programs.

On January 8, 2014, EPA issued a new proposal for GHG emissions from new fossil fuel-fired electric utility steam generating units (79 FR 1430). It also proposes standards of performance for natural gas-fired stationary combustion turbines based on modern, efficient NGCC technology as the best system of emission reduction. In response to the Consolidated Appropriations Act of 2008 (Public Law 110-161), EPA issued final mandatory GHG reporting regulations for major sources effective in December 2009 (EPA 2012b). For the purposes of GHG reporting, major sources are defined as those emitting more than 25,000 MT of CO_{2eq} for all GHGs per year. An NGCC alternative would be subject to these reporting regulations with or without carbon capture.

As noted above, a new NGCC plant would be subject to several EPA regulations designed to minimize air quality impacts from operations. Estimated carbon monoxide, sulfur oxides, and particulate matter emissions would not exceed the threshold for major sources (100 tons per year). However, the impacts from nitrogen oxide emissions would be significant and subject to

[15] On June 23, 2014, the U.S. Supreme Court issued a decision that EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or Title V permit, but could continue to require PSD and Title V permits, otherwise required based on emissions of conventional pollutants. On July 2014, EPA issued a memorandum in response to the U.S. Supreme Court's decision and acknowledged that, although the decision is pending judicial action, EPA will no longer require PSD or Title V permits for GHG-emitting sources that are not sources subject to PSD or Title V permits based on emissions of conventional pollutants (e.g., nitrogen oxides and carbon monoxide) (EPA 2014a).

a Title V permit requirement. Nitrogen oxides are an ozone precursor for which Monroe County is currently a designated maintenance area and can contribute to violation of NAAQS. Furthermore, GHG emissions would be noticeable and significant; carbon dioxide emissions would be much larger than the threshold in EPA's GHG Tailoring Rule. The NRC staff concludes that the overall air quality impacts associated with operation of an NGCC alternative would be SMALL to MODERATE.

4.3.3.2 Noise

As discussed in Section 2.3.1, the NRC staff evaluated an NGCC alternative that consists of three 400-MW units for a total of 1,200 MW. The NGCC alternative would be located at the Fermi site in Monroe County outside the Fermi 2 and proposed Fermi 3 footprints. Section 3.3 characterizes the noise environment surrounding the Fermi site. Continuous offsite noise measurements surrounding the Fermi site resulted in L_{DN} that ranged between 54 and 63 dBA (DECo 2011). Furthermore, offsite hourly equivalent sound intensity level (L_{eq}) measurements were the greatest between 10 a.m. and 2 p.m., ranging between 52 dBA and 70 dBA, and were the lowest between 11 p.m. and 3 a.m., ranging between 36 and 48 dBA (DECo 2011).

Construction

Construction of an NGCC plant is similar to that of other large industrial projects. Several factors, including source-receptor configuration, land cover, meteorological conditions (e.g., temperature, relative humidity, and vertical profiles of wind and temperature), and screening (e.g., topography and natural or manmade barriers) affect noise propagation to receptors. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities would take place, during the construction of an NGCC plant. Other noise sources include commuter, delivery, and support vehicular traffic traveling within, to, and from the facility.

Offsite continuous noise measurements surrounding the Fermi site resulted in L_{DN} between 54 and 63 dBA. Furthermore, hourly L_{eq} measurements surrounding Fermi were the greatest between 10 a.m. and 2 p.m., ranging between 52 dBA and 70 dBA, and were the lowest between 11 p.m. and 3 a.m., ranging between 36 and 48 dBA (DECo 2011). Construction vehicles and equipment associated with the construction of the NGCC plant would generate noise; these impacts would be intermittent and last only through the duration of plant construction (2 to 3 years). Noise emissions from common construction equipment would be in the 85- to 100-dBA range (Knauer and Pedersen 2011); however, noise levels attenuate rapidly with distance. For instance, at a 1,000-foot (ft) (300-meter (m)) distance from construction equipment with a sound strength of 85 to 90 dBA, noise levels drop to 59 to 69 dBA. At a 0.5-mi (0.8-km) distance from the construction noise source/equipment, noise levels drop to 51 to 61 dBA (NRC 2002b). Although the layout and the distance from primary construction noise sources to the nearby receptors are unknown, the additional noise levels from construction related activities are not expected to be noticeable given current noise levels surrounding Fermi. Additionally, noise abatement and controls can be incorporated to reduce noise impacts. Furthermore, construction activities must be in accordance with the Frenchtown Charter Township Noise Ordinance (Ordinance No. 184) (FTC 1988), which prohibits excessive or loud noise and disturbance.

The NRC staff concludes that construction-related noise impacts associated with the NGCC alternative would be SMALL.

Operation

Noise sources from operations of the NGCC alternative would include the cooling tower, transformers, turbines, pumps, compressors, exhaust stack, the combustion inlet filter house, condenser fans, high-pressure steam piping, and vehicles (Saussus 2012). Pipelines delivering natural gas fuel could be audible off site near gas compressor stations. Most noise-producing equipment is located inside the power block buildings and no outside fuel-handling activities will occur. Minor offsite noise sources could be pipeline compressor stations. The NRC staff does not expect noise impacts for the NGCC alternative to be any greater than that analyzed for Fermi 2. The NRC staff concludes that operation-related noise impacts from the NGCC alternative would be SMALL.

4.3.4 IGCC Alternative

4.3.4.1 Air Quality

As discussed in Section 2.2.2.2, the NRC staff evaluated an IGCC plant alternative that would consist of two 618-MW units for a total 1,236 MW. The IGCC alternative would be located at the Fermi site in Monroe County. Section 3.3.2 characterizes the air quality environment surrounding the Fermi site. Monroe County is designated a maintenance area for the 8-hour ozone 1997 standard and $PM_{2.5}$ 1997 and 2006 standard.

Construction

Construction of an IGCC plant would be similar to that of other large industrial projects. Construction-related activities and associated emissions (i.e., criteria pollutants, VOCs, hazardous air pollutants (HAPs), and GHGs) would be similar as those described for the NGCC alternative. Air emissions would be intermittent and would vary based on the level and duration of a specific activity throughout the construction phase. Construction lead times for IGCC plants are estimated to be 3 years (NETL 2007). Impacts would be localized, intermittent, and short lived, and adherence to well-developed and well-understood construction best management practices (BMPs) would mitigate such impacts. The NRC staff concludes that construction-related impacts on air quality from an IGCC alternative would be of relatively short duration and would be SMALL.

Operation

Operation of the IGCC plant would result in emissions of criteria pollutants, including carbon dioxide, nitrogen oxides, sulfur oxides, and PM. The sources of air emissions during operation include HRSG stacks, wet gas sulfuric acid system exhaust, acid gas removal process startup/shutdown vents, startup stacks, flares, material-handling equipment, and mechanical draft cooling towers (DOE 2010). The HRSG stacks would release the most emissions. Auxiliary boilers and firewater pumps would also generate emissions on an infrequent basis.

Compared to conventional coal-fired power plants, the proposed IGCC power plant would reduce sulfur dioxide, nitrogen oxides, mercury, and particulate matter emissions by removing constituents from the synthesis gas (syngas) (i.e., gasifiers convert coal into a gas) (DOE 2010). The IGCC alternative would also result in lower nitrogen oxide emissions because nearly 100 percent of the fuel-bound nitrogen from the syngas would be removed from the syngas before combustion in the gas turbine. Sulfur removal technology would remove more than 99 percent of the sulfur in the syngas. The use of sulfide-activated carbon could remove more than 92 percent of mercury from the syngas. More than 99.9 percent of particulate matter emissions would be removed from the syngas using high-temperature, high-pressure filtration.

Emissions for an IGCC plant were estimated using emission factors presented in Table 4.3-1 in the GEIS (NRC 2013d). Assuming a total gross capacity of 1,236 MW, subbituminous coal, and capacity factor of 0.85, the NRC staff estimates the following air emissions for an IGCC alternative plant:

- sulfur dioxide—398 tons (360 MT) per year,
- nitrogen oxides—1,456 tons (1,320 MT) per year,
- PM_{10}—232 tons (210 MT) per year,
- carbon monoxide—992 tons (900 MT) per year, and
- carbon dioxide—6.9 million tons (6.2 million MT) per year.

Operation of the mechanical-draft cooling tower will also result in additional particulate matter emissions above those presented above. Additional emissions will also be associated with worker vehicles commuting to and from the plant.

Various Federal and state regulations aimed at controlling air pollution would affect an IGCC alternative. A new IGCC plant would qualify as a new major source because of its potential to emit greater than 100 tons (91 MT) per year of criteria pollutants, and it would be subject to the NSR Permitting Program requirements under the CAA (EPA undated(a)). An NSR permit or construction permit would specify emission limits for each pollutant, along with monitoring and reporting requirements, specifications for fuel and control equipment, and monitoring and performance testing. The new IGCC plant would be required to secure a Title V operating permit from the Michigan Department of Environmental Quality (MDEQ).

An NSR would limit emissions for criteria pollutants and would reflect existing ambient air quality at the site location. The IGCC alternative also would need to comply with the standard of performance for new stationary sources set forth in Subpart Da, “Standards of Performance for Electric Utility Steam Generating Units,” of 40 CFR Part 60. If the IGCC alternative were located close to a mandatory Class I area, additional air pollution control requirements would be necessary (Subpart P, “Protection of Visibility,” of 40 CFR Part 51) as mandated by the Regional Haze Rule. As discussed in Section 3.3.2, the nearest Class I Federal area for visibility protection is the Otter Creek Wilderness, about 269 mi (432.9 km) of the Fermi site. EPA recommends that sources located within 62 mi (100 km) of a Class I area be modeled to consider adverse impacts (EPA 1992). Considering the distance to the nearest Class I area, operation of the IGCC at the Fermi site is not likely to adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) at the nearest Class 1 area.

The IGCC plant would have to comply with Title IV of the CAA reduction requirements for sulfur dioxide and nitrogen oxides, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum sulfur dioxide and nitrogen oxide emission rates from the existing plants and a system of sulfur dioxide emission allowances that can be used, sold, or saved for future use by the new plants. The new plant would be subjected to the continuous monitoring requirements of sulfur dioxide and nitrogen oxides as specified in 40 CFR Part 75. The CSAPR requires states (including Michigan) to significantly improve air quality by reducing power plant emissions that contribute to ozone and particulate matter in other states. CSAPR requires states to reduce annual sulfur dioxide and nitrogen oxide emissions to assist in attaining the 1997 ozone and fine particle and 2006 fine particle NAAQS. A new IGCC plant would be subject to these additional rules and regulations.

The IGCC alternative would emit approximately 6.9 million tons (approximately 6.2 million MT) per year of carbon dioxide. The CCS could be used as a method to reduce carbon dioxide by up to 90 percent; however, it would also decrease the power production capacity of an IGCC plant by up to 17 percent (NETL 2013). The plant would be subjected to the continuous monitoring requirements for carbon dioxide, as specified in 40 CFR Part 75. In May 2010, EPA issued the GHG Tailoring Rule establishing a process to permit GHG emission under PSD and Title Programs. On July 12, 2012, EPA issued the third-step of the final rule tailoring the criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V Programs of the CAA (77 FR 41051). Operating permits issued to major sources of GHG under the PSD or Title V Programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons per year of CO_{2eq}. If the IGCC alternative meets PSD or Title V permitting requirements for non-GHG pollutant emissions and the GHG emission thresholds established in the rule, GHG emissions from this alternative would be regulated under the PSD and Title V Programs. In response to the Consolidated Appropriations Act of 2008, EPA issued final mandatory GHG reporting regulations for major sources effective in December 2009 (EPA 2012b). For the purposes of GHG reporting, major sources are defined as those emitting more than 25,000 MT per year of CO_{2eq} for all GHGs per year. An IGCC alternative would be subject to these reporting regulations with or without carbon capture. On January 8, 2014, EPA issued a new proposal for GHG emissions from new fossil fuel-fired electric utility steam generating units (79 FR 1430). It also proposes standards of performance for IGCC units that burn coal. The performance standards are based on partial implementation of the CCS method as the best system of emission reduction. Although the proposed rule has not been finalized, the IGCC alternative analysis includes an option for future implementation of the CCS method.

An IGCC alternative also would be subject to the Mercury and Air Toxics Standards (MATS) final rule, finalized by EPA on December 16, 2011 (77 FR 9304). Standards for emissions of heavy metals (mercury, arsenic, chromium, and nickel) and acid gases (hydrochloric acid and hydrofluoric acid) are set by MATS. Mercury is the most prominent HAP emitted and is subject to regulation by the MATS rule. New IGCC units are required to meet a mercury emission limit of 0.003 pound per gigawatt-hour (Subpart UUUUU of 40 CFR Part 63). The NRC staff estimates that an IGCC alternative replacing the electrical output of Fermi 2 would generate 0.01 ton (0.01 MT) of mercury per year.

Estimated criteria pollutants from operation of the IGCC alternative would exceed the threshold for major sources (100 tons per year). The impact from criteria pollutant emissions from the operation of the IGCC would be significant and would be subject to a Title V permit. Nitrogen oxides (precursors of ozone) and particulate matter are of particular concern because Monroe County is designated a maintenance area for ozone and PM; therefore, the pollutants can contribute to violation of NAAQS. The GHG emissions also would be noticeable and significant. The GHG emissions would be much larger than the threshold in EPA's GHG Tailoring Rule, and such emissions may be regulated under the PSD and Title V Programs. The NRC staff concludes that the air quality impacts associated with the operation of an IGCC alternative would be MODERATE.

4.3.4.2 Noise

As discussed in Section 2.2.2.2, the NRC staff evaluated an IGCC plant alternative that would consist of two 618-MW units for a total 1,236 MW. The IGCC alternative would be located at the Fermi site in Monroe County outside the Fermi 2 and proposed Fermi 3 footprints. Section 3.3.3 characterizes the noise environment surrounding the Fermi site. Continuous offsite noise measurements surrounding the Fermi site resulted in L_{DN} that ranged between 54 and 63 dBA (DECo 2011). Furthermore, offsite hourly L_{eq} measurements were the greatest between 10 a.m. and 2 p.m., ranging between 52 dBA and 70 dBA, and were the lowest between 11 p.m. and 3 a.m., ranging between 36 and 48 dBA (DECo 2011).

Construction

Construction of an IGCC plant is similar to that of other large industrial projects, and construction-related noise sources would be similar to those for construction of the NGCC alternative discussed above. Although the distance from construction-related noise sources to the nearby receptors are unknown, the additional noise levels from construction-related activities are not expected to be noticeable given current noise levels surrounding Fermi. Additionally, noise abatement and controls can be incorporated to reduce noise impacts. Furthermore, construction activities will need to be done in accordance with the Frenchtown Charter Township Noise Ordinance (Ordinance No. 184), which prohibits excessive or loud noise and disturbance. The NRC staff concludes that construction-related noise associated with the IGCC alternative would be SMALL.

Operation

Operation of an IGCC plant would introduce mechanical sources of noise that would be audible off site. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical-draft cooling towers. Intermittent sources include the equipment related to coal handling, solid waste disposal, transportation related to coal, and the commuting of plant employees. Noise levels from operation of the IGCC plant are expected to be similar to the noise levels from operation of Fermi 2. However, noise associated with the rail delivery of coal and lime/limestone would extend beyond the plant site boundary and would be most significant for residents living in the vicinity of the facility and along the rail route. Noise impacts associated with rail delivery are predicted to be in the 80- to 96-dBA range (NRC 2002b).

Transportation-related noise sources have the potential to have offsite noise impact because noise levels may be noticeable beyond current noise levels surrounding the Fermi site. The NRC staff concludes that the potential impacts of noise on residents in the vicinity of the alternative IGCC facility and the rail line are considered to range from SMALL to MODERATE, depending on the distance from primary noise sources to nearby sensitive receptors.

4.3.5 New Nuclear Alternative

4.3.5.1 Air Quality

This alternative includes the construction and operation of one economic simplified boiling water reactor (ESBWR) with an approximate generating capacity of 1,170 megawatt electric (MWe). The new nuclear alternative could be located at the Fermi site in Monroe County outside the Fermi 2 and proposed Fermi 3 footprints. Using an existing power plant site will maximize the use of existing infrastructure. Section 3.3.2 characterizes the air quality environment surrounding the Fermi site. Monroe County is designated a maintenance area for the 8-hour ozone 1997 standard and the $PM_{2.5}$ 1997 and 2006 standard.

Construction

Construction of the new nuclear plant would result in temporary impacts on local air quality. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling within, to, and from the facility. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicle traffic on unpaved surfaces, concrete batch plant operations, and wind erosion to a lesser extent. Air emissions include criteria pollutants (PM, nitrogen oxide, carbon monoxide, and sulfur dioxide), VOCs, HAPs, and GHGs. Small quantities of VOCs and HAPs emissions would be released from equipment refueling; organic solvents used in cleaning, onsite storage, and use of petroleum-based fuels; onsite maintenance of the heavy construction equipment; and certain painting and other construction-finishing activities.

Air emissions would be intermittent and would vary based on the level and duration of a specific activity throughout the construction phase. Construction lead times for nuclear plants are anticipated to be 7 years (NRC 2013f). DTE provided preconstruction and construction air emission estimates related to building Fermi 3 to assist the NRC in developing its conformity applicability analysis on whether a general conformity determination would be required under Subpart B, “Determining Conformity of General Federal Actions to State or Federal Implementation Plans,” of 40 CFR Part 93, for construction and operation of Fermi 3 (NRC 2013a). The NRC staff expects that construction-related emissions from the new nuclear alternative would be bounded by the estimates that DTE provided because they include emissions from preconstruction and construction activities of a new nuclear plant. Annual emissions would be bounded by the following:

- sulfur dioxide—0.4 tons (0.3 MT) per year,
- nitrogen oxides—123 tons (112 MT) per year,
- $PM_{2.5}$—70 tons (64 MT) per year,
- carbon dioxide—26,230 tons (23,800 MT) per year, and
- volatile organic carbons (VOCs)—53 tons (48 MT) per year.

The emissions presented above account for peak worker vehicle emissions, nonroad construction engines, and fugitive dust. Air emissions from construction activities are anticipated to be lower than those presented above because the estimates account of preconstruction activities. Furthermore, State and Federal permits and regulated practices for managing air emissions from construction equipment and temporary stationary sources, controlling fugitive dust, and developing vehicle inspection and traffic management plans can result in even lower emissions than those quantified above. The NRC staff developed an applicability analysis and determined that construction of Fermi 3 would not result in any exceedance of the emissions budget in the State implementation plan and will not contribute to violation of NAAQS (NRC 2013c). Therefore, the overall air quality impacts associated with construction of a new nuclear alternative would be SMALL.

Operation

Operation of a new nuclear generating plant would result in air emissions similar in magnitude to those of Fermi 2. Nuclear power plants do not burn fossil fuels to generate electricity. Sources of air emissions include stationary combustion sources (e.g., diesel generators and auxiliary boilers), natural-draft cooling towers, and mobile sources (e.g., worker vehicles, onsite heavy equipment and support vehicles, and delivery of materials and disposal of wastes). A new nuclear power plant would need to secure a permit from MDEQ for air pollutants emitted from stationary combustion sources (e.g., criteria pollutants, VOCs, HAPs, and GHGs) associated with its operations.

The NRC staff expects the air emissions for combustion sources from a new nuclear plant to be similar to those currently being emitted from Fermi 2, as follows:

- sulfur dioxide—2 tons (1.8 MT) per year,
- nitrogen oxides—47 tons (42 MT) per year,

- carbon monoxide—5 tons (4.5 MT) per year,
- PM_{10}—2 tons (1.8 MT) per year, and
- CO_{2eq}—10,250 tons (9,300 MT) per year.

In general, most stationary combustion sources at a nuclear power plant would operate only for limited periods, often for periodic maintenance testing. Thus, emissions from stationary combustion sources are expected to fall far below the threshold for major sources (100 tons (91 MT) per year) and the threshold for mandatory GHG reporting (27,558 tons (25,000 MT) per year of CO_{2eq}). Additional particulate matter would result from operation of a natural-draft cooling tower, and emissions are anticipated to be minimal and similar to Fermi 2 emissions for PM_{10}, which is approximately 0.10 tons (0.09 MT) per year (DTE 2014a, 2014c). Additional emissions will also be associated with worker vehicles commuting to and from the plant.

Estimated operational emissions for criteria pollutants would be below the 100-tons- (91-MT)-per-year threshold for major sources, and GHG emissions will be below 25,000 MT) per year. Therefore, air emissions from operation of a new nuclear alternative are not expected to contribute to NAAQS violations. The NRC staff concludes that the impacts of operation of a new nuclear alternative on air quality from the emissions of criteria pollutants and GHGs would be SMALL.

4.3.5.2 Noise

This alternative includes the construction and operation of one ESBWR with an approximate generating capacity of 1,170 MWe. The new nuclear alternative would be located at the Fermi site in Monroe County outside the Fermi 2 and proposed Fermi 3 footprints. Section 3.3.3 characterizes the noise environment surrounding the Fermi site. Offsite continuous noise measurements surrounding the Fermi site resulted in L_{DN} between 54 and 63 dBA (DECo 2011). Furthermore, hourly L_{eq} measurements surrounding Fermi were the greatest between 10 a.m. and 2 p.m., ranging between 52 dBA and 70 dBA, and were the lowest between 11 p.m. and 3 a.m., ranging between 36 and 48 dBA (DECo 2011).

Construction

Construction of a new nuclear power plant is similar to that of other large industrial projects and involves many noise-generating activities. In general, noise emissions vary with each phase of construction, depending on the level of activity, the mix of construction equipment for each phase, and site-specific conditions. Several factors, including source-receptor configuration, land cover, meteorological conditions (e.g., temperature, relative humidity, and vertical profiles of wind and temperature), and screening (e.g., topography, and natural or manmade barriers), affect noise propagation to receptors. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities would take place, during the construction of a new nuclear power plant. Other noise sources include commuter, delivery, and support vehicular traffic traveling within, to, and from the facility.

During the construction phase, a variety of construction equipment would be used for varying durations. Noise levels from construction equipment are predicted to be in the 85- to 100-dBA range (Knauer and Pedersen 2011); however, noise levels attenuate rapidly with distance. For instance, at a 1,000-ft (300-m) distance from construction equipment with a sound strength of 85 to 90 dBA, noise levels drop to 59 to 69 dBA. At a 0.5-mi (0.8-km) distance from the construction noise source/equipment, noise levels drop to 51 to 61 dBA (NRC 2002b). The maximum hourly L_{eq} resulting from operation of Fermi 3 was estimated to be 67 dBA at 300 meters (1,000 ft.) away from the construction area (DECo 2011; NRC 2013a), which is below current L_{eq} noise levels surrounding Fermi. Although the distance from primary construction-related noise sources of a new a nuclear alternative to the nearby receptors are unknown, the additional noise levels from construction-related activities are not expected to be noticeable given current noise levels surrounding Fermi. Additionally, noise abatement and controls can be incorporated to reduce noise impacts. Furthermore, construction activities must be in accordance with the Frenchtown Charter Township Noise Ordinance (Ordinance No. 184), which prohibits excessive or loud noise and disturbance.

Based on the temporary nature of construction activities, consideration of noise attenuation from the construction site to residences, and good noise control practices, the NRC staff concludes that the potential noise impacts of construction activities from a new nuclear alternative would be SMALL.

Operation

During the operation phase, noise sources from the new nuclear power plant would include the cooling tower; transformers; turbines; other auxiliary equipment, such as standby generators or auxiliary boilers; and vehicular traffic (e.g., commuting, delivery, and support), similar to the Fermi 2 noise sources discussed in Section 3.3.3 of this SEIS. As discussed in Section 3.3.3., continuous measurements surrounding the Fermi site resulted in L_{DN} between 54 and 63 dBA. Therefore, noise levels from the new nuclear power plant may exceed EPA's guideline L_{DN} of 55 dBA, but they may be less than the U.S. Department of Housing and Urban Development's acceptable noise level guideline L_{DN} of 65 dBA.

Modeled L_{DN} for operation of Fermi 3 ranged between 54 and 63 dBA at three nearby noise-sensitive receptors, indicating no increase over existing L_{DN} surrounding Fermi (DECo 2011; NRC 2013a). Although the new nuclear plant layout and the distance from primary noise sources are unknown, the NRC staff does not expect noise impacts for a new nuclear plant to be any greater than those analyzed for the existing Fermi 2. Therefore, the noise impacts of a new nuclear plant would be SMALL.

4.3.6 Combination Alternative (NGCC, Wind, and Solar)

4.3.6.1 Air Quality

The combination alternative relies on NGCC-, wind-, and solar-generating capacity. This alternative includes the construction and operation of one 400-MW NGCC plant, a total wind capacity of 2,000 MW, and total installed solar photovoltaic (PV) capacity of 1,052 MW. The NGCC component would be located at the Fermi site (in Monroe County) to maximize use of available infrastructure and to reduce any disruption to the land. Monroe County is designated a maintenance area for the 8-hour ozone 1997 standard and $PM_{2.5}$ 1997 and 2006 standard. The wind and solar components of the combination alternative would be located elsewhere within DTE service area, an 11-county region in southeastern Michigan. Because the wind and solar components of the combination alternative would be located elsewhere within DTE service area, it is unknown at this time whether the specific site(s) would be located within a designated attainment area.

Construction

Air emissions associated with the construction of the NGCC portion of the combination alternative are similar to the NGCC alternative. As discussed in Section 4.3.3, construction activities for an NGCC alternative would cause some temporary impacts to air quality from dust generation during operation of the earthmoving and material-handling equipment and exhaust emissions from worker vehicles and construction equipment. These emissions include criteria pollutants, VOCs, GHGs, and small amounts of HAPs. However, these impacts would be localized, intermittent, and short lived, and adherence to well-developed and well-understood construction BMPs would mitigate such impacts. The NRC staff concludes that construction-related impacts on air quality from an NGCC portion of the combination alternative would be of relatively short duration and would be SMALL.

For the wind portion of the combination alternative, only a small percentage of site land (5 to 10 percent) would be disturbed by construction activities because wind turbines need to be separated from one another to maximize energy production and to avoid wake turbulences created by upwind turbines. Construction of the wind portion of the combination alternative would involve a number of activities, including road and staging/laydown area construction, land clearing, topsoil stripping, earthmoving operations, grading, ground excavation, drilling, foundation treatment, wind turbine erection, ancillary building/structure construction, and electrical and mechanical installation. For most wind energy facilities, the site preparation phase would last for only a few months, followed by a year-long construction phase (depending on size of the wind energy facility) (Tegen 2006). Air emissions associated with construction activities result from fugitive dust from soil disturbances and engine exhaust from heavy equipment and vehicular traffic. These emissions include criteria pollutants, VOCs, GHGs, and HAPs. Dust suppression methods and other mitigation measures could reduce impacts from fugitive dust. The wind portion of the combination alternative would not have a power block building requiring intensive construction and excavation activities. Accordingly, the number of heavy equipment and workforce, level of activities, and construction duration would be substantially lower than that for the other alternatives. Therefore, the NRC staff concludes that the overall air quality impacts associated with construction of the wind portion of the combination alternative would be SMALL.

Construction of the solar portion of the combination alternative would cause temporary impacts to air quality from fugitive dust from soil disturbances and engine exhaust from heavy equipment and vehicular traffic. Air emissions associated with construction activities include criteria pollutants; VOCs; GHGs; and, to a lesser extent, HAPs. Dust suppression methods and other mitigation measures could reduce impacts from fugitive dust. The solar PV portion of the combination alternative would also not require a power block building. Accordingly, the number of heavy equipment and workforce, level of activities, and construction duration would be substantially lower than that for other alternatives. Therefore, the NRC staff concludes that the overall air quality impacts associated with construction of the solar PV portion of the combination alternative would be SMALL.

Operation

Air emissions associated with the operation of the NGCC portion of the combination alternative are similar to those associated with the NGCC alternative in Section 4.3.3, but these emissions are reduced proportionally because its electricity output is approximately 33 percent of that of the NGCC alternative.

Emissions for a NGCC plant were estimated using emission factors developed by the DOE's NETL life-cycle NGCC analysis (NETL 2010). Assuming a total gross capacity of 400 MW and a capacity factor of 0.85, the NRC staff estimates the following air emissions for an NGCC alternative plant:

- sulfur dioxide—5 tons (4 MT) per year,
- nitrogen oxides—100 tons (90 MT) per year,
- PM_{10}—7 tons (6 MT) per year,

- carbon monoxide—10 tons (9 MT) per year, and
- CO_{2eq}—1.3 million tons (1.2 million MT) per year.

Annual emissions of nitrogen oxides would exceed the major source threshold and the threshold for mandatory GHG reporting (25,000 MT (27,558 tons) CO_{2e}q per year). Nitrogen oxides are an ozone precursor for which Monroe County is currently a designated maintenance area and can contribute to violation of NAAQS. Therefore, overall air quality impacts associated with operation of the NGCC portion of the combination alternative would be SMALL to MODERATE.

Emissions from the operation of wind energy facilities would include minor dust and engine exhaust emissions from vehicles and heavy equipment associated with site inspections, maintenance activities, and wind erosion from cleared land and access roads. There would be no direct emissions from operation of the wind portion of this alternative. The NRC staff concludes that the overall air quality impacts associated with the operation of the wind portion of the combination alternative would be SMALL.

In general, air emissions associated with the operation of solar energy facilities are negligible because no fossil fuels are burned to generate electricity. Emissions from solar fields would include fugitive dust and engine exhaust emissions from vehicles and heavy equipment associated with site inspections, maintenance activities (panel washing or replacement), and minor wind erosion from cleared lands and access roads. These emissions should not cause exceedances of air quality standards or should not have any impacts on climate change. There would be no direct emissions from operation of the solar component of the alternative. The NRC staff concludes that the overall air quality impacts associated with the operation of the solar PV portion of the combination alternative would be SMALL.

The overall air quality impacts associated with construction and operation of the combination alternative would be SMALL to MODERATE.

4.3.6.2 Noise

As discussed in Section 2.3.4, the NGCC portion of the combination alternative would be located at the Fermi site in Monroe County outside the Fermi 2 and proposed Fermi 3 footprints. Section 3.3.3 characterizes the noise environment surrounding the Fermi site. Offsite continuous noise measurements surrounding the Fermi site resulted in L_{DN} between 54 and 63 dBA (DECo 2011). Furthermore, hourly L_{eq} measurements surrounding Fermi were the greatest between 10 a.m. and 2 p.m., ranging between 52 dBA and 70 dBA, and were the lowest between 11 p.m. and 3 a.m., ranging between 36 and 48 dBA (DECo 2011). The wind and solar portion of the combination alternative would be located elsewhere within the DTE service area and the noise environmental will depend on the specific site location.

Construction

The construction-related noise sources for the NGCC portion of the combination alternative would be similar to those for construction of the NGCC alternative. The construction period for the NGCC portion would be shorter, and the level of construction activities would be less extensive than the NGCC alternative. Consequently, the NRC staff concludes that construction-related noise associated with the NGCC portion of the combination alternative would be SMALL.

Construction of the wind portion of the combination alternative would involve a number of activities, as described in Section 4.3.6.1 above. Noise levels to nearby receptors will depend on the distance from primary noise sources to the nearby receptors. Because the wind portion of the combination alternative would have no power block building requiring construction, the number of heavy equipment and workforce, level of activities, and construction duration would be substantially lower than that for the other alternatives. Considering these factors, the NRC staff concludes that construction-related noise associated with the wind portion of the combination alternative would be SMALL.

Construction of the solar PV portion of the combination alternative would involve a number of activities. Noise levels to nearby receptors will depend on the distance from primary noise construction-related sources to the nearby receptors. The solar PV portion of the combination alternative would also not require construction of a power block building. Thus, the intensity and duration of construction activities would be substantially lower than they would be for other alternatives. Considering these factors, the NRC staff concludes that construction-related noise associated with the solar PV portion of combination alternative would be SMALL.

Operation

Operation of the NGCC portion of the combination alternative would be virtually the same as operation of the NGCC alternative, as described in Section 4.3.3.1. Noise sources will include the power block area, cooling tower, and vehicular traffic. Most noise-producing equipment is located inside the power block buildings, and no outside fuel-handling activities would occur. Minor offsite noise sources could be pipeline compressor stations. Although the plant layout and the distance from primary noise sources to the nearby receptors is unknown, the NRC staff does not expect noise impacts for the NGCC portion of the combination alternative to be any greater than those analyzed for the existing Fermi 2. Therefore, the NRC staff concludes that operation-related noise from the NGCC portion of the combination alternative would be SMALL.

Noise impacts from wind generation operations would include aerodynamic noise from the turbine rotors and mechanical noise from the turbine drivetrain components. Noise levels are dependent on the wind and atmospheric conditions, which vary with time, and on site-specific conditions, including the number and size of wind turbines, their layout and distance to nearby sensitive receptors, land cover, and topography. Wind turbine noise levels can reach 105 dBA; however, studies show that, at approximately 1,000 ft (300 m) from a wind turbine, noise levels can fall to 43 dBA (GE 2010; Hessler 2011). Unless noise from wind turbines is masked by high background levels (e.g., near major highways or industrial complexes), it can be noticeable and annoying at farther distances. One study indicated that, for the same A-weighted sound level, a proportion of the individuals who were surveyed reported being more annoyed by wind turbine noise than by other community noise, such as aircraft, road, or railway traffic (Pedersen and Persson Waye 2004). Therefore, the NRC staff concludes that operation-related noise from the wind portion of the combination alternative would be SMALL to MODERATE, depending on the layout and location of the wind facility and its distance to nearby sensitive receptors.

The solar PV portion of the combination alternative would have no power block building and cooling towers; therefore, only a minimal number of noise sources with low-level noises would be present. Noise sources include small-scale cooling systems to dissipate heat from solar module assemblies, solar tracking devices, inverters, transformers, and vehicle traffic for maintenance and inspection. Because of minimal noise-generating activities, noise from a solar PV facility is expected to be inaudible or barely perceptible at the facility boundaries. Considering the minimum number of sources with low-noise levels and the relative size of the solar PV facility, the NRC staff concludes that operation-related noise from the solar PV portion of the combination alternative would be SMALL.

The noise impacts associated with construction and operation of the combination alternative would be SMALL to MODERATE.

4.4 Geologic Environment

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on geologic and soil resources.

4.4.1 Proposed Action

Table 4–3 identifies issues related to geology and soils that are applicable to Fermi 2 during the renewal term. Section 3.4 describes the local and regional geologic environment of the Fermi site.

Table 4–3. Geology and Soils Issues

Issue	GEIS Section	Category
Geology and Soils	4.4.1	1

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d

The NRC staff did not identify any new and significant information associated with the Category 1 geology and soils issue identified in Table 4–3 during the review of the applicant's ER, the site audit, the scoping process, or the evaluation of other available information. As a result, no information or impacts related to these issues were identified that would change the conclusions presented in the GEIS. For these geology and soil issues, the GEIS concludes that the impacts are SMALL (NRC 2013d). It is expected that there would be no incremental impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS, and, therefore, the impacts associated with these issues by the proposed action would be SMALL.

4.4.2 No-Action Alternative

There would not be any impacts to the geology and soils at the Fermi site with shutdown of the facility. With the shutdown of the facility, no additional land would be disturbed. Therefore, impacts would be SMALL.

4.4.3 NGCC Alternative

For this alternative, the impacts on geology and soil resources would occur during construction and no additional land would be disturbed during operations. During construction, sources of aggregate material, such as crushed stone and sand and gravel, would be required to construct buildings, foundations, roads, and parking lots. The NRC staff assumes that these resources would be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces would expose soils to erosion and alter surface drainage. BMPs would be implemented in accordance with applicable permitting requirements to reduce soil erosion. These practices would include the use of sediment fencing, staked hay bales, check dams, sediment ponds, riprap aprons at construction and laydown yard entrances, mulching and geotextile matting of disturbed areas, and rapid reseeding of temporarily disturbed areas. Removed soils and any excavated materials would be stored on site for redistribution (e.g., for backfill at the end of construction). Construction activities would be temporary and localized. Therefore, the impacts of the NGCC alternative on geology and soils resources would be SMALL.

4.4.4 IGCC Alternative

For this alternative, the impacts on geology and soil resources would occur during construction and no additional land would be disturbed during operations. Geologic construction material would be obtained, and BMPs would be applied as described in Section 4.4.3 for the NGCC alternative. Therefore, the impacts of the IGCC alternative on geology and soils resources would be SMALL.

4.4.5 New Nuclear Alternative

For this alternative, the impacts on geology and soil resources would occur during construction and no additional land would be disturbed during operations. Geologic construction material would be obtained, and BMPs would be applied as described in the NGCC alternative in Section 4.4.3. Therefore, the impacts of the new nuclear alternative on geology and soils resources would be SMALL.

4.4.6 Combination Alternative (NGCC, Wind, and Solar)

For this alternative, the impacts on geology and soil resources would occur during construction, and no additional land would be disturbed during operations. Geologic construction material would be obtained, and BMPs would be applied as described in Section 4.4.3 for the NGCC alternative. The solar PV and the wind farm part of this alternative requires a large amount of land (up to 6,928 ac (2,804 ha)). However, much of the land would be undisturbed as only a small area would be disturbed by road and facility construction. Therefore, the impacts of the combination alternative on geology and soils resources would be SMALL.

4.5 Water Resources

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on surface water and groundwater resources.

4.5.1 Proposed Action

4.5.1.1 Surface Water Resources

The Category 1 (generic) surface water use and quality issues applicable to Fermi 2 are discussed in the following sections and listed in Table 4–4. There are no plant-specific Category 2 surface water use and quality issues applicable to Fermi 2 because Fermi 2 withdraws water for cooling and other purposes from a lake, not from a river. Surface water resources-related aspects and conditions relevant to the Fermi site are described in Section 3.5.1.

Table 4–4. Surface Water Resources Issues

Issue	GEIS Section	Category
Surface water use and quality (noncooling system impacts)	4.5.1.1	1
Altered current patterns at intake and discharge structures	4.5.1.1	1
Scouring caused by discharged cooling water	4.5.1.1	1
Discharge of metals in cooling system effluents	4.5.1.1	1
Discharge of biocides, sanitary wastes, and minor chemical spills	4.5.1.1	1

Issue	GEIS Section	Category
Effects of dredging on surface water quality	4.5.1.1	1
Temperature effects on sediment transport capacity	4.5.1.1	1
Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d		

Generic Surface Water Resources

The NRC staff did not identify any new and significant information associated with the Category 1 surface water issues identified in Table 4-4 during the review of the applicant's ER (DTE 2014a), the applicant's response to the NRC's request for additional information (DTE 2014c), the scoping process, or the evaluation of other available information as documented in Section 3.5.1 of this SEIS. As a result, no information or impacts related to these issues were identified that would change the conclusions presented in the GEIS (NRC 2013d). For these issues, the GEIS concludes that the impacts are SMALL. It is expected that there would be no incremental impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

4.5.1.2 Groundwater Resources

The groundwater issues applicable to Fermi 2 during the license renewal term are listed in Table 4–5. Section 3.5.2 describes groundwater resources at the Fermi site.

Table 4–5. Groundwater Issues

Issue	GEIS Section	Category
Groundwater contamination and use (noncooling system impacts)	4.5.1.2	1
Groundwater use conflicts (plants that withdraw less than 100 gpm)	4.5.1.2	1
Radionuclides released to groundwater	4.5.1.2	2
Key: gpm = gallons per minute.		
Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d		

The NRC staff did not identify any new and significant information associated with the Category 1 groundwater issues identified in Table 4–5 during the review of the applicant's ER, the site audit, the scoping process, or the evaluation of other available information. As a result, no information or impacts related to these issues were identified that would change the conclusions presented in the GEIS (NRC 2013d). For these issues, the GEIS concludes that the impacts are SMALL. Therefore, it is expected that there would be no incremental impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

The Category 2 issue (Table 4–5) related to radionuclides released to groundwater during the renewal term is discussed in the following text.

Radionuclides Released to Groundwater

This issue looks at the potential contamination of groundwater from the release of radioactive liquids from plant systems into the environment. In evaluating the potential impacts on groundwater quality associated with license renewal, the NRC staff uses as its baseline the existing groundwater conditions as described in Section 3.5.2.3 of this SEIS. These baseline conditions encompass the existing quality of groundwater that could be potentially affected by continued operations (as compared to relevant State or EPA primary drinking water standards), as well as the current and potential onsite and offsite uses and users of groundwater for drinking and other purposes. The baseline also considers other downgradient or in-aquifer uses and users of groundwater. As described Section 3.5.2.3 of this SEIS, no leaks or inadvertent releases of radionuclides to groundwater have been detected at the Fermi site. Tritium concentrations in groundwater near the plant buildings remain well below the EPA's standard (20,000 picocuries per liter) for public drinking water.

During the license renewal term, no use of onsite groundwater by Fermi 2 is expected, and DTE does not propose to discharge any radioactive effluents to groundwater. Present and future Fermi operations are not expected to impact the quality of groundwater in any aquifers that are a current or potential future source of water for offsite users. Therefore, the NRC staff concludes that the impacts on groundwater use and quality during the Fermi license renewal term would be SMALL.

4.5.2 No-Action Alternative

4.5.2.1 Surface Water Resources

Surface water withdrawals and the rate of consumptive water use would greatly decrease and eventually cease after Fermi 2 is shut down. Wastewater discharges would be reduced considerably. Therefore, shutdown would reduce the overall impacts on surface water use and quality. Stormwater would continue to be discharged from the Fermi site throughout plant shutdown and decommissioning. Overall, the impact of this alternative on surface water resources would remain SMALL.

4.5.2.2 Groundwater Resources

As discussed in Section 3.5.2.2, groundwater is not used (consumed) at the Fermi site. Groundwater quality would not be impacted by the cessation of activities. There would be no impact on groundwater resources with the cessation of operations. Therefore, the impact of this alternative on groundwater resources would be SMALL.

4.5.3 NGCC Alternative

4.5.3.1 Surface Water Resources

Construction activities associated with the NGCC alternative would be similar to those for most large industrial facilities. The direct impacts from construction activities associated with the NGCC alternative on surface water resources would be less intensive and would be shorter in duration than those under either the new nuclear or IGCC alternative. A new NGCC plant on the existing Fermi site would occupy a much smaller footprint (i.e., about 24 ac (10 ha)) than that of the current Fermi 1 and 2 facilities or new IGCC or nuclear replacement power facilities. The new NGGC plant would likely be located on previously disturbed land within the Fermi site. Some additional land would also be required for construction of a natural gas supply pipeline along a corridor to connect with existing natural gas distribution infrastructure located about 10 mi (16 km) west of the Fermi site (DTE 2014a).

Temporary impacts to surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas and excavations, from spills and leaks from construction equipment, and from any dredge-and-fill activities. These sources could potentially affect surface water quality in near shore lake waters and connecting waterways to Lake Erie. Nevertheless, adherence to BMPs, in accordance with a Michigan Soil Erosion and Sediment Control (SESC) permit (Michigan Administrative Code (MAC) Rule

(R) 323.1701–1714) and an MDEQ-issued National Pollutant Discharge Elimination System (NPDES) construction stormwater permit, would prevent or minimize any surface water quality or groundwater quality impacts during construction. These BMPs would include appropriate waste management, water discharge, stormwater pollution prevention, and spill prevention practices.

Existing Fermi 2 surface water intake and discharge infrastructure would be used, after necessary refurbishment, to the maximum extent possible to reduce construction-related impacts on surface water quality. Dredge-and-fill operations necessary to operate and maintain surface water intake and discharge structures would be conducted under a permit from the U.S. Army Corps of Engineers (USACE) and under MDEQ equivalent permits and would require the implementation of applicable BMPs to minimize associated impacts. These permit requirements would be similar to those under which Fermi 2 currently conducts maintenance dredging as described in Section 3.5.1.3 of this SEIS.

Water would be required for uses, such as potable and sanitary use by the construction workforce, and for concrete production, equipment washdown, dust suppression, and soil compaction. The NRC staff assumes that the modest volumes of water needed would be taken from the Fermi 2 service water system. Alternatively, water could be supplied directly via a connection from the municipal local water utility (Frenchtown Township) or trucked to the point of use. Use of portable sanitary facilities, typically serviced offsite by a commercial contractor, would serve to reduce the volume of water needed to meet the sanitary needs of the construction workforce.

Some stream-crossings activities could be necessary, depending on the path of any required new gas pipelines and new or upgraded transmission lines to service the NGCC plant. However, because of the short-term nature of any required dredging and filling and stream-crossing activities, the hydrologic alterations and sedimentation would be localized; water-quality impacts would be temporary and would cease after construction has been completed and after the site has been stabilized. The use of modern pipeline construction techniques, such as horizontal directional drilling, would further minimize the potential for water quality impacts in any affected streams. In addition, as described above, water quality impacts would be minimized by the application of BMPs and by compliance with local and State-issued permits for soil erosion and sediment control during construction. Any dredge-and-fill operations would be conducted under a permit from the USACE and State-equivalent permits requiring the implementation of BMPs to minimize impacts.

For onsite facility operations, cooling water demand and consumptive water use for a three-unit NGCC plant using closed-cycle cooling with mechanical-draft cooling towers would be substantially less than those for current Fermi 2 operations and those for the IGCC and new nuclear alternatives. The NGCC plant would require approximately 7.5 million gallons per day (mgd) or 5,200 gallons per minute (gpm) (11.6 cubic feet per second (cfs) or 0.33 cubic meters per second (m^3/s)) of surface water for cooling water makeup and other processes, with consumptive use totaling about 5.7 mgd or 3,960 gpm (8.8 cfs or 0.25 m^3/s). Thus, this alternative would consume about 70 percent less surface water than that for current Fermi 2 operations, which consumes an average of approximately 19 mgd or 13,190 gpm (29.4 cfs or 0.83 m^3/s) of lake water.

Surface water withdrawals would be subject to applicable State water withdrawal permitting and registration requirements to manage surface water use conflicts. Michigan is a party to the 2008 Great Lakes–St. Lawrence River Basin Water Resources Compact (the Compact) (Public Law 110-342) as discussed in Section 3.5.1.2 of this SEIS). As projected withdrawals under the NGCC alternative would result in consumptive water use greater than 5 mgd (18,925 cubic meters per day (m^3/day)), surface water withdrawals would be subject to the MDEQ's water withdrawal permitting program (451 MCL 324.32723).

Cooling water treatment additives would be similar to those used by Fermi 2. Although the discharge water quality would be chemically similar except for differences in the total dissolved solids concentration, the discharge volume from a new NGCC plant would be a small fraction of the volume of cooling tower blowdown and related effluents discharged from Fermi 2. All effluent discharges would be subject to an MDEQ-issued NPDES individual permit for the discharge of wastewater and industrial stormwater to waters of the United States, in accordance with MAC R 323.2101–2196. Sanitary effluent would likely be discharged to Monroe Metropolitan Wastewater Facility in compliance with their influent acceptance criteria. To prevent and respond to accidental nonnuclear releases to surface water, facility operations would be conducted in accordance with a spill prevention, control, and countermeasures plan; stormwater pollution prevention plan; or equivalent plans and associated BMPs and procedures.

Based on this analysis, the NRC staff concludes that the overall impacts on surface water resources from construction and operations under the NGCC alternative would be SMALL.

4.5.3.2 Groundwater Resources

For the NGCC alternative, the NRC staff assumed that construction water would be obtained from surface water or from a local water utility, as further described in Section 4.5.3.1. The dewatering of excavations is unlikely to consume enough water to affect groundwater supplies. During construction and throughout the life of this alternative, groundwater withdrawals would be subject to applicable State water appropriation and registration requirements. The application of BMPs in accordance with a State-issued NPDES general permit, including appropriate waste management, water discharge, stormwater pollution prevention plan, and spill prevention practices, would prevent or minimize groundwater quality impacts during construction. For this alternative, after the facility is constructed and operational, groundwater would not be consumed or used. During operations, the consumptive use of potable water and water for fire protection would be similar to the proposed action. Therefore, the impact of this alternative on groundwater resources would be SMALL.

4.5.4 IGCC Alternative

4.5.4.1 Surface Water Resources

Impacts from construction activities associated with the IGCC alternative on surface water resources would be substantially greater than those under the NGCC alternative (Section 4.5.3.1). The potential for greater impacts is primarily attributable to the additional land required for construction of the power block buildings for the two IGCC units, excavation and construction of other onsite facilities for coal handling and storage, and coal ash and scrubber waste management. Otherwise, the same general assumptions for construction and operations described in Section 4.5.3.1 for the NGCC alternative also apply to this alternative, except as noted.

A new IGCC plant and associated infrastructure at the Fermi site would require about 1,000 ac (405 ha), necessitating the acquisition of adjacent land parcels. This would be likely to permanently disturb additional mapped wetland areas (NRC 2013a) on and adjoining the site, with attendant hydrologic impacts. In addition, temporary impacts to surface water quality may result from increased sediment loading and from pollutants in stormwater runoff from disturbed areas and from excavation and dredge-and-fill activities. There also would be the potential for hydrologic and water-quality impacts to occur from the extension or refurbishment of rail spurs to transport coal and other materials to, and coal ash from, the site. Regardless, as described in Section 4.5.3.1 for the NGCC alternative, the application of BMPs and compliance with State-issued SESC and NPDES permits for construction would minimize water quality impacts. Any dredge-and-fill activities would be conducted under a permit from the USACE and State-equivalent permits requiring the implementation of BMPs to minimize impacts.

Siting a new IGCC plant at the Fermi site would have the advantage of using the existing cooling water intake, effluent discharge, and rail infrastructure. Dredge-and-fill operations necessary to operate and maintain surface water intake and discharge structures would also be conducted under a Department of the Army permit from the USACE and MDEQ equivalent permits and would require the implementation of applicable BMPs to minimize associated impacts.

Operation of an IGCC plant would require less makeup water and would have lower consumptive use than that for current Fermi 2 operations. The projected surface water makeup requirement for cooling and other processes for an IGCC plant under this alternative is 16.5 mgd or 11,460 gpm (25.5 cfs or 0.72 m^3/s), with consumptive use of about 13 mgd or 9,030 gpm (20.1 cfs or 0.57 m^3/s). This alternative would consume about 32 percent less surface water than that for current Fermi 2 operations, which consumes an average of approximately 19 mgd or 13,190 gpm (29.4 cfs or 0.83 m^3/s) of lake water.

As summarized in Section 4.5.3.1 for the NGCC alternative, surface water withdrawals, effluent discharges, and materials handling would be subject to applicable regulatory requirements under this alternative. However, management of runoff and leachate from coal and ash storage facilities would require additional regulatory oversight and would present an additional risk to surface water resources, including Lake Erie.

For this alternative, based on the projected magnitude of ground disturbance and hydrologic alteration and the potential water quality impacts from coal and ash handling and management along with other operational impacts, the NRC staff concludes that the overall impacts on surface water resources would be SMALL to MODERATE.

4.5.4.2 Groundwater Resources

The facts considered, assumptions made, and conclusions reached in determining the impact significance level on groundwater resources for this alternative are the same as those for the NGCC alternative described in Section 4.5.3.2. Therefore, impacts of the IGCC alternative on groundwater resources would be SMALL.

4.5.5 New Nuclear Alternative

4.5.5.1 Surface Water Resources

Impacts from construction activities on surface water resources associated with the new nuclear alternative would be appreciable because of the land area required for new nuclear units (i.e., 301 ac (122 ha)) using available land on the Fermi site and needed adjacent land parcels. Deep excavation work for the nuclear island, extensive site clearing, and a large laydown area for facility construction would have the potential for direct and indirect impacts on water resources. Otherwise, the same assumptions for construction and operations as described in Section 4.5.3.1 for the NGCC alternative also apply to this alternative, except as noted.

Construction activities would alter surface water drainage features within the construction footprints, including mapped wetland areas (NRC 2013a) on and adjoining the site. As previously described in Section 4.5.3.1 for the NGCC alternative, water quality impacts would be minimized by the application of BMPs and compliance with State-issued SESC and NPDES permits for construction.

In particular, use of the Fermi site would offer the advantage of use of the existing cooling water intake and discharge infrastructure. Some additional construction impacts may result from the potential need to refurbish or expand the capacity of the facilities. Nevertheless, dredge-and-fill operations necessary to operate and maintain surface water intake and discharge structures would also be conducted under a Department of the Army permit from the USACE and MDEQ equivalent permits and would require the implementation of applicable BMPs to minimize associated impacts.

Water required to support construction activities under this alternative would be greater than under either the NGCC or IGCC alternatives due to the larger scale of construction, magnitude of excavation work, and longer schedule. Extensive groundwater dewatering of deep excavations would be also necessary. The NRC staff assumes that water needed for facility construction would be taken from the Fermi 2 service water system. Alternatively, water could be supplied directly via a connection from the municipal water utility (Frenchtown Township) or trucked to the point of use. Dewatering of excavations would not be expected to affect offsite surface water bodies. Groundwater removed from excavations would be managed in accordance with MDEQ requirements.

The operation of a new 1,170 MWe ESBWR unit would require an estimated 32 mgd or 22,200 gpm (49.5 cfs or 1.4 m^3/s) of surface water for cooling makeup and related processes. Consumptive water use would be approximately 16 mgd or 11,100 gpm (24.8 cfs or 0.7 m^3/s). This alternative would consume about 16 percent less surface water than that for current Fermi 2 operations, which consumes an average of approximately 19 mgd or 13,190 gpm (29.4 cfs or 0.83 m^3/s) of lake water (Section 3.5.1.2 of this SEIS).

The NRC further expects that water treatment additives for new nuclear plant operations and effluent discharges would be relatively similar in quality and volume to Fermi 2. All effluent discharges would be subject to an MDEQ-issued NPDES individual permit for the discharge of wastewater and industrial stormwater to waters of the United States. Sanitary effluent would likely be discharged to the Monroe Metropolitan Wastewater Facility in compliance with its influent acceptance criteria. In accordance with the Great Lakes Compact, surface water withdrawals and consumptive use would be subject to MDEQ's water withdrawal permitting program (451 MCL 324.32723). To prevent and respond to accidental nonnuclear releases to surface water, facility operations would also be conducted in accordance with a spill prevention, control, and countermeasures plan; stormwater pollution prevention plan; or equivalent plans and associated BMPs and procedures.

For the new nuclear alternative, the NRC staff concludes that overall impacts on surface water use and quality from construction and operations would be SMALL.

4.5.5.2 Groundwater Resources

The facts considered, assumptions made, and conclusions reached in determining the impact significance level on groundwater resources from the new nuclear alternative are the same as that for the NGCC alternative described in Section 4.5.3.2. Therefore, impacts of the new nuclear alternative on groundwater resources would be SMALL.

4.5.6 Combination Alternative (NGCC, Wind, and Solar)

4.5.6.1 Surface Water Resources

For the NGCC component of this alternative, the impacts on surface water resources from facility construction and operations would be a fraction of those described in Section 4.5.5.1 because the NGCC plant would be scaled back to a single 400-MW unit. Otherwise, the same general assumptions for construction and operations also apply to this alternative. Operational cooling water demands would be about 33 percent less than those under the NGCC alternative. As a result, the NGCC component under this alternative would require approximately 2.5 mgd or 1,700 gpm (3.9 cfs or 0.11 m^3/s) of surface water for cooling and other processes, with consumptive use totaling about 1.8 mgd or 1,250 gpm (2.8 cfs or 0.08 m^3/s). Thus, this alternative would consume about 90 percent less surface water than that for current Fermi 2 operations, which consumes an average of approximately 19 mgd or 13,190 gpm (29.4 cfs or 0.83 m^3/s) of lake water.

Direct impacts on surface water resources for the wind and solar portion of this alternative during construction are expected to be minimal because the NRC staff assumes that wind turbines and utility-scale PV farms would be sited in upland areas to avoid direct impacts on surface water features (e.g., lakes, streams, and wetlands) and associated hydrologic alteration. Construction of up to 1,117 land-based wind turbines on 1 to 3 ac (0.4 to 1.2 ha) sites each would require relatively small amounts of water for dust suppression and soil compaction during site clearing and for concrete production. Construction of utility-scale solar PV farms would require relatively larger volumes of water per site due to the larger land area required per megawatt of replacement power produced. However, for both components under this alternative, the NRC staff also assumes water would be procured from offsite sources and would be trucked to the point of use (such as from a local water utility) as opposed to the use of nearby surface water or onsite groundwater. The likely use of ready-mix concrete would also reduce the need for onsite use of nearby water sources for construction.

Installation of land-based wind turbines and utility-scale solar PV farms would also require construction of access roads and possibly transmission lines (especially for sites not already proximal to transmission line corridors). Access road construction would also require some water for dust suppression and roadbed compaction and would have the potential to result in soil erosion and stormwater runoff from cleared areas. For construction, water would likely be trucked to the point of use from offsite locations along with road construction materials. In all cases, it is expected that construction activities would be conducted in accordance with State-issued NPDES or equivalent permits for stormwater discharges associated with construction activity, which would require the implementation of appropriate BMPs to prevent or mitigate water quality impacts. In contrast to land-based wind turbine sites and utility-scale solar PV farms, installation of small solar PV units on rooftops and at sites that have already been developed would essentially have no impact on surface water resources.

To support the operation of wind turbine and PV installations, there would be no direct use of surface water, and no industrial wastewater effluents would be produced. It is expected that water would be obtained from groundwater or purchased from a local water utility. Regardless, only very small amounts of water would be needed to periodically clean turbine blades and motors; water could be trucked to the point of use as part of routine servicing. Water also would be required to clean panels at solar PV farms or those situated in rooftop arrays. Adherence to appropriate waste management and minimization plans, spill prevention practices, and pollution prevention plans during servicing of wind turbine and solar PV installations and operation of vehicles connected with site operations would minimize the risks to soils and surface water resources from spills of petroleum, oil, and lubricant products and stormwater runoff.

In consideration of these facts, the NRC staff concludes that the impacts on surface water resources from construction and operations under the combination alternative would be SMALL.

4.5.6.2 Groundwater Resources

Construction dewatering would be minimal because of the small footprint of foundation structures, pad sites, and piling emplacements. Little or no impacts on groundwater use or water quality would be expected from routine operations. Consequently, the impacts on groundwater use and quality under this alternative would be SMALL.

4.6 Terrestrial Resources

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on terrestrial resources.

4.6.1 Proposed Action

Section 3.6 of this SEIS describes terrestrial resources on and in the vicinity of the Fermi site. The generic (Category 1) and site-specific (Category 2) issues that apply to terrestrial resources during the proposed license renewal period appear in Table 4–6. The GEIS discusses these issues in Section 4.6.1.1 (NRC 2013d).

Table 4–6. Terrestrial Resource Issues

Issue	GEIS Section	Category
Effects on terrestrial resources (noncooling system impacts)	4.6.1.1	2
Exposure of terrestrial organisms to radionuclides	4.6.1.1	1
Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)	4.6.1.1	N/A[(a)]
Cooling tower impacts on vegetation (plants with cooling towers)	4.6.1.1	1
Bird collisions with plant structures and transmission lines[(b)]	4.6.1.1	1
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	4.6.1.1	N/A[(c)]
Transmission line right-of-way (ROW) management impacts on terrestrial resources[(b)]	4.6.1.1	1
Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)[(b)]	4.6.1.1	1

(a) This issue does not apply because the Fermi 2 cooling system is a closed-cycle system and does not include a cooling pond.

(b) This issue applies only to the in-scope portion of electric power transmission lines, which are defined as transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid.

(c) This issue does not apply because Fermi 2 draws water from Lake Erie, not from a river.

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

4.6.1.1 Generic Terrestrial Resource Issues

The NRC staff did not identify any new and significant information related to the generic (Category 1) issues listed above during the review of the applicant's ER (DTE 2014a), the site audit, or the scoping process. Specifically regarding the Category 1 issue, "bird collisions with plant structures and transmission lines," the NRC staff concludes, based on a review of bird collision records and bird strike surveillance data for Fermi 2, that DTE's bird strike information does not constitute new and significant information that would change the GEIS's conclusion of SMALL for this issue (Section 4.14).

The NRC expects no impacts associated with the Category 1 terrestrial issues identified above in Table 4–6 beyond those discussed in the GEIS. The GEIS concludes that the impact level for each of these issues is SMALL.

4.6.1.2 Effects on Terrestrial Resources (Noncooling System Impacts)

In the GEIS (NRC 2013d), the NRC staff determined that “noncooling system effects on terrestrial resources” is a Category 2 issue (Table 4–6) that requires site-specific evaluation during each license renewal review. According to the GEIS, noncooling system impacts can include those impacts that result from landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the renewal period and that could affect terrestrial resources on and near a plant site.

Landscape Maintenance Activities

Section 3.2 indicates that approximately 1,048 ac (424 ha) of the Fermi site (83.1 percent) remains as natural areas that are managed by the FWS as part of the DRIWR, leased for agricultural use, or are not managed (DTE 2014a). The majority of site landscape maintenance is performed within the protected area and not within natural areas on the site (DTE 2014a). Typically, only trees and shrubs that pose a safety or security threat would be removed from natural areas. Leased agricultural lands would be maintained by the leasee and in accordance with the standing lease. DTE (2014c) has no plans to disturb undeveloped areas of the site as part of the proposed Fermi 2 license renewal. Several ongoing restoration projects would result in positive impacts to terrestrial resources during the license renewal term. These projects are discussed in Section 3.6 and include two prairie restoration projects and the continued maintenance of the site’s delineated wetlands and the DRIWR Lagoona Beach Unit.

Stormwater Management

Stormwater drainages direct Fermi site runoff to six NPDES-permitted stormwater outfalls. The outfalls flow into the quarry lakes (Outfalls 004, 005, and 007), the North Canal (Outfalls 002 and 014), and the South Lagoon (Outfall 012) (DTE 2014a). Two additional outfalls (003 and 008) are unused (DTE 2014a). Section A.13 of Part I of the Fermi 2 NPDES permit requires DTE (2014a) to maintain and implement a Stormwater Pollution Prevention Plan. This plan identifies potential sources of pollution that could affect the quality of stormwater and describes practices that DTE uses to reduce such pollutants. Areas with spill potential, such as areas around tanks that contain oil, are further monitored under site chemical control procedures and spill prevention plans (DTE 2014a). Additionally, any ground disturbances of 1 ac (0.4 ha) or more or within 500 ft (152 m) of a lake or stream requires DTE (2014a) to obtain an SESC permit from the Monroe County drain commissioner. SESC permits specify BMPs to reduce erosion caused by stormwater runoff. Collectively, these measures ensure that the effects to terrestrial resources from pollutants carried by stormwater would be minimized during the proposed license renewal term.

Noise

The GEIS (NRC 2013d) indicates that elevated noise levels could be a noncooling system impact to terrestrial resources. However, the GEIS also concludes that generic noise impacts would be small because noise levels would remain well below regulatory guidelines for offsite receptors during continued operations and refurbishment associated with license renewal. The NRC staff did not identify any information during its review that would indicate that noise impacts to terrestrial resources at Fermi 2 would be unique or would require separate analysis.

Other Operations and Maintenance Activities

DTE (2014a) anticipates no refurbishment or other operations or maintenance activities during the license renewal term that would disturb terrestrial habitats or that would result in changes to existing land uses.

DTE (2014c) would continue to maintain its Wildlife Management Plan and Wildlife Habitat Council certification during the proposed license renewal term. DTE (2014c) would also continue biannual qualitative prairie vegetation surveys, which would be performed by a botanist from the FWS or the Michigan Natural Features Inventory. The Fermi 2 Wildlife Habitat Team would also conduct periodic wildlife surveys of site-specific areas several times per year to monitor the site's animal communities and to document the occurrence of any new species.

When new activities that could impact the environment occur at Fermi 2, DTE follows several procedures to ensure that it considers potential environmental effects and appropriately addresses them. DTE (2014c) maintains an Environmental Monitoring Conduct Manual (MCE06), which requires DTE staff to screen proposed activities, such as maintenance activities, operational changes, procedure changes, and other facility activities, to determine whether the activity warrants further evaluation for environmental impact or risk. If work is to be performed in undeveloped areas of the site, a Protected Species Protection Plan must be developed (DTE 2014c), and personnel must be briefed on the plan before beginning work. Nuclear Licensing Work Instruction 11801, "Unusual or Important Environmental Events Reporting Guidance," provides guidance on reporting unusual or important environmental events casually related to plant operation as required by Appendix B to the Fermi 2 operating license (DTE 2014c). Additionally, DTE (2014c) corporate personnel continually monitor changes to Federal and State requirements and modify applicable company and site-specific procedures as necessary.

Conclusion

Based on its independent review, the NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that DTE might undertake during the renewal term would primarily be confined to disturbed areas of the Fermi site. These activities would not have noticeable effects on terrestrial resources, nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the Fermi site. Therefore, the NRC staff expects noncooling system impacts on terrestrial resources during the license renewal term to be SMALL.

4.6.2 No-Action Alternative

If Fermi 2 were to shut down, the impacts to terrestrial ecology would remain similar to those during operations until the plant is fully decommissioned. Temporary buildings and staging or laydown areas may be required during large component and structure dismantling. Fermi 2 is likely to have sufficient space within previously disturbed areas for these needs; therefore, no additional land disturbances would occur on previously undisturbed land. Adjacent lands may experience temporary increases in erosional runoff, dust, or noise, but these impacts could be minimized with the implementation of standard BMPs (NRC 2002b). In NUREG–0586, the NRC (2002b) concludes generically that impacts to terrestrial ecology during decommissioning activities would be SMALL. In the case of Fermi 2, DTE (2014c) anticipates that decommissioning would not affect its cooperative agreement with the FWS for management of the DRIWR or other sensitive habitats on the Fermi site. Reclamation of the site following decommissioning could create terrestrial habitat in areas currently used as industrial areas. The GEIS (NRC 2013d) notes that terrestrial resource impacts could occur in other areas beyond the immediate nuclear plant site as a result of the no-action alternative if new power plants are needed to replace lost capacity. The NRC staff concludes that the no-action alternative would unlikely noticeably alter or have more than minor effects on terrestrial resources. Thus, the NRC staff concludes that the impacts of the no-action alternative on terrestrial resources during the proposed license renewal term would be SMALL.

4.6.3 NGCC Alternative

This alternative assumes that a new NGCC facility would be built at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. The facility would require an estimated 24 ac (9.7 ha) of land for the plant with the possibility of additional land requirements for gas pipeline ROWs. Additional offsite land would be required for gas extraction and collection, although this impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Fermi 2.

During construction, the use of the existing site would maximize availability of existing infrastructure. However, construction would likely require the conversion of natural areas because the new facility would be built outside the existing industrial footprint. This could result in noticeable impacts to terrestrial habitats and species, although the level of direct impact would vary based on the specific location of new buildings and infrastructure on the site. During construction, terrestrial species could experience habitat loss or fragmentation, loss of food resources, and altered behavior due to noise and other construction-related disturbances. Erosion and sedimentation from clearing, leveling, and excavating land could affect adjacent riparian and wetland habitats, if present. Implementation of appropriate BMPs would minimize these effects. This alternative could also require construction of new pipelines or upgrades to existing lines. Collocating lines within existing corridors would minimize land disturbance. Although construction activities could noticeably alter terrestrial resources, primarily through habitat loss or fragmentation, construction is unlikely to destabilize any important attributes of the terrestrial environment due to the small footprint of the facility. The exact magnitude of impacts would vary based on the chosen location of the facility within the Fermi site footprint and on the amount and types of undisturbed habitat that would be disturbed for construction of the alternative; therefore, impacts of construction could range from SMALL to MODERATE.

The GEIS (NRC 2013d) concludes that impacts to terrestrial resources from operation of fossil energy alternatives would essentially be similar to those from continued operations of a nuclear facility. Unique impacts would include air emissions of GHGs, such as nitrogen oxides, carbon dioxide, and methane, all of which can have far-reaching consequences because they contribute to climate change. The effects of climate change on terrestrial resources are discussed in Section 4.15.3.2. Although the impacts of operating the NGCC alternative may be noticeable, they are unlikely to destabilize any important attribute of the terrestrial environment and, therefore, would be SMALL.

The NRC concludes that the impacts of the NGCC alternative on terrestrial resources would be SMALL to MODERATE during construction and SMALL during operation.

4.6.4 IGCC Alternative

Like the NGCC alternative, this alternative assumes that a new facility would be built at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. However, an IGCC facility would require significantly more land (an estimated 1,000 ac (405 ha)) than that for the NGCC alternative, which would only require 24 ac (9.7 ha). The larger footprint of the IGCC facility would require DTE to obtain additional parcels of land adjacent to the existing site. Additional offsite land would be required for coal mining, although this impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Fermi 2.

During construction, impacts to terrestrial habitats and species are likely to be similar to the types of impacts described for the NGCC alternative in Section 4.6.3 but would likely be larger in magnitude due to the larger footprint of the IGCC facility. The purchase of additional parcels of land could affect sensitive habitats, including wetlands and riparian areas. Accordingly, construction would likely noticeably alter terrestrial resources and could destabilize important attributes of the terrestrial environment. The exact magnitude of impacts would vary based on the chosen location of the facility within the Fermi site footprint, the purchased land parcels, and the amount and types of undisturbed habitat that would be disturbed for construction of the alternative. Thus, impacts of construction could range from MODERATE to LARGE.

The GEIS (NRC 2013d) concludes that impacts to terrestrial resources from operation of fossil energy alternatives would essentially be similar to those from continued operations of a nuclear facility. Unique impacts would include periodic maintenance dredging if coal is delivered by barge, which could create noise, dust, and sedimentation. Dredging and delivery of coal to the site could introduce minerals and trace elements to water resources on which terrestrial biota rely. Such minerals could also bioaccumulate in nearby riparian or wetland habitats. Air emissions during operation would include sulfur oxides and nitrogen oxides, which can combine with water vapor and create sulfuric and nitric acids. These acids would then be released back into the environment through precipitation, which could affect the acidity levels of water resources and could have detrimental effects to plant foliage. Acid precipitation has the potential to destabilize the terrestrial environment by creating conditions that are too acidic for certain plants or animals. The IGCC facility would also emit various GHGs during operation, which is an effect that can have far-reaching consequences because GHGs contribute to climate change. The effects of climate change on terrestrial resources are discussed in Section 4.13.3.2. The various air emissions during operation of the IGCC facility could create noticeable impacts that could destabilize certain attributes of the terrestrial environment; therefore, the operational impacts would be MODERATE.

The NRC concludes that the impacts of the IGCC alternative on terrestrial resources would be MODERATE to LARGE during construction and would be MODERATE during operation.

4.6.5 New Nuclear Alternative

Like the NGCC and IGCC alternatives, this alternative assumes that a new nuclear facility would be built at the Fermi site outside the existing Fermi 2 and proposed Fermi 3 footprints. The facility would require an estimated 301 ac (122 ha) of land. Although the land requirement for this alternative is not as large as that for the IGCC facility, the new nuclear alternative would still require DTE to obtain additional parcels of land adjacent to the existing site. Additional offsite land would be required for uranium mining, although this impact would result in no net change in land use impacts from those that would be associated with the proposed license renewal of Fermi 2.

During construction, impacts to terrestrial habitats and species are likely to be similar to the types of impacts described for the NGCC alternative in Section 4.6.3, but these impacts would likely be larger in magnitude due to the larger footprint of the new nuclear facility. The purchase of additional parcels of land could affect sensitive habitats, including adjacent wetlands and riparian areas. Although the NRC (2013a) has previously determined that construction of a new nuclear plant on the Fermi site (the proposed Fermi 3) would result in SMALL to MODERATE impacts to terrestrial resources (with the potential for MODERATE impacts limited to the eastern fox snake) (NRC 2013a), the new nuclear alternative considered here represents an additional disturbance to the Fermi site because the footprints of the proposed Fermi 3 and this new nuclear alternative are assumed not to overlap. The conversion of sensitive natural areas, such as DRIWR wetlands, for industrial use would noticeably affect terrestrial habitats and species

4.7.1 Proposed Action

Section 3.1.3 of this SEIS describes the Fermi 2 cooling and auxiliary water systems, and Section 3.7 describes the aquatic resources. The generic (Category 1) and site specific (Category 2) issues that apply to aquatic resources at Fermi 2 during the proposed license renewal period appear in Table 4–7. The GEIS (NRC 2013d) discusses these issues in Section 4.6.1.2.

Table 4–7. Aquatic Resource Issues

Issue	GEIS Section	Category
All plants		
Entrainment of phytoplankton and zooplankton	4.6.1.2	1
Infrequently reported thermal impacts	4.6.1.2	1
Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication	4.6.1.2	1
Effects of nonradiological contaminants on aquatic organisms	4.6.1.2	1
Exposure of aquatic organisms to radionuclides	4.6.1.2	1
Effects of dredging on aquatic organisms	4.6.1.2	1
Effects on aquatic resources (noncooling system impacts)	4.6.1.2	1
Impacts of transmission line ROW management on aquatic resources[a]	4.6.1.2	1
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.6.1.2	1
Plants with cooling towers		
Impingement and entrainment of aquatic organisms	4.6.1.2	1
Thermal impacts on aquatic organisms	4.6.1.2	1

[a] This issue applies only to the portion of electric power transmission lines that connect a nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid.

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d

4.7.1.1 Generic GEIS Issues

The GEIS (NRC 2013d) concludes that the 11 Category 1 issues listed in Table 4–7 would have a SMALL impact on aquatic resources during the license renewal term for all plants. For these issues, no additional plant-specific analysis is required unless new and significant information is identified.

During its review, the NRC staff considered DTE’s aquatic surveys and studies performed at Fermi and in Lake Erie and available scientific literature; attended a site audit; and considered Federal and State agency and public comments received during the scoping process. The NRC staff identified new information related to harmful algal blooms, which are discussed in the GEIS under the issue, “Infrequently Reported Thermal Impacts.” The new information related to algal blooms is discussed in Section 4.14. Based on its review, the NRC staff concludes that this information does not constitute new and significant information that would change the GEIS’s conclusion of SMALL for this issue (Section 4.14). For the other generic issues, the NRC staff identified no new and significant information; therefore, no site-specific analysis is required for these issues, and no impacts would be associated with these issues beyond those discussed in the GEIS.

4.7.2 No-Action Alternative

If Fermi 2 were to cease operating, impacts to aquatic ecology would decrease or stop following reactor shutdown. Some withdrawal of water from Lake Erie would continue during the shutdown period as the fuel is cooled, although the amount of water withdrawn would decrease over time. The reduced demand for cooling water would further decrease the effects of impingement, entrainment, and thermal effluents that were determined to be SMALL for Fermi 2 during the proposed license renewal term (Section 4.7.1.1).

In NUREG–0586, NRC (2002) concludes generically that impacts to aquatic ecology during decommissioning activities would be SMALL for facilities at which the decommissioning activities would be limited to existing operational areas. In the case of Fermi 2, the NRC staff did not identify any effects that would have more than minor effects on aquatic resources. Thus, the NRC staff concludes that the impacts of the no-action alternative on aquatic resources during the proposed license renewal term would be classified as SMALL and would be less than any current effects.

4.7.3 NGCC Alternative

Construction of an NGCC alternative (three 400-MW units) would occur at the Fermi site outside the Fermi 2 and proposed Fermi 3 footprints. The GEIS (NRC 2013d) indicates that the impacts of new power plant construction on ecological resources would be qualitatively similar to the new nuclear alternative. Thus, those impacts discussed under the new nuclear alternative would apply during the construction phase. Construction of new natural gas pipelines, if necessary, could impact previously undisturbed habitats. This impact would vary depending on the location of the plant and would be more likely to impact terrestrial resources than aquatic resources, and the NGCC alternative may occupy (and disturb) less land than the new nuclear or IGCC alternatives. Because the NGCC alternative would be built on the existing power plant site, new pipelines could be located in existing corridors to reduce impacts. Overall, construction impacts would be SMALL.

Operation of the NGCC alternative cooling system would be qualitatively similar to the IGCC alternative but would result in smaller impacts because the NGCC alternative would consume less cooling water. Air emissions from the NGCC units would include nitrogen oxide, carbon dioxide, and particulates that would settle on water bodies or that would be introduced into the water from soil erosion. The plant would have closed-cycle cooling with mechanical-draft cooling towers; therefore, the effects of entrainment and the thermal effluent would be similar to those of Fermi 2. The new plant would probably have a traveling screen with a fish return system on the cooling water intake structure (which Fermi 2 lacks), thus resulting in less impingement mortality than that for Fermi 2. Overall operational impacts would be less for the NGCC alternative than those for the continued operation of Fermi 2, and the level of impact would be SMALL.

The NRC staff concludes that the impacts to aquatic resources from construction of an IGCC plant would be SMALL, the impacts of operation would be SMALL, and the fish impingement mortality would be less than that for Fermi 2 today.

4.7.4 IGCC Alternative

Construction of an IGCC alternative would occur at the Fermi site outside of the Fermi 2 and proposed Fermi 3 footprints. The GEIS (NRC 2013d) indicates that the impacts of new power plant construction on ecological resources would be qualitatively similar to those of a new nuclear alternative. Those impacts discussed under the new nuclear alternative would apply during the construction phase. Because the IGCC alternative would require significantly more land than that for the new nuclear alternative (1,000 ac (400 ha) versus 301 ac (122 ha)), the magnitude of impacts would likely be greater and could create noticeable effects on aquatic resources. Thus, construction impacts would be MODERATE.

Operation of the IGCC alternative would require less cooling water than Fermi 2. Accordingly, impingement, entrainment, and thermal effects on aquatic resources would likely be smaller than those for continued operation of Fermi 2. Chemical discharges from the cooling system would be similar to those at Fermi 2. Operation would require coal deliveries, cleaning, and storage, which would require periodic dredging (if coal is delivered by barge); create dust, sedimentation, and turbidity; and introduce trace elements and minerals into the water. Air emissions from the IGCC units would include small amounts of sulfur dioxide, particulates, and mercury that would settle on water bodies or be introduced into the water from soil erosion. Overall operational impacts would be similar to the continued operation of Fermi 2. The plant would have closed-cycle cooling with mechanical-draft cooling towers; therefore, the effects of entrainment and the thermal effluent would be similar to those of Fermi 2. The new plant would probably have a traveling screen with a fish return system on the cooling water intake structure (which Fermi 2 lacks), thus resulting in less impingement mortality than that for Fermi 2. Based on the above information, impact levels from operation would likely be SMALL.

The NRC staff concludes that the level of impacts to aquatic resources from construction of an IGCC plant would be MODERATE, the impacts of operation would be SMALL, and the fish impingement mortality would be less than that for Fermi 2 today.

4.7.5 New Nuclear Alternative

Construction of a new nuclear alternative would occur at the existing Fermi site, although not on the footprints of the existing Fermi 2 or proposed Fermi 3 units. Construction activities could degrade the water quality of Lake Erie near the site and of nearby streams or ponds through erosion and sedimentation, could result in loss of habitat through pond or wetland filling, or could result in direct mortality of aquatic organisms from dredging or other in-water work. Because of the short-term nature of construction activities, these effects would likely be relatively localized and temporary. Constructing a new nuclear plant on the existing site could make use of the existing transmission lines, roads, parking areas, and other infrastructure, which would limit the amount of habitat disturbance that would be required. Less habitat disturbance would create less erosion and sedimentation. The construction of intake and discharge structures could result in direct mortality of individuals and in water quality degradation. Appropriate permits would ensure that water quality impacts would be addressed through mitigation or BMPs, as stipulated in the permits. The EPA, USACE, or the State of Michigan would oversee applicable permitting, including a Section 404 permit under the Clean Water Act of 1977, as amended (CWA) (33 U.S.C. 1251 et seq.); Section 401 certification under the CWA; and a Section 402(p) NPDES general stormwater permit. The NRC staff (2013a) has completed the review of one combined license (COL) application to build and operate a new nuclear plant on the Fermi site (Fermi 3) and found that construction would have SMALL impacts on aquatic resources. Although the NRC staff assumes a new nuclear alternative would not occupy the same footprint as the proposed Fermi 3 unit, it would be on the same Fermi site and would use closed-cycle cooling and the same cooling lake and Lake Erie discharge structure as the Fermi 2 and proposed Fermi 3 units would so that aquatic impacts would be similar to those that the NRC staff expects for the proposed Fermi 3. The NRC finds it reasonable to adopt its previous impact conclusions regarding Fermi 3 for the construction portion of this alternative.

Operational impacts would include those listed in Table 4-8, and the GEIS (NRC 2013d) conclusions of SMALL for Category 1 issues in the table would apply during the operational phase of the new nuclear alternative. The NRC staff assumes that the new plant would use closed-cycle cooling; therefore, the effects of entrainment and the thermal effluent would be similar to those of Fermi 2. The new plant would likely have a traveling screen with a fish return system on the cooling water intake structure (which Fermi 2 lacks), thus resulting in less impingement mortality than that for Fermi 2.

The NRC staff concludes that the impacts to aquatic resources from construction and operation of a new nuclear alternative would be classified as SMALL and that the fish impingement mortality would be less than that for Fermi 2 today.

4.7.6 Combination Alternative (NGCC, Wind, and Solar)

The NGCC portion of this alternative could be located at the Fermi site outside the Fermi 2 and proposed Fermi 3 footprints. Construction and operation impacts would be qualitatively similar to those discussed for the NGCC alternative, but these impacts would be much lower in magnitude due to the smaller footprint of the plant, reduced cooling water consumption, and lowered air emissions. The wind and solar portions of the alternative, which account for 90 percent of the alternative's power generation, would not require cooling or consumptive water use during operation and, therefore, may only have a negligible effect on aquatic resources. The NRC staff concludes that the impacts on aquatic resources from the combination alternative would be SMALL.

4.8 Special Status Species and Habitats

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on special status species and habitats.

4.8.1 Proposed Action

Section 3.8 of this SEIS describes the special status species and habitats that have the potential to be affected by the proposed action. The discussion of species and habitats protected under the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C.1531 et seq.), includes a description of the action area as defined by the ESA section 7 regulations at 50 CFR 402.02. The action area encompasses all areas that would be directly or indirectly affected by the proposed Fermi 2 license renewal.

Table 4–8 lists the one Category 2 issue related to special status species and habitats identified in the GEIS (NRC 2013d). Appendix C.1 contains information on the NRC staff's ESA section 7 consultation with the FWS for the proposed action. The NRC did not consult with the National Marine Fisheries Service (NMFS) as part of the Fermi 2 license renewal review because (as described in Section 3.8) no species or habitats under the NMFS's jurisdiction occur within the action area.

Table 4–8. Special Status Species and Habitat Issues

Issue	GEIS Section	Category
Threatened, endangered, and protected species; critical habitat; and essential fish habitat	4.6.1.3	2

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d and has the potential to destabilize important attributes of the terrestrial environment. Accordingly, the NRC staff concludes that construction impacts would be MODERATE to LARGE depending on the specific parcels of land converted to industrial use or disturbed during construction.

During operation, impacts would be similar in type and magnitude to those assessed in Section 4.6.1 for continued operation of Fermi 2 under the proposed renewal term and, therefore, would be SMALL.

The NRC concludes that the impacts of the new nuclear alternative on terrestrial resources would be MODERATE to LARGE during construction and would be SMALL during operation.

4.6.6 Combination Alternative (NGCC, Wind, and Solar)

The NGCC component of this alternative would have the same land requirements as discussed for the NGCC alternative in Section 4.2.3.1. Accordingly, the impacts to terrestrial resources would be similar to those concluded for the NGCC alternative and, therefore, would be SMALL to MODERATE during construction and would be SMALL during operation.

The wind component of this alternative would require an estimated 1,117 to 3,351 ac (452 to 1,356 ha) of land at onshore wind farm sites across the ROI. However, the majority of this land would only be temporarily disturbed during construction. Permanently disturbed land would hold the wind turbines, access roads, and transmission lines. Land used for equipment laydown and turbine component assembly and erection could be returned to its original state. Use of BMPs would ensure that disturbed lands were appropriately restored to reduce long-term impacts to the terrestrial environment. Operation of wind turbines could uniquely affect terrestrial species through mechanical noise, collision with turbines and meteorological towers, and interference with migratory behavior. Bat and bird mortality from turbine collisions is an ongoing concern for operating wind farms; however, recent developments in turbine design have reduced the potential for bird and bat strikes. The NRC staff expects that this component has the potential to noticeably alter terrestrial resources, primarily through the loss of habitat and bird and bat mortalities associated with wind turbine operation. However, it is unlikely that the wind component would destabilize any important attribute of the terrestrial environment; therefore, impacts would be MODERATE.

The solar component of this alternative would require an estimated 3,577 ac (1,448 ha) of land across the ROI. The majority of solar installations could be installed on building roofs at existing residential, commercial, or industrial sites or at larger standalone solar facilities; therefore, it is possible that little terrestrial habitat would be disturbed during construction. However, the exact magnitude of impacts on terrestrial resources would depend on the amount of terrestrial habitat that is lost or fragmented during construction of solar installations. Operation would have no measurable effects on the terrestrial environment. Overall impacts from construction and operation of this component of the alternative would range from SMALL to MODERATE depending on the locations of solar installations and the amount of terrestrial habitat affected.

Overall, the NRC staff concludes that the impacts of the combination alternative on terrestrial resources would be SMALL to MODERATE.

4.7 Aquatic Resources

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on aquatic resources.

4.8.1.1 Species and Habitats Protected under the Endangered Species Act of 1973

Species and Habitats under the U.S. Fish and Wildlife Service's Jurisdiction

Section 3.8 considers whether the nine Federally listed species identified in Table 4–9 occur in the action area based on each species' habitat requirements, life history, and other available information. In that section, the NRC staff concludes that four of these species—Karner blue butterfly (*Lycaeides melissa samuelis*), northern riffleshell (*Epioblasma torulosa rangiana*), snuffbox mussel (*Epioblasma triquetra*), and rayed bean (*Villosa fabalis*)—are not likely to occur in the action area. The NRC staff also concludes that no proposed or candidate species or proposed or designated critical habitat occurs in the action area. During consultation with the FWS for the proposed construction and operation of Fermi 3, which is a proposed new nuclear unit that would be built on the Fermi site, the FWS (2012) concurred with the NRC staff's determination that the proposed construction and operation would have no effect on the Karner blue butterfly, northern riffleshell, snuffbox mussel, and rayed bean. The types and intensity of potential effects from the proposed license renewal of Fermi 2 would likely be bounded by the potential effects from the proposed construction and operation of Fermi 3 because the activities associated with Fermi 3 would include construction and operation, whereas the activities associated with the proposed license renewal for Fermi 2 would be limited to continued operations. Thus, the NRC staff concludes that the proposed license renewal for Fermi 2 would have no effect on these four Federally listed species, any proposed or candidate species, or proposed or designated critical habitats under the FWS's jurisdiction.

In the following sections, the NRC staff analyzes the potential impacts on the other five listed species: (1) red knot (*Calidris canutus*), (2) piping plover (*Charadrius melodus*), (3) northern long-eared bat (*Myotis septentrionalis*), (4) Indiana bat (*Myotis sodalis*), and (5) eastern prairie fringed orchid (*Platanthera leucophaea*).

Table 4–9. Effect Determinations for Federally Listed Species

Species	Common Name	Federal Status	Effect Determination
Mammals			
Calidris canutus rufa	red knot	T	may affect, but is not likely to adversely affect
Charadrius melodus	piping plover	E	may affect, but is not likely to adversely affect
Myotis septentrionalis	northern long-eared bat	T	may affect, but is not likely to adversely affect
Myotis sodalis	Indiana bat	E	may affect, but is not likely to adversely affect
Insects			
Lycaeides melissa samuelis	Karner blue butterfly	E	no effect
Plants			
Platanthera leucophaea	Eastern prairie fringed orchid	T	may affect, but is not likely to adversely affect
Mussels			
Epioblasma torulosa rangiana	northern riffleshell	E	no effect
Epioblasma triquetra	snuffbox mussel	E	no effect
Villosa fabalis	rayed bean	E	no effect

Species	Common Name	Federal Status	Effect Determination
Key: E = endangered, and T = threatened.			
Sources: 80 FR 17973; FWS 2014a, 2014b, 2014c			

Red Knot (*Calidris canutus rufa*)

- Within the action area, the red knot is most likely to use a shoreline habitat near Lake Erie. This habitat may provide suitable or marginal resting or foraging habitat for the red knot (Kogge 2014; DTE 2014c). However, shoreline habitat on the Fermi site is not likely to provide preferred foraging habitat for the red knot (Kogge 2014).

One potential impact of the proposed license renewal is the direct mortality of individuals from collision with the cooling tower, other plant structures, or in-scope transmission lines. Although the NRC (2013d) generically determined this impact to be SMALL for birds at all nuclear plants during the license renewal term, this impact could uniquely affect the red knot because of its status as Federally threatened.

The NRC staff reviewed the licensee's bird collision records for the past 10 years (2005 to 2014) and bird strike surveillance data from 2008 and 2009. These records are summarized in Section 3.6.6. Aside from two larger bird collision events (50 birds in 1973 and 45 birds in October 2007), DTE has relatively few records of bird collisions with plant structures or transmission lines. None of DTE's records include the red knot (DTE 2014c). Additionally, DTE has implemented some measures at Fermi 2 that were determined to reduce bird collision hazards during consultations between DTE, the FWS, and the Federal Aviation Administration for the proposed Fermi 3. These measures include flashing strobe lights on the top of the cooling towers (DTE 2014c). DTE (2014c) is also in the process of developing a company-wide program to reduce operational risks resulting from avian collisions. The program is based on an avian protection plan from the Avian Powerline Interaction Committee and on conversations with FWS personnel at the Lansing, Michigan, office (DTE 2014c). The program will address changes that are needed to prevent avian fatalities and will require documentation of bird strikes to help DTE determine whether reporting to local, State, or Federal agencies is required (DTE 2014c). DTE (2014c) expects to begin implementation of the program in early 2015.

Based on the available information on bird mortality, the NRC staff finds that it is possible, although unlikely, that red knot individuals could experience injury or mortality resulting from collisions with plant structures during the proposed license renewal term. If a red knot were to collide with plant structures or transmission lines during the proposed license renewal term, such a collision could result in a "take," as defined by the ESA. The NRC staff believes that the likelihood of this happening is extremely unlikely to occur because the red knot is relatively rare in the action area, the last red knot observed at the Fermi site was in 1973, the red knot is only in the action area for a short period of time each year, and the red knot is not likely to inhabit the inland developed portions of the site that contain collision hazards (NUS 1974; Niles et al. 2008; DTE 2014c, 2015a). However, because this species was recently listed in December 2014 (79 FR 73705), the ESA has not afforded this species protection for the majority of the operation of Fermi 2. Accordingly, until now, the ESA has not necessitated the NRC and DTE consult with the FWS in the event that an individual was found injured or dead as a result of collision with Fermi 2 plant structures. Although the NRC has no records indicating that such an event happened, the NRC staff cannot rely on the absence of records to predict the likelihood of future collisions because the ESA has not necessitated action following such an event until recently. Thus, the NRC staff assumes that there is a potential for red knots to collide with plant structures or transmission lines during the proposed license renewal term, and such collisions could result in a take.

In addition to collision hazards, the NRC staff also considered the likelihood of direct mortality, loss of habitat or food resources, or behavioral changes resulting from other activities associated with continued operations (e.g., regular site maintenance and infrastructure repairs during the proposed license renewal term). Applicable infrastructure includes roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure.

As discussed in Chapter 2 of this SEIS, DTE presently has no plans to conduct refurbishment or replacement actions associated with license renewal to support the continued operation of Fermi 2. Furthermore, DTE (2014a, 2014c) anticipates no new construction or other ground-disturbing activities, changes in operations, or changes in existing land use conditions in natural areas because of license renewal. As a result, the NRC staff does not expect any new impacts on red knot habitat as a result of these types of license renewal activities.

Operational and maintenance activities that DTE might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure), likely would be confined to previously disturbed areas of the Fermi site. Noise levels and human activity would remain similar to the current operations and would not cause any additional disturbances that would cause red knots to avoid or abandon shoreline habitat within the action area. Therefore, the NRC staff determined that maintenance and infrastructure repair activities would result in insignificant or discountable effects to the red knot.

When new activities that could impact the environment occur at Fermi 2, DTE follows several procedures to ensure that it considers potential environmental effects and appropriately addresses them, as described in Section 4.6.1.2. These procedures detail reporting requirements in the event that a Federally listed species is observed on site and requirements to update company and site-specific procedures for Federal requirements, such as those for Federally listed species (DTE 2014c).

Given that the red knot has not been observed on site since wildlife studies began in 1973, bird collisions with cooling towers or other plant infrastructure would be unlikely and given that any impacts from continued operations (including maintenance and infrastructure repairs) would result in insignificant or discountable effects, the NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the red knot.

<u>Piping Plover (*Charadrius melodus*)</u>

- The Fermi site may provide marginal resting and feeding habitat for migrating piping plovers, but the occurrence of this species within the action area would be rare.

As with the red knot, it is possible, although unlikely, that the piping plover could experience injury or mortality resulting from collisions with plant structures during the proposed license renewal term. This impact and a summary of previous bird mortality surveys conducted at Fermi 2 are discussed above in the assessment of effects on the red knot. The NRC staff believes a piping plover collision is extremely unlikely to occur because the piping plover is relatively rare in the action area, the piping plover was not collected during DTE's bird mortality study, the piping plover is only in the action area for a short period of time each year, and the piping plover is not likely to inhabit the inland developed portions of the site that contain collision hazards (NUS 1974; Niles et al. 2008; DTE 2014a, 2014c). Additionally, because the species has been listed under the ESA since 1985, the ESA has obligated the NRC and DTE to consult with the FWS if new information reveals effects of the action that may affect listed species in a manner, or to an extent, not previously considered (50 CFR 402.16(b)). No such information has been identified for which the NRC staff has determined that reinitiation of consultation is appropriate. Because no such collisions are known to have occurred to date and piping plovers are rare within the action area, the NRC staff finds it reasonable to assume that the likelihood of collisions would be very unlikely in the future.

In addition to collision hazards, the NRC staff also considered the likelihood of direct mortality; loss of habitat or food resources; or behavioral changes resulting from continued operations, regular site maintenance, and infrastructure repairs during the proposed license renewal term. The nature of these effects is discussed above in the assessment of effects on the red knot. For example, DTE (2014a) presently anticipates no new construction or other ground-disturbing activities, changes in operations, or changes in existing land use conditions in natural areas because of license renewal. Similarly, operational and maintenance activities that DTE might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure), likely would be confined to previously disturbed areas of the Fermi site. When new activities that could impact the environment occur at Fermi 2, DTE would follow several procedures to ensure that potential effects to the piping plover are considered and are reported to the appropriate Federal agencies, as described in Section 4.6.1.2. The NRC staff did not identify any direct or indirect adverse effects to piping plovers that would result from continued operation during the proposed license renewal term. Therefore, the NRC staff determined that maintenance and infrastructure repair activities would result in insignificant or discountable effects.

Given that the piping plover is rare within the action area, bird collisions with cooling towers or other plant infrastructure would be very unlikely and given that any impacts from continued operations (including maintenance and infrastructure repairs) would result in insignificant or discountable effects, the NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the piping plover.

Northern Long-Eared Bat (*Myotis septentrionalis*)

The FWS published a final rule to list the northern long-eared bat as threatened throughout its range on April 2, 2015 (80 FR 17973). The FWS did not propose to designate critical habitat for the species because it found that such habitat is “not determinable at this time” (80 FR 17973).

The FWS (80 FR 17973) identified the primary threat to northern long-eared bat as white nose syndrome, a disease caused by the fungus *Geomyces destructans*, and other sources of mortality to the species include wind-energy development, habitat modification, destruction and disturbance (e.g., vandalism to hibernacula and roost tree removal), effects of climate change, and contaminants.

The Fermi site provides potential roosting and foraging habitat for the northern long-eared bat. This species has not been observed on site since wildlife studies began in 1973 (NUS 1974; Black and Veatch 2009a; DECo 2011; NRC 2013a; Kogge and Heslinga 2013; Kogge 2014; DTE 2014a, 2014c). However, DTE has not conducted onsite mist-net surveys for northern long-eared bats that follow protocols recommended by the FWS.

Over the duration of the proposed license renewal term, DTE (2014a, 2014c) presently has no plans for landscape-altering activities related to license renewal, such as those that might adversely affect northern long-eared bats or its habitat. For example, DTE has no plans to conduct refurbishment or replacement actions associated with license renewal to support the continued operation of Fermi 2. Furthermore, DTE (2014a) anticipates no new construction or other ground-disturbing activities, changes in operations, or changes in existing land use conditions in natural areas because of license renewal. Similarly, operational and maintenance activities that DTE might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure), likely would be confined to previously disturbed areas of the Fermi site. Noise levels and human activity would remain similar to the current operations and would not cause any additional disturbances that would cause northern long-eared bats to avoid or abandon habitat within the action area. Therefore, the NRC staff determined that activities during continued operations, such as maintenance and infrastructure repair activities, would result in insignificant or discountable effects to the northern long-eared bat.

As part of regular site maintenance, DTE may need to remove trees that pose a safety concern. Although it is unlikely that DTE would need to remove trees in the forested tracts on the site where northern long-eared bats may roost, the NRC staff assumes that any tree removal could potentially affect the species if the trees have not been assessed for bat presence or use. When new activities that could impact the environment occur at Fermi 2, such as tree removal, DTE follows several procedures to ensure that it considers potential environmental effects and appropriately addresses them, as described in Section 4.6.1.2. These procedures detail reporting requirements in the event that a Federally listed species is observed on site and requirements to update company and site-specific procedures for Federal requirements, such as those for Federally listed species (DTE 2014c). In addition, if work is to be performed in undeveloped areas of the site, a Protected Species Protection Plan must be developed (DTE 2014c), and personnel must be briefed on the plan before beginning work. Furthermore, in the Interim 4(d) Rule for the northern long-eared bat published on April 2, 2015 (80 FR 17973), the FWS determined that activities that remove 1 ac (0.4 ha) or less of forested habitat are expected to have minimal impacts on the northern long-eared bat because changes to such a small area would have little or no impact on the ecological value and function of the forest. In addition, the Interim 4(d) Rule states that incidental takes caused by removal and management of hazardous trees (i.e., trees that need to be removed for the protection of human safety or human facilities) is not expected to adversely affect conservation and recovery efforts for the species (80 FR 17973).

The proposed license renewal could affect the northern long-eared bat by causing direct mortality through collision with plant structures. Based on the available information on bat mortality, the NRC staff finds that it is possible, although unlikely, that northern long-eared bat individuals could experience injury or mortality resulting from collisions with plant structures during the proposed license renewal term. If a northern long-eared bat were to collide with plant structures or transmission lines during the proposed license renewal term, such a collision could result in a take, as defined by the ESA. The NRC staff believes that such a collision is extremely unlikely to occur because the northern long-eared bat is not common in the action area and because no northern long-eared bats have been observed at the Fermi site (NUS 1974; DTE 2014c). However, because this species was just recently listed on April 2, 2015 (80 FR 17973), the ESA has not afforded this species protection during operation of Fermi 2. Accordingly, the ESA has not necessitated the NRC and DTE to consult with the FWS in the event that an individual was found injured or dead as a result of collision with Fermi 2 plant structures. Although the NRC has no records indicating that such an event happened, the NRC staff cannot rely on the absence of records to predict the likelihood of future collisions because the ESA has not necessitated action following such an event. Thus, the NRC staff assumes that there is a potential for the northern long-eared bat to collide with plant structures or transmission lines during the proposed license renewal term, and such collisions could result in a take.

DTE (2014c) is in the process of developing a company-wide program to reduce operational risks resulting from bird and bat collisions. The program is based on an avian protection plan from the Avian Powerline Interaction Committee and on conversations with FWS personnel at the Lansing, Michigan, office (DTE 2014c). The program will address changes that are needed to prevent avian and bat fatalities and will require documentation of bird and bat strikes to help DTE determine whether reporting to local, State, or Federal agencies is required (DTE 2014c). DTE (2014c) expects to begin implementation of the program in early 2015.

Several ongoing restoration projects would result in positive impacts to habitat for the northern long-eared bat during the license renewal term. These projects are discussed in Section 3.6 and include two prairie restoration projects and the continued maintenance of the site's delineated wetlands and the DRIWR Lagoona Beach Unit.

Given the above information, the NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the northern long-eared bat. The conclusion is based on the following:

- The FWS has identified the white-nose syndrome disease as the primary threat to northern long-eared bat; this disease typically spreads in the winter hibernacula, and such hibernacula do not occur on the Fermi site.
- DTE plans no landscape-altering activities.
- Bat collisions with cooling towers or other plant infrastructure would be very unlikely.
- Any impacts from continued operations (including maintenance and infrastructure repairs) would result in insignificant or discountable effects.

<u>Indiana Bat (*Sodalis myotis*)</u>

- The Fermi site provides some potential summer roosting areas for the Indiana bat. However, most of the trees within forested areas on the Fermi site are either too small or otherwise unsuitable for Indiana bat summer roosts (Black and Veatch 2011; NRC 2013a). In addition, other habitat features usually preferred by Indiana bats are generally lacking at the Fermi site (Black and Veatch 2011; NRC 2013a).

License renewal activities could result in direct mortality, loss of roosting or other habitat or food resources, or behavioral changes resulting from construction or refurbishment activities, regular site maintenance, and infrastructure repairs during the proposed license renewal term.

Over the duration of the proposed license renewal term, DTE (2014a, 2014c) reports no plans for landscape-altering activities related to license renewal, such as those that might adversely affect Indiana bats. For example, DTE (2014a) has no plans to conduct refurbishment or replacement actions associated with license renewal to support the continued operation of Fermi 2. Furthermore, DTE (2014a) anticipates no new construction or other ground-disturbing activities, changes in operations, or changes in existing land use conditions in natural areas because of license renewal. Similarly, operational and maintenance activities that DTE might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure), likely would be confined to previously disturbed areas of the Fermi site. Noise levels and human activity would remain similar to the current operations and would not cause any additional disturbances that would cause Indiana bats to avoid or abandon habitat within the action area. Therefore, the NRC staff determined that activities during continued operations, such as maintenance and infrastructure repair activities, would result in insignificant or discountable effects to the Indiana bat.

As part of regular site maintenance, DTE may need to remove trees that pose a safety concern. Although it is unlikely that DTE would need to remove trees in the forested tracts on the site where Indiana bats may roost, the NRC staff assumes that any tree removal could potentially affect the species if the trees have not been assessed for bat presence or use. When new activities that could impact the environment occur at Fermi 2, such as tree removal, DTE follows several procedures to ensure that it considers potential environmental effects and appropriately addresses them, as described in Section 4.6.1.2. These procedures detail reporting requirements in the event that a Federally listed species is observed on site and requirements to update company and site-specific procedures for Federal requirements, such as those for Federally listed species (DTE 2014c). In addition, if work is to be performed in undeveloped areas of the site, a Protected Species Protection Plan must be developed, and personnel must be briefed on the plan before beginning work (DTE 2014c).

The proposed license renewal could affect the Indiana bat by causing direct mortality through collision with plant structures. Based on the available information on bat mortality, the NRC staff finds that it is possible, although unlikely, that Indiana bat individuals could experience injury or mortality resulting from collisions with plant structures during the proposed license renewal term. If an Indiana bat were to collide with plant structures or transmission lines during the proposed license renewal term, such a collision could result in a take, as defined by the ESA. The NRC staff believes that such a collision is very unlikely to occur because the Indiana bat is relatively rare in the action area and because no Indiana bats have been observed at the Fermi site (NUS 1974; MNFI 2007b; DTE 2014a). Additionally, because the species has been listed under the ESA since 1967, the ESA has obligated the NRC and DTE to consult with the FWS if new information reveals effects of the action that may affect listed species in a manner, or to an extent, not previously considered (50 CFR 402.16(b)). No such information has been identified for which the NRC staff has determined that reinitiation of consultation is appropriate. Furthermore, as described above for the northern long-eared bat, DTE (2014c) is in the process of developing a company-wide program to reduce operational risks resulting from bird and bat collisions. Because no such collisions are known to have occurred to date and because Indiana bats are not common within the action area, the NRC staff finds it reasonable to assume that an Indiana bat collision with plant structures would be very unlikely in the future.

Several ongoing restoration projects would result in positive impacts to habitat for the Indiana bat during the license renewal term. These projects are discussed in Section 3.6 and include two prairie restoration projects and the continued maintenance of the site's delineated wetlands and the DRIWR Lagoona Beach Unit.

During consultation with the FWS for the proposed construction and operation of Fermi 3, the FWS (2012) concurred with the NRC staff's determination that the proposed construction and operation may affect, but is not likely to adversely affect, the Indiana bat. The types and intensity of potential effects from the proposed license renewal of Fermi 2 would likely be bounded by the potential effects from the proposed construction and operation of Fermi 3 because the activities associated with Fermi 3 would include construction and operations, whereas the activities associated with the proposed license renewal for Fermi 2 would be limited to continued operations.

Given the above information, NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the Indiana bat. The conclusion is based on the following:

- DTE plans no landscape-altering activities.
- Bat collisions with cooling towers or other plant infrastructure would be very unlikely.
- Any impacts from continued operations (including maintenance and infrastructure repairs) would result in insignificant or discountable effects.

Eastern Prairie Fringed Orchid (*Platanthera leucophaea)*

The eastern prairie fringed orchid may occur in areas of suitable habitat within the action area, such as lakeplain prairies or wetland habitats. Although emergent wetlands exist on the Fermi site, large portions of these emergent wetlands have been severely degraded by the common reed (*Phragmites australis*), an invasive plant (NRC 2013a). This species has not been observed on site since vegetation studies began in 1973 (NUS 1974; Black and Veatch 2009b; DECo 2011; NRC 2013a; Kogge and Heslinga 2013; DTE 2014a).

The Fermi 2 license renewal would include maintenance and operation activities within developed or previously disturbed areas and would not involve new construction, refurbishment, ground-disturbing activities, changes to conduct of operations, or changes to existing land use conditions in either natural or developed areas (DTE 2014a). If new activities are planned on the Fermi site, DTE follows several procedures to ensure that it considers potential environmental effects and appropriately addresses them, as described in Section 4.6.1.2. These procedures detail reporting requirements in the event that a Federally listed species is observed on site and requirements to update company and site-specific procedures for Federal requirements, such as those for Federally listed species (DTE 2014c). Furthermore, if work is to be performed in undeveloped areas of the site, a Protected Species Protection Plan must be developed (DTE 2014c), and personnel must be briefed on the plan before beginning work. In addition, several ongoing restoration projects would result in positive impacts to habitat for the eastern prairie fringed orchid during the license renewal term. These projects are discussed in Section 3.6 and include two prairie restoration projects and the continued maintenance of the site's delineated wetlands and the DRIWR Lagoona Beach Unit. Therefore, the NRC staff determined that activities during continued operations, such as maintenance and infrastructure repair activities, would result in insignificant or discountable effects to the eastern prairie fringed orchid.

During consultation with the FWS for the proposed construction and operation of Fermi 3, the FWS (2012) concurred with the NRC staff's determination that the proposed construction and operation may affect, but is not likely to adversely affect, the eastern prairie fringed orchid. The types and intensity of potential effects from the proposed license renewal of Fermi 2 would likely be bounded by the potential effects from the proposed construction and operation of Fermi 3 because the activities associated with Fermi 3 would include construction and operations, whereas the activities associated with the proposed license renewal for Fermi 2 would be limited to continued operations.

Because any impacts from continued operations (including maintenance and infrastructure repairs) would result in insignificant or discountable effects, because this species has not been observed on site since vegetation studies began in 1973, and because potential habitat for this species on the Fermi site is highly degraded, the NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the eastern prairie fringed orchid.

Species and Habitats under the National Marine Fisheries Service's Jurisdiction

As discussed in Section 3.8, no species or habitats under the NMFS's jurisdiction occur within the action area. Thus, the NRC staff concludes that the proposed action would have no effect on Federally listed species or habitats under the NMFS's jurisdiction.

Cumulative Effects

The ESA regulations at 50 CFR 402.12(f)(4) direct Federal agencies to consider cumulative effects as part of the proposed action effects analysis. Under the ESA, cumulative effects are defined as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Unlike the definition of cumulative impacts under the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq.) (Section 4.16), cumulative effects under the ESA do not include past actions or other Federal actions requiring separate ESA section 7 consultation. When formulating biological opinions under formal ESA section 7 consultation, the FWS and the NMFS (1998) consider cumulative effects when determining the likelihood of jeopardy or adverse modification. Therefore, consideration of cumulative effects under the ESA is necessary only if listed species will be adversely affected by the proposed action (FWS 2014d).

In the case of Fermi 2, because the NRC staff concluded earlier in this section that the proposed license renewal would have no effect on designated or proposed critical habitat and some species and that it may affect, but is not likely to adversely affect other species, consideration of cumulative effects is not necessary.

<u>Reporting Requirements</u>

In the future, a Federally listed species could be observed on the Fermi site. For example, as part of DTE's Wildlife Management Plan and Wildlife Habitat Council certification, DTE would also continue biannual qualitative prairie vegetation surveys, which would be performed by a botanist from the FWS or the Michigan Natural Features Inventory (DTE 2014c). The Fermi 2 Wildlife Habitat Team would also conduct periodic wildlife surveys of site-specific areas several times per year to monitor the site's animal communities and to document the occurrence of any new species.

If, during these future activities or other onsite activities, a Federally listed species is observed on the Fermi site, the NRC has measures in place to ensure that the NRC staff would be appropriately notified so that it could determine the appropriate course of action, such as possibly reinitiating section 7 consultation under the ESA with the FWS at that time. Fermi 2's operating license, Appendix B, "Environmental Protection Plan," Section 4.1, "Unusual or Important Environmental Events," requires DTE to report to the NRC within 24 hours any occurrence of a species protected by the ESA on the Fermi site (NRC 1985). Additionally, the NRC's regulations concerning notification requirements require operating nuclear power reactors to report to the NRC within 4 hours "any event or situation, related to…protection of the environment, for which a news release is planned or notification to other government agencies has been or will be made" (Title 10 of the *Code of Federal Regulations* (10 CFR) 50.72(b)(2)(xi)). Such notifications include reports regarding Federally listed species, as described in Section 3.2.12 of NUREG–1022, *Event Report Guidelines: 10 CFR 50.72 and 50.73* (NRC 2013b).

4.8.1.2 Species and Habitats Protected under the Magnuson–Stevens Act of 2006

As discussed in Section 3.8, the NMFS has not designated essential fish habitat pursuant to the Magnuson–Stevens Fishery Conservation and Management Act of 2006, as amended (MSA) (16 U.S.C. 1801–1884), in Lake Erie. Thus, the NRC staff concludes that the proposed action would have no effect on essential fish habitat.

4.8.2 No-Action Alternative

Under the no-action alternative, Fermi 2 would shut down. Federally listed species and designated critical habitat can be affected not only by operation of nuclear power plants but also by activities during shutdown. The ESA action area for the no-action alternative would most likely be the same or similar to the action area described in Section 3.8. Because the plant would require substantially less cooling water, potential impacts to aquatic species and habitats would be reduced, although the plant would still require some cooling water for some period of time. The water in the immediate vicinity near the discharge would likely decrease in temperature due to the decrease in, or stopping of, thermal discharge. Changes in land use and other shutdown activities might affect terrestrial species differently than they would under continued operation.

Because Federally listed species or habitats occur in the action area, the NRC would assess the need for ESA consultation if any activities associated with plant shutdown have the potential to affect a Federally listed species and if they meet the criteria in 50 CFR Part 402 for initiation or reinitiation of section 7 consultation. The ESA forbids the "take" of a listed species, where "take" means "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." In the case of a take, ESA section 7 requires the NRC to initiate consultation with the FWS or the NMFS. The implementing regulations at 50 CFR 402.16 also direct Federal agencies to reinitiate consultation in circumstances in which (1) the incidental take limit in a biological opinion is exceeded, (2) new information reveals effects to Federally listed species or designated critical habitats that were not previously considered, (3) the action is modified in a manner that causes effects not previously considered, or (4) new species are listed or new critical habitat is designated that may be affected by the action. An ESA section 7 consultation could identify impacts on Federally listed species or critical habitat, require monitoring and mitigation to minimize such impacts, and provide a level of exempted take. Regulations and guidance regarding the ESA section 7 consultation process are provided in 50 CFR Part 402 and in the *Endangered Species Consultation Handbook* (FWS and NMFS 1998).

The effects on ESA-listed aquatic species would likely be smaller than the effects under continued operation but would depend on the listed species and habitats present when the alternative is implemented. The type of impacts on ESA-listed species would likely be similar to those described for terrestrial and aquatic resources in Sections 4.6 and 4.7. However, the magnitude of such impacts could be larger than that for terrestrial and aquatic resources because ESA-listed species are rare and more sensitive to environmental stressors. The magnitude of adverse impacts to ESA-listed species would depend on the shutdown activities and the listed species and habitats present when the alternative is implemented; therefore, the NRC cannot forecast a particular level of impact for this alternative.

4.8.3 NGCC Alternative

This alternative entails shutdown and decommissioning of Fermi 2 and construction of a new NGCC facility at the Fermi site. Section 4.8.2 discusses ESA considerations for the shutdown of Fermi 2.

Unlike license renewal or the new nuclear alternative, the NRC does not license NGCC facilities; therefore, it would not be responsible for initiating section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids take of a listed species for non-Federal entities.

If the NGCC alternative were to be built on the Fermi site, the ESA action area might be different, and the activities and structures associated with the site would be different from those described for the proposed license renewal. The type of impacts on ESA-listed species would likely be similar to those described for terrestrial and aquatic resources in Sections 4.6 and 4.7. However, the magnitude of such impacts could be larger than that for terrestrial and aquatic resources because ESA-listed species are rare and more sensitive to environmental stressors. Because the magnitude of adverse impacts to ESA-listed species would depend on the site layout, plant design, operation, and species and habitats listed when the alternative is implemented, the NRC cannot forecast a particular level of impact for this alternative.

4.8.4 IGCC Alternative

This alternative entails shutdown and decommissioning of Fermi 2 and construction of a new IGCC facility at the Fermi site. Section 4.8.2 discusses ESA considerations for the shutdown of Fermi 2.

Unlike license renewal or the new nuclear alternative, the NRC does not license IGCC facilities; therefore, it would not be responsible for initiating section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids take of a listed species for non-Federal entities.

If the IGCC alternative were to be built on the Fermi site, the ESA action area might be different, especially if DTE constructs the facility on newly acquired land adjacent to the current Fermi site. In addition, the activities and structures associated with the site would be different from those described for the proposed license renewal. The type of impacts on ESA-listed species would likely be similar to those described for terrestrial and aquatic resources in Sections 4.6 and 4.7. However, the magnitude of such impacts could be larger than that for terrestrial and aquatic resources because ESA-listed species are rare and more sensitive to environmental stressors. Because the magnitude of adverse impacts to ESA-listed species would depend on the site layout and the extent to which new land is acquired, plant design, operation, and species and habitats listed when the alternative is implemented, the NRC cannot forecast a particular level of impact for this alternative.

4.8.5 New Nuclear Alternative

This alternative entails shutdown and decommissioning of Fermi 2 and construction of a new nuclear alternative on the Fermi site. Section 4.8.2 discusses ESA considerations for the shutdown of Fermi 2.

If the new nuclear alternative were to be built on the Fermi site, the ESA action area might be different, and the activities and structures associated with the site would be different from those described for the proposed license renewal. Because the NRC would remain the licensing agency under this alternative, the ESA would require the NRC to initiate consultation with the FWS, as applicable, before construction to ensure that the construction and operation of the new nuclear plant would not adversely affect any Federally listed species or adversely modify or destroy designated critical habitat.

The type of impacts on ESA-listed species would likely be similar to those described for terrestrial and aquatic resources in Sections 4.6 and 4.7. However, the magnitude of such impacts could be larger than that for terrestrial and aquatic resources because ESA-listed species are rare and more sensitive to environmental stressors. Because the magnitude of adverse impacts to ESA-listed species would depend on the site layout, plant design, operation, and species and habitats listed when the alternative is implemented, the NRC cannot forecast a particular level of impact for this alternative.

4.8.6 Combination Alternative (NGCC, Wind, and Solar)

This alternative entails shutdown and decommissioning of Fermi 2 and construction and operation of a new NGCC plant at the Fermi site and wind turbines and solar PV systems throughout the ROI. Section 4.8.2 discusses ESA considerations for the shutdown of Fermi 2.

Unlike license renewal and the new nuclear alternative, the NRC does not license NGCC, wind, and solar facilities; therefore, it would not be responsible for initiating section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids take of a listed species for non-Federal entities.

If the NGCC portion of the combination alternative were to be built on the Fermi site, the ESA action area might be different, and the activities and structures associated with the site would be different from those described for the proposed license renewal. The wind and solar portions of this alternative would not be built on the Fermi site; therefore, the listed species and habitats affected by this alternative would be different from those identified for the proposed license renewal. The type of impacts on ESA-listed species would likely be similar to those described for terrestrial and aquatic resources in Sections 4.6 and 4.7. However, the magnitude of such impacts could be larger than that for terrestrial and aquatic resources because ESA-listed species are rare and more sensitive to environmental stressors. Because the magnitude of adverse impacts to ESA-listed species would depend on the selected sites, alternative design, operation, and species and habitats listed when the alternative is implemented, the NRC cannot forecast a particular level of impact for this alternative.

4.9 Historic and Cultural Resources

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on historic and cultural resources.

4.9.1 Proposed Action

The historic and cultural resource issue applicable to Fermi 2 during the license renewal term is listed in Table 4–10. Section 3.9 of this SEIS describes the historic and cultural resources that have the potential to be affected by the proposed action.

Table 4–10. Historic and Cultural Resources

Issue	GEIS Section	Category
Historic and Cultural Resources	4.7.1	2

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

The National Historic Preservation Act of 1966, as amended (NHPA) (54 U.S.C. 300101 et seq.), requires Federal agencies to consider the effects of their undertakings on historic properties, and renewing the operating license of a nuclear power plant is an undertaking that could potentially affect historic properties. Historic properties are defined as resources eligible for listing in the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 CFR Part 60.4 and include (1) association with significant events in history, (2) association with the lives of persons significant in the past, (3) embodiment of distinctive characteristics of type, period, or construction, and (4) sites or places that have yielded, or are likely to yield, important information.

The regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800 define the process for identifying and evaluating historic properties (Section 106 of the NHPA).

In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties included in, or eligible for, inclusion in the NRHP in the area of potential effect. The area of potential effect for a license renewal action includes the power plant site; transmission lines up to the first substation; and immediate environs that may be affected by the license renewal decision, including land-disturbing activities associated with continued reactor operations during the license renewal term. For Fermi 2, the first substation is located on site at the 345-kilovolt switchyard (DTE 2014a).

If historic properties are present within the APE, the NRC is required to contact the State Historic Preservation Office (SHPO), assess potential adverse effects of the undertaking (license renewal) on historic properties, and resolve any possible adverse effects. In addition, the NRC is required to notify the SHPO if historic properties would not be affected by license renewal or if no historic properties are present. In Michigan, the SHPO is part of the Michigan State Housing Development Authority.

Consultation

In accordance with 36 CFR 800.8(c), on July 8, 2014, the NRC initiated consultations with the Advisory Council on Historic Preservation, the Michigan SHPO, and the following 17 Federally recognized Indian Tribes (NRC 2014a, 2014b, 2014c) (see Appendix D):

- Keweenaw Bay Indian Community,
- Bay Mills Indian Community,
- Grand Traverse Band of Ottawa and Chippewa Indians,
- Lac Vieux Desert Band of Lake Superior Chippewa Indians,
- Little Traverse Bay Bands of Odawa Indians,
- Pokagon Band of Potawatomi Indians,
- Sault Ste. Marie Tribe of Chippewa Indians of Michigan,
- Hannahville Indian Community,
- Nottawaseppi Huron Band of the Potawatomi,
- Saginaw Chippewa Indian Tribe of Michigan,
- Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan,
- Little River Band of Ottawa Indians,
- Forest County Potawatomi,
- Shawnee Tribe,
- Delaware Nation,
- Wyandotte Nation, and
- Ottawa Tribe of Oklahoma.

By letter, the NRC provided information about the proposed undertaking (license renewal), defined the APE, and indicated that the Section 106 review would be coordinated with the NEPA process in accordance with 36 CFR 800.8. The NRC invited the SHPO and the Tribes to participate in the identification of historic properties and in any decisions potentially affecting historic properties. They were also invited to participate in the scoping process. To date, the NRC has not received any response or comments from any of the contacted Tribes. The NRC met with the Michigan SHPO in September 2014. The Michigan SHPO did not express any concerns about the proposed Fermi 2 license renewal during the meeting (NRC 2015a).

Separate from these consultations, an Indian Tribe from Ontario, Canada, the Walpole Island First Nation, sent a letter to the NRC stating that it would like an opportunity to thoroughly review the Fermi 2 license renewal process to ensure that their rights to fish and harvest resources in western Lake Erie and other nearby areas are not adversely impacted. Accordingly, the NRC invited the Tribe to provide input on the Fermi 2 license renewal environmental review process (NRC 2014f).

The entire 1,260-ac (510-ha) Fermi site has been surveyed using field observations and aerial photography (DTE 2014c). DTE currently has no plans for physical changes or ground-disturbing activities related to the license renewal of Fermi 2 (DTE 2014a). As described in Section 3.9, there are both NHRP-eligible (i.e., Fermi 1), and non-NRHP-eligible cultural resources present within the APE. In accordance with the stipulations of the 2012 Memorandum of Agreement (MOA) between the NRC and the Michigan SHPO, DTE (1) created a permanent record of the Fermi 1 nuclear power plant, (2) created a historical public exhibit about Fermi 1 that opened at the Monroe County Community College in 2013, and (3) contacted potentially interested parties and local, State, and Federal agencies regarding the retention of archival materials. In response to these actions, the Michigan SHPO concurred that all requirements of the MOA have been met (DTE 2014c).

DTE has established site procedures and work instructions to ensure the consideration of historic and cultural resources before the commencement of any ground-disturbing activities at the Fermi site (DTE 2014c). These procedures instruct DTE staff on how to handle possible impacts to historic and cultural resources and require work planned in previously undisturbed areas of the site to consider the potential for inadvertent discovery of historic and archaeological artifacts (DTE 2014c). Furthermore, these site procedures and related work instructions direct DTE staff to stop work, protect exposed resources, and contact the appropriate DTE personnel and the SHPO in the event that such resources are inadvertently discovered during ground-disturbing activities (DTE 2014c).

Based on (1) the fulfillment of the MOA stipulations regarding the NRHP-eligible Fermi 1 nuclear power plant, (2) there currently being no other known NRHP-eligible historic properties on the Fermi site, (3) DTE's establishment of site procedures and work instructions to protect cultural resources, (4) DTE's assurance that no license renewal-related physical changes or ground-disturbing activities would occur, (5) the Michigan SHPO's input, and (6) this cultural resource assessment, no historic properties would be adversely affected by the license renewal decision (36 CFR Section 800.4(d)(1)).

4.9.2 No-Action Alternative

Not renewing the operating licenses and terminating reactor operations would have no effect on historic properties and cultural resources within the site boundaries of Fermi 2. In the decommissioning GEIS, the NRC determined that, for all nuclear plant sites at which decommissioning does not anticipate disturbing lands beyond existing site boundaries, impacts to cultural resources would be SMALL. If disturbance beyond the operational areas is anticipated, the impacts may or may not be detectable or destabilizing, depending on site-specific conditions, and cannot be predicted generically. In those cases, the potential impacts may be SMALL, MODERATE, or LARGE and must be determined through site-specific analysis (NRC 2002b).

The regulations at 10 CFR 50.82 require power reactor licensees to submit a post-shutdown decommissioning activities report (PSDAR). The PSDAR must be submitted within 2 years following permanent cessation of operations and must include a description of planned decommissioning activities. Until the PSDAR is submitted, the NRC does not know whether land disturbance would only occur within the existing site boundary after the nuclear plant is shut down.

4.9.3 NGCC Alternative

This alternative assumes that a new NGCC facility would be built at the Fermi site separate from Fermi 1, Fermi 2, and the proposed location for Fermi 3. The new NGCC facility would require an estimated 24 ac (9.7 ha) of land for the power plant with the possibility of additional land requirements for gas pipeline ROWs. Areas of the Fermi site that could potentially be affected by the construction and operation of a new NGCC power plant may need to undergo additional field surveys to identify and record any potentially affected historic and cultural resources. Previously disturbed areas of the Fermi site known to not contain historic and cultural resources could be used; however, if the NGCC plant were to be sited on undisturbed land, a survey could be conducted before construction to identify potentially affected historic and cultural resources. Power plant operators could also survey areas associated with any new pipelines, roads, transmission corridors, and other ROWs. Any resources found in these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. Areas of greatest cultural sensitivity should be avoided. Visual impacts on significant cultural resources, such as the viewsheds of historic properties near the proposed NGCC power plant site, would need to be assessed and evaluated.

The potential for impacts on historic and cultural resources from the construction and operation of a new NGCC power plant would vary depending on the specific location chosen within the Fermi site. Given the preference to site the power plant on previously disturbed land, avoidance of significant historic and cultural resources would be possible and could be effectively managed. However, historic and archaeological resources could potentially be affected, depending on the resource richness of the land required for a new gas pipeline; however, as with the plant site itself, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, historic and cultural resource impacts from the construction and operation of a new NGCC power plant would be SMALL.

4.9.4 IGCC Alternative

This alternative assumes that a new IGCC power plant would be built at the Fermi site separate from Fermi 1, Fermi 2, and the proposed location for Fermi 3. The new IGCC facility would require an estimated 1,000 ac (405 ha) of land for the power plant and would require DTE to obtain additional parcels of land adjacent to the Fermi site. Areas of the Fermi site and adjacent parcels that could potentially be affected by the construction and operation of an IGCC power plant may need to undergo additional field surveys to identify and record any potentially affected historic and cultural resources. Previously disturbed areas of the Fermi site known to not contain historic and cultural resources could be used; however, if the IGCC plant were to be sited on undisturbed land, a survey could be conducted before construction to identify potentially affected historic and cultural resources. Power plant operators could also survey the land parcels acquired to support this alternative. Any resources found in these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. Areas of greatest cultural sensitivity should be avoided. Visual impacts on significant cultural resources, such as the viewsheds of historic properties near the proposed IGCC power plant site, would need to be assessed and evaluated.

The potential for impacts on historic and cultural resources from the construction and operation of a new IGCC power plant would vary, depending on the specific location chosen within the Fermi site and adjacent land parcels. Given the preference to site the power plant on previously disturbed land and given that no major infrastructure upgrades would be necessary, avoidance of significant historic and cultural resources would be possible and could be effectively managed. However, historic and archaeological resources could potentially be affected, depending on the resource richness of the adjacent land parcels required to site the larger footprint of this facility. Therefore, historic and cultural resource impacts from the construction and operation of a new IGCC power plant would be SMALL to MODERATE.

4.9.5 New Nuclear Alternative

This alternative assumes that a new nuclear power plant would be built at the Fermi site separate from Fermi 1, Fermi 2, and the proposed location for Fermi 3. The new nuclear plant would require an estimated 301 ac (122 ha) of land for the power plant and would require DTE to obtain additional parcels of land adjacent to the existing Fermi site. Areas of the Fermi site and adjacent parcels that could potentially be affected by the construction and operation of a new nuclear power plant may need to undergo additional field surveys to identify and record any potentially affected historic and cultural resources. Previously disturbed areas of the Fermi site known to not contain historic and cultural resources could be used; however, if the new nuclear power plant were to be sited on undisturbed land, a survey would need to be conducted before construction to identify potentially affected historic and cultural resources. Power plant operators would also need to survey all of the land parcels acquired to support this alternative. Any resources found in these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. Areas of greatest cultural sensitivity should be avoided. Visual impacts on significant cultural resources, such as the viewsheds of historic properties near the proposed nuclear power plant site, would need to be assessed and evaluated.

The potential for impacts on historic and cultural resources from the construction and operation of a new nuclear power plant would vary depending on the specific location chosen within the Fermi site and adjacent land parcels. Given the preference to site the power plant on previously disturbed land and given that no major infrastructure upgrades would be necessary, avoidance of significant historic and cultural resources would be possible and could be effectively managed. However, historic and archaeological resources could potentially be affected, depending on the resource richness of the adjacent land parcels required to site the new nuclear power plant. New cooling towers could also impact historic property viewsheds. Therefore, historic and cultural resource impacts from the construction and operation of a new nuclear power plant would be SMALL to MODERATE.

4.9.6 Combination Alternative (NGCC, Wind, and Solar)

Land area potentially affected by the construction and operation of an NGCC power plant and wind and solar PV power-generating facilities could be surveyed before construction to identify and evaluate the potential effects to historic and archaeological resources. Any historic and cultural resources found during these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. Impacts to historic and cultural resources from the NGCC portion of this alternative would be similar to those described for the NGCC alternative in Section 4.9.3.

The wind component of this alternative would require an estimated 1,117 to 3,351 ac (452 to 1,356 ha) of land at onshore wind farm sites across the ROI. The potential for impacts on historic and cultural resources from the construction and operation of the wind portion of this alternative would vary greatly, depending on the location of the proposed site(s). Areas with the greatest cultural sensitivity should be avoided or effectively managed. Construction of wind farms and their support infrastructure could impact historic and cultural resources because of ground-disturbing activities, and aesthetic changes to historic property viewsheds could be LARGE.

The solar component would require an estimated 3,577 ac (1,448 ha) of land across the ROI. The impacts from the construction of a new solar PV alternative on historic and cultural resources would vary, depending on where the solar power generating units are installed. Rooftop installations would minimize land disturbance and any modifications to the transmission system, thereby minimizing potential impacts to historic and cultural resources. Land-based solar installations would be larger than rooftop installations and would require some degree of land disturbance for installation, thus potentially causing greater impacts to historic and cultural resources. Aesthetic changes caused by the installation of both forms could have a noticeable effect on historic property viewsheds. Using previously disturbed sites for land-based installations and collocating any new transmission lines with existing ROWs could minimize impacts to historic and cultural resources. Areas with the greatest cultural sensitivity should be avoided or effectively managed. Therefore, depending on the sites chosen for the NGCC, wind, and solar PV alternative, historic and cultural resource impacts could range from SMALL to LARGE.

4.10 Socioeconomics

This section describes the potential socioeconomic impacts of the proposed action (license renewal) and alternatives to the proposed action.

4.10.1 Proposed Action

Socioeconomic effects of ongoing reactor operations at Fermi 2 have become well established as regional socioeconomic conditions have adjusted to the presence of the nuclear power plant. These conditions are described in Section 3.10. Any changes in employment and tax payments caused by license renewal and any associated refurbishment activities could have a direct and indirect impact on community services and housing demand, as well as traffic volumes in the communities around a nuclear power plant.

Socioeconomic NEPA issues from Table B–1 in Appendix B to Subpart A of Part 51, applicable to the license renewal of Fermi 2 are listed in Table 4–11. The review conducted for the 2013 revision to the GEIS did not identify any Category 2 socioeconomic NEPA issues (NRC 2013d).

Table 4–11. Socioeconomic NEPA Issues

Issues	GEIS Sections	Category
Employment and income, recreation and tourism	4.8.1.1	1
Tax revenues	4.8.1.2	1
Community services and education	4.8.1.3	1
Population and housing	4.8.1.4	1
Transportation	4.8.1.5	1

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d

The supplemental site-specific socioeconomic impact analysis for the license renewal of Fermi 2 includes a review of DTE's ER, scoping comments, other information records, and a data-gathering site visit to Fermi 2. The NRC staff did not identify any new and significant information during the review that would result in impacts that would exceed the predicted socioeconomic impacts evaluated in the GEIS, and no additional socioeconomic NEPA issues were identified beyond those listed in Table B–1.

In addition, DTE indicated that they have no plans to add nonoutage workers during the license renewal term and that increased maintenance and inspection activities could be managed using the current workforce. Consequently, people living in the vicinity of Fermi 2 are not likely to experience any changes in socioeconomic conditions during the license renewal term beyond what is currently being experienced. Therefore, the impact of continued reactor operations during the license renewal term would not exceed the socioeconomic impacts predicted in the GEIS. For these issues, the GEIS predicted that the impacts would be SMALL for all nuclear plants.

4.10.2 No-Action Alternative

4.10.2.1 Socioeconomics

Not renewing the operating license and terminating reactor operations would have a noticeable impact on socioeconomic conditions in the communities located near Fermi 2. The loss of jobs and income would have an immediate socioeconomic impact. Some, but not all, of the approximately 870 employees would begin to leave after reactor operations are terminated, and overall tax revenue generated by plant operations would be reduced (DTE 2014a). DTE pays annual property taxes to Frenchtown Township, Monroe County, Michigan. The Frenchtown Township Treasurer collects DTE's property tax payment and disperses it to various entities to partially fund their respective operating budgets. The property tax revenue is used to fund Monroe County Community College; Monroe County Intermediate Schools; Monroe County seniors; Lake Erie Transportation; additional voted school millage; local township operations; and, when applicable, the Resort Authority (DTE 2014a). The loss of tax revenue could reduce or eliminate some public and educational services. Indirect employment and income generated by power plant operations would also be reduced.

Former Fermi 2 workers and their families could leave in search of employment elsewhere. The increase in available housing along with decreased demand could cause housing prices to fall. Since the majority of employees reside in Monroe and Wayne Counties, socioeconomic impacts from the termination of reactor operations would be concentrated in these Counties, with a corresponding reduction in purchasing activity and tax revenue in the regional economy. Income and revenue losses from the termination of reactor operations at Fermi 2 would directly affect Monroe County and nearby communities most reliant on income from power plant operations. However, the impact of the job loss may not be as noticeable in local communities given the amount of time required for decommissioning. The socioeconomic impacts from the termination of nuclear plant operations (which may not entirely cease until after decommissioning) would, depending on the jurisdiction, range from SMALL to LARGE.

4.10.2.2 Transportation

Traffic congestion caused by commuting workers and truck deliveries on roads in the vicinity of Fermi 2 would be reduced after power plant shutdown. Most of the reduction in traffic volume would be associated with the loss of jobs. The number of truck deliveries to Fermi 2 would be reduced until decommissioning. Traffic-related transportation impacts would be SMALL as a result of the shutdown of the nuclear power plant.

4.10.3 NGCC Alternative

4.10.3.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the construction and operation of a power plant could affect regional employment, income, and expenditures.

Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of a new NGCC power plant were evaluated to measure their possible effects on current socioeconomic conditions.

The construction workforce could peak at 1,440 workers (NRC 1996). The relative economic effect of this many workers on the local economy and tax base would vary with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short-term economic "boom" from increased tax revenue and income generated by construction expenditures and the increased demand for temporary (rental) housing and public, as well as commercial services.

After construction, local communities could experience a return to preconstruction economic conditions. Based on this information and given the number of workers, socioeconomic impacts during construction in communities near an existing power plant site could range from MODERATE to LARGE.

An estimated 75 workers would be required during power plant operations (NRC 1996). Local communities would experience the economic benefits from increased tax revenue and income generated by operational expenditures and demand for housing and public, as well as commercial services. The amount of property tax payments under the NGCC alternative may also increase if additional land is required to support this alternative.

This alternative would also result in a loss of approximately 870 relatively high-paying jobs at Fermi 2 and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. If Fermi 2 were to cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 870 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the impact of the job loss may not be noticeable in local communities given the amount of time required for decommissioning of the existing Fermi 2 facilities. Based on this information and given the number of operations workers, socioeconomic impacts during NGCC power plant operations on local communities could range from SMALL to MODERATE.

4.10.3.2 Transportation

Transportation impacts associated with construction and operation of a three-unit NGCC power plant would consist of commuting workers and truck deliveries of construction materials to the power plant site. During periods of peak construction activity, up to 1,440 workers could be commuting daily to the construction site. Workers commuting to the construction site would arrive via site access roads, and the volume of traffic on nearby roads could increase substantially during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thus increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Pipeline construction and modification of existing natural gas pipeline systems could also have a temporary impact. In addition, materials could be delivered by barge or rail, depending on location. Traffic-related transportation impacts during construction would likely range from MODERATE to LARGE.

Traffic-related transportation impacts would be greatly reduced after completing the installation of the NGCC alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. The operations workforce of 75 workers would not be noticeable relative to total traffic volumes on local roadways. Since fuel is transported by pipeline, the transportation infrastructure would experience little to no increased traffic from plant operations. Overall, given the relatively small operations workforce estimate of 75 workers, transportation impacts would be SMALL during power plant operations.

4.10.4 IGCC Alternative

4.10.4.1 Socioeconomics

As explained in Section 4.10.3.1, two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of a new IGCC power plant were evaluated to measure their possible effects on current socioeconomic conditions.

The construction workforce could peak at 2,300 workers (DOE 2010). The relative economic effect of this many workers on the local economy and tax base would vary with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short-term economic "boom" from increased tax revenue and income generated by construction expenditures and the increased demand for temporary (rental) housing and public, as well as commercial services.

After construction, local communities could experience a return to preconstruction economic conditions. Based on this information and given the number of workers, socioeconomic impacts during construction in communities near an existing power plant site could range from MODERATE to LARGE.

An estimated 210 workers would be required during power plant operations (DOE 2010). Local communities would experience the economic benefits from increased tax revenue and income generated by operational expenditures and demand for housing and public, as well as commercial services. The amount of property tax payments under the IGCC alternative may also increase if additional land is required to support this alternative.

This alternative would also result in a loss of approximately 870 relatively high-paying jobs at Fermi 2 and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. If Fermi 2 were to cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 870 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the impact of the job loss may not be noticeable in local communities given the amount of time required for decommissioning of the existing Fermi 2 facilities. Based on this information and given the number of operations workers, socioeconomic impacts during IGCC power plant operations on local communities could range from SMALL to MODERATE.

4.10.4.2 Transportation

Transportation impacts associated with construction and operation of the two-unit, IGCC power plants would consist of commuting workers and truck deliveries of construction materials to the power plant site. During periods of peak construction activity, up to 2,300 workers could be commuting daily to the construction site. Workers commuting to the construction site would arrive via site access roads, and the volume of traffic on nearby roads could increase substantially during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thereby increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Materials could also be delivered by rail or barge, depending on location. Traffic-related transportation impacts during construction would likely range from MODERATE to LARGE.

Traffic-related transportation impacts on local roads would be greatly reduced after the completion of the power plant. The estimated maximum number of operations workers commuting daily to the power plant site could be 210 (DOE 2010). Fewer workers would be required if multiple units are operated at the same site. Frequent coal and limestone deliveries and ash removal by rail would add to the overall transportation impact. The increase in traffic on roadways would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Onsite coal storage would make it possible to receive several trains per day at a site with rail access. If the IGCC power plant is located on navigable waters, coal and other materials could be delivered by barge. Coal and limestone delivery and ash removal via rail would cause levels of service impacts due to delays at railroad crossings. Overall, transportation impacts would be SMALL to MODERATE during IGCC power plant operations.

4.10.5 New Nuclear Alternative

4.10.5.1 Socioeconomics

As explained in Section 4.10.3.1, two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of a new nuclear power plant were evaluated to measure their possible effects on current socioeconomic conditions.

The construction workforce could peak at 2,900 workers (NRC 2013a). The relative economic effect of this many workers on the local economy and tax base would vary with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short-term economic “boom” from increased tax revenue and income generated by construction expenditures and the increased demand for temporary (rental) housing and public, as well as commercial services.

After construction, local communities could experience a return to preconstruction economic conditions. Based on this information and given the number of workers, socioeconomic impacts during construction in communities near an existing nuclear power plant or retired coal site could range from MODERATE to LARGE.

Approximately 900 workers would be required during nuclear power plant operations (NRC 2013a). Some Fermi 2 operations workers could transfer to the new nuclear power plant. Local communities near the new nuclear power plant would experience the economic benefits from increased tax revenue and income generated by operational expenditures and demand for housing and public, as well as commercial services. The amount of property tax payments under the new nuclear alternative may also increase if additional land is required to support this alternative.

This alternative would also result in a loss of approximately 870 relatively high-paying jobs at Fermi 2 and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. If Fermi 2 were to cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 870 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the impact of the job loss may not be noticeable in local communities given the amount of time required for decommissioning of the existing Fermi 2 facilities. Based on this information and given the number of operations workers, socioeconomic impacts during nuclear power plant operations on local communities could range from SMALL to MODERATE.

4.10.5.2 Transportation

Transportation impacts associated with construction and operation of a new nuclear power plant would consist of commuting workers and truck deliveries of construction materials to the power plant site. During periods of peak construction activity, up to 2,900 workers could be commuting daily to the construction site (NRC 2013a). Workers commuting to the construction site would arrive via site access roads, and the volume of traffic on nearby roads could increase substantially during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thereby increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Materials could also be delivered by rail or barge, depending on the location. Traffic-related transportation impacts during construction would likely range from MODERATE to LARGE.

Traffic-related transportation impacts on local roads would be greatly reduced after the completion of the power plant. The estimated maximum number of operations workers commuting daily to the new nuclear power plant site could be 900 (NRC 2013a). Transportation impacts would include daily commuting by the operating workforce, material deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. Traffic on roadways would peak during shift changes and refueling outages, resulting in temporary levels of service impacts and delays at intersections. Overall, at the new nuclear power plant site, transportation impacts would be SMALL to MODERATE during operations.

4.10.6 Combination Alternative (NGCC, Wind, and Solar)

4.10.6.1 Socioeconomics

As explained in Section 4.10.3.1, two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact, and (2) operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the NGCC, wind, and solar generation components of this combination alternative were evaluated to estimate their possible effects on current socioeconomic conditions.

Fewer workers would be required to construct the single NGCC unit at the Fermi site than those required for the full-power NGCC alternative. Installation of an estimated 1,117 wind turbines would likely be done in stages and could employ up to 307 construction workers (NREL 2013).

Additional workers would be required to install solar PV systems on existing buildings or structures at residential, commercial, or industrial sites that have already been developed. Similar to the wind farms, installation would likely be done in stages and could employ up to 528 construction workers (DOE 2011).

Conversely, a small number of operations workers would be needed to operate the single NGCC unit, and additional small numbers of workers would be required to maintain the wind farms (187 workers) and solar PV systems (53 workers). Local communities could experience the economic benefits from increased tax revenue and income generated by operational expenditures and demand for housing and public, as well as commercial services. The amount of property tax payments under the wind and solar PV components may also increase if additional land is required to support this combination alternative.

This combination alternative would also result in a loss of approximately 870 relatively high-paying jobs at Fermi 2, and a corresponding reduction in purchasing activity, tax payments, and revenue contributions would occur in the surrounding regional economy. If Fermi 2 were to cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 870 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the impact of the job loss may not be noticeable in local communities given the amount of time required for decommissioning of the existing Fermi 2 facilities. Based on this information and given the relatively small numbers of construction and operations workers, socioeconomic impacts during construction and operations on local communities would be SMALL.

4.10.6.2 Transportation

Transportation impacts during the construction and operation of the NGCC unit, as well as the wind and solar components, of this combination alternative would be less than the impacts for any of the previous alternatives discussed. This is because the construction workforce for each component and the volume of materials and equipment needing to be transported to the respective construction site would be smaller than those for any one of the individual replacement power alternatives. In other words, the transportation impacts would not be as concentrated as they would be for the other alternatives; instead, they would be spread out over a wider area.

Workers commuting to the construction site would arrive via site access roads, and the volume of traffic on nearby roads could increase during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thereby increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Transporting heavy and oversized components on local roads could have a noticeable impact over a large area. Some components and materials could also be delivered by rail or barge, depending on location. Traffic-related transportation impacts during construction could range from SMALL at the Fermi site and SMALL to MODERATE at the wind farms and solar installations, depending on current road capacities and average daily traffic volumes.

During operations, transportation impacts would be less noticeable during shift changes and maintenance activities. Given the small numbers of operations workers, the levels of service traffic impacts on local roads from NGCC, wind farm, and solar PV operations would be SMALL.

4.11 Human Health

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on human health resources.

4.11.1 Proposed Action

The human health issues applicable to Fermi 2 are discussed below and are listed in Table 4–12 for Category 1, Category 2, and uncategorized issues. Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 contains more information on these issues.

Table 4–12. Human Health Issues

Issue[a]	GEIS Section	Category
Radiation exposures to the public	4.9.1.1.1	1
Radiation exposures to plant workers	4.9.1.1.1	1
Human health impact from chemicals	4.9.1.1.2	1
Microbiological hazards to plant workers	4.9.1.1.3	1
Chronic effects of electromagnetic fields (EMFs)[b]	4.9.1.1.4	N/A[c]
Physical occupational hazards	4.9.1.1.5	1
Electric shock hazards[b]	4.9.1.1.5	2

[a] Microbiological hazards to the public for plants with cooling ponds or canals or cooling towers that discharge to a river is a Category 2 issue, but it is not applicable to Fermi 2.

[b] This issue applies only to the in scope portion of electric power transmission lines, which are defined as transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid.

[c] N/A (not applicable). The categorization and impact finding definition does not apply to this issue.

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013d

4.11.1.1 Normal Operating Conditions

<u>Generic Human Health Issues (Category 1)</u>

The NRC staff did not identify any new and significant information during its review of DTE's ER (DTE 2014a), the site audit, or the scoping process for the Category 1 issues listed in Table 4–12. In regard to the Category 1 issue, "Radiation exposures to the public," the NRC staff reviewed a Radiation and Public Health Project (RPHP) report submitted during the public scoping process entitled, "Potential Health Risks Posed by Adding a New Reactor at the Fermi Plant: Radioactive contamination from Fermi 2 and changes in local health status," authored by Joseph J. Mangano, MPH, MBA, RPHP Executive Director. The NRC concluded that the RPHP report does not constitute new and significant information that would change the GEIS's conclusion of SMALL for this issue (Section 4.14). Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. For these Category 1 issues, the GEIS concluded that the impacts are SMALL.

Chronic Effects of Electromagnetic Fields

The GEIS does not designate the chronic effects of 60-hertz electromagnetic fields (EMFs) from power lines as Category 1 or 2 (NRC 2013d); these effects will not be categorized as such until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the DOE.

The report by NIEHS (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) 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 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.

This statement is not sufficient to cause the NRC staff to change its position with respect to the chronic effects of EMFs. The NRC staff considers the GEIS finding of "UNCERTAIN" still appropriate and will continue to follow developments on this issue.

Electric Shock Hazards

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been a problem at most operating plants and generally is not expected to be a problem during the license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS.

As discussed in Section 3.11.4 of this SEIS, the transmission lines that connect Fermi 2 to the regional electrical distribution grid and that would remain energized only if the plant's operating license were renewed are in-scope for evaluation in this SEIS. These in-scope transmission lines are entirely within the Fermi 2 owner-controlled area and span industrial areas within the Fermi site. As a result, the public does not have access to this area and could not come into contact with these energized transmission lines. Therefore, there is no potential shock hazard to members of the public from these transmission lines.

For plant workers, the Michigan Occupational Safety and Health Administration safety standards govern the nonradiological occupational safety and health of Fermi 2 workers and are incorporated into Fermi 2's occupational health and safety program (DTE 2014a). Compliance with the Fermi 2's operational safety requirements is expected for all plant workers.

Because transmission lines are not accessible to members of the public and because an occupational safety and health program is in place to prevent electric shock hazards to plant workers, the NRC staff concludes that the potential impacts from acute electric shock during the license renewal term would be SMALL.

4.11.1.2 Environmental Impacts of Postulated Accidents

This section describes the environmental impacts from postulated accidents that Fermi 2 might experience during the period of extended operation. The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. The two classes of postulated accidents listed in Table 4–13—design-basis accidents (DBAs) and severe accidents—are contained in Table B–1 of Appendix B to Subpart A of 10 CFR Part 51 and are evaluated in detail in the GEIS.

Table 4–13. Issues Related to Postulated Accidents

Issue	GEIS Section	Category
DBAs	4.9.1.2	1
Severe accidents	4.9.1.2	2

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51; NRC 2013a

Design-Basis Accidents

To receive NRC approval to operate a nuclear power plant, an applicant for an initial operating license must submit a Safety Analysis Report (SAR) as part of its application. The SAR presents the design criteria and information for the proposed reactor, along with comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements, which include, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the applicant and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but they are evaluated to establish the design basis for the preventive and mitigative safety systems of the nuclear power plant. The regulations at 10 CFR Part 50 and 10 CFR Part 100 describe the acceptance criteria for DBAs.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license. The results of these evaluations are found in licensee documentation, such as the applicant's final SAR, the safety evaluation report, the final environmental statement, and this section of the SEIS. A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements to maintain acceptable design and performance criteria and to implement programs to manage the effects of aging during the period of extended operation, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the period of extended operation. Accordingly, the design of the plant relative to DBAs during the period of extended operation is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue. The early resolution of DBAs makes them a part of the current licensing basis of the plant; the licensee must maintain the current licensing basis of the plant under its current license; therefore, under the provisions of 10 CFR 54.30, it is not subject to review under license renewal.

No new and significant information related to DBAs was identified during the review of DTE's ER (DTE 2014a), site audit, the scoping process, or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS.

Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. In the GEIS, the NRC staff assessed the effects of severe accidents during the period of extended operation, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the period of extended operation.

Severe accidents initiated by external phenomena, such as tornadoes, floods, earthquakes, fires, and sabotage, have not traditionally been discussed in quantitative terms in final environmental statements (NRC 1996). However, the GEIS did evaluate existing impact assessments performed by NRC and by the industry at 44 nuclear plants in the United States, including Fermi 2, and concluded that the risk from beyond-design-basis earthquakes at existing nuclear power plants is SMALL. The GEIS for license renewal performed a discretionary analysis of terrorist acts in connection with license renewal and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the Commission concludes that the risk from sabotage and beyond-design-basis earthquakes at existing nuclear power plants is small and additionally that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents (NRC 1996, 2013d).

Based on information in the GEIS, the NRC staff found the following to be true:

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

The NRC staff identified no new and significant information related to postulated accidents during the review of DTE's ER for Fermi 2 (DTE 2014a), the site audit, the scoping process, or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for Fermi 2. The results of the review are discussed below.

Severe Accident Mitigation Alternatives

If the NRC staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment, 10 CFR Part 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. Pursuant to 10 CFR 54.21, "Contents of Application—Technical Information," the only changes that must be implemented by the applicant as part of the license renewal process are those that are related to adequately managing the effects of aging during the period of extended operation. SAMAs have not been previously considered for the Fermi 2; therefore, the remainder of this section summarizes the SAMA evaluation.

DTE submitted an assessment of SAMAs for Fermi 2 as part of its ER (DTE 2014a). This assessment was based on the most recent Fermi 2 probabilistic risk assessment (PRA) available at that time; a plant-specific accident progression and source term analysis performed using the Modular Accident Analysis Program (MAAP), version 4.0.7, computer code; a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System (MACCS2),version 3.7.0, computer code; and insights from the Fermi 2 individual plant examination (DECo 1992) and individual plant examination of external events (IPEEE) (DECo 1996).

In identifying and evaluating potential SAMAs, DTE considered SAMAs that addressed the major contributors to core damage frequency (CDF) and release frequency at Fermi 2, as well as SAMA candidates for other operating plants that have submitted license renewal applications. DTE initially identified 220 potential SAMAs. This list was reduced to 79 unique SAMA candidates by eliminating SAMAs that are not applicable to Fermi 2 because of design differences, that have already been implemented at Fermi 2, that were combined with another SAMA candidate during the assessment, that have excessive implementation costs, that have a very low benefit to Fermi 2, or that are undergoing implementation at Fermi 2. DTE assessed the costs and benefits associated with each of the 79 potential SAMAs and concluded in the ER that one SAMA candidate was potentially cost beneficial. Sensitivity analyses performed by DTE indicated that three additional SAMA candidates had the potential to be cost beneficial.

Overview of SAMA Process

This section presents a summary of the SAMA evaluation for Fermi 2 as described in the ER (DTE 2014a); requests for additional information (RAIs) (DTE 2015a, 2015b, 2015c); and the review of those evaluations. The NRC staff performed its review with contract assistance from the Center for Nuclear Waste Regulatory Analyses. Appendix F includes the NRC staff's detailed review; the Fermi 2 SAMA evaluation is available in Attachment D to DTE's ER.

The SAMA evaluation for Fermi 2 was conducted with a four-step approach. In the first step, DTE quantified the level of risk associated with potential reactor accidents using the plant-specific PRA and other risk models. In the second step, DTE examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. In the third step, DTE estimated the benefits and the costs associated with each of the candidate SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses. The costs of implementing the candidate SAMAs were also estimated. In the fourth step, DTE compared the cost and benefit of each of the remaining SAMAs to determine whether each SAMA was cost beneficial, meaning that the benefits of the SAMA exceeded its cost.

The NRC staff has reviewed DTE's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDFs and offsite doses reported by DTE.

Potential Plant Improvements

DTE identified potential plant improvements (SAMAs) by reviewing industry documents and by considering other plant-specific enhancements that were not identified in the published industry documents. Appendix F identifies the industry documents that DTE reviewed.

Based on this review, DTE identified an initial set of 220 candidate SAMAs, referred to as Phase I SAMAs. In Phase I of the evaluation, DTE performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- Not Applicable. If a proposed SAMA does not apply to the Fermi 2 design, it is not retained.
- Already Implemented. If the SAMA or equivalent was previously implemented, it is not retained.
- Combined with Another SAMA. If a SAMA is similar in nature and can be combined with another SAMA to develop a more comprehensive or plant-specific SAMA, only the combined SAMA is further evaluated.
- Excessive Implementation Cost. If the estimated cost of implementation is greater than the modified Maximum Averted Cost-Risk, the SAMA cannot be cost beneficial and is screened from further analysis.
- Very Low Benefit. If the SAMA is related to a non-risk significant system that is known to have negligible impact on the risk profile, it is not retained.
- Implementation in Progress. If plant improvements that address the intent of the SAMA are already in progress, it is not retained.

During this process, 141 SAMA candidates were screened out based on the criteria listed above. Table D.2-1 of the ER (DTE 2014a) provides a description of each of the 79 Phase II SAMA candidates. In Phase II, a detailed evaluation was performed for each of the 79 remaining SAMA candidates, as discussed in Sections F.4 and F.6 of Appendix F.

The NRC staff concludes that DTE used a systematic and comprehensive process for identifying potential plant improvements for Fermi 2 and that the set of SAMAs evaluated in the ER, together with those evaluated in response to NRC staff inquiries, is reasonably comprehensive and, therefore, acceptable. The NRC staff evaluation included reviewing insights from the Fermi 2 plant-specific risk studies that included internal initiating events as well as fire, seismic, and other external initiated events, and reviewing plant improvements considered in previous SAMA analyses. Section F.3 of Appendix F presents additional details on the NRC staff's evaluation.

Evaluation of Risk Reduction and Costs of Improvements

DTE evaluated the risk-reduction potential of the 79 SAMAs retained for the Phase II evaluation in the ER (DTE 2014a). The SAMA evaluations were generally performed by DTE in a realistic or slightly conservative fashion that overestimates the benefit of the SAMA. In most cases, the failure likelihood with the added equipment is considered optimistically low, thereby overestimating the benefit of the SAMA. In other cases, it was assumed that the SAMA eliminated all of the risk associated with the proposed enhancement. The NRC staff notes that this bounding approach overestimates the benefit and is conservative.

Except for SAMAs associated with internal fires, DTE used model requantification to determine the potential benefits for most of the SAMAs. Reductions to the CDF, population dose, and offsite economic cost were estimated using the Fermi 2 PRA model. Section D.2.3 of the ER describes changes made to the model to quantify the impact of each SAMA. Table 4–14 summarizes the assumptions used to estimate the risk reduction for each of the evaluated SAMAs, the estimated risk reduction in terms of percent reduction in CDF, the population dose, the offsite economic cost, and the estimated total benefit (present value) of the averted risk.

The NRC staff reviewed the assumptions used in evaluating the benefit or risk reduction estimate of each of the SAMAs, as described in the ER Section D.2.3. Section F.4 of Appendix F discusses the resolution to RAIs that resulted from this review, and Section F.6 of Appendix F further discusses the determination of the benefits for the various SAMAs.

DTE estimated the costs of implementing the 79 Phase II SAMAs through the use of other licensees' estimates for similar improvements and the development of site-specific cost estimates, where appropriate.

DTE indicated that it used the cost ranges in Table 4–15 based on the review of previous SAMA applications and an evaluation of expected implementation costs at Fermi 2.

DTE stated that the Fermi 2 site-specific cost estimates were based on the engineering judgment of project engineers experienced in performing design changes at the facility and were compared, where possible, to estimates developed and used at plants of similar design and vintage.

In response to an NRC staff RAI to provide further information as to what was included in the Fermi 2 cost estimates, DTE indicated that cost estimates were developed based on initial hardware and installation costs only not on reoccurring costs (DTE 2015a). The estimates did not include costs for replacement power during SAMA implementation, lifetime maintenance, and procedure costs. DTE indicated that the only exceptions are the cost estimates for SAMA 145 to increase training and operating experience feedback to improve operator response and a new SAMA evaluated in response to an RAI to implement an inspection program for the piping associated with the risk-significant internal flooding initiators. SAMA 145 is training related; therefore, costs estimated by DTE included additional operator training for the life of the plant. Because the new SAMA pertains to a proposed inspection program, DTE included reoccurring costs associated with plant walkdowns of piping segments that are significant to the internal flooding risk (DTE 2015a).

The NRC staff reviewed the applicant's cost estimates presented in Table D.2-1 of the ER (DTE 2014a). For certain improvements, the NRC staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors. With the requested clarifications presented in Section F.5 of Appendix F, the NRC staff concludes that the cost estimates provided by DTE are sufficient and appropriate for use in the SAMA evaluation.

Table 4–14. Potentially Cost-Beneficial SAMAs for Fermi Unit 2[(a)]

Individual SAMA and Assumption	% Risk Reduction			Total Benefit ($)[(b)]		Cost ($)[(b)]
	CDF	Population Dose	OECR	Baseline (Internal + External)	Larger Result: Baseline with Sensitivity	
112 - Revise emergency operating procedures to improve ISLOCA identification	**<1**	**6**	**3**	**119K**	**297K**	**200K**
Assumption: This analysis was used to evaluate the change in plant risk from reducing the frequency of ISLOCA events and improving operator's ability to cope with ISLOCAs. To assess this potential benefit, the frequency of all ISLOCA initiating events was decreased by 25 percent.						
113 - Improve operator training on ISLOCA coping	**<1**	**6**	**3**	**119K**	**297K**	**200K**
Assumption: This analysis was used to evaluate the change in plant risk from reducing the frequency of ISLOCA events and improving operator's ability to cope with ISLOCAs. To assess this potential benefit, the frequency of all ISLOCA initiating events was decreased by 25 percent.						
115 - Revise procedures to control vessel injection to prevent boron loss or dilution following standby liquid control injection	**2**	**4**	**4**	**122K**	**304K**	**200K**
Assumption: This analysis was used to evaluate the change in plant risk from controlling vessel injection to ensure adequate boron concentration is maintained in the core following an ATWS. To determine the benefit from revising procedures to improve control of vessel injection, the failure probability of the human actions control level early during an ATWS sequence and to control level late during an ATWS sequence were each improved by 10 percent.						
206 - Improve the ability of operators to manually close a damper to isolate the third floor of the reactor building from hardened vent path	**13**	**13**	**13**	**438K**	**1.1M**	**100K**
Assumption: Three cabinets on the second floor of the Reactor Building (RB06) account for approximately 50 percent of the fire CDF in the room. These cabinets are R1600S003J, H2100P627, and R1600S003D. The addition of incipient fire detection and automatic actuation systems for these cabinets will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/automatic suppression system has a failure probability of 0.05. It is also assumed that the conditional core damage probability for a fire with successful suppression is reduced by an order of magnitude compared to the original conditional core damage probability. Therefore, the original fire scenarios for these components are revised from one scenario to two scenarios—one with successful suppression and one with failed suppression. With this modification, the fire CDF is reduced by 2.09×10^{-7} per year. This reduction in fire CDF was applied proportionately to each release category.						

Individual SAMA and Assumption	% Risk Reduction			Total Benefit ($)[b]		Cost ($)[b]
	CDF	Population Dose	OECR	Baseline (Internal + External)	Larger Result: Baseline with Sensitivity	

[a] Potentially cost-beneficial SAMAs from DTE's baseline and sensitivity analyses are listed. Refer to Section F.6.2 of Appendix F for three additional SAMAs determined by DTE to be potentially cost beneficial as a result of questions raised by the NRC staff during the SAMA evaluation review.

[b] DTE identified potentially cost-beneficial SAMAs by comparing the largest total benefit with sensitivity to the estimated implementation cost.

[c] In response to the NRC staff's RAIs, DTE updated the assessment related to several SAMAs not listed in this table (SAMAs 023, 031, 074, 078, 183, and 187, as described in Section F.4 of Appendix F).

[d] The NRC staff calculated corrected benefits for several SAMAs not listed in this table (SAMAs 021, 024, 050, 067, 078, 123, 145, 152, 177, and 194, as listed in Table F–6 of Appendix F).

Key: ATWS = anticipated transients without scram, CDF = core damage frequency, ISLOCA = interfacing systems loss-of-coolant accident, NRC = U.S. Nuclear Regulatory Commission, OECR = offsite economic cost risk, SAMA = severe accident mitigation alternative.

Source: DTE 2014a

Table 4–15. Estimated Cost Ranges of SAMA Implementation Costs at Fermi Unit 2

Type of Change	Estimated Cost Range
Procedural only	$50K
Procedural change with engineering or training required	$50K to $200K
Procedural change with engineering and testing or training required	$200K to $300K
Hardware modification	$100K to >$1,000K

Cost-Benefit Comparison

If the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was determined not to be cost beneficial. If the SAMA benefit exceeded the estimated cost, the SAMA candidate was considered to be potentially cost beneficial. DTE's baseline cost-benefit analysis identified one SAMA candidate as potentially cost-beneficial. From the sensitivity analysis for the 95th percentile uncertainty in the CDF, DTE identified an additional three SAMA candidates as potentially cost beneficial. Table F–5 in Appendix F presents the results of the cost-benefit evaluation. Considering the results from the baseline and sensitivity analyses, the full set of potentially cost-beneficial SAMAs for Fermi 2 is as follows:

- SAMA 112: Revise emergency operating procedures to improve identification of interfacing system loss-of-coolant accidents (ISLOCA).
- SAMA 113: Improve operator training on coping with ISLOCA.
- SAMA 115: Revise procedures to control vessel injection to prevent boron loss or dilution following standby liquid control injection.
- SAMA 206: Improve the ability of operators to manually close a damper to isolate the third floor of the reactor building from the hardened vent path.

As described in Section F.3.2 of Appendix F, the NRC staff asked the applicant to evaluate potentially lower cost alternatives to the SAMA candidates. In response to questions raised by the NRC staff, DTE concluded that the following new SAMAs would be potentially cost beneficial (DTE 2015a):

- Install a flood barrier or curb between the direct current switchgear room and Division 2 alternating current switchgear room.
- Develop a new procedure to close valves to terminate the flood from emergency equipment cooling water in the AB3 switchgear room.
- Revise existing alarm response procedures to direct operators to the direct current switchgear room and the Division 2 alternating current switchgear room following indication of leakage in the reactor building closed cooling water/emergency equipment cooling water system piping.

These three potentially cost-beneficial SAMAs are not listed in Table 4–14

DTE indicated that the seven SAMAs, the four numbered ones and the three additional unnumbered SAMAs, will be incorporated into the design evaluation process and evaluated considering other planned plant modifications.

Conclusions

DTE considered 220 candidate SAMAs based on risk-significant contributors at Fermi 2 from updated probabilistic safety assessment models, SAMA-related industry documentation, plant-specific enhancements not found in published industry documentations, and its review of SAMA candidates from potential improvements primarily at eight other plants. Phase I screening reduced the list to 79 unique SAMA candidates by eliminating SAMAs that were not applicable to Fermi 2, that had already been implemented at Fermi 2, that were combined into a more comprehensive or plant-specific SAMA, that had excessive implementation cost, that had a very low benefit, or that related to in-progress implementation of plant improvements that addressed the intent of the SAMA. For the remaining SAMA candidates, DTE performed a cost-benefit analysis with results shown in Table F–5 of Appendix F. The baseline cost-benefit analysis identified one SAMA candidate as potentially cost beneficial. From a sensitivity analysis, DTE identified an additional three SAMA candidates as potentially cost beneficial. In response to questions raised by the NRC staff, DTE concluded that three new SAMAs would be potentially cost beneficial. Because the potentially cost-beneficial SAMAs do not relate to aging management during the period of extended operation, their implementation is not required as part of license renewal pursuant to 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Nevertheless, DTE indicated that these seven SAMAs will be incorporated into the design evaluation process and evaluated considering other planned plant modifications.

The NRC staff reviewed DTE's SAMA analysis and concludes that, subject to the discussion in Appendix F, the methods used and implementation of the methods were sound. The NRC staff's concerns were addressed by DTE's responses and the NRC staff's review. Furthermore, a calculation performed by the NRC staff with DTE's information did not change the identification of cost-beneficial SAMAs. Based on the applicant's treatment of SAMA benefits and costs, NRC staff finds that the SAMA evaluations performed by DTE are reasonable and sufficient for the license renewal submittal. The NRC staff agrees with DTE's conclusion that seven SAMA candidates are potentially cost beneficial for Fermi 2 and notes that DTE's assessment was based on a generally conservative treatment of costs, benefits, and uncertainties. Furthermore, this conclusion of a relatively small number of potentially cost-beneficial SAMAs is consistent with a low level of residual risk indicated in the Fermi 2 PRA. Based on the NRC staff's review of DTE's SAMA evaluations, including DTE's response to the NRC staff's RAIs, the NRC staff concludes that DTE has adequately identified areas in which risk can be further reduced through the implementation of the identified potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the NRC staff agrees that further evaluation by DTE of the seven potentially cost-beneficial SAMAs is warranted.

Additionally, the NRC staff evaluated whether the identified potentially cost-beneficial SAMAs are subject to aging management. The evaluation considered any structures, systems, and components associated with these SAMAs that perform intended functions without moving parts or without a change in configuration or properties and that would not be subject to replacement based on a qualified life or specified time period. Because the potential cost-beneficial SAMAs are associated with procedure changes, new hardware to improve a manual action, and a new structure between switchgear rooms, the NRC staff determined that these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal in accordance with 10 CFR Part 54. Nevertheless, DTE will consider potentially cost-beneficial SAMAs incorporated into the design evaluation process and evaluated considering other planned plant modifications. The NRC staff accepts this course of action.

4.11.2 No-Action Alternative

Human health risks would be smaller following plant shutdown. A shutdown reactor unit would emit less radioactive gaseous, liquid, and solid material to the environment than an operating reactor unit would. In addition, following shutdown, the variety of potential accidents at the plant (radiological or industrial) are reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 4.11.1, the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL, except for "Chronic effects of EMFs," for which the impacts are UNCERTAIN. In Section 4.11.1.2, the NRC staff concluded that the impacts of accidents during operation were SMALL. Therefore, as radioactive emissions to the environment decrease and as the likelihood and types of accidents decrease following shutdown, the NRC staff concludes that the risk to human health following plant shutdown would be SMALL.

4.11.3 NGCC Alternative

Impacts on human health from construction of the NGCC alternative would be similar to effects associated with the construction of any major industrial facility (NRC 2013d). Compliance with worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the public would be minimal since crews would limit active construction area access to authorized individuals. Based on the above, the NRC staff concludes that the impacts on human health from the construction of the NGCC alternative would be SMALL.

Impacts from the operation of an NGCC facility include the introduction of public risk from inhalation of gaseous emissions. The risk may be attributable to nitrogen oxide emissions that contribute to ozone formation, which in turn contribute to health risk. Regulatory agencies, including the EPA and state agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by EPA and state agencies, the NRC staff concludes that the human health impacts from the NGCC alternative would be SMALL.

4.11.4 IGCC Alternative

Impacts on workers are expected to be similar to those experienced during construction of any major industrial facility (NRC 2013d). Construction would increase traffic on local roads, which could affect the health of the public. Human health impacts would be the same as those found at an existing nuclear plant. Personal protective equipment, training, and engineered barriers would protect the workforce (NRC 2013d). Therefore, the NRC staff concludes that the impacts on human health from the construction of a coal facility would be SMALL.

The coal alternative introduces worker risks from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal-combustion waste, and public risk from inhalation of stack emissions. In addition, human health risks are associated with the management and disposal of coal combustion waste. Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. Human health risks may extend beyond the facility workforce to the public, depending on the public's proximity to the coal combustion waste disposal facility. The character and the constituents of coal combustion waste depend on both the chemical composition of the source coal and the technology used to combust it. Generally, the primary sources of adverse consequences from coal combustion waste are from exposure to sulfur oxides and nitrogen oxides in air emissions and radioactive elements like uranium and thorium, as well as the heavy metals and hydrocarbon compounds contained in fly ash, bottom ash, and scrubber sludge (NRC 2013d).

Regulatory agencies, including the EPA and state agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by EPA and state agencies, the NRC staff concludes that the human health impacts from radiological doses and inhaled toxins and particulates generated from the coal alternative would be SMALL.

4.11.5 New Nuclear Alternative

Impacts on human health from construction of a new nuclear power plant would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the general public would be minimal since limiting active construction area access to authorized individuals is expected. Therefore, impacts on human health from the construction of a new nuclear power plant would be SMALL.

The human health impacts from the operation of a new nuclear power plant would be similar to those of the existing Fermi 2. As presented in Section 4.11.1.1, impacts on human health from the operation of Fermi 2 would be SMALL, except for “Chronic effects of electromagnetic fields (EMFs),” for which the impacts are UNCERTAIN. Therefore, the impacts on human health from the operation of a new nuclear power plant would be SMALL.

4.11.6 Combination Alternative (NGCC, Wind, and Solar)

Impacts on human health from construction of a combination of NGCC, wind, and solar PV technologies would be similar to effects associated with the construction of any major industrial facility (NRC 2013d). Compliance with worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the public would be minimal since crews would limit active construction area access to authorized individuals. Based on the above, the NRC staff concludes that the impacts on human health from the construction of the NGCC, wind, and solar alternative would be SMALL.

Operational hazards at an NGCC facility are discussed in Section 4.11.3 and are SMALL.

Operational hazards at a wind facility for the workforce include working at heights, near rotating mechanical or electrically energized equipment, and in extreme weather. Potential impacts to workers and the public include ice thrown from rotor blades and broken blades thrown due to mechanical failure. Potential impacts also include EMF exposure, aviation safety, and exposure to noise and vibration from the rotating blades (NRC 2013d).

Operational hazards at a solar PV facility may involve exposure to airborne toxic metals (e.g., cadmium) and silicon if the solar PV cell loses its integrity, for example, due to fire. Workers could also inhale silicon dust if the solar PV cell was smashed by an object or from a fall to the ground. (NRC 2013d)

However, given the expected compliance with worker protection rules and remediation efforts to contain the toxic material, the NRC staff concludes that the impacts to workers at the facility and offsite exposure to the public would be SMALL.

4.12 Environmental Justice

This section describes the potential human health and environmental effects of the proposed action (license renewal) and alternatives to the proposed action on U.S. minority and low-income populations and special pathway receptors.

4.12.1 Proposed Action

The environmental justice NEPA issue from Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 applicable to the license renewal of Fermi 2 is listed in Table 4–16. Section 3.12 identifies U.S. minority and low-income populations living in the vicinity of Fermi 2.

Table 4–16. Environmental Justice NEPA Issue

Issue	GEIS Section	Category
Minority and low-income populations	4.10.1	2

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

The NRC addresses environmental justice matters for license renewal by (1) identifying the location of U.S. minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the license renewal term, (2) determining whether there would be any potential human health or environmental effects to these populations and special pathway receptors, and (3) determining whether any of the effects may be disproportionately high and adverse.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Figures 3.12-1 and 3.12-2 show the location of predominantly minority and low-income population U.S. Census block groups residing within a 50-mi (80-km) radius of Fermi 2. This area of impact is consistent with the impact analysis for public and occupational health and safety, which also focuses on U.S. populations within a 50-mi (80-km) radius of the plant. Chapter 4 of this SEIS presents the assessment of environmental and human health impacts for each resource area. The analyses of impacts for all environmental resource areas indicated that the impact from license renewal would be SMALL.

Potential impacts on U.S. minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the license renewal term are expected to continue at current levels, and they would remain within regulatory limits. Section 4.11.1.2 of this SEIS discusses the environmental impacts from postulated accidents that might occur during the license renewal term, which include both design basis and severe accidents. In both cases, the Commission has generically determined that impacts associated with design basis accidents are SMALL because U.S. nuclear plants are designed and operated to successfully withstand such accidents, and the probability weighted consequences of severe accidents are SMALL.

Therefore, based on this information and the analysis of human health and environmental impacts presented in Chapter 4 of this SEIS, there would be no disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations from the continued operation of Fermi 2 during the license renewal term.

As part of addressing environmental justice concerns associated with license renewal, the NRC also assessed the potential radiological risk to special population groups (such as migrant workers or Native Americans) from exposure to radioactive material received through their unique consumption practices and interaction with the environment, including subsistence consumption of fish and wildlife, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the plant during routine operation. This analysis is presented below.

Subsistence Consumption of Fish and Wildlife

The special pathway receptors analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area, such as migrant workers or Native Americans.

Section 4–4 of Executive Order 12898 (59 FR 7629) directs U.S. Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this SEIS, the NRC considered whether there were any means for U.S. minority or low-income populations to be disproportionately affected by examining impacts on American Indian, Hispanic, migrant worker, and other traditional lifestyle special pathway receptors. The assessment of special pathways considered the levels of radiological and nonradiological contaminants in vegetation, crops, soils and sediments, groundwater, surface water, fish, and game animals on or near Fermi 2.

Radionuclides released to the atmosphere may deposit on soil and vegetation and, therefore, may eventually be incorporated into the human food chain. To assess the impact of Fermi 2 operations to humans from the ingestion pathway, samples of milk, green leafy vegetables, and groundwater are collected and analyzed for radioactivity. The following describes DTE’s radiological environmental monitoring program.

DTE has an ongoing comprehensive Radiological Environmental Monitoring Program (REMP) to assess the impact of Fermi 2 operations on the environment. To assess the impact of nuclear power plant operations, samples are collected annually from the environment and analyzed for radioactivity. A plant effect would be indicated if the radioactive material detected in a sample were larger or higher than background levels. Two types of samples are collected. The first type, a control sample, is collected from areas that are beyond the influence of the nuclear power plant or any other nuclear facility. These samples are used as reference data to determine normal background levels of radiation in the environment. These samples are then compared with the second type of samples, indicator samples, collected near the nuclear power plant. Indicator samples are collected from areas where any contribution from the nuclear power plant will be at its highest concentration. These samples are then used to evaluate the contribution of nuclear power plant operations to radiation or radioactivity levels in the environment. An effect would be indicated if the radioactivity levels detected in an indicator sample were larger or higher than those in the control sample or background levels.

Samples were collected from the aquatic and terrestrial environment in the vicinity of Fermi 2 in 2013. The aquatic environment includes groundwater, surface water, fish, and shoreline sediment. Aquatic monitoring results for 2013 of water, sediment, and fish showed only naturally occurring radioactivity and radioactivity associated with fallout from past atmospheric nuclear weapons testing and were consistent with levels measured before the operation of Fermi 2. No radioactivity was detected greater than the minimum detectable activity in any aquatic sample during 2013, and no adverse long-term trends were identified in aquatic monitoring data (DTE 2014b).

The terrestrial environment includes airborne particulates, milk, and food products (i.e., broccoli, Brussel sprouts, cabbage, cauliflower, collards, and horseradish). Terrestrial monitoring results for 2013 of milk, groundwater and leafy garden vegetable samples showed only naturally occurring radioactivity. The radioactivity levels detected were consistent with levels measured before the operation of Fermi 2. No radioactivity was detected greater than the minimum detectable activity in any terrestrial samples during 2013. The terrestrial monitoring data also showed no adverse trends in the terrestrial environment (DTE 2014b).

Analyses performed on all samples collected from the environment at Fermi 2 in 2013 showed no significant measurable radiological constituent above background levels. Overall, radioactivity levels detected in 2013 were consistent with previous levels and with radioactivity levels measured before the operation of Fermi 2. REMP sampling in 2013 did not identify any radioactivity above the minimum detectable activity (DTE 2014b).

In a decision issued on February 6, 2015, the Atomic Safety and Licensing Board admitted three contentions for litigation in the Fermi 2 license renewal adjudicatory proceeding (Atomic Safety and Licensing Board, Memorandum and Order, LBP-15-5, February 6, 2015 (ADAMS No. ML15037A618)). One of those admitted contentions, which had been filed by Citizens' Resistance at Fermi 2, was concerned with DTE's lack of discussion of whether members of the Walpole Island First Nation would be negatively affected by the renewal of the Fermi 2 operating license due to impacts on tribal hunting and fishing rights, especially with respect to the potential for the consumption of contaminated foods. In a decision issued on September 8, 2015, the Commission reversed the Board's decision admitting the contention regarding the Walpole Island First Nation and directed the Atomic Safety and Licensing Board to terminate the adjudicatory proceeding (CLI-15-18, Memorandum and Order, September 8 2015 (ADAMS No. ML15251A049)). Nevertheless, the subsistence consumption of fish and wildlife analysis presented in this section addresses whether any subsistence consumption activities, including those of the Walpole Island First Nation, would be negatively affected by the renewal of Fermi 2's operating license. Significantly, the analysis presented addresses the potential consumption of contaminated foods by providing the sampling results from the REMP.

Conclusion

Based on the radiological environmental monitoring data from Fermi 2, the NRC finds that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of water, local food, fish, and wildlife. Continued operation of Fermi 2 would not have disproportionately high and adverse human health and environmental effects on these populations.

4.12.2 No-Action Alternative

This section evaluates the potential for disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations that could result from the no-action alternative. Impacts on U.S. minority and low-income populations would depend on the number of jobs and the amount of tax revenues lost by communities in the immediate vicinity of the power plant after Fermi 2 ceases operations. Not renewing the operating licenses and terminating reactor operations would have a noticeable impact on socioeconomic conditions in the communities located near Fermi 2. The loss of jobs and income would have an immediate socioeconomic impact. Some, but not all, of the approximately 870 employees would begin to leave after reactor operations are terminated, and overall tax revenue generated by plant operations would be reduced. The reduction in tax revenue would decrease the availability of public services in Monroe County. This decrease in the availability of services could disproportionately affect minority and low-income populations that may have become dependent on these services. (See also Appendix J to NUREG–0586, Supplement 1 (NRC 2002b), for additional discussion of these impacts.)

4.12.3 NGCC Alternative

This section evaluates the potential for disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations that could result from the construction and operation of a new NGCC plant. Some of these potential effects have been identified in resource areas discussed in this SEIS. For example, increased demand for rental housing during replacement power plant construction could disproportionately affect low-income populations. Everyone living near the proposed power plant site could be affected by the construction and operation of a new NGCC power plant, including minority and low-income populations.

Potential impacts to U.S. minority and low-income populations from the construction and operation of a new NGCC plant at the Fermi site would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. However, these effects would be temporary during certain hours of the day and would not likely be high and adverse. Increased demand for rental housing during construction could affect low-income populations in the vicinity of the Fermi site. However, given the proximity of Fermi 2 to the Detroit and Toledo metropolitan areas, many construction workers could commute to the site, thereby reducing the potential demand for rental housing.

Emissions from the NGCC plant during power plant operations could disproportionately affect U.S. minority and low-income populations living in the vicinity of the new power plant. However, permitted air emissions are expected to remain within regulatory standards.

Based on this information and on the analysis of human health and environmental impacts presented in this SEIS, the construction and operation of a new NGCC plant would not likely have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations. However, this determination would depend on the location, plant design, and operational characteristics of the new power plant. Therefore, the NRC cannot determine whether this alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.4 IGCC Alternative

This section evaluates the potential for disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations that could result from the construction and operation of a new IGCC power plant. Some of these potential effects have been identified in resource areas discussed in this SEIS. For example, increased demand for rental housing during replacement power plant construction could disproportionately affect low-income populations. Everyone living near the proposed power plant site could be affected by the construction and operation of a new IGCC power plant, including minority and low-income populations.

Potential impacts to U.S. minority and low-income populations from the construction and operation of a new IGCC plant at the Fermi site would consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. However, these effects would be temporary during certain hours of the day and would not likely be high and adverse. Increased demand for rental housing during construction could affect low-income populations. However, given the proximity of some existing power plant sites to the Detroit and Toledo metropolitan areas, many construction workers could commute to the site, thereby reducing the potential demand for rental housing.

Emissions from the IGCC plant during power plant operations could disproportionately affect U.S. minority and low income populations. However, permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in this SEIS, the construction and operation of a new IGCC plant would not likely have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations. However, this determination would depend on the location, plant design, and operational characteristics of the new power plant. Therefore, the NRC cannot determine whether this alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.5 New Nuclear Alternative

This section evaluates the potential for disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations that could result from the construction and operation of a new nuclear power plant. Some of these potential effects have been identified in resource areas discussed in this SEIS. For example, increased demand for rental housing during replacement power plant construction could disproportionately affect low-income populations. Everyone living near the proposed power plant site could be affected by the construction and operation of a new nuclear power plant, including minority and low-income populations.

Potential impacts to U.S. minority and low-income populations from the construction and operation of a new nuclear power plant at the Fermi site would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. However, these effects would be temporary during certain hours of the day and would not likely be high and adverse. Increased demand for rental housing during construction could affect low-income populations. However, given the proximity of some existing nuclear power plant sites to the Detroit and Toledo metropolitan areas, many construction workers could commute to the site, thereby reducing the potential demand for rental housing.

Potential impacts to U.S. minority and low-income populations from new nuclear power plant operations would mostly consist of radiological effects; however, radiation doses are expected to be well below regulatory limits. All people living near the nuclear power plant would be exposed to the same potential effects from power plant operations, and permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in this SEIS, the construction and operation of a new nuclear power plant would not likely have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations. However, this determination would depend on the location, plant design, and operational characteristics of the new power plant. Therefore, the NRC cannot determine whether this alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.12.6 Combination Alternative (NGCC, Wind, and Solar)

This section evaluates the potential for disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations that could result from the construction and operation of a combination of NGCC, wind, and solar PV electrical power-generating activities. Some of these potential effects have been identified in resource areas discussed in this SEIS. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. Everyone living near the new NGCC, wind farms, and solar PV installations could be affected by construction activities and facility operations, including minority and low-income populations.

Potential impacts to U.S. minority and low-income populations from the construction and operation of a new NGCC plant, wind turbines, and solar PV installations would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. However, these effects would be temporary during certain hours of the day and would not likely be high and adverse. Increased demand for rental housing during construction could affect low-income populations. However, given the small number of construction workers and the possibility that many workers could commute to these construction sites, the potential need for rental housing would not be significant.

Minority and low-income populations living in close proximity to wind farm and solar PV power-generating installations could be disproportionately affected by maintenance and operations activities. However, operational impacts from the wind turbines and solar PV installations would mostly be limited to noise and aesthetic effects.

Based on this information and on the analysis of human health and environmental impacts presented in this SEIS, the construction and operation of a new NGCC plant, wind farms, and solar PV installations would not likely have disproportionately high and adverse human health and environmental effects on U.S. minority and low-income populations. However, this determination would depend on the location, plant design, and operational characteristics of these new power-generating facilities. Therefore, the NRC cannot determine whether this alternative would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

4.13 Waste Management and Pollution Prevention

This section describes the potential impacts of the proposed action (license renewal) and alternatives to the proposed action on waste management and pollution prevention.

4.13.1 Proposed Action

The waste management issues applicable to Fermi 2 are discussed below and listed in Table 4–17. Table B–1 of Appendix B to Subpart A of 10 CFR Part 51 contains more information on these issues.

Table 4–17. Waste Management Issues

Issue	GEIS Section	Category
Low-level waste storage and disposal	4.11.1.1	1
Onsite storage of spent nuclear fuel	4.11.1.2[(a)]	1
Offsite radiological impacts of spent nuclear fuel and high-level waste disposal	4.11.1.3[(b)]	1
Mixed-waste storage and disposal	4.11.1.4	1
Nonradioactive waste storage	4.11.1.4	1

[(a)] The environmental impact of this issue for the timeframe beyond the licensed life for reactor operations is discussed in NUREG–2157 (NRC 2014e).

[(b)] The technical feasibility of disposal in a geologic repository is discussed in NUREG–2157 (NRC 2014e).

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

The NRC staff's evaluation of the environmental impacts associated with spent nuclear fuel is addressed in two issues in Table 4–17, "Onsite storage of spent nuclear fuel," and "Offsite radiological impacts of spent nuclear fuel and high-level waste disposal." The onsite storage of spent nuclear fuel issue now incorporates the generic environmental impact determinations codified in Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51 and in the revision to 10 CFR 51.23 pursuant to the Continued Storage Rule (79 FR 56238). The offsite radiological impacts of spent nuclear fuel and high-level waste disposal issue are codified in Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51, and the technical feasibility of disposal in a geologic repository is discussed in NUREG–2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC 2014e). For this issue, the Commission concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

The NRC staff did not identify any new and significant information related to waste management issues listed in Table 4–17 during its review of the applicant's ER (DTE 2014a), the site visit, or the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS (NRC 2013d) and in Volumes 1 and 2 of NUREG–2157 (NRC 2014e). During the license renewal term, the GEIS concludes that the impacts for these Category 1 issues are SMALL.

4.13.2 No-Action Alternative

If the no-action alternative were implemented, Fermi 2 would cease operation no later than the end of the initial operating licenses and would enter decommissioning. Fermi 2 would cease to generate spent nuclear fuel and would emit less gaseous and liquid radioactive effluents into the environment than those emitted during operation. In addition, following shutdown, the variety of potential accidents at the plants (radiological and industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 4.11 of this SEIS, the NRC staff concluded that the impacts of continued operations on human health would be SMALL. In Section 4.11 of this SEIS, the NRC staff concluded that the impacts of accidents would be SMALL. In Section 4.15.2 of this SEIS, the NRC staff concludes that the impacts from decommissioning would be SMALL. Therefore, as radioactive emissions to the environment decrease and as the likelihood and variety of accidents decrease following shutdown and decommissioning, the NRC staff concludes that the risk to human health following plant shutdown would be SMALL.

4.13.3 NGCC Alternative

Construction-related debris would be generated during plant construction activities and would be recycled or disposed of in approved landfills.

Waste generation from NGCC technology would be minimal. The only significant waste generated at a NGCC power plant would be spent selective catalytic reduction (SCR) catalyst, which is used to control nitrogen oxide emissions.

The spent SCR catalyst would be regenerated or disposed of offsite in approved landfills. Other than the spent SCR catalyst, waste generation at an operating natural gas-fired plant would be limited largely to typical operations and maintenance nonhazardous waste. Overall, the NRC staff concludes that waste impacts from the NGCC alternative would be SMALL.

4.13.4 IGCC Alternative

Construction-related debris would be generated during plant construction activities and would be recycled or disposed of in approved landfills.

Coal combustion generates waste in the form of fly ash and bottom ash. In addition, equipment for controlling air pollution generates additional ash, spent SCR catalyst, and scrubber sludge. The management and disposal of the large amounts of coal combustion waste is a significant part of the operation of a coal-fired power-generating facility.

Although a coal facility is likely to use offsite disposal of coal combustion waste, some short-term storage of coal combustion waste (either in open piles or in surface impoundments) is likely to take place on site, thus establishing the potential for leaching of toxic chemicals into the local environment.

The impacts of managing the significant amounts of solid waste, especially fly ash and scrubber sludge generated during operation of this alternative, would be significant (NRC 1996). The amount of the construction waste would be small compared to the amount of waste generated during the operational stage, and much of it could be recycled (i.e., marketed for beneficial use). Therefore, the NRC staff concludes that the overall waste management impacts from construction and operation of this alternative would be MODERATE.

4.13.5 New Nuclear Alternative

Construction-related debris would be generated during construction activities and would be recycled or disposed of in approved landfills. During normal plant operations, routine plant maintenance and cleaning activities would generate low-level radioactive waste, spent nuclear fuel, high-level radioactive waste, and nonradioactive waste. Sections 3.1.4 and 3.1.5 of this SEIS discuss radioactive and nonradioactive waste management at Fermi 2. Quantities of radioactive and nonradioactive waste generated from the operation of a new nuclear power plant would be similar to that generated by Fermi 2. According to the GEIS (NRC 2013d), the generation and management of radioactive and nonradioactive solid waste during the license renewal term are not expected to result in significant environmental impacts. Therefore, the waste impacts from the operation of a new nuclear power plant alternative would be SMALL.

4.13.6 Combination Alternative (NGCC, Wind, and Solar)

Construction-related debris would be generated during construction activities and would be recycled or disposed of in approved landfills.

Waste generation from NGCC technology is discussed in Section 4.13.3, and the impacts would be SMALL.

Waste generation from a combination of wind and solar PV technologies would be minimal, consisting of debris from routine maintenance and the disposal of worn or broken parts. Based on this information, the NRC staff concludes that waste impacts from the construction and operation of a combination NGCC, wind, and solar PV alternative would be SMALL.

4.14 Evaluation of New and Potentially Significant Information

New and significant information is information that must be new, based on a review of the GEIS (NRC 2013d) and codified in Table B–1 of Appendix B to Subpart A of 10 CFR Part 51, and must bear on the proposed action or its impacts, presenting a seriously different picture of the impacts from those envisioned in the GEIS (i.e., impacts of greater severity than impacts considered in the GEIS, considering their intensity and context).

In accordance with 10 CFR 51.53(c), the ER that the applicant submits must provide an analysis of the Category 2 issues in Table B–1 of Appendix B to Subpart A of 10 CFR Part 51. Additionally, it must discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action. In accordance with 10 CFR 51.53(c)(3), the ER does not need to contain an analysis of any Category 1 issue unless there is new and significant information on a specific issue.

The NRC process for identifying new and significant information is described in NUREG–1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2013e). The search for new information includes the following activities:

- review of an applicant’s ER and the process for discovering and evaluating the significance of new information;
- review of public comments;
- review of environmental quality standards and regulations;
- coordination with Federal, state, local, and tribal environmental protection and resource agencies; and
- review of the technical literature.

New information that the NRC staff discovers is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues in which new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to assessment of the relevant new and significant information; the scope of the assessment does not include those facets of an issue that are not affected by the new information.

The NRC staff reviewed the discussion of environmental impacts associated with operation during the renewal term in the GEIS and has conducted its own independent review, including a public involvement process (e.g., public meetings) to identify new and significant issues for the Fermi 2 license renewal application environmental review. Based on its review of available information and on comments provided during the scoping period, the NRC staff identified new and potentially significant information relevant to the following three environmental issues related to operation of Fermi 2 during the renewal term: (1) bird collisions with plant structures, (2) algal blooms in Lake Erie, and (3) the effects of radiation exposures to the public. The NRC staff's evaluation of this information follows.

Bird Collisions with Plant Structures

Regarding the Category 1 issue, "Bird collisions with plant structures and transmission lines," the NRC staff reviewed the licensee's bird collision records for the past 10 years (2005 to 2014) and bird strike surveillance data from 2008 and 2009. These records are summarized in Section 3.6.6. Aside from two larger bird collision events (50 birds in 1973 and 45 birds in October 2007), DTE has relatively few records of bird collisions with plant structures or transmission lines, and these records indicate that impacts fall well within those discussed in Section 4.6.1.1 of the GEIS for this issue. None of DTE's records include Federally or State-listed species. Additionally, DTE has implemented some measures at Fermi 2 that were determined to reduce bird collision hazards during consultations between DTE, the FWS, and the Federal Aviation Administration for the proposed Fermi 3. These measures include installation of flashing strobe lights on the top of the cooling towers (DTE 2014c). DTE (2014c) is also in the process of developing a company-wide program to reduce operational risks resulting from avian and bat collisions. The program is based on an avian protection plan from the Avian Powerline Interaction Committee and on conversations with FWS personnel at the Lansing, Michigan, office (DTE 2014c). The program will address changes that are needed to prevent avian or bat fatalities and will require documentation of bird or bat strikes to help DTE (2014c) determine whether reporting to local, State, or Federal agencies is required. DTE (2014c) expects to begin implementation of the program in early 2015. The NRC staff concludes that DTE's bird strike information does not constitute new and significant information that would change the GEIS's conclusion of SMALL for this issue.

Algal Blooms in Lake Erie

During the scoping period for Fermi 2, the NRC received several public comments expressing concern regarding the role of Fermi's effluent on harmful algal blooms. Toledo's drinking water crises in August 2014 has raised public concern over large harmful algal blooms in Lake Erie, which has been increasingly susceptible to such blooms since 2002 (University of Michigan 2014). Fermi lies about halfway between Toledo, Ohio, and Detroit, Michigan, on the shore of the western basin of Lake Erie—the lake basin where the algal blooms have been most prominent. The public interest in these blooms and the possible role of temperature increases in extending or exacerbating Lake Erie algal blooms constitute new information that the GEIS had not considered.

Algae are natural components of freshwater ecosystems, and when conditions are favorable, they can rapidly multiply and cause "blooms." Favorable conditions for algal blooms include eutrophication, one definition of which is:

> [Eutrophication is] the enrichment of bodies of fresh water by inorganic plant nutrients (e.g., nitrate, phosphate). It may occur naturally but can also be the result of human activity (cultural eutrophication from fertilizer runoff and sewage discharge) and is particularly evident in slow-moving rivers and shallow lakes [USGS 2014].

One group of algae, the cyanobacteria (called blue-green algae in the past), has members that can produce toxins that can have harmful effects on people and natural resources (EPA 2014d). These toxins are produced and contained internally in the cyanobacterial cells and are released during the death and rupture of the cells (EPA 2014c). The most commonly occurring genera that produce such toxins are *Microcystis*, *Anabaena*, and *Planktothrix* (also called *Oscillatoria*), and the most the most commonly identified groups of cyanotoxins (toxins produced by cyanobacteria) identified in U.S. waters are microcystins, cylindrospermopsins, anatoxins, and saxitoxins (EPA 2014c). These toxins can cause skin irritations, liver and nerve damage, and gastrointestinal distress in humans; stress the structure and functioning of lake ecosystems; and adversely affect the aesthetics and ecological services that the lakes provide to people (EPA 2014c; Michalak et al. 2013; NOAA undated(c)). Detection of the microcystin toxins in the western basin of Lake Erie left nearly half a million Ohio and Michigan residents without drinking water for several days in early August 2014 (University of Michigan 2014).

Lake Erie is the shallowest, most biologically productive, and most southern of the Laurentian Lakes, and these factors have contributed to substantial eutrophication over the past half century, with concomitant nuisance algal blooms (Michalak et al. 2013). Although eutrophication is a natural process in lakes, it can be accelerated by human activities, particularly high phosphorus and nitrogen inputs, in a process known as cultural eutrophication (EPA 2014i). By the 1960s the public had recognized that Lake Erie was highly eutrophic due to recognizable symptoms such as large algal blooms, large areas of attached algae along shorelines, decomposing algae washing up of beaches, cyanobacteria causing taste and odor problems in water supplies, and low dissolved oxygen levels in deeper areas of the lake from decomposing algae (EPA 2014i). In response, the United States and Canada signed the Great Lakes Water Quality Agreement in 1972 to reduce phosphorus inputs to the Great Lakes, which resulted in better water quality and large algal blooms of decreasing intensity and frequency by the 1970s.

In the 1980s, two invasive nuisance species of Asiatic clams, zebra and quagga mussels, were introduced into the Great Lakes and caused dramatic food web changes because of their numbers and ability to remove planktonic algae from the water through their filter feeding. In Lake Erie, algal production switched from phytoplankton to bottom-dwelling plants and algae, and water clarity increased. By the 1990s, large algal blooms began to reappear in western Lake Erie, and the frequency and intensity of the blooms has increased since then. Massive blooms of the cyanobacteria genus *Microcystis* occurred in the western Lake Erie basin in the 2000s in the area offshore of the Detroit and Maumee Rivers (EPA 2014i).

The Lake Erie ecosystem is complicated and poorly understood. The recent algal blooms may be linked to nutrient loading, nutrient releases by zebra mussels, and selective feeding by zebra mussels (EPA 2014i). Very large algal blooms occurred in western Lake Erie in 2003, 2006, 2009, 2011, and 2014.

Bridgeman et al. (2012) studied the algal bloom of 2009 involving the cyanobacteria *Mycrocystis*, which is planktonic, and the then newly emergent cyanobacteria *Lyngbia wollei*, which forms mats on the lake bottom. They found that the Maumee River had higher concentrations of phosphorus than Lake Erie, that significant populations of *Microcystis* develop in the river before developing in the lake, and that the Maumee River may be a major source not only of nutrients that feed the blooms but also of the *Microcystis* seed populations that develop into blooms.

A subsequent cyanobacterial bloom of record-setting magnitude and duration occurred in western Lake Erie in 2011. The bloom was initially composed almost entirely of *Microcystis*, which then declined and was replaced by *Anabaena* sp. (another potentially toxic cyanobacteria) in a secondary bloom. Michalak et al. (2013) investigated possible causes of the bloom, including increases in agricultural nonpoint sources of bioavailable phosphorus; the presence of invasive mussel species, specifically *Dreissena rostriformis bugensis* (quagga mussels) and *D. polymorpha* (zebra mussels); and internal phosphorus loading to Lake Erie's central basin that increases in response to hypoxic conditions. They attributed the intensity and duration of that algal bloom to long-term trends in agricultural land usage that has resulted in increased phosphorus loads and decreased wind speeds that caused weak lake circulation and warm and quiescent lake conditions. Temperature and mixing conditions are important in promoting these blooms because cyanobacteria have a higher temperature optimum (around 25 °C (77 °F)) than that of eukaryotic phytoplankton, and temperature-dependent gas vacuoles increase *Microcystis* buoyancy, which causes them to rise to more favorable light and temperature conditions under quiescent lake conditions. They also predict that if the long-term trends in agricultural land use and trends in climate change continue (such as decreasing wind speeds that weaken lake circulation), such blooms may become more common in the future.

The NPDES permit for Fermi 2 authorizes a maximum discharge to Lake Erie of 45.1 mgd (171,000 m^3/day) of cooling tower blowdown, processed radioactive wastewater, residual heat removal system service water, chemical metal cleaning wastes, and nonchemical metal cleaning wastes through Outfall 001 (DTE 2014a). The temperature of the discharge water is typically about 18 °F (10 °C) higher than that of the intake water, and the NPDES permit has no numerical temperature limits for this outfall other than daily reporting (DTE 2014a). The plant extracts cooling water from Lake Erie and presently does not add phosphorus or nitrogen compounds, so that the cooling water system adds no net loading of these plant nutrients to the lake (DTE 2014a). Water evaporates from the closed cycle cooling system and cooling pond, however, and so concentrations of these plant nutrients will be higher in the effluent than in the intake. The NPDES permit has no numerical limits on nitrogen and phosphorus compounds for Outfall 001.

Lowe (2012) assessed possible discharge effects on cyanobacteria for the proposed Fermi 3 discharge, which is close to the present Fermi 2 discharge. Lowe reports that, in September 2011, 10 replicate petite Ponar grab samples of lake bottom were collected near the Fermi 2 discharge and at the proposed Fermi 3 diffuser outlet, and subsamples of about 2 to 4 cubic centimeters (0.12 to 0.24 cubic inch) from each grab were examined for benthic algae. Lowe found no evidence of *Lyngbya* mats. The algal communities were heavily dominated by diatoms and represented "a typical and *healthy* [italics in original] assemblage of benthic algal community." *Mycrocystis*, a potentially toxic species, was present in these benthic samples at low levels of about "four units out of 10,000 algal units counted." *Mycrocystis* is a planktonic species, not a benthic species, and the NRC staff is unaware of any clear relationship between planktonic concentrations and benthic concentrations for this species. Lowe also reports that he reviewed ship and dive logs from a Detroit Edison Energy research vessel and Scuba dive team that has sampled for the REMP since the plant began operation. The REMP program requires sediment sampling in the spring and fall of each year. Lowe found that "logs contained no notations about the appearance/occurrence of algal mats at Fermi 2 REMP sediment sampling sites." Lowe also interviewed the company divers and found that "[b]ased on visual (naked eye) inspection, they confirmed the absence of algae at nuisance levels in the vicinity of Fermi 2." Lowe concludes that "*Lyngbya* and other nuisance algal species are not present at the current Fermi 2 discharge location" and that the "samples indicated that a healthy algal community typical of sandy-bottom areas of Lake Erie was present with no evidence of *Lyngbya wollei*."

The Fermi 2 discharge is warmer than, and contains somewhat higher concentrations of nitrogen and phosphorus compounds than, the ambient intake water of Lake Erie. Conceptually, these conditions might extend the duration and intensity of harmful algal blooms locally at the effluent. The affected area would be limited, however, due to mixing and diffusion, and harmful algal blooms at the Fermi 2 discharge have not been reported from empirical observation. This information does not contradict the conclusion on page 4-98 of the GEIS (NRC 2013d), which states, "Impacts of thermal discharges on the geographic distribution of aquatic organisms are considered to be of SMALL significance if populations in the overall region are not reduced. This is because heat is usually dissipated rapidly from power plant discharge plumes, and heated plumes are often small relative to the size of the receiving water body."

The NRC staff has reviewed new site-specific information regarding the possible effects of the Fermi 2 discharge on harmful algae blooms in Lake Erie. The information does not contradict the generic conclusion of the GEIS that the level of impact would be SMALL.

The Effects of Radiation Exposures to the Public

During the scoping process, the NRC staff received information in the form of a report (the RPHP report described in Section 4.11.1.1) that members of the public claim shows increases in cancer and mortalities in Monroe County, Michigan, attributable to the operation of Fermi 2. The RPHP report contains data on demographic characteristics, types of cancers, death rates, and cancer death rates for selected time periods reported for Monroe County, Michigan; the State of Michigan; and the United States. Additionally, the RPHP report contains selected data on radioactive effluent releases from Fermi 2 and other U.S. nuclear power plants.

Based on the NRC staff's review, the report is a compilation of selected data from publically available documents. The data do not provide a technical basis linking the cancer and death rate data to the radiological impacts from the operations of the Fermi 2 plant. The NRC staff found that the RPHP report does not contain information to determine the cause of the cancers.

The NRC staff reviewed the radiation doses to members of the public from radioactive effluent releases from the Fermi 2 plant in Section 3.1.4 of this SEIS. Based on its review, the NRC staff concluded that the dose to members of the public was within the NRC's dose limits in 10 CFR Part 20.

In addition, the NRC staff evaluated data from Fermi 2's REMP in Section 3.1.4 of this SEIS. The REMP monitors the local environment around the Fermi site, starting before the plant operates to establish background radiation levels and continuing throughout its operating lifetime. The REMP provides a mechanism for determining the levels of radioactivity in the environment to determine whether there is any buildup of radioactivity from plant operations. The REMP also measures radioactivity from other nuclear facilities that may be in the area (i.e., other nuclear power plants, hospitals using radioactive material, research facilities, or any other facility licensed to use radioactive material) and from natural background radiation and fallout from atomic weapons testing and nuclear accidents. Thus, the REMP monitors the cumulative impacts from all sources of radioactivity in the vicinity of Fermi 2. Based on its review of Fermi 2's REMP, the NRC staff concluded that there was no indication of an adverse trend (i.e., increased buildup) in radioactivity levels in the area and that there is no measurable impact to the environment from operations at Fermi 2.

The NRC staff does not agree that the RPHP report contains information that supports that there are significant radiological impacts associated with Fermi 2 operations greater than those determined in the GEIS. This conclusion is based on the NRC staff's review of radiological data from Fermi 2 (Section 3.1.4). Therefore, as discussed in Section 4.11.1 of this SEIS, the radiological impact to human health (i.e., radiation exposures to the public) remains a Category 1 issue with a SMALL impact.

4.15 Impacts Common to All Alternatives

This section describes the impacts that are considered common to all alternatives discussed in this SEIS, including the proposed action and replacement power alternatives. The continued operation of a nuclear power plant and replacement fossil fuel power plants both involve mining, processing, and the consumption of fuel that result in comparative impacts (NRC 2013d). In addition, the following sections discuss termination of operations and the decommissioning of both a nuclear power plant and replacement fossil fuel power plants and GHG emissions.

4.15.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of the proposed action and replacement power alternatives. Most replacement power alternatives employ a set of steps in the use of their fuel sources, which can include extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle (NRC 2013d).

4.15.1.1 Uranium Fuel Cycle

The uranium fuel cycle issues applicable to Fermi 2 are discussed below and are listed in Table 4–18 for Category 1 issues. Table B–1 of Appendix B to Subpart A of 10 CFR Part 51 contains more information on these issues.

Table 4–18. Issues Related to the Uranium Fuel Cycle

Issue	GEIS Section	Category
Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	1
Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	1
Nonradiological impacts of the uranium fuel cycle	4.12.1.1	1
Transportation	4.12.1.1	1

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

The uranium fuel cycle includes 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. The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in NUREG–1437 (NRC 1996, 1999, 2013d).

The NRC staff did not identify any new and significant information related to the uranium fuel cycle issues listed in Table 4–18 during its review of the applicant’s ER (DTE 2014a), the site visit, and the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. For these Category 1 issues, the GEIS concludes that the impacts are SMALL, except for the issue, “Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste,” to which the NRC has not assigned an impact level. This issue assesses the 100-year radiation dose to the U.S. population (i.e., collective effects or collective dose) from radioactive effluent released as part of the uranium fuel cycle for a nuclear power plant during the license renewal term compared to the radiation dose from natural background exposure. It is a comparative assessment for which there is no regulatory standard to base an impact level.

4.15.1.2 Replacement Power Plant Fuel Cycles

Fossil Fuel Energy Alternatives

Fuel cycle impacts for a fossil fuel-fired plant result from the initial extraction of fuel, cleaning and processing of fuel, transport of fuel to the facility, and management and ultimate disposal of solid wastes from fuel combustion. These impacts are discussed in more detail in Section 4.12.1.2 of the GEIS (NRC 2013d) and can generally include the following:

- significant changes to land use and visual resources;
- impacts to air quality, including release of criteria pollutants, fugitive dust, VOCs, and coalbed methane in the atmosphere;
- noise impacts;
- geology and soil impacts due to land disturbances and mining;
- water resource impacts, including degradation of surface water and groundwater quality;
- ecological impacts, including loss of habitat and wildlife disturbances;
- historic and cultural resources impacts within the mine footprint;
- socioeconomic impacts from employment of both the mining workforce and service and support industries;
- environmental justice impacts;
- health impacts to workers from exposure to airborne dust and methane gases; and
- generation of coal and industrial wastes.

New Nuclear Energy Alternatives

Uranium fuel cycle impacts for a nuclear plant result from the initial extraction of fuel, transport of fuel to the nuclear plant, and management and ultimate disposal of spent fuel. The environmental impacts of the uranium fuel cycle are discussed in Section 4.15.1.1.

Renewable Energy Alternatives

The term “fuel cycle” has varying degrees of relevance for renewable energy facilities. The term has meaning for renewable energy technologies that rely on combustion of fuels, such as biomass grown or harvested for the express purpose of power production. The term is somewhat more difficult to define for renewable technologies, such as wind, solar, geothermal, and ocean wave and current. Those natural energy resources exist regardless of any effort to harvest them for electricity production. The common technological strategy for harvesting energy from such natural resources is to convert the kinetic or thermal energy inherent in that resource to mechanical energy or torque. The torque is then applied directly (e.g., as in the case of a wind turbine) or indirectly (e.g., for those facilities that use conventional steam cycles to drive turbines that drive generators) to produce electricity. However, because those renewable technologies capture very small fractions of the total kinetic or thermal energy contained in those resources, impacts from the presence or absence of the renewable energy technology are often indistinguishable (NRC 2013d).

4.15.2 Terminating Power Plant Operations and Decommissioning

This section describes the environmental impacts associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations. For the proposed action, license renewal would delay this eventuality for an additional 20 years beyond the current license period, which ends in 2025.

4.15.2.1 Existing Nuclear Power Plant

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 Supplement 1 of NUREG–0586 (NRC 2002b). Additionally, the GEIS discusses the incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term.

Table 4–19 lists the Category 1 issues in Table B–1 of Appendix B to Subpart A of 10 CFR Part 51 that are applicable to Fermi 2 decommissioning following the license renewal term.

Table 4–19. Issues Related to Decommissioning

Issue	GEIS Section	Category
Radiation doses	4.12.2.1	1
Waste management	4.12.2.1	1
Air quality	4.12.2.1	1
Water quality	4.12.2.1	1
Ecological resources	4.12.2.1	1
Socioeconomic impacts	4.12.2.1	1

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51

Decommissioning would occur whether Fermi 2 were shut down at the end of its current operating license or at the end of the license renewal term. In its ER, DTE stated that it is not aware of any new and significant information on the environmental impacts of Fermi 2 during the license renewal term (DTE 2014a). The NRC staff has not found any new and significant information during its independent review of DTE's ER, the site visit, or the scoping process. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all these issues, the NRC staff concluded in the GEIS that the impacts are SMALL.

4.15.2.2 Replacement Power Plants

<u>Fossil Fuel Energy Alternatives</u>

The environmental impacts from the termination of power plant operations and decommissioning of a fossil fuel-fired plant are dependent on the facility's decommissioning plan. General elements and requirements for a fossil fuel plant decommissioning plan are discussed in Section 14 of the GEIS and can include the removal of structures to at least 3 ft (1 m) below grade; removal of all coal, combustion waste, and accumulated sludge; removal of intake and discharge structures; and the cleanup and remediation of incidental spills and leaks at the facility. The decommissioning plan outlines the actions necessary to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013d).

The environmental consequences of decommissioning are discussed in Section 4.12.2.2 of the GEIS and can generally include the following:

- short-term impacts on air quality and noise from the deconstruction of facility structures,
- short-term impacts on land use and visual resources,
- long-term reestablishment of vegetation and wildlife communities,
- socioeconomic impacts due to decommissioning the workforce and the long-term loss of jobs, and
- elimination of health and safety impacts on operating personnel and general public.

New Nuclear Alternatives

Termination of operations and decommissioning impacts for a nuclear plant include all activities related to the safe removal of the facility from service and the reduction of residual radioactivity to a level that permits release of the property under restricted conditions or unrestricted use and termination of a license (NRC 2013d). The environmental impacts of the uranium fuel cycle are discussed in Section 4.15.1.1.

Renewable Alternatives

Termination of power plant operation and decommissioning for renewable energy facilities would be similar to the impacts discussed for fossil fuel-fired plants above. Decommissioning would involve the removal of facility components and operational wastes and residues to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013d).

4.15.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss GHG emissions released from operation of Fermi 2 and the environmental impacts that could occur from changes in climate conditions. The cumulative impacts of GHG emissions on climate are discussed in Section 4.16.11.

4.15.3.1 Greenhouse Gas Emissions from the Proposed Project and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in Earth's climate are collectively termed GHGs. GHGs include carbon dioxide, methane, nitrous oxide (N_2O), water vapor, and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (SF_6). The Earth's climate responds to changes in concentration of GHGs in the atmosphere because GHGs affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing GHG concentration in the atmosphere generally increases Earth's surface temperature. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have significantly increased since 1750 (IPCC 2007a). Carbon dioxide, methane, nitrous oxide, water vapor, and fluorinated gases (termed long-lived GHGs) are well mixed throughout the Earth's atmosphere, and their impact on climate is long lasting as a result of their long atmospheric lifetime (EPA 2009a). Carbon dioxide is of primary concern for global climate change due to its long atmospheric lifetime, and it is the primary gas emitted as a result of human activities. Climate change research indicates that the cause of the Earth's warming over the last 50 years is due to the buildup of GHGs in the atmosphere resulting from human activities (USGCRP 2014). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496).

Proposed Action

Operation of Fermi 2 does not directly emit GHG emission because fossil fuel is not used to generate electricity. However, plant operations at Fermi 2 release GHG emissions (primarily carbon dioxide) from stationary combustion sources, such as auxiliary boilers, diesel generators, and combustion turbines on site. Other sources include mobile combustion sources (e.g., employee vehicles and nonroad equipment) and refrigerant appliances at Fermi 2 that contain fluorinated gases (DTE 2014c). Fluorinated gases are typically emitted in small quantities but their impacts could be substantial because of their high global warming potential (GWP).

Annual GHG emissions at Fermi 2 are presented in Table 4–20 for the 2009 to 2013 period. The GHG emissions presented include stationary combustion sources, mobile combustion sources, and refrigerant sources. The GHG emissions resulting from operations at Fermi are below the EPA's threshold of 25,000 MT (25,558 tons) per year of CO_{2eq}, which requires facilities to report GHG emissions to EPA annually in accordance with 40 CFR Part 98.

Table 4–20. Estimated GHG Emissions from Operations at Fermi 2

Year	Stationary Combustion Related Sources[(a)] (CO_{2eq} MT/year)	Onsite Vehicles and Nonroad Equipment (CO_{2eq} MT/year)	Worker Vehicles (CO_{2eq} MT/year)	Refrigerant Sources (CO_{2eq} MT/year)	Total (CO_{2eq} MT/year)[(b)]
2009	9,023	476	3,775	-	13,300
2010	9,163	496	3,775	-	13,500
2011	10,249	477	3,775	65	14,600
2012	5,498	317	3,775	-	9,600
2013	8,827	324	3,775	-	13,000

[(a)] These sources include emissions from diesel generator, combustion turbines, and auxiliary boiler.

[(b)] The values are rounded.

Key: CO_{2eq} = carbon dioxide equivalents, and MT = metric ton.

Source: DTE 2014c

No-Action Alternative

As discussed in previous no-action alternative sections, the no-action alternative represents a decision by the NRC not to renew the operating license of a nuclear power plant beyond the current operating license term. At some point, all nuclear plants will terminate operations and undergo decommissioning. Under the no-action alternative, plant operations for Fermi 2 would terminate at or before the end of the current license. When the plant stops operating, a reduction in GHG emissions from activities related to plant operation, such as use of diesel generators and employee vehicles, will occur. GHG emissions are anticipated to be less than those presented in Table 4–20.

NGCC Alternative

As discussed in Section 2.2.2.1, the NRC staff evaluated an NGCC alternative that consists of three 400-MWe units for a total of 1,200 MW. The GEIS presents lifecycle GHG emissions associated with natural gas power generation. As presented in Table 4.12-5 of the GEIS, lifecycle GHG emissions from natural gas can range from 120 to 930 grams (g) of carbon equivalent per kilowatt-hour (g C_{eq}/kWh). The NRC staff estimates that operation of the NGCC alternative directly will emit about 3.9 million tons of CO_{2eq} per year (3.5 million MT/year).

IGCC Alternative

As discussed in Section 2.2.2.2, the NRC staff evaluated the IGCC plant alternative that would consist of two 618-MWe units for a total 1,236 MW. The GEIS presents lifecycle GHG emissions associated with coal power generation. As presented in Table 4.12-4 of the GEIS, lifecycle GHG emissions from coal power generation can range from 264 to 1,689 g C_{eq}/kWh. However, these lifecycle emission factors are for conventional coal power plants; recent studies report lifecycle GHG emissions for an IGCC estimate of 937 kg of CO_{2eq} per kilowatt-hour (937 g C_{eq}/kWh) (NETL 2010). The NRC staff estimates that operation of the IGCC alternative directly will emit about 6.9 million tons of CO_{2eq} per year (6.2 million MT/year).

New Nuclear Alternative

As discussed in Section 2.2.2.3 the NRC staff evaluated the new nuclear power plant alternative that would consist of one ESBWR reactor with approximate generating capacity of 1,170 MWe. The GEIS presents lifecycle GHG emissions associated with nuclear power generation. As presented in Tables 4.12-4 through 4.12-6 of the GEIS, lifecycle[16] GHG emissions from nuclear power generation can range from 1 to 288 g C_{eq}/kWh. Operation of nuclear power plants does not burn fossil fuels to generate electricity and, therefore, does not directly emit GHG emissions. Sources of GHG emissions would include stationary combustion sources (e.g., diesel generators, auxiliary boilers, and combustion turbines) and mobile sources (e.g., worker vehicles, onsite heavy equipment, and support vehicles). As discussed in Section 4.3.5, it is anticipated that air emissions from a new nuclear power plant would be similar to those from Fermi 2. Therefore, it is anticipated that GHG emissions from the new nuclear alternative would be similar to those presented in Table 4–21.

Combination Alternative (NGCC, Wind, and Solar)

As discussed in Section 2.2.2.4, the NRC staff evaluated an alternative that relies on NGCC (33 percent), wind (50 percent), and solar (17 percent) capacity to replace Fermi 2. The total installed capacity for the combination alternative would be 400 MWe for NGCC, 1,052 MWe for solar PV, and 2,000 MWe for onshore wind. For this combination alternative, it is assumed that the majority of the GHG emissions result from the NGCC portion only because renewable portions (wind and solar PV) do not burn fossil fuels to generate electricity. As discussed in Section 4.3.3., GHG emissions associated with the operation of the NGCC portion are reduced proportionally because its electricity output is approximately 33 percent that of the NGCC alternative. The NRC staff estimates that operation of the combination alternative will directly result in about 1.3 million tons of CO_{2eq} per year (1.2 MT/year).

Summary of GHG Emissions from the Proposed Action and Alternatives

Table 4–21 presents the direct GHG emissions from operation of the proposed action and alternatives. The GHG emissions from the proposed action (continued operation at Fermi 2) and the new nuclear alternative would be lowest compared to those from the other alternatives.

[16] Lifecycle carbon emissions analyses consider construction, operation, decommissioning, and associated processing of fuel (e.g., gas and coal).

The GHG emissions for IGCC, NGCC, and combination alternatives are higher than those for the proposed action and a new nuclear alternative by several orders of magnitude.

Table 4–21. Direct GHG Emissions[a] from Operation of the Proposed Action and Alternatives

Technology	CO_{2eq} (MT/year)
Fermi 2 continued operation[b]	10,250
New nuclear	10,250
NGCC	3.5×10^6
IGCC	6.2×10^6
Combination[c]	1.2×10^6

[a] The GHG emissions presented include only direct emissions from operation of the electricity-generating technology. For the NGCC and IGCC alternatives, GHG emissions result from direct combustion. For the proposed action and new nuclear alternative, direct GHG emissions are a result of combustion sources, such as diesel generators, auxiliary boilers, and turbines.

[b] Emissions include operation of combustion sources (i.e., diesel generators, auxiliary boiler, and turbines). The data reflect the highest GHG emissions from the most recent 5 years of Fermi 2 operation (DTE 2014c).

[c] Only the NGCC portion of GHG emissions is shown.

Key: CO_{2eq} = carbon dioxide equivalents, and MT = metric ton.

4.15.3.2 Climate Change Impacts to Resource Areas

Climate change is the decades or longer change in climate measurements (e.g., temperature and precipitation) that has been observed on a global, national, and regional level (EPA 2012c; IPCC 2007a; USGCRP 2014). Climate change can vary regionally, spatially, and seasonally depending on local, regional, and global factors. Just as the regional climate differs throughout the world, the impacts of climate change can vary between locations.

On a global level from 1901 to 2012, the Earth's average surface temperatures have risen at a rate of 0.15 °F (0.08 °C) per decade, and precipitation has increased at an average rate of 0.2 percent per decade (EPA 2014b). The observed global changes in average surface temperature and precipitation have been accompanied by an increase in sea surface temperatures, a decrease in global glacier ice, an increase in sea level, and changes in extreme weather events. Such extreme events include increases in frequency of heat waves, heavy precipitation, and minimum and maximum temperatures (EPA 2012c; IPCC 2007a; USGCRP 2009, 2014).

In the United States, the U.S Global Change Research Program (USGCRP) reports that, from 1895 to 2012, average surface temperature has increased from 1.3 °F to 1.9 °F (0.72 to 1.06 °C), and since 1900, average annual precipitation has increased by 5 percent (USGCRP 2014). On a seasonal basis, warming has been the greatest in winter and spring. From 1895 to 2011, an increase in the length of the freeze-free season, the period between the last occurrence of 0 °C (32 °F) in the spring and first occurrence of 0 °C (32 °F) in the fall, has been observed for the contiguous United States; between 1991 and 2011, the average freeze-free season was 10 days longer than that between 1901 and 1960 (USGCRP 2014). Since the 1970s, the United States has warmed at a faster rate as the surface temperature rose at an average rate of 0.17 to 0.25 °C (0.31 to 0.45°F) per decade. In addition, the year 2012 was the warmest on record (USGCRP 2014). Observed climate-related changes in the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of sea level in coastal areas of the United States, increase in occurrence of heat waves, and a decrease in occurrence of cold waves (EPA 2012c; NOAA 2013a; USGCRP 2009, 2014).

Temperature data indicate that the Midwest region, where Fermi 2 is located, experienced a 0.06 °C (0.11 °F) per decade increase in annual mean temperature during the 1900 to 2010 period (NOAA 2013b). Temperature data for the recent past indicate an increased rate of warming for the Midwest: 0.12 °C (0.22 °F) per decade for the 1950 to 2010 time period and a 0.26 °C (0.47 °F) temperature increase for the 1979 to 2010 time period. Average annual precipitation data for the Midwest exhibit an increasing trend of 0.31 inch (in.) (0.79 centimeter (cm)) per decade for the long-term period (1895 to 2011) (NOAA 2013b). Precipitation data over the 1958 to 2007 period exhibit clear trends toward more very heavy precipitation events (defined as the heaviest 1 percent of all daily events) for the Nation as a whole and particularly in the Northeast and Midwest.

The NRC staff analyzed temperature and precipitation trends for the period of 1865 to 2014 in the southeastern region of Michigan (NCDC 2014). Average annual temperatures during this time period show large year-to-year variations, although a clear upward trend in temperature is observed starting since the 1960s. Since 1865, temperatures have increased 0.2 °F (0.1 °C) per decade, and since 1960, temperatures have increased at a rate of 0.5 °F (0.2 °C) per decade. Average annual precipitation also displays year-to-year variations, although precipitation has increased at a rate of 0.4 in. (1.0 cm) per decade. The Great Lakes have experienced higher water temperatures and less ice cover as a result of changes in regional climate (USGCRP 2014; NOAA 2013b). Since the early 1970s, total winter ice coverage has decreased by 63 percent. Water levels for Lake Erie have exhibited a downward trend since the 1860s (NOAA 2013b). The NRC staff obtained modeled monthly Lake Erie surface water temperatures from the National Oceanic and Atmospheric Administration's (NOAA's) Great Lake Environmental Research Laboratory for 1950 to 2012; these water surface temperatures were derived from the NOAA's Great Lakes continuous evaporation model (Croley 2005). For the years 1950 to 2012, Lake Erie annual surface water temperatures increased at a rate of 0.037 °C (0.067 °F) per decade (NOAA 2014). Additionally, the NRC staff obtained daily Lake Erie surface water temperatures from satellite measurements for the years 1995 to 2013 (NOAA undated(a)); daily annual mean surface water temperatures during this period increased at a rate of 0.045 °C (0.081 °F) per year. However, these measurements are based on satellite imagery, and Nizoli (2002) has noted that satellite-derived lake temperatures have a seasonal warm or cool bias when compared to actual Great Lakes buoy measurements.

Future GHG emission concentration and climate models are commonly used to project possible climate change. Climate models indicate that over the next few decades, temperature increases will continue due to current GHG emissions concentrations in the atmosphere (USGCRP 2014). Over the longer term, the magnitude of temperature increases and climate change effects will depend on both past and future GHG emissions (IPCC 2007a; USGCRP 2009, 2014).

For the license renewal period of Fermi 2 (2025 to 2045), climate simulations (between 2021 to 2050 relative to the reference period (1971 to 1999)) indicate an increase in annual mean temperature in the Midwest region of 2.5 to 3.5 °F (4.5 to 6.3 °C) for both a low- and high-emission-modelled scenario (NOAA 2013b). The predicted increase in temperature during this time period occurs for all seasons with the largest increase occurring in the summertime (June, July, and August). Climate model simulations (for the time period 2021 to 2050) suggest spatial differences in annual mean precipitation changes for the Midwest with northern areas experiencing an increase in precipitation and the southern areas experiencing a decrease in precipitation. For Michigan, the models indicate a 0- to 6-percent increase in annual mean precipitation, with the fall, winter, and spring seasons experiencing precipitation change increases and the summer season experiencing a decrease in precipitation for both a low- and high-emission-modeled scenario. However, these changes in precipitation were not significant under a low-emission-modeled scenario, and the models indicate changes that are less than normal year-to-year variations (NOAA 2013b). The average lake level of Lake Erie could decrease by 7.8 to 9.8 in. (20 to 25 cm) compared to the current long-term mean by 2050 (Mackey 2012; USGCRP 2014). Future lake level changes are highly uncertain and climate models have a low confidence level associated with estimated water level changes. Future lake levels will depend on evaporative losses, local precipitation changes, wind speeds, and storm frequency. Furthermore, models project that water surface temperatures by 2050 will increase by 1.6 to 3.2 °C (2.8 to 5.7 °F) under a low-emission-modeled scenario and 1.5 °C to 3.9 °C (2.7 to 7.0 °F) under a high-emission-modelled scenario (Mackey 2012).

Changes in climate have broader implications for public health, water resources, land use and development, and ecosystems. For instance, changes in precipitation patterns and increase in air temperature can affect water availability and quality; distribution of plant and animal species; land use patterns; and land cover, which can in turn affect terrestrial and aquatic habitats. The sections below discuss how future climate change may impact air quality, water resources, land use, terrestrial resources, aquatic resources, and human health in the ROI for Fermi 2. Although the exact future climate change is uncertain, the discussions provided below demonstrate the potential implications of climate change on resources.

Air Quality

As discussed above, a noticeable increase in average temperatures in Michigan have been observed. Despite the strong year-to-year variations, climate models project continued warming in the Midwest region during the license renewal period. Air pollutant concentrations result from complex interactions between physical and dynamic properties of the atmosphere, land, and ocean. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007b). Air pollutant concentrations are sensitive to winds, temperature, humidity, and precipitation (EPA 2009a). Hence, climate change can impact air quality as a result of the changes in meteorological conditions.

Ozone has been found to be particularly sensitive to climate change (IPCC 2007b; EPA 2009b). Ozone is formed, in part, as a result of the chemical reaction of nitrogen oxides and VOCs in the presence of heat and sunlight. Nitrogen oxides and VOC sources include both natural emissions (e.g., biogenic emissions from vegetation or soils) and human activity-related emissions (e.g., motor vehicles and power plants). Sunshine, high temperatures, and air stagnation are favorable meteorological conditions to higher levels of ozone (IPCC 2007b; EPA 2009a). The emission of ozone precursors also depends on temperature, wind, and solar radiation (IPCC 2007b); both nitrogen oxide and biogenic VOC emissions are expected to be higher in a warmer climate (EPA 2009b). Although surface temperatures are expected to increase in the Midwest, this may not necessarily result in an increase in ozone concentrations. The observed correlation between increased ozone concentrations and temperature has been found to occur in polluted and urban regions (those areas where ozone concentration are greater than 60 parts per billion). Additionally, increases in ozone concentrations correlated with temperature increases occur in combination with cloud-free regions and air stagnation episodes (Jacob and Winner 2009; IPCC 2013). Furthermore, climate models do not agree on the sign of ozone response to climate change. Some models indicate increases in ozone concentrations with climate change for the Midwest and Northeast (e.g., Wu et al. 2008), and others project decreases in ozone concentrations with climates for the Northern regions of the United States (e.g., Tagaris et al. 2009). Climate change may make it difficult for regions to meet ozone NAAQS (USGCRP 2009).

Water Resources

Predicted changes in the timing, intensity, and distribution of precipitation would likely result in changes in surface water runoff affecting water availability across the Midwest. As discussed above, the Midwest may experience increased mean precipitation during the fall, winter, and spring. Additionally, increases in the frequency and intensity of extreme (heavy) precipitation are projected across the entire region, particularly in the eastern part of the region where Fermi 2 is located (USGCRP 2014). As cited by the USGCRP, in spite of increased annual average precipitation, the loss of moisture from soils because of higher temperatures along with increased evapotranspiration from vegetation and the increased average number of days without precipitation is likely to intensify short-term (seasonal or shorter) droughts across the region into the future (USGCRP 2009, 2014). Such conditions can potentially reduce the amount of water available for surface runoff and streamflow on a seasonal timeframe. Runoff and streamflow at a regional scale for the Midwest region indicate no clear trend during the last half century; however, annual runoff and river flow are projected to increase in the upper Midwest. Increases in the frequency and magnitude of extreme precipitation events projected for the winter and spring months will contribute to higher seasonal lake levels (USGCRP 2014; Mackey 2012). However, annual mean water levels for Lake Erie are projected to be below historical levels. The average lake level of Lake Erie could decrease by 7.8 to 9.8 in. (20 to 25 cm) compared to the current long term-mean by 2050 (Mackey 2012; USGCRP 2014). As for water quality implications, increases in the frequency intensity of very heavy precipitation events can result in increases in nutrients; sediment loads; and contaminants into Lake Erie, which can lower the overall lake water quality (Mackey et al. 2012). The effects of climate change are projected to significantly increase water demand across most of the United States. However, when accounting for changes in proposed population and climate change projections, the southern regions of Michigan (where Fermi 2 is located) do not experience increases in water demand; conversely, northern areas of Michigan may experience an increase of up to 10 percent (USGCRP 2014, Figure 3.11).

Increased precipitation in the fall, winter, and spring is likely to result in increased groundwater recharge. More precipitation during these seasons (as opposed to summer) would percolate into the groundwater because it would experience lower evaporation and transpiration rates. Furthermore, a portion of the winter precipitation would fall as snow. Instead of running off the land, much of the snow is likely to slowly melt in place and contribute to groundwater recharge. Future climate change is not likely to affect groundwater supplies near the site. Local aquifers under the site are in hydrologic communication with Lake Erie. If groundwater levels in the local aquifers rise, more water will be discharged by these aquifers to Lake Erie. Alternatively, should groundwater levels in the local aquifers decrease, more water would flow from the lake into the local aquifers. Any future climate impacts on Lake Erie water levels are not anticipated to change this natural rhythm. This phenomenon is illustrated in Figure 3–13 (Bed Rock Water Levels and Lateral Groundwater Flow Direction) in Section 3.5.2.1 of this SEIS. Figure 3–13 shows groundwater flowing from Lake Erie as a result of quarry dewatering activities and groundwater flowing into the lake in those areas that are not impacted by dewatering activities. The Fermi site does not use groundwater. Future climatic changes should not result in changes to site operations, which could result in increased impacts to the availability and quality of groundwater resources.

Land Use

Anthropogenic land use is both a contributor to climate change, as well as a receptor of climate change impacts (Dale 1997). As described previously in this section, the Midwest will likely experience rising temperatures and heavier precipitation events during the proposed license renewal period. Agriculture (the major land use in the vicinity of Fermi 2) and growing urban areas will further exacerbate these changes by continuing to inhibit natural ecosystem functions that could moderate climate change effects. For instance, air temperatures and near-surface moisture levels change in areas where natural vegetation is converted to agricultural use, and higher temperatures have been observed in the Midwest as a result of converting land to agricultural use (USGCRP 2014). The USGCRP (2014) indicates that land use changes, such as the continued expansion of urban areas, paired with climate change effects, such as heaver precipitation events, can exacerbate climate change effects, including reduced water filtration into the soil and increased surface runoff due to increases in impervious surface area. Although anthropogenic land uses will contribute to climate change in these and other ways, land uses will also be affected by climate change in several ways. For instance, plant winter hardiness zones are likely to shift one-half to one full zone by the end of the proposed license renewal period (USGCRP 2014). This shift will affect the ability to grow certain crops because the Midwest will likely contain plants now associated with the Southeast by the end of the century (USGCRP 2014). Additionally, the USGCRP (2014) projects that the Midwest will experience a loss in cropland cover and an expansion in exurban and suburban areas. Changes in cropland cover and expansion of exurban and suburban areas can then reduce the quality and availability of land resources and agricultural productivity. Changes or fluctuations in lake water levels could result in land use changes along affected water bodies and in impacts to infrastructure. Such changes or fluctuations could necessitate infrastructure redesign and replacement. For example, decreases in lake levels can result in increases in dredging of commercial channels (Mackey 2012).

Aquatic Resources

Climate change can affect the flow of energy, water, and other materials through ecosystems, which, in turn, affect living aquatic resources. Mackey (2012) identified three climate stressors on the Great Lakes and near shore coastal systems: (1) changing water level regimes, (2) changing patterns of storms and precipitation, and (3) altered thermal regimes. These affect the physical characteristics and processes of shorelines and coastal and aquatic habitats, which then affect biological communities and ecosystems. Some of these effects on aquatic resources are discussed below.

The Midwest is warming. The USGCRP (2014) reports that between 1900 and 2010, average Midwest air temperatures increased more than 1.5 °F (0.85 °C). Mackey (2012) projected that Lake Erie surface water temperatures could increase 1.6 to 3.2 °C (2.8 to 5.7 °F) under a low-emission-modeled scenario and 1.5 °C to 3.9 °C (2.7 to 7.0 °F) under a high-emission-modeled scenario by 2050. Higher water temperatures are not only a direct stressor to aquatic resources, but they can exacerbate other existing environmental stressors, such as excess nutrients, sedimentation, and lowered dissolved oxygen associated with eutrophication (USGCRP 2014). Warmer water temperatures combined with increased nutrient loads can increase the growth and duration of algal blooms that adversely affect water quality and habitats. For example, Michalak et al. (2013) predict that if the long-term trends in agricultural land use (which have increased phosphorus loads) and trends in climate change continue (such as decreasing wind speeds that weaken lake circulation), harmful algal blooms in Lake Erie may become more common in the future.

The Midwest will likely experience an increased frequency of extreme rainfall events, which will cause erosion and will lead to a decline in water quality (Mackey 2012; USGCRP 2014). Increased agricultural runoff, which can increase phosphorus and nitrogen loadings to water resources, can contribute to low-oxygen zones in Lake Erie. Species that require cleaner waters, such as freshwater mussels, could experience further population declines. USGCRP (2014) predict habitat loss and local extinctions of fish and other aquatic species throughout the United States from the combined effects of water withdrawal and climate change and shifts in species assemblages and distributions as climate change continues. For instance, in the Great Lakes, increases in lakebed erosion could result in coarsening of lakebed substrates and in more favorable habitat for invasive zebra mussels. Special status species, such as those that are Federally protected under the ESA, would be most sensitive to climate changes because those populations are already stressed and at low levels. Invasions of non-native species that thrive under a wide range of environmental conditions could further disrupt the current composition of aquatic communities.

Furthermore, changes in lake water levels would also affect aquatic habitat. Mackey (2012) found that although future lake level projections are uncertain, long-term average projections indicate a decrease in Lake Erie water levels of 20 to 25 cm (7.9 to 9.8 in.) by 2050. Decreases in lake water levels can change the location and distribution of nearshore fish spawning and nursery habitats and may affect the depth of the thermocline, which would also affect the habitat of midwater species.

Terrestrial Resources

As described above, the Midwest will likely experience rising temperatures and heavier precipitation events during the proposed license renewal period. As the climate changes, terrestrial resources will either need to be able to tolerate the new physical conditions or shift their population range to new areas with a more suitable climate. Scientists currently estimate that species are shifting their ranges at a rate of between 6.1 to 11 m (20 to 36 ft) in elevation per decade and 6.1 to 16.9 km (3.8 to 10.5 mi) in latitude per decade (Chen et al. 2011; Thuiller 2007). Although some species may readily adapt to a changing climate, others may be more prone to experience adverse effects. For example, species whose ranges are already limited by habitat loss or fragmentation or who require very specific environmental conditions may not be able to successfully shift their ranges over time. Migratory birds that travel long distances may also be disproportionately affected because they may not be able to pick up on environmental clues that a warmer, earlier spring is occurring in the United States while they are overwintering in tropical areas. Fraser et al. (2013) found that songbirds overwintering in the Amazon did not leave their winter sites earlier, even when spring sites in the Eastern United States experienced a warmer spring. As a result, the song birds missed periods of peak food availability. For many Midwest species, migration to changed habitats is projected to be slow due to flat topography; high latitudes; and fragmented habitats, including the Great Lakes (USGCRP 2014). Special status species and habitats, such as those that are Federally protected by the ESA, would likely be more sensitive to climate changes because these species' populations are already experiencing threats that are endangering their continued existence throughout all, or a significant portion of, their ranges. For instance, in its final rule to list the red knot (*Calidris canutus rufa*), a shorebird that uses the Great Lakes during spring and fall migration, the FWS cites several effects resulting from climate change as factors contributing to the decline of the species (79 FR 73705). These effects include habitat loss from sea level rise, asynchronies in the timing of annual cycles, and increased frequency of severe storm events. Habitat ranges for forest systems in the Midwest, such as paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*), are projected to decline as they shift northward, and species that are common farther south, such as oaks (*Quercus* spp.) and pines (*Pinus* spp.), will expand their range north into the Midwest region (USGCRP 2014). Climate changes could also favor non-native invasive species and promote population increases of insect pests and plant pathogens, which may be more tolerant to a wider range of climate conditions.

Changes in water level regimes can alter the composition of the Great Lakes coastal wetland-dependent fish communities and other aquatic organisms. The Great Lakes coastal wetlands provide essential habitat for more than 80 species of fish and habitats for a diverse number of nesting birds, amphibians, and reptiles (Mackey 2012). Coastal wetlands are vulnerable to hydrologic isolation during periods of low water levels. Isolation from adjacent tributaries and lake water bodies disconnects potential spawning and nursery habitats, which can reduce or alter available food resources for birds, amphibians, reptiles, and other wetland-dependent terrestrial organisms.

Historic and Cultural Resources

Increases in river and lake water levels because of changes in meteorological conditions due to climate change could result in the loss of historic and cultural resources from flooding, erosion, or inundation. Because of water-level changes, some resources could be lost before they could be documented or otherwise studied. However, as discussed above, future lake water level changes are uncertain and confidence levels regarding model projections are low. The limited extent of climate change that could occur during the 20-year license renewal term would not have a significant effect on historic and cultural resources at Fermi.

Socioeconomics

Rapid changes in climate conditions could have an impact on the availability of jobs in certain industries. For example, tourism and recreation are major job creators in some regions, bringing billions of dollars to regional economies. Across the Nation, fishing, hunting, and other outdoor activities make important economic contributions to rural economies and are also a part of the cultural tradition. A changing climate would mean reduced opportunities for some activities in some locations and expanded opportunities for others. Hunting and fishing opportunities could also change as animals' habitats shift and as relationships among species are disrupted by their different responses to climate change (USGCRP 2014). For instance, surface water thermal changes might cause a northward shift of warm- and cold-water fish; changes in the abundance and distribution of fish can potentially impact commercial and recreational fishing (Mackey 2012). Water-dependent recreation could also be affected (USGCRP 2009). The USGCRP reports that increasing heat and humidity associated with climate change in parts of the Midwest region by the year 2050 could create unfavorable conditions for summertime outdoor recreation and tourism activity (USGCRP 2014). Reduced ice cover may benefit commerce by lengthening the navigation and shipping season. On the other hand, changes in lake water levels could affect Great Lakes port operations. However, the limited extent of climate change that could occur during the 20-year license renewal term would not cause any significant changes in socioeconomic conditions in the vicinity of Fermi.

Human Health

Changes in climate conditions could have an impact on human health, such as increased respiratory, cardiovascular, and infectious diseases (USGCRP 2014). However, changes in climate conditions that may occur during the license renewal term will not result in any change to the impacts discussed in Section 3.11 from Fermi's radioactive and nonradioactive effluents. Increased water temperatures in Lake Erie as discussed above, however, may increase the potential to support the survival of thermophilic organisms and the potential for adverse effects these organisms that can be a threat to human health.

Environmental Justice

Rapid changes in climate conditions could disproportionately affect minority and low-income populations. The USGCRP (2014) indicates that "infants and children, pregnant women, the elderly, people with chronic medical conditions, outdoor workers, and people living in poverty are especially at risk from a variety of climate-related health effects." Examples of these effects include increased heat stress; air pollution; extreme weather events; and diseases carried by food, water, and insects. The greatest health burdens related to climate change are likely to fall on the poor, especially those lacking adequate shelter and access to other resources, such as air conditioning. Elderly people living on a fixed income are more likely to be poor and are more likely to have debilitating chronic diseases or limited mobility. In addition, elderly people can have a reduced ability to regulate their own body temperature or to sense when they are too hot. According to the USGCRP (2009), they "are at greater risk of heart failure, which is further exacerbated when cardiac demand increases in order to cool the body during a heat wave." The USGCRP (2009) study also found that people taking medications, such as diuretics for high blood pressure, have a higher risk of dehydration. The USGCRP (2014) study reconfirmed the previous report findings regarding the risks of climate change on low-income populations and warns that climate change could affect the availability and access to local plant and animal species, thus impacting the people that have historically depended on them for food or medicine. For instance, in the Great Lakes regions, wild rice, a sacred food and medicine to the Anishinaabe people, has declined due to warming winters and changing water levels (USGCRP 2014). However, because of the limited extent of climate change that could occur during the 20-year license renewal term, minority and low-income populations living near Fermi 2 are not expected to experience disproportionately high and adverse impacts from the limited extent of climate change in the environment that could occur during the license renewal term.

4.16 Cumulative Impacts of the Proposed Action

The NRC staff considered potential cumulative impacts in the environmental analysis of continued operation of Fermi 2 during the 20-year license renewal period. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with other past, present, and reasonably foreseeable actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. An impact that may be SMALL by itself possibly could result in a MODERATE or LARGE cumulative impact when it is 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.

For the purposes of this cumulative analysis, past actions are those before the receipt of the license renewal application; present actions are those related to the resources at the time of current operation of the power plant; and future actions are those that are reasonably foreseeable through the end of plant operation, including the period of extended operation. Therefore, the analysis considers potential impacts through the end of the current license terms, as well as the 20-year renewal license term. The geographic area over which past, present, and reasonably foreseeable actions would occur depends on the type of action considered and is described below for each resource area.

To evaluate cumulative impacts, the incremental impacts of the proposed action, as described in Sections 4.2 to 4.15, are combined with other past, present, and reasonably foreseeable future actions regardless of which agency (Federal or non-Federal) or person undertakes such actions. The NRC staff used the information provided in DTE's ER; responses to RAIs; information from other Federal, State, and local agencies; scoping comments; and information gathered during the visits to the Fermi site to identify other past, present, and reasonably foreseeable actions. To be considered in the cumulative analysis, the NRC staff determined whether the project would occur within the noted geographic areas of interest and within the period of extended operation, whether it was reasonably foreseeable, and whether there would be a potential overlapping effect with the proposed project. For past actions, consideration within the cumulative impacts assessment is resource and project specific. In general, the effects of past actions are included in the description of the affected environment in Chapter 3, which serves as the baseline for the cumulative impacts analysis. However, past actions that continue to have an overlapping effect on a resource that potentially could be affected by the proposed action are considered in the cumulative analysis.

Appendix E describes other actions and projects identified during this review and considered in the NRC staff's analysis of the potential cumulative effects. Not all actions or projects listed in Appendix E are considered in each resource area because of the uniqueness of the resource and its geographic area of consideration.

4.16.1 Air Quality and Noise

This section addresses the direct and indirect effects of license renewal on air quality and noise when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. As described in Section 4.3.1, the incremental impacts on air quality and noise levels from the proposed license renewal would be SMALL.

4.16.1.1 Air Quality

The geographic area considered in the cumulative air quality analysis is the County where the proposed action is located as air quality designations for criteria air pollutants are generally made at the County level. The Fermi site is located in Monroe County, Michigan. With regard to the NAAQS criteria pollutants, Monroe County is designated a maintenance area for the 8-hour ozone 1997 standard and the $PM_{2.5}$ 1997 and 2006 standard (EPA 2014e). Counties are further grouped together based on a common airshed—known as an Air Quality Control Region (AQCR)—to provide for the attainment and maintenance of the NAAQS. Monroe County, along with two Counties (Lucas County and Wood County) in the State of Ohio are part of the Metropolitan Toledo Interstate AQCR (40 CFR 81.43).

As noted in Section 3.3.2, the U.S. EPA regulates six criteria pollutants under the NAAQS, including carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and PM. Criteria pollutant air emissions from Fermi 2 are presented in Table 3–5 of Section 3.3.2. No refurbishment-related activities will occur during the license renewal period. However, DTE will be installing generators and pumps at Fermi 2 in response to the NRC's order (Order EA-12-049) (NRC 2012) to maintain or restore core cooling, containment, and spent fuel cooling. DTE has obtained a permit to install (Permit No. 3-14) from MDEQ for these additional air emission sources (DTE 2014c). While not associated with license renewal, operation of this additional equipment will be intermittent for periodic routine testing, similar to current permitted sources at Fermi 2; therefore, additional emissions will be limited and in accordance with the requirements set forth in the air emissions permit. As a result, the NRC staff expects similar emissions during the license renewal period, as presented in Section 3.3.2.

Appendix E provides a list of present and reasonably foreseeable projects that could contribute to cumulative impacts to air quality. Operating projects listed in Appendix E are not anticipated to increase air emissions above their current levels, and most projects are not located in Monroe County and, therefore, are unlikely to contribute to a cumulative impact due to their distance or location. The following existing power plants listed in Appendix E are within Monroe County:

- J.R. Whiting Power Plant and
- Monroe Power Plant.

These facilities are classified as major sources of air emissions (EPA 2014f). The EPA's Enforcement and Compliance History Online database identifies an additional 6 facilities that are major sources and 42 facilities that are minor sources of air emissions in Monroe County

(EPA 2014f). Major sources emit, or have the potential to emit, 10 tons per year of any one HAP, 25 tons per year of any combination of HAPs, or 100 tons per year of any other regulated air contaminant (MDEQ undated). A minor source has a potential to emit air emissions that are less than the threshold levels for a major source (MDEQ 2005). As discussed in section, Fermi 2 is a synthetic minor source because conditions in the facility's air permit restricts emissions below the threshold levels for a major source. A minor source classification typically indicates that the facility has little to no potential for significantly impacting air quality or interfering with plans to achieve compliance with the NAAQS (IEPA 2014). In 2011, J.R. Whiting Power Plant and Monroe Power Plant were responsible for 74, 88, 99, and 69 percent of carbon monoxide, nitrogen oxides, sulfur dioxide and PM_{10} emissions, respectively, in Monroe County. Therefore, J.R. Whiting Power Plant and Monroe Power Plant are the dominant sources that can contribute to air quality impacts. However, J.R. Whiting Power Plant will cease operations in 2016, and Monroe Power Plant is undergoing refurbishment to install controls that will reduce emissions resulting from operation (DTE 2014d). Any new sources of emissions that would be established in Monroe County would be required to apply for an air permit from MDEQ and must be operated in accordance with Federal regulatory requirements. For instance, construction and operation of Fermi 3 can result in an increase in criteria pollutants; air emission sources will be permitted and operated in accordance with State and Federal regulatory requirements. The potential impacts from construction and operation of Fermi 3 on air quality are expected to be SMALL (NRC 2013a).

Climate change can impact air quality as a result of changes in meteorological conditions. Air pollutant concentrations are sensitive to winds, temperature, humidity, and precipitation (EPA 2009a). As discussed in Section 4.15.3.2, ozone levels have been found to be particularly sensitive to climate change influences (EPA 2009b; Solomon et al. 2007). Climate change may make it difficult for regions to meet ozone NAAQS (USGCRP 2009). However, as discussed in Section 4.15.3, although surface temperatures are expected to increase in the Midwest, this increase in temperatures may not necessarily result in an increase in ozone concentrations. Changes in air emission concentrations will depend on the combination of higher temperatures, current levels of ozone, stagnant air masses, sunlight, and emissions of precursors. Furthermore, climate models do not agree on the direction of ozone changes (increase or decrease) in response to climate change for the Midwest (Wu et al. 2008; Tagaris et al. 2009).

Because of the small quantity of emissions from Fermi 2 and no expected emissions increase associated with license renewal, the potential for Fermi 2 to contribute to a cumulative impact with other air pollutant sources is SMALL. The NRC staff concludes that, combined with the emissions from other past, present, and reasonably foreseeable future actions, cumulative impacts on air quality from hazardous and criteria air pollutant emissions from Fermi 2-related actions would be SMALL.

4.16.1.2 Noise

Section 3.3.3 presents a summary of noise sources at Fermi 2 and in the vicinity of the site. Major noise sources at Fermi 2 that are audible beyond the site boundary include the cooling towers, firing range, and transmission lines (DECo 2011).

Noise levels in the vicinity of a nuclear power plant could increase from planned activities associated with urban, industrial, and commercial development. The magnitude of cumulative impacts depends on the nuclear plant's proximity to other noise sources. A 3-dBA change in sound level is considered barely discernible, as discussed in Section 3.3.3. A 3-dBA increase would occur with the placement of another identical source over an existing source (e.g., double the traffic volume). Ongoing or foreseeable future projects in and around the Fermi site, as identified in Appendix E, can increase noise levels only in the vicinity of their noise sources, and combined noise levels are not expected to be high enough to cause noise issues. For instance, construction and operation of Fermi 3 will introduce additional noise sources. However, noise levels are not expected to be greater than current levels surrounding the Fermi site, and impacts on noise are expected to be SMALL (NRC 2013a). Furthermore, as indicated in Appendix E, most of the projects are not located within 1 mi (1.6 km) of Fermi 2. Generally, as distance is doubled from a point source, noise levels decrease by 6 dBA (MPCA 2014). Therefore, noise levels from present and future actions are not anticipated to contribute to noise impacts in the vicinity of Fermi 2. Cumulative impacts on noise environment are expected to be SMALL.

4.16.2 Geology and Soils

This section addresses the direct and indirect effects of license renewal on geology and soils when they are added to the aggregate effects of other past, present, and reasonably foreseeable future actions. As described in Section 4.4.1, the incremental impacts on geology and soils from continued operations of Fermi 2 during the license renewal term would be SMALL. Ongoing operation and maintenance activities at the Fermi site are expected to be confined to previously disturbed areas. Any use of geologic materials, such as aggregates, to support operation and maintenance activities would be procured from local and regional sources. These materials are abundant in the region.

Construction activities for a new reactor (Fermi 3) represent the largest source of potential soil-related environmental impacts on the Fermi site. The site for the new reactor is well defined, and access is restricted. Soil-disturbing activities will be localized to the site and are distant from surrounding populations. Soil erosion will be minimized by adherence to regulations and permits and the use of BMPs (NRC 2013a). In addition, operation of Fermi 3 would not prevent access to economically valuable mineral resources. Geologic materials, such as aggregates and engineered backfill, needed to support construction would be procured from local and regional sources. These materials are abundant in the region.

As described in Section 3.4.2, the local site soils are poorly drained low-lying soils that are in hydrologic communication with Lake Erie. Future changes in climate are unlikely to change the soils or result in changes to site operations that could impact local soils. Geologic conditions are not expected to change during the license renewal term. Thus, activities associated with continued operations are not expected to affect the geologic environment. Considering ongoing activities and reasonably foreseeable actions, the NRC staff concludes that the cumulative impacts on geology and soils during the Fermi 2 license renewal term would be SMALL.

4.16.3 Water Resources

This section addresses the direct and indirect effects of license renewal on surface water and groundwater when they are added to the aggregate effects of other past, present, and reasonably foreseeable future actions.

4.16.3.1 Surface Water Resources

This section addresses the direct and indirect effects of the proposed action (license renewal) on surface water resources when they are added to the aggregate effects of other past, present, and reasonably foreseeable future actions. As described in Section 4.5.1.1, the incremental impacts on surface water resources from continued operations of Fermi 2 during the license renewal term would be SMALL. The NRC staff has also evaluated other projects and actions for consideration in determining their cumulative impacts on surface water resources (Table E–1 in Appendix E).

The description of the affected environment in Section 3.5.1 serves as the baseline for the cumulative impacts assessment for surface water resources. The geographic area of analysis considered for the surface water resources component of the cumulative impacts analysis comprises the western basin of Lake Erie and further focuses on a 15-mi (24-km) radius surrounding Fermi 2's intake and discharge structures. As such, this review focused on those projects and activities that would withdraw water from, or discharge effluent to, the western basin of Lake Erie and to its connecting waterways. The cumulative impacts on surface water use and quality, along with associated climate change considerations, are presented below.

Water Use Considerations

The Great Lakes Commission (GLC), in partnership with the Great Lakes–St. Lawrence River Basin Water Resources Council and its Regional Body, maintains a regional water use tracking and reporting database (the Great Lakes–St. Lawrence River Regional Water Use Database) that provides comparable water use information on withdrawals, diversions, and consumptive uses.

The GLC issues annual water use reports with information summarized by jurisdiction and lake watershed based on data collected and reported by the states and provinces. The energy sector is the largest water user in the Great Lakes Basin region, most significantly for thermoelectric power generation followed by public water supply. This excludes in-stream water use for hydroelectric power generation, which is not considered a water withdrawal use or potential consumptive use. This usage pattern is true for the Lake Erie watershed as well (GLC 2014a).

In 2013, the GLC prepared an interim cumulative impact assessment for the period of 2006 to 2012. The assessment was prepared as required by the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement and Compact and focused on hydrologic effects of consumptive uses and water diversion losses within individual watersheds and the basin as a whole. For each watershed, total diversion losses and consumptive uses are compared to the average water budget for the watershed. This provides a net accounting of water flows into and out of the watershed. In the GLC's assessment, all flows are reported in cubic feet per second rather than in million gallons per day to facilitate comparisons. In summary, the latest assessment indicates that the net effect of consumptive uses and diversion losses was positive over the timeframe (i.e., more water was diverted into the Great Lakes–St. Lawrence River Basin as a whole than the total combined amount of water diverted out of the basin or withdrawn and not returned). Furthermore, consumptive use and diversion losses remained very small relative to the total inflow to the basin, with inflows encompassing estimated precipitation, surface runoff, diversions into the watershed, and channel flow into the watershed. Specific to the Lake Erie watershed, the hydrologic effect of annualized consumptive uses and diversions was also found to be small relative to inflows. For the 2006 to 2010 period, the annual average percentage of inflow consumptively used or diverted remained relatively steady between about 3.9 and 4.3 percent. The estimated net volume of consumptive uses and diversion losses showed an increase from 2010 to 2011 (from 4.3 to 4.8 percent of the water withdrawn) followed by a decrease from 2011 to 2012 (4.8 to 4.3 percent) (GLC 2014a); this trend was evident for 2013, as further discussed below.

Based on the latest available data for 2013, reported water withdrawals from the entire Lake Erie watershed totaled 51,623 mgd. Consumptive uses totaled 444.94 mgd and intra-basin diversions to Lake Ontario through the Welland Canal totaled 4,936.34 mgd. This represents a total loss from the watershed of about 3.40 percent in 2013 as compared to the estimated annual average inflow of 244,739 cfs (6,914 m^3/s or 158,202 mgd) (GLC 2014a, 2014b). However, although the water conveyed through the Welland Canal is lost from Lake Erie, it is not lost to the Great Lakes Basin as a whole. By comparison, of the total water withdrawn from the Michigan portion of the Lake Erie watershed, facilities in Michigan withdrew 5,012 mgd of water with a consumptive use of 191.5 mgd, which is 3.8 percent of the total volume withdrawn (Table 4–22). Demands by the largest water use sectors include 3,885.15 mgd for thermoelectric power production (once-through cooling), 620.54 mgd for public water supply, 441.06 mgd for industrial use, and 48.15 mgd for thermoelectric power production (recirculated cooling).

It should be noted that substantial uncertainty exists in drawing definitive conclusions from these data, particularly on larger scales. As previously noted in Section 3.5.1.1 of this SEIS, there is inherent uncertainty in calculating Lake Erie's water balance with respect to watershed inflows and outflows, including in the estimates of consumptive use by specific entities and across water use sectors. For example, it is estimated that the uncertainty associated with estimated inflow and outflow data is larger than the total consumptive use for the basin. In addition, the reporting jurisdictions implemented new water use data collection and reporting protocols beginning with the 2012 water use data. Any changes, such as in consumptive water use, may in fact reflect improvements in data quality along with other factors (GLC 2014a). For the purposes of this cumulative impacts assessment, the information and comparisons pertaining to the Michigan portion of the Lake Erie watershed (western basin) are the most relevant and insightful.

Table 4–22. Cumulative Surface Water Withdrawals from the Michigan Portion of the Lake Erie Watershed by Water Use Sector (2013)

Water Use Sector	Withdrawals (mgd)	Consumptive Use (mgd)[(a)] (% Consumptive Use)
Public water supply	620.54	77.57 (12)
Commercial/institutional	0.15	0.02 (13)
Irrigation	15.07	13.56 (90)
Livestock	0.15	0.12 (80)
Industrial	441.06	44.11 (10)
Thermoelectric power (Once-through cooling)	3,885.15	37.23 (1)
Thermoelectric power (Recirculated cooling)	48.15	18.89 (39)
Off-stream hydroelectric power	0.0	0.0
In-stream hydroelectric	0.0	0.0
Other	2.24	0.0
Total	5,012.5	191.5 (3.8)

Note: Michigan reported no diversions of water out of the Lake Erie watershed in 2013.

(a) Some values are rounded. To convert million gallons per day (mgd) to million cubic meters (m^3), divide by 264.2. To convert million gallons per day to cubic feet per second (cfs), multiply by 1.547.

Source: GLC 2014b

DTE's Monroe Power Plant, with a generation capacity of 3,280 MWe, is the single largest user of water from the western basin of Lake Erie. The Monroe Power Plant's makeup water demand averages 1,550 mgd, primarily for once-through condenser cooling, with cooling and associated wastewater return discharges of 1,546 mgd (MDEQ 2015a), which indicates a consumptive use of less than 1 percent. The Monroe Power Plant illustrates a very high water withdrawal rate coupled with very low consumptive use, which is typical of power plants using once-through cooling (as indicated in Table 4–22). Table 4–22 also represents other power plants using once-through cooling and withdrawing water from the western basin of Lake Erie, including the J.R. Whiting Power Plant, the Trenton Channel Power Plant, and the Bayshore Power Plant. (See Table E–1 in Appendix E for additional information on these facilities.) All these power plants withdraw cooling water from, and discharge heated effluent into, the western basin of Lake Erie (NRC 2013a). The combined water demands for once-through cooling accounted for 78 percent of the total volume of water withdrawn from the Michigan portion of the Lake Erie watershed in 2013 and accounted for 19 percent of the total volume of water used consumptively. However, the J.R. Whiting Power Plant is scheduled to be shut down by the end of 2016, and the Trenton Channel Power Plant will have all but one generating unit retired by then. Meanwhile, the Monroe Power Plant is undergoing a major refurbishment and is projected to stay in operation into the license renewal term for Fermi 2. The shuttering of generation capacity at the J.R. Whiting Power Plant and Trenton Channel Power Plant will result in a substantial reduction in cooling water makeup demand and return wastewater discharge on the western basin of Lake Erie.

Surface water withdrawals for the public water supply represent the second largest user of the western basin's waters (Table 4–22). The two public water providers within the geographic area of analysis include Frenchtown Township and the City of Monroe. The Frenchtown Township Water Department has a supply capacity of 8 mgd and current demands of approximately 4 mgd. Frenchtown Township withdraws water from Lake Erie via an intake located south of the Fermi site at Pointe Aux Peaux that it shares with the City of Monroe. The City of Monroe's water filtration plant has a water supply and treatment capacity of 18 mgd and a current demand of approximately 8 mgd (NRC 2013a). Although Table 4–22 indicates a consumptive use rate of approximately 12 percent for the public water supply sector, some of the reported consumptive use may otherwise be returned to the western basin as treated sanitary effluent from one of the several publicly owned treatment works in the region (Table E–1 listing in Appendix E).

Other than for power generation, surface water demands for various other industrial uses (as summarized in Table E–1 in Appendix E) reflect the developed nature of the western basin of Lake Erie. As shown in Table 4–22, the reported consumptive use rate of these general industry users is about 10 percent.

Fermi 2, a closed-cycle (recirculated cooling) power plant, is also represented in Table 4–22; it accounts for withdrawals totaling 48.15 mgd with consumptive use of 18.9 mgd (about 40 percent of the total reported withdrawal). Fermi 2 has a power generation capacity of about one-third that of DTE's Monroe Power Plant. As compared to the Monroe Power Plant, Fermi 2 demonstrates not only the relatively low cooling water makeup water demands for closed-cycle power plants as compared to those for once-through plants but also their substantially higher consumptive water use necessary to ensure optimal cooling of return water. Over the past 5 years, Fermi 2's reported surface water withdrawals have averaged approximately 52.3 mgd. Return discharges to Lake Erie have averaged 32.9 mgd, which represents a consumptive use rate averaging 37 percent or about 19 mgd (Section 3.5.1.2 of this SEIS). As documented in NUREG–2105 (NRC 2013a), the proposed Fermi 3 nuclear power plant would withdraw an average of 28,993 gpm of lake water (equivalent to 41.7 mgd) with consumptive use of about 14,488 gpm (20.8 mgd), which reflects a consumptive use rate of about 50 percent. Fermi 3 would also use approximately 35 gpm (0.05 mgd) of potable water supplied by the Frenchtown Township Water Department. The NRC previously concluded that Fermi 3's incremental water withdrawal and consumptive use would have a SMALL impact on surface water resources in

Lake Erie because of the minor change in lake water availability and no measurable effect on other industrial and public water supply users with no mitigation required (NRC 2013a).

Fermi 2 and Fermi 3 combined would withdrawal an annual average of up to 94 mgd of water from the western basin of Lake Erie with consumptive use of approximately 40 mgd, which reflects a consumptive use rate of about 42 percent. These combined water withdrawals and consumptive uses would equate to 1.9 and 21 percent of the current total withdrawals and consumptive water use, respectively, from the Michigan portion of the Lake Erie watershed, as summarized in Table 4–22. This consumptive use is extremely small compared to the volume of Lake Erie (about 128 trillion gal (0.48 trillion m^3)), as well as only about 0.03 percent of the average daily volume of water (i.e., about 133,300 mgd) that naturally outflows from Lake Erie to Lake Ontario through the Niagara River.

Nevertheless, the Lake Erie watershed is home to over 12.5 million people, which is more than one-third of the entire population of the Great Lakes Basin (GLC 2014a); the population is expected to grow along with associated water demands. In predicting future water demands relative to the construction and operation of proposed Fermi 3, the NRC relied on projections that the population within a 50-mi (80-km) radius of the Fermi site could increase by as much as 40 percent by 2060 (NRC 2013a). This projection used year 2000 data as a baseline year. The growth that has, in fact, occurred has been more modest (Section 3.10 of this SEIS); Table 4–22 presents the actual available water use data for this growth. More recent data from DTE (2014a) indicate that the region's population (50-mi (80-km) radius) may grow by about 5 percent between 2010 and 2045. Similarly, projections from the Southeast Michigan Council of Governments, reported by the Monroe County Planning Department and Commission (2010), forecast growth of 3.4 percent in southeast Michigan by 2035, with about an 11-percent growth in Monroe County where the Fermi site is located.

Any growth would partially overlap with the proposed period of continued operations for Fermi 2 (2025 to 2045) and operation of Fermi 3, if constructed. Assuming that the population growth will be 40 percent and that its demand has a direct and equal correlation across the water use sectors identified in Table 4–22, total annualized water withdrawals from the Michigan portion of the Lake Erie watershed could be as much as 7,018 mgd with a consumptive use of approximately 268 mgd. These growth-induced water demands would far eclipse operational water demands associated with the continued operations of Fermi 2 combined with those associated with the proposed Fermi 3. This scenario could have implications for regional water supply infrastructure and could potentially affect water supply availability. However, increases in water demand proportional to the more modest growth projections of around 5 to 10 percent could produce total annualized water withdrawals of as much as 5,514 mgd with a consumptive use of approximately 211 mgd. Such a modest increase in demand could likely be accommodated through routine infrastructure planning and upgrades without any measurable adverse impacts on water supply availability. The contribution of Fermi 2's consumptive water use (averaging 19 mgd) would continue to be a relatively small percentage (about 9 percent) of consumptive use in the western basin during the license renewal term.

With respect to water use regulation under the Compact, any water withdrawals within the Great Lakes Basin, including those within the State of Michigan that would result in a new or increased consumptive use of 5 mgd (18,925 m^3/day) are subject to review by all the Compact members. Fermi 3 and other new or increased consumptive water uses would be subject to such a review. The MDEQ has established a water withdrawal permitting program to meet the consumptive use and water diversion requirements of the Compact (Section 3.5.1.2). As a result, water use regulation undertaken by the Compact members would be expected to ensure that water withdrawals and consumptive water uses are managed to support the beneficial uses and safe yield of Lake Erie waters.

Water Quality Considerations

Ambient water quality of the western basin of Lake Erie is the product of past and present activities (e.g., water withdrawal, effluent discharges, and accidental spills and releases) associated with urban development, industrial and commercial development, agricultural practices, and shoreline development and waterway maintenance and improvement projects (e.g., dredging) within the Lake Erie watershed. Hartig et al. (2007) noted that nearly 40 years of U.S. and Canadian pollution prevention and control efforts have led to substantial improvements in overall resource and water quality in the western basin of Lake Erie. These improvements have included reductions in oil, phosphorus, chloride, and untreated waste from combined sewer overflow discharges; declines in contaminants in fish and wildlife; and substantial progress in remediating contaminated sediment. Nonetheless, the following water quality-related challenges remain: (1) population growth and accompany land use changes, (2) nonpoint pollutant sources, (3) toxic substances, (4) degradation and loss of habitat, (5) introduction of exotic species, and (6) GHGs (Hartig et al. 2007). In addition, the EPA's Great Lakes National Program Office has initiated the Great Lakes Restoration Initiative program, a consortium of 11 Federal agencies that developed an action plan to address environmental issues. These issues fall into five areas: (1) cleaning up toxins and areas of concern, (2) combating invasive species, (3) promoting nearshore health by protecting watersheds from polluted runoff, (4) restoring wetlands and other habitats, and (5) tracking progress and working with strategic partners. The results of this long-term initiative are aimed at addressing water quality concerns in Lake Erie (NRC 2013a).

Development projects can result in water quality impacts if they increase sediment loading to nearby surface water bodies. The magnitude of cumulative impacts would depend on the nature and location of the actions relative to surface water bodies; the number of actions (e.g., facilities or projects); and whether facilities comply with regulating agency requirements (e.g., land use restrictions, habitat avoidance and restoration requirements, stormwater management, and wastewater discharge limits). Table E–1 in Appendix E of this SEIS identifies a number of ongoing and reasonably foreseeable future actions. However, in accordance with the Compact (Section 3.5.1.2 of this SEIS), the State of Michigan and its partners are charged with enacting and administering laws necessary to protect the waters of the Great Lakes Basin. Wastewater discharges from existing and new and modified industrial and large commercial facilities would be subject to regulation under the Federal Water Pollution Control Act of 1972, as amended (the current CWA) (33 U.S.C. 1251 et seq.). Across a particular watershed, Section 303(d) of the Federal CWA requires states to identify all "impaired" waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards and to establish total maximum daily loads to ensure future compliance with water quality standards. On an individual facility basis, State-administered NPDES permits issued under Section 402 of the CWA set limits on wastewater, stormwater, and other point source discharges to surface waters. Ongoing cooling and associated wastewater discharges from Fermi 2, which are subject to a Michigan-issued NPDES permit (Section 3.5.1.3 of this SEIS), are a very small contributor to the pollutant and thermal loading to Lake Erie. Discharges from the proposed Fermi 3 plant would likewise be subject to NPDES permit requirements, which would effectively limit the facility's chemical and thermal contributions to Lake Erie in accordance with Michigan's water quality-based effluent limitations. In summary, a substantial regulatory framework exists to address current and potential future sources of water quality degradation within the Great Lakes Basin while addressing legacy issues.

Climate Change Considerations

The NRC staff also considered the USGCRP's most recent compilations of the state of knowledge relative to global climate change effects (USGCRP 2009, 2014). As detailed in Section 4.15.3.2 of this SEIS, an increase in average temperatures in Michigan has been observed, and climate models project continued warming in the Midwest region during the license renewal period. This warming coupled with predicted changes in the timing, intensity, and distribution of precipitation, which have already been observed, would have implications for surface water availability in the western basin of Lake Erie and ambient water quality.

In the NUREG–2105 prepared for the Fermi 3 COL review (NRC 2013a), the NRC staff projected that water levels could decrease by up to 1.5 ft (0.5 m) by about 2050 to 2060 because of rising lake water temperatures, resulting in the reduction of the volume of Lake Erie by 2 percent. This decrease in lake water levels, in turn, would measurably reduce its storage volume from an estimated 128 trillion gal (0.48 trillion m^3) of water to 125 trillion gal (0.47 trillion m^3) (annualized as 342,466 mgd). Assuming a linear correlation between volumetric loss in Lake Erie and outflow from Lake Erie to Lake Ontario (excluding the Welland Canal diversion), this projected loss would reduce natural outflow via the Niagara River from about 206,202 cfs (5,825 m^3/s or 133,292 mgd) to 202,078 cfs (5,798 m^3/s or 130,626 mgd). Under this possible scenario, Fermi 2 and Fermi 3's combined consumptive use of 40 mgd would remain a very small percentage (i.e., 0.01 percent) of the annualized volume of Lake Erie and about 0.03 percent of the average daily volume of water that would drain from Lake Erie to Lake Ontario. On a cumulative basis, the projected future consumptive water use (211 mgd, given a 10-percent population growth) for all users withdrawing water from the Michigan portion of the western basin of Lake Erie would equate to 0.06 percent of the annualized volume of Lake Erie and approximately 0.16 percent of the average daily volume of water that would drain from Lake Erie to Lake Ontario.

Nevertheless, the analysis (NRC 2013a) was based on the USGCRP's report (USGCRP 2009) and companion studies that predicted greater temperature and associated lake level impacts (i.e., a 1.5-ft (0.5-m) decline) under the highest emissions scenario. Although great uncertainty persists with respect to regional warming, future precipitation patterns, and related factors, the latest projections indicate that Lake Erie surface water temperatures could increase by 2.8 to 5.7 °F (1.6 to 3.2 °C) under a low-emission-modeled scenario and 2.7 to 7.0 °F (1.5° C to 3.9 °C) under a high-emission-modeled scenario by 2050. This projection is driven by increased evaporative losses despite the increases in the frequency and intensity of extreme (heavy) precipitation across the region. Furthermore, annual mean water levels for Lake Erie are projected to be below historical levels, with the potential for average water levels to decrease by 7.8 to 9.8 in. (20 to 25 cm) as compared to the current long-term mean by 2050 (Mackey 2012). As a result, the volumetric loss in Lake Erie may be lower than that presented by NUREG–2105 (NRC 2013a).

Climate change is projected to increase water demand across most of the United States. However, when accounting for changes in proposed population coupled with predicted climate change impacts, current projections indicate that southern regions of Michigan (where Fermi 2 is located) will not experience increases in water demand; conversely, northern areas of Michigan may experience an increase of up to 10 percent attributable to climate change (USGCRP 2014, Figure 3.11).

As for direct water quality implications, higher temperatures and increased runoff associated with heavy precipitation events would impact the near-shore thermal regime of Lake Erie along with increases in runoff laden with nutrients, sediment, and other contaminants. More specifically, higher surface water temperatures decrease the cooling efficiency of thermoelectric power generating facilities and plant capacity because of the need to reduce the discharge of thermal effluent (USGCRP 2014). As intake water temperatures warm, cooling water makeup requirements increase. Degraded surface water quality also increases the costs of water treatment for both industrial cooling water and potable water because of the need for increased filtration and higher additions of chemical treatments, including for disinfection. Power plants, other industrial interests, and public water supply facilities would have to account for such changes in operational practices and procedures and perhaps would require investment in additional infrastructure and capacity. Specific to Fermi 2 and the proposed Fermi 3, the warming of lake waters would lead to an increase in the average monthly use of cooling water and would result in a slightly larger volume of heated water discharged back to the lake, along with an increase in the size of their thermal plumes and associated mixing zones (NRC 2013a). As previously indicated, thermal and chemical discharges would be required to meet applicable NPDES permit requirements under the Federal CWA, local and regional health standards, and total maximum daily loads imposed by the State of Michigan. Such provisions would also apply in other states where the pollutant sources reside within their jurisdiction.

In summary, the waters of Lake Erie are extensively used, and the region has surface water planning, allocation, related environmental quality improvement, and development systems and programs in place to manage the use of the surface water resources of the Great Lakes Basin as a whole. The withdrawal of surface water and associated consumptive water use to support Fermi 2 operations have a very small impact on the availability of surface water, and the discharge of cooling and associated wastewater in accordance with NPDES permit provisions is a very small contributor to the pollutant and thermal loading to Lake Erie. Consumptive water use by continued operations of Fermi 2, combined with consumptive use by other present and potential future users in the western basin of Lake Erie, will continue to be a very small percentage of the annualized volume of Lake Erie and of the average daily volume of water that drains from Lake Erie to Lake Ontario. Furthermore, it is reasonable to assume that water quality-based effluent limits imposed by NPDES permits on cooling water, wastewater, and stormwater discharges and similar limits on sources of development, agricultural, and urban runoff will continue to maintain or improve ambient surface water quality across the western basin of Lake Erie.

Based on this evaluation, the NRC staff concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions and trends on surface water resources during the license renewal term would be SMALL to MODERATE. A SMALL impact would be expected under the condition of minimal climate change associated with the lowest emissions scenario and lower population growth and development. A MODERATE impact would be expected under the highest emissions scenario, which is expected to produce the highest increases in air and water temperatures, and higher population growth and development. Projected increases in air and water temperature combined with water supply and treatment demands could noticeably alter water levels and affect near-shore water quality, but the impacts are not expected to destabilize the dependent resources and the surrounding environment. This conclusion is based, in part, on consideration of the cooperative planning and regulatory framework established by the regional and international partners under the Compact and the 2005 Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement.

4.16.3.2 Groundwater Resources

This section addresses the direct and indirect effects of license renewal on groundwater use and quality when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. In 2013, the NRC published a final EIS that considered the cumulative impacts of the continued operation of Fermi 2 and the construction and operation of a new reactor (Fermi 3) at the Fermi site. This evaluation concluded that the cumulative impacts of preconstruction, construction, and operation of the proposed new reactor and the continued operation of Fermi 2 on groundwater resources would be SMALL (NRC 2013a).

Laterally, the geographic area of interest is considered to be the area within 15 mi (24 km) of the Fermi site and vertically to be the unconsolidated material beneath the Fermi site and the Bass Islands Group aquifer. From a local standpoint, changes within the unconsolidated material would not affect any other groundwater users. From a regional standpoint, the Bass Islands Group aquifer is tapped for public water supply, industrial use, thermoelectric power generation, agricultural irrigation, golf course irrigation, and dewatering for quarry mining operations. In Monroe County, only a small percentage (0.59 percent) of the total water use in 2004 was from groundwater. Of that amount, approximately 1.6 percent was used for public water, and 82.5 percent was used to supply industrial facilities (MDEQ 2015b). Groundwater elevations in the vicinity of the Fermi site have declined between 10 and 15 ft (3 to 4.6 m) since the early 1990s as a result of dewatering from offsite quarry operations elsewhere in Monroe County. It is estimated that by 2060, total freshwater groundwater withdrawals in Monroe County would increase from about 28 mgd in 2000 to 49 mgd (106,000 to185,000 m^3/d) (NRC 2013a).

For the proposed Fermi 3 reactor, preconstruction and construction dewatering operations would temporarily lower groundwater levels in the vicinity of the Fermi site. However, the wetlands on and around the site are expected to be unaffected because they are hydraulically connected to Lake Erie. Because of their low yield and spatial discontinuity, the unconsolidated sediments are not used or likely to be used in the future as a source of groundwater at the Fermi site or the area immediately surrounding the site. The unconsolidated sediments are in direct contact with Lake Erie in many places. Slurry walls will be in place around the dewatering operation to limit groundwater inflows from the unconsolidated sediments into building excavations. Consequently, it is unlikely that there would be a noticeable drawdown in unconsolidated sediments outside the new reactor construction area.

To construct the new reactor, dewatering wells for building excavations will only pump groundwater from the Bass Islands Group aquifer. Groundwater wells that could be affected by drawdown from dewatering during the building of Fermi 3 are nearby residential/private wells, irrigation wells, and other wells that extract water from the Bass Islands Group aquifer. It is estimated that, at a distance of 1.5 mi (2.4 km) from the Fermi site, water levels in the Bass Islands Group aquifer would at most be lowered by 1 ft (0.3 m) below current water levels. According to groundwater modeling scenarios, the offsite well with the highest amount of projected drawdown is a domestic water supply well located about 3,800 ft (1,158 m) from the center of the Fermi 3 reactor power block area where drawdown would be up to 2 ft (0.6 m) (NRC 2013a).

The proposed Fermi 3 reactor and the existing Fermi 2 reactor would not use groundwater for operations. There would be no discharges to groundwater from either reactor. Temporary dewatering operations during preconstruction and construction activities for the proposed new reactor would have limited spatial effect and would not affect the overall productivity of the Bass Islands Group aquifer. Operations of the existing and proposed new reactor are not expected to impact the quality of groundwater in any aquifers that are a current or potential future source of water for offsite users.

As discussed in Section 4.15.3.2, increased precipitation in the fall, winter, and spring is likely to result in increased groundwater recharge. Precipitation falling in the fall, winter, and spring would experience lower evaporation and transpiration rates (as opposed to the summer), and more water would percolate into the ground and down to the water table. Furthermore, a portion of the winter precipitation would fall as snow. Instead of running off the land, much of the snow is likely to slowly melt in place and contribute to groundwater recharge.

Groundwater supplies near the site are not likely to be impacted by future climate change. Local aquifers under the site are in hydrologic communication with Lake Erie. If groundwater levels in the local aquifers rise, more water will be discharged by these aquifers to Lake Erie. Alternatively, should groundwater levels in the local aquifers decrease, more water would flow from the lake into the local aquifers. Any future climate impacts on Lake Erie water levels are not anticipated to change this natural rhythm. Figure 3–13 in Section 3.5.2.1 illustrates the phenomenon, which shows groundwater flowing from Lake Erie as a result of quarry dewatering activities and groundwater flowing into the lake in those areas that are not impacted by dewatering activities.

The Fermi site does not use groundwater. Future climatic changes should not result in changes to site operations. There should not be any increased impacts to the availability and quality of groundwater resources.

Considering ongoing activities and reasonably foreseeable actions, the NRC staff concludes that the cumulative impacts on groundwater use and quality during the Fermi license renewal term would be SMALL.

4.16.4 Terrestrial Resources

This section addresses the direct and indirect effects of license renewal on terrestrial resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. Section 4.6 of this SEIS finds that the direct and indirect impacts on terrestrial resources from the proposed license renewal when considered in the absence of the aggregate effects would be SMALL. The cumulative impact is the total effect on terrestrial resources of all actions taken, no matter who has taken the actions (the second principle of cumulative effects analysis in CEQ 1997).

Two related concepts bound the analysis of cumulative impacts: (1) the timeframe and (2) geographic extent. The timeframe for cumulative analyses for ecological resources extends far enough into the past to understand the processes that affect the present resource conditions and to examine whether and why terrestrial resources are stable or unstable, which the NRC's definitions of impact levels require. The timeframe for cumulative impact analysis is more extensive than that for the direct and indirect impact analysis.

The geographic extent considered in this cumulative terrestrial resource analysis depends on the particular cumulative impacts being discussed. Direct and indirect impacts from Fermi 2 operation are largely limited to the Fermi site and immediate vicinity. However, projects or actions located beyond this geographic area could directly or indirectly affect terrestrial resources in this area. This section focuses on the cumulative effects of such actions.

The level of cumulative impacts is measured against a baseline. Consistent with other Federal agencies' and the Council on Environmental Quality's (CEQ 1997) NEPA guidance, the term "baseline" pertains to the condition of the resource without the action (i.e., under the no-action alternative). Under the no-action alternative, the plant would shut down, and the resource would conceptually return to its condition without the plant (which is not necessarily the same as the condition before the plant was constructed). The baseline, or benchmark, for assessing cumulative impacts on terrestrial resources takes into account the preoperational environment as recommended by EPA (1999) for its review of NEPA documents.

Past Development and Habitat Alteration

As discussed in Section 3.6, the Fermi site was partially disturbed during construction of Fermi 2. Of the site's 1260 ac (510 ha), 212 ac (86 ha) were permanently converted for industrial use to support the decommissioned Fermi 1 and Fermi 2 buildings and infrastructure. A series of quarry lakes were formed when water filled abandoned rock quarries that were created during construction, which further reduced the site's terrestrial habitat. Much of the land was also graded to raise the site elevation, which temporarily destroyed existing terrestrial habitats. Scattered stumps in forested tracts along the southern edge of the site indicate that the site was likely logged before Fermi 2 construction (DTE 2014a). Many of the site's natural areas have since recovered from these activities but may not have the species diversity or richness they once contained. Green ash (*Fraxinus pennsylvanica*) was formerly common within the site's forests before the emerald ash borer (*Agrilus planipennis*), an invasive beetle, killed most of the ash trees on the site (DTE 2014a). Other areas of the site, such as the land managed by the FWS as part of the DRIWR, has remained unaltered.

In the broader area—the Southern Lower Peninsula within the Maumee Lake Plain Level IV Ecoregion—native tallgrass prairies, wetlands, and floodplain forests have been converted to agricultural and urban land, which now account for the major land use types (MDNR 2006a). Habitat loss, in general, can negatively affect breeding success, dispersal success, predation rate, and other animal behaviors (Fahrig 2003). Habitat fragmentation (the breaking up of a larger area of habitat into smaller patches of smaller total area) can also negatively affect terrestrial biota. In a study of breeding bird communities in 24 Illinois grassland fragments, Herkert (1994) found that fragmentation was likely a factor in Midwestern grassland bird population declines. A study conducted in 2012 on the partridge pea (*Chamaecrista fasciculata*) (Mannouris and Byers 2013) concludes that native prairie plant species that occur in smaller, isolated prairie fragments are likely to suffer a reduction in genetic fitness. The Michigan Department of Natural Resources (MDNR 2006a) reports that almost all of the original tallgrass and wet prairies have been converted to farmland, and most of the oak savannahs in the State have been eliminated or converted to closed-canopy forest due to fire suppression. Accordingly, remaining native populations in these habitats are likely to suffer from reduced genetic fitness, which is further exacerbated by fragmentation.

Energy Production and Development

One nuclear power plant site with one operating reactor (Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse)) lies within 50 mi (80 km) of the Fermi site. Because the effects of this facility would primarily be limited to the terrestrial resources on the Davis-Besse site and immediate vicinity, the operation of Davis-Besse during the proposed Fermi 2 license renewal term would not result in cumulative effects to the terrestrial resources affected by Fermi 2 operation.

The construction and operation of Fermi 3, a proposed new nuclear plant on the Fermi site, could result in cumulative impacts on terrestrial resources during the license renewal term. The NRC (2013a) has previously concluded that the impacts of construction and operation of Fermi 3 on terrestrial resources would be SMALL to MODERATE (with MODERATE impacts limited to the eastern fox snake). These impacts would primarily result from construction-related loss or disturbance of upland and wetland habitat and associated plant and animal species on site and along transmission line corridors (NRC 2013a). Construction would also necessitate DTE (2014c) to modify its cooperative agreement with the FWS for management of the DRIWR to allow for temporary construction buildings and laydown area and construction of permanent site access roads and a meteorological tower. Proposed wetland and wildlife habitat mitigation would offset some impacts, including those potential impacts to the eastern fox snake

(State-listed as threatened) and its habitat (NRC 2013a). Fermi 3 operational impacts would be similar to those discussed in Section 4.6.1 for the proposed license renewal of Fermi 2.

Decommissioning activities associated with Fermi 1, which terminated operations in 1972, would likely be confined to the developed portion of the Fermi site and would not result in noticeable cumulative effects to the terrestrial environment.

Five coal-fired energy facilities occur in the region (Table E–1 in Appendix E) and vary in proximity from 6 mi (10 km) to 26 mi (42 km) from the Fermi site. An additional natural gas-fired facility, Oregon Clean Energy Center, is under construction, and other coal and gas energy projects may arise over the proposed license renewal term. Air emissions from these facilities include GHGs, such as nitrogen oxides, carbon dioxide, and methane, all of which can have far-reaching consequences because they cumulatively contribute to climate change. The effects of climate change on terrestrial resources are discussed in Section 4.15.3.2.

<u>Development, Urbanization, and Habitat Fragmentation</u>

As the region surrounding the Fermi site becomes more developed, habitat fragmentation will increase and the amount of forested, prairie, and wetland habitat is likely to decline further. Transmission lines and associated corridors established to connect Fermi 2 and other energy-producing facilities to the regional electric grid represent past habitat fragmentation because some of the corridors split otherwise continuous tracts of habitat. Construction of transmission lines associated with new energy projects may also result in habitat fragmentation if the lines are not collocated within existing corridors or sited within previously developed areas. Edge species that prefer open or partially open habitats will likely benefit from the fragmentation, whereas species that require interior forest or wetland habitat will likely suffer.

Continued urbanization in the future will likely include construction of additional housing units and associated commercial buildings; roads, bridges, and rail; and water or wastewater treatment and distribution facilities and associated pipelines. Increased development will likely decrease the overall availability and quality of terrestrial habitats. Species that require larger ranges, especially predators, will likely suffer reductions in their populations. Similarly, species with threatened or endangered Federal or State status or otherwise declining populations would be more sensitive to declines in habitat availability and quality. Native prairie plants will likely continue to experience reductions in genetic fitness, as previously discussed.

<u>Wildlife Refuges, State Parks, and Recreational Areas</u>

A number of wildlife refuges, State parks, and recreational areas located near Fermi 2 (Table–1 in Appendix E) provide valuable habitat to native wildlife, migratory birds, and protected terrestrial species and habitats. As fragmentation and land use changes continue, these protected areas will become ecologically more important because they provide large, uninterrupted areas of minimally disturbed habitat. The DRIWR, which comprises nearly 6,000 ac (2,400 ha) of coastal wetlands, marshes, shoals, waterfront lands, and islands along 48 shoreline miles (77 km) along the lower Detroit River and western shore of Lake Erie, provides particularly high-quality habitat to many species of native wildlife and migrating birds.

As discussed in Sections 3.2 and 3.6.5.2, the Lagoona Beach Unit of the DRIWR is managed by the FWS through a cooperative agreement between DTE and the FWS that the parties entered into in 2003. DTE intends to maintain the cooperative agreement with the FWS for management of the DRIWR Lagoona Beach Unit throughout the proposed license renewal term. However, if Fermi 3 is built, modifications to the agreement, which are discussed above under the section entitled, “Energy Production and Development,” would be made that could result in temporary and permanent reductions in terrestrial habitat.

4.16.4.1 Conclusion

NRC staff concludes that the cumulative impacts on terrestrial resources in the vicinity of the Fermi site are MODERATE to LARGE based on past, present, and reasonably foreseeable future actions. This level of impact is primarily the result of past habitat alteration and loss on the Fermi site and within the larger Maumee Lake Plain Level IV Ecoregion. The environmental effects of these actions are clearly noticeable and have destabilized important attributes of certain terrestrial communities. The loss of genetic fitness of native prairie species and the loss of tallgrass prairies, wet prairies, and oak savannahs are demonstrative of such effects. The incremental, site-specific impact from the continued operation of Fermi 2 during the license renewal period would be an unnoticeable or minor contributor to cumulative impacts on terrestrial resources.

4.16.5 Aquatic Resources

This section addresses the direct and indirect effects of license renewal on aquatic resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative aquatic resources analysis includes the western basin of Lake Erie, along which the Fermi site is located.

Consistent with NEPA guidance from other agencies and the CEQ (1997), the term “baseline” pertains to the condition of the resource without the action (i.e., under the no-action alternative). Under the no-action alternative, the plant would shut down, and the resource would conceptually return to its condition without the plant (which is not necessarily the same as the condition before the plant was constructed). The baseline, or benchmark, for assessing cumulative impacts on aquatic resources takes into account the preoperational environment as recommended by EPA (1999) for its review of NEPA documents.

Designating existing environmental conditions as benchmark may focus the environmental impact assessment too narrowly, thus overlooking cumulative impacts of past and present actions or limiting assessment to the proposed action and future actions. For example, if the current environmental condition were to serve as the condition for assessing the impacts of relicensing a dam, the analysis would only identify the marginal environmental changes between the continued operation of the dam and the existing degraded state of the environment. In this hypothetical case, the affected environment has been seriously degraded for more than 50 years with accompanying declines in flows, reductions in fish stocks, habitat loss, and disruption of hydrologic functions. If the assessment took into account the full extent of continued impacts, the significance of the continued operation would more accurately express the state of the environment and thereby better predict the consequences of relicensing the dam.

Other power plants that affect or may affect the aquatic resources near the Fermi site include the Monroe Power Plant and the proposed Fermi 3 nuclear generating station that would be built on the Fermi site. The Monroe Power Plant is a coal-fired power plant that is also located in Monroe, Michigan, on the western shore of Lake Erie 6 miles (10 km) southwest of the Fermi site. It is owned by DTE, a subsidiary of DTE Energy. The plant has four generating units, each with an output of 850 MW, and it is the eleventh largest electric plant in the United States. The plant has a once-through cooling water system that withdraws and discharges cooling water from Lake Erie under NPDES Permit No. MI0001848. The permit authorizes the plant “to discharge a maximum of 1,978 MGD of noncontact cooling water, fly ash transport water, bottom ash transport water, coal pile runoff, chemical metal cleaning wastes, nonchemical metal cleaning wastes, boiler water drained from boilers during outages, treated flue gas desulfurization wastewater, flue gas desulfurization pre-treatment system backwash, demineralizer regeneration wastes, miscellaneous low volume wastes, and storm water runoff." The permit has no temperature limits, but it does require monitoring of discharge temperature and a maximum thermal loading to the lake of 15,500 million BTU per hour.

Jensen (1982) applied a fisheries stock assessment model to assess the entrainment and impingement impact of the Monroe Power Plant on the yellow perch standing stock and fishery in the western basin of Lake Erie. He found that the impact of the Monroe Power Plant is relatively small in that it decreases biomass and the maximum sustainable yield of the yellow perch stock by only a few percent.

Several other coal-fired power plants with once-through cooling water systems are located and operated near the Fermi site, including the 730-MW Trenton Channel Power Plant, located 12 miles (19 km) north-northeast on the Detroit River; the 328-MW J.R. Whiting Power Plant, located 14 miles (23 km) south-southwest on Lake Erie; the 136-MW Bayshore Power Plant, located 20 miles (32 km) south-southwest on Lake Erie at Maumee Bay; and the 540-MW River Rouge Power Plant, located 26 miles (42 km) north-northeast on the Detroit River. Over the projected period of license renewal for Fermi 2, DTE plans to retire two of the three units at the Trenton Channel Power Plant in 2016 and reduce operations to one 520-MW unit, and the J.R. Whiting Power Plant is scheduled to be shut down in 2016. All of these power plants adversely affect aquatic resources though entrainment, impingement, and thermal discharges, although the NRC staff did not find any reports quantifying these effects at these power plants.

Davis-Besse is a single-unit nuclear power plant located in Ottawa County, Ohio, 27 mi (43 km) southeast of the Fermi site on Lake Erie. Davis-Besse uses closed-cycle cooling with a cooling tower to recirculate up to 95 percent of the cooling water. The plant is licensed for an electrical output of 2,817 megawatt thermal (MWt) and 908 MWe. The closed-cycle cooling reduces the need for cooling water, which minimizes the effects of impingement, entrainment, and the thermal discharge. In studies of phytoplankton, zooplankton, benthic invertebrates, and ichthyoplankton at 25 sites in Lake Erie from 1972 through 1979, Reutter et al. (1980) reported finding no clear correlations between any aquatic populations and Davis-Besse's thermal discharge. In 1980, CLEAR conducted studies of the effects of impingement (Reutter 1981b) and entrainment (Reutter 1981a) at Besse-Davis. Reutter (1981a) concluded that the entrainment losses at Davis-Besse were relatively small when compared to lake-wide populations and that the loss of gizzard shad, walleye, and perch eggs and larvae accounted for a loss of fecundity of less than 0.2 percent of the number captured in sport fishing in 1980. NRC (2015b) reviewed these studies and others and found that the direct and indirect impacts of license renewal for Davis-Besse would be SMALL according to the NRC's definitions of level of impact for the purposes of NEPA. The NRC (2015b) also found that the cumulative impact of past, present, and reasonably foreseeable future actions on aquatic resources in the western basin of Lake Erie where the Davis–Besse site (as well as the Fermi site) is located would be LARGE because of the effects of invasive species, fishing, energy development, urbanization and shoreline development, and climate change.

In 2008, Detroit Edison Company submitted to the NRC an application for a COL for Fermi 3 to be located on the Fermi site adjacent to the existing Fermi 1 and Fermi 2. The proposed plant would have a thermal power rating of 4,500 MWt and would use a closed-cycle, wet cooling system with a natural-draft cooling tower for heat dissipation. The NRC (2013a) reviewed the application and concluded that the impacts of preconstruction and construction activities on aquatic biota and habitats would be SMALL and that, 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."

To categorize levels of environmental impact, the NRC uses criteria based on (1) whether the impact is discernable or observable and (2) whether the impact has destabilized an important attribute of the resource in question. In considering the cumulative impacts of license renewal to aquatic resources of Lake Erie in the vicinity of Fermi 2, the NRC staff finds that the ecology of Lake Erie exhibits readily observable cumulative impacts that have destabilized the aquatic ecosystem, even though the direct and indirect effects of Fermi 2 are small. The following discussion summarizes how the aquatic community became destabilized.

The action area for license renewal is very small in relation to the size of Lake Erie and the Great Lakes Basin, but the processes that affect Lake Erie affect the action area. Degradation of Lake Erie has a long history, and much has been written about its causes, processes, and mitigation. It probably began early in the 1800s with massive forest cutting, construction of sawmills and dams, and the draining of wetlands. The human population and the economy of the Great Lakes watershed increased dramatically between about 1900 and the 1950s, which increased the load of plant nutrients to the lakes that caused anthropogenic eutrophication. Major industrial expansion occurred in the 1940s, prompted by the demands for chemicals, steel, rubber, and other products for the Second World War, and brought with it large-scale chemical and heavy metal discharges to the lakes. Peak pollution may have occurred in the 1960s and 1970s, and Lake Erie was called “America’s Dead Sea.” In the 1970s, the United States and Canada initiated a bi-national effort in nutrient and pollution abatement—the Great Lakes Water Quality Agreement signed first in 1972 and renewed in 1978 (EPA 2012a)—and those effort continue. The CWA of 1973 initiated a major U.S. effort to restore water quality in the Great Lakes, and it has had dramatic results (Burlakova et al. 2014).

One definition of eutrophication (Art 1993; USGS 2014) is as follows:

> The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process.

The western basin of Lake Erie, where the Fermi site is located, has experienced severe eutrophication with accompanying blooms of toxic algae and low dissolved oxygen levels.

Burlakova et al. (2014) provide a history of eutrophication and its effects on Lake Erie ecology, particularly in the benthos. Before human-driven eutrophication, mayflies (*Ephemeroptera*) and caddisflies (*Trichoptera*) were very abundant in western Lake Erie. Members of both of these insect orders typically live most of their lives as immature aquatic larvae followed by a very short-lived flying adult reproductive stage. In the 1930s, the benthic community of the western basin was dominated by the mayfly (*Hexagenia*) and the caddisfly (*Oecetis*), with average mayfly densities of 300 to 500 meter^{-2} (m^{-2}) (yard^{-2}) (yd^{-2}) and a maximum average to up to 1,000 m^{-2} (yd^{-2}). These extensive *Hexagenia* populations were devastated in September 1953 as a result of the first recorded significant large-scale depletion of dissolved oxygen in the western basin. Densities of mayflies somewhat recovered in 1954 but then were reduced again almost to extirpation in 1960s. The western basin is highly susceptible to human-caused eutrophication because of its shallow depth (average depth 7.4 m (24 ft)); discharge of the major tributaries (the Detroit and Maumee rivers, which account for 90 percent of the organic loading and 84 percent of the water volume entering the lake); and its proximity to large urban centers, such as Detroit and Toledo. Extensive changes have occurred in other groups of benthos, including a sharp decline in the density of *Oecetis* and a large increase in the taxa tolerant to organic enrichment, particularly tubificid worms and midge larvae (flies of the family *Chironomidae*).

Under the Great Lakes Water Quality Agreement of 1972, the United States and Canada undertook an extensive binational effort to reduce and eliminate sources of pollution to Lake Erie, including bans on the sale of phosphate detergents, improvements in organic waste collection and treatment systems, and reductions in industry discharges. The results were dramatic and, in some cases, occurred more rapidly than expected. Water quality in the lake responded to those measures; open-lake concentrations of total phosphorus, chlorophyll *a*, phytoplankton abundance, and biomass were reduced by the mid-1980s, and the pelagic ecosystem became less eutrophic (Burlakova et al. 2014).

Algal blooms resulted from the eutrophication. By the mid- to late-1960s, seasonal algal blooms were reported over the entire portion of the western basin of Lake Erie. Mats of algae washed ashore, fouling beaches. In the 1970s, algal blooms occurred annually, predominated by *Aphanizomenon flos-aquae*, but such blooms were reported as decreasing in intensity and number. No massive algal blooms were reported during the early 1980s, and algal blooms, when present, were predominated by *A. flos-aquae*. In the mid-1980s, zebra and quagga mussels arrived in Lake Erie, and their effects are discussed below. In 1995 and 1998, large algal blooms of *Microcystis*, a toxic cyanobacteria or blue-green alga, were reported in western Lake Erie. During the 2000s, blooms of toxic *Microcystis* were common in the western basin. In August 2003, a massive bloom of *Microcystis aeruginosa* formed in western Lake Erie and persisted for nearly a month. Recent research indicates that recent algal blooms in western Lake Erie are linked to nutrient loading, nutrient releases by zebra mussels, and selective feeding by zebra mussels, but much more work needs to be done (EPA 2014i).

The Great Lakes Water Quality Agreement brought about substantial improvements in water quality (Munawar et al. 2005), but the factors disrupting Great Lakes aquatic ecosystems are not limited to chemical contamination and nutrient pollution that results in eutrophication and low dissolved oxygen levels. Invasive non-native species have and are destabilizing the Great Lakes ecosystems. Knowing the exact number of invasive species at any time is difficult. Sharp (2007) estimates that a new non-native species is discovered in the Great Lakes about once every 7 months. Gunderson (undated) reports that the Great Lakes harbor 182 non-native species, including 55 rooted plants, 27 species of algae, 49 invertebrates, 18 mollusks, 20 crustaceans, 23 pathogens, and 28 species of fish. Of the 28 fish, 9 were intentionally stocked, and 19 were unintentionally introduced.

At one time, Niagara Falls prevented many non-native species from migrating to the Upper Great Lakes (i.e., those above Lake Ontario, including Lake Erie). Construction of locks and canals allowed species to migrate into the lakes or to come in with ship ballast water. The Great Lakes are now connected to the Mississippi River and Gulf of Mexico by means of a diversion out of Lake Michigan, to James Bay and Hudson Bay through a diversion into Lake Superior, and to the Hudson River Drainage through the Erie Canal (Gunderson undated).

Perhaps the first non-native invasive species to enter the Great Lakes were sea lampreys (*Petromyzon marinus*) and alewives (*Alosa pseudoharengus*), which were initially recorded in Lake Ontario in the 1800s after the opening of the Erie Canal in 1825 (Sharp 2007). Niagara Falls kept invasive species out of the four Upper Lakes—Erie, Huron, Michigan and Superior—until 1829 when the Welland Canal opened a waterway between Lakes Ontario and Erie. Sea lamprey were first reported in Lake Erie in 1921, 2 years after the Welland Canal was enlarged. Sea lamprey are predatory fish that attach themselves to other fish species, and their prey may then die from the wound, from a secondary infection, or from predation due to weakened condition and increased vulnerability. Combined with overfishing and pollution, sea lamprey had driven native lake trout (*Salvelinus namaycush*) populations almost to extinction (Domske and O'Neill undated).

Alewife, a small-sized member of the herring family, may have moved through the Erie Canal into the Great Lakes Basin from the Atlantic drainage, or they may have been stocked into the lake accidentally after being misidentified as juvenile shad (the two look very similar in their early life stages). Alewives have affected the ecosystem because they are superior competitors that have been able to outcompete native fishes like lake herring (*Coregonus artedi*), bloaters (*C. hoyi*), and whitefish (*C. clupeaformis*) and because they also feed readily on young native fish species, including lake trout, yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), and whitefish (Domske and O’Neill undated).

When the populations of the top predators that might have fed on alewives were decimated, alewife populations dramatically increased until they comprised up to 80 percent of the fish biomass in the Great Lakes (Sharp 2007). Beginning in 1966, the states around the lakes attempted to control the alewife population by introducing non-native predatory Pacific salmon, chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*), to prey on alewives (Sharp 2007). The alewife population in Lake Erie has become the primary food resource of adult non-native Pacific salmon and native lake trout (Domske and O’Neill undated). Alewives feed primarily on plankton, and another invasive non-native species, the zebra mussel (*Dreissena polymorpha*), consumed so much plankton in Lake Huron by 2003 that alewives disappeared, which caused the salmon fishery to collapse (Sharp 2007).

Zebra mussels are one of two related bivalve species; the other is the quagga mussel (*D. bugensis*). together often called dreissenids, that were carried to the United States as planktonic larvae in the freshwater ballast of freighters coming from the Black and Caspian Sea regions of eastern Europe and western Asia. Although small individually, these mussels can filter up to 2 liters (2 quarts) of water per day per adult mussel from which they primarily consume phytoplankton (the microscopic plant life that forms the base of the aquatic food chain), small zooplankton (tiny aquatic animals), and bacteria. Filtered material is expelled and drops to the bottom as feces (consumed matter) or pseudofeces (unconsumed matter) and is removed from the water column. Colonies of these mussels can reach densities of up to several hundred thousand mussels per square meter (1.2 square yards), and their removal of plankton from the lakes has dramatically increased water clarity. An individual female dreissenid can produce up to a million eggs per year, and the planktonic larvae are dispersed by waves and water currents before they settle out of the water column, attach, and form colonies (Domske and O’Neill undated).

Zebra mussels have profoundly affected the Great Lakes ecosystem (EPA 2015a). Through their filter-feeding, they divert nutrients from open water to lake bottom systems. Bottom-feeding fish (and their predators) then gain advantage over fish, such as alewife and smelt (and their predators), that feed in the open water. Aquatic rooted plants (macrophytes) and their associated communities (which include largemouth bass) thrive in water cleared by zebra mussels, whereas habitat is reduced for species, such as walleye that are adapted to turbid waters. In areas where zebra mussels abound, common algae-eating species of microbenthos have been replaced by opportunistic omnivorous and bacteria-eating species (EPA 2015a). In Lake Erie, declines in phytoplankton size structure and changes in community composition along with significant declines in primary productivity in the west basin, where the Fermi site is located, have occurred following invasion by dreissenid mussels (Munawar et al. 2005).

Both non-native dreissenid mussels and the non-native round goby (*Neogobius melanostomus*) have shifted the food web from a pelagic-based to a benthic-based one, and this change potentially creates a new pathway for contaminant transfer to top predators (Hogan et al. 2007). Round goby is a relatively new invasive fish species in the Great Lakes that was first identified in the St. Clair River in 1990 and has already spread to Lakes Erie, Huron, Michigan, and

Superior (EPA 2015a). Domske and O'Neill (undated) describe round gobies as an aggressive fish that outcompete native fish, such as sculpins, for food and territory. They are benthic fish with highly developed sensory systems that allow them to find food and avoid predation much better than the native species. They can also feed at night, which gives them an advantage over many native fish that typically feed only during the day. Round gobies can spawn several times each year, and the males guard the nests filled with eggs. This behavior reduces predation on the eggs and increases survival rates, and round goby populations have proliferated throughout the Great Lakes Basin (Domske and O'Neill undated).

Studies by Hogan et al. (2007) in Lake Erie suggest that round gobies may influence the trophic transfer of mercury up the food chain to top predators and perhaps humans. Round gobies feed on dreissenids, which filter vast amounts of water and accumulate some contaminants. Smallmouth bass (*Micropterus dolomieu*) have a high consumption of round gobies and have been accumulating high levels of mercury. As smallmouth bass continue to consume round gobies during their lives, their mercury concentrations may continue to increase, which would potentially increase the risk of mercury contamination to humans.

Common carp (*Cyprinus carpio*) come from the Caspian Sea and parts of Asia. The U.S. Fish Commission originally stocked common carp in the Great Lakes Basin in the late 1800s as a source of "cheap" food for the future, although carp quickly fell out of favor as a food species. Common carp were often stocked in farm ponds from where they often escaped into nearby ecosystems during periods of flooding. Once released into the Great Lakes Basin, carp spread quickly and easily. The common carp is a very hardy species, capable of surviving in less than optimal habitats. As a result of their feeding behavior (they pull out plants and root around in the bed of lakes and streams), they degrade lakes by causing excessive turbidity (cloudiness caused by disturbed silt), which can lead to declines in submerged aquatic plants and organisms, waterfowl, and important native fish species. Common carp are also prolific breeders, inflicting substantial competition for habitat on other more desirable species. Common carp may prey on the eggs of other native fish species and, therefore, reduce breeding stocks of native populations. Carp negatively alter their aquatic environment and are generally considered a nuisance species wherever they occur (Domske and O'Neill undated)

Several other invasive species have adversely affected the Great Lakes ecosystems, including the cladoceran crustaceans spiny waterflea (*Bythotrephes cederstroemi*), fishhook waterflea (*Cercopagis pengoi*), and others. A present concern is that Asian carp may soon be introduced.

Arkansas commercial fish farmers imported bighead and silver carp (*Hypophthalmichthys nobilis* and *H. molitrix*) in the early 1970s to eat algae in fishponds. When the Mississippi River flooded the ponds in the 1980s, some of these carp escaped into the wild (some authorities believe that fish farmers also deliberately released carp that had grown too large) and they still were escaping from flooded Missouri fish farms as late as 1994. Asian carp could enter the Great Lakes via the Chicago Sanitary and Ship Canal, which lies about 30 mi (48 km) below Lake Michigan and connects Lake Michigan with the Illinois–Mississippi River system. Asian carp have been reported from the Canal. In 2003, Illinois researchers set nets in the Illinois River about 250 river miles (400 river kilometers) from Lake Michigan and reported catching several tons of silver and bighead carp in only 30 minutes. In 2007, Congress introduced legislation to provide funds for completing a permanent electronic barrier on the canal (Sharp 2007).

Silver carp and bighead carp grow to about 70 and 110 pounds (lb) (30 and 50 kilograms (kg)), respectively, in their native waters in Southeast Asia; however, in North America, the maximum sizes reported have so far been about 20 lb (9 kg) for silver carp and 50 lb (23 kg) for bighead carp. Silver carp have been in news reports because they leap 10 to 15 ft (3 to 4.5 m) out of the water when spooked by boats, and several boaters have suffered injuries that include broken jaws, noses, ribs, arms, and legs after being hit by flying carp. Both species consume up to more than half their own weight in algae and zooplankton every day, and fisheries scientists fear they could completely disrupt the food web in the Great Lakes. Everywhere they have turned up, Asian carp have become an overwhelmingly dominant species that replaces native species, including bass (various species), crappies (*Pomoxis* spp.), bluegills (*Lepomis macrochirus*), buffalo fish (*Ictiobus* spp.), and catfish (*Ictalurus* spp.). Some fisheries scientists believe that Asian carp could become at least as destructive to the Great Lakes ecosystems and fisheries as sea lampreys and zebra mussels (Sharp 2007).

In summary, the Great Lakes aquatic ecosystem has been constantly destabilized over many decades by the cumulative effects of chemical contamination, nutrient pollution that results in eutrophication and low dissolved oxygen levels, and invasive non-native species. Lake Erie has undergone cycles of degradation and remediation, and these lake-wide effects affect the aquatic resources near the Fermi site. Continued releases of nutrients, particularly from non-point sources, continued introductions of invasive non-native species, continued Federal and State remediation efforts, and continued changes in temperature and rainfall due to climate change will prevent stabilization over the period of license renewal. Even without these changes, stability would take decades, if not centuries, to occur. Although the direct and indirect effects of Fermi 2 are small, the cumulative impacts of all stressors combined are readily observable and have destabilized the aquatic ecosystem; therefore, the level of cumulative impact is LARGE.

4.16.6 Historic and Cultural Resources

This section addresses the direct and indirect effects of license renewal on historic and cultural resources when they are added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in this analysis is the area of potential effect associated with the proposed undertaking, as described in Section 3.9.

The archaeological record for the region indicates prehistoric and historic occupation of the Fermi site and its immediate vicinity. The construction of Fermi 1 and Fermi 2 may have resulted in the destruction of cultural resources within the Fermi site and surrounding area. Previous historic land development in the vicinity of Fermi also resulted in impacts on, and the potential loss of, cultural resources on the Fermi site and its immediate vicinity. However, there remains the possibility for additional historic or cultural resources to be located within the Fermi site. The present and reasonably foreseeable projects that could affect these resources, reviewed in conjunction with license renewal, are noted in Appendix E to this document. Direct impacts would occur if historic and cultural resources in the area of potential effect were physically removed or disturbed. Indirect visual or noise impacts could occur from new construction or maintenance. Fermi 1 decommissioning activities and Fermi 3 construction and operation are the projects located within the area of potential effect that were considered for cumulative impacts to cultural resources.

As described in Section 4.9, no cultural resources would be adversely affected by Fermi 2 license renewal activities because no physical changes or ground-disturbing activities would occur beyond ongoing maintenance activities during the license renewal term (DTE 2014a). Fermi 1 decommissioning activities and Fermi 3 construction and operation have the potential to result in impacts on cultural resources through inadvertent discovery during ground-disturbing activities. However, as discussed in Section 4.9, DTE has established site procedures and work instructions to ensure cultural resources at the Fermi site are considered in project planning during Fermi 2 operations. Therefore, the NRC staff concludes that the cumulative impact of license renewal on historic and cultural resources within the area of potential effect, when combined with other past, present, and reasonably foreseeable future activities, would be SMALL.

4.16.7 Socioeconomics

This section addresses socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Fermi 2 in addition to the aggregate effects of other past, present, and reasonably foreseeable future actions. The primary geographic area of interest considered in this cumulative analysis is Monroe and Wayne Counties where approximately 78 percent of Fermi 2 employees reside (Table 3–25 in Section 3.10.1). This area is where the economy, tax base, and infrastructure would most likely be affected because the majority of Fermi 2 workers and their families reside, spend their incomes, and use their benefits within these two Counties.

As discussed in Section 4.10, continued operation of Fermi 2 during the license renewal term would have no impact on socioeconomic conditions in the region beyond what is already being experienced. Because DTE has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at Fermi 2 would remain relatively unchanged with no new or increased demand for housing and public services. Based on this and other information presented in Chapter 4, there would be no contributory effect on socioeconomic conditions in the region during the license renewal term from the continued operation of Fermi 2 beyond what is currently being experienced. Therefore, the only contributory effects would come from reasonably foreseeable future planned activities at Fermi 2, unrelated to the proposed action (license renewal), and other reasonably foreseeable planned offsite activities. For example, offsite residential development is planned throughout the Fermi 2 region. The availability of new housing could attract individuals and families from outside the region, thus increasing the local population and subsequently increasing traffic on local roads and the demand for public services.

<u>Fermi 1 Decommissioning</u>

Full decommissioning of Fermi 1 is expected to be complete before initiation of Fermi 3 construction. DTE has not determined whether to remove the Fermi 1 external structure after the site is decommissioned and after its NRC license is terminated (NRC 2013a). Potential socioeconomic effects from decommissioning Fermi 1 include fluctuations in the size of the workforce at the Fermi site and associated changes in the demand for public services and housing and in traffic volumes in the region.

<u>Construction and Operation of Fermi 3</u>

Construction (including preconstruction) impacts could range from MODERATE to LARGE in Monroe and Wayne Counties for 9 to 12 years. Up to 2,900 construction workers working daily at the Fermi 3 site would create a considerable demand for temporary rental housing and other commercial and public services in the two-County region. In addition, the high volume of construction and commuter vehicles on local roads during shift changes would have a noticeable impact on traffic conditions. An estimated maximum of 2,900 workers would be commuting daily to the Fermi 3 construction site (NRC 2013a).

Conversely, impacts during Fermi 3 nuclear power plant operations would be SMALL to MODERATE. An estimated 900 Fermi 3 operations workers would need permanent housing and commercial and public services, such as schools, police and fire, and public water and electric services (NRC 2013a). The addition of 900 Fermi 3 operations workers to the current workforce commuting daily to the Fermi site would also have a noticeable impact on traffic conditions on local roads during shift changes.

The additional 900 Fermi 3 operations workers would likely reside in the same Counties and in the same pattern as the current Fermi 2 workforce. Most of the operations workers would be expected to settle where there is readily available housing in Monroe and Wayne Counties.

4.16.7.1 Conclusion

When combined with other past, present, and reasonably foreseeable future activities (e.g., the decommissioning of Fermi 1 and the construction and operation of Fermi 3), the contributory effects of continued reactor operations at Fermi 2 would have no new or increased impact on socioeconomic conditions in the region beyond what is currently being experienced. The contributory effects from the construction and operation of Fermi 3 on socioeconomic conditions in the 50-mi (80-km) region would include LARGE beneficial economic impacts and beneficial impacts on property taxes in Monroe County; SMALL impacts on most infrastructure and community services (recreation, housing, public services, and education); and MODERATE traffic impacts during peak construction and outages. These contributory effects are described in greater detail in NUREG–2105 (NRC 2013a), which is incorporated by reference.

4.16.8 Human Health

The NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are codified in 10 CFR Part 20 and 40 CFR Part 190. As discussed in Section 4.11.1, the NRC staff concluded impacts to human health from continued plant operations are SMALL.

For the purposes of this cumulative analysis, the geographical area considered is the area included within an 80-km (50-mi) radius of the Fermi site. One other nuclear power plant is located within the applicable geographical area; Davis-Besse, Unit 1, in Ottawa County, Ohio, is approximately 43km (27mi) southeast of the Fermi site. On the Fermi site, in addition to the Fermi 2 operating reactor, there is the Fermi 1 nuclear unit that was shut down in 1972 and is undergoing decommissioning. In addition to storing its spent nuclear fuel in a storage pool, Fermi 2 also stores some of its spent nuclear fuel in an onsite independent spent fuel storage installation. One other reasonably foreseeable project has the potential to contribute to the cumulative radiological impacts—the construction and operation of a new reactor unit (Fermi 3) on the Fermi site (DTE 2014a).

The NRC staff evaluated the potential cumulative impacts from the construction and operation of Fermi 3 in NUREG–2105 (NRC 2013a). The NRC staff concluded that the cumulative radiological impacts to human health from onsite and offsite sources of radiation would be SMALL (NRC 2013a).

The EPA’s regulations in 40 CFR Part 190 limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.1.4.4, Fermi 2 has conducted a REMP since 1978. This program measures radiation and radioactive materials in the environment from Fermi 2 and from all other onsite and offsite sources. The NRC staff reviewed the radiological environmental monitoring results for the 5-year period from 2009 to 2013 as part of the cumulative impacts assessment. The NRC staff’s review of DTE’s data showed no indication of an adverse trend in radioactivity levels in the environment from Fermi 2 or other sources. The data showed that there was no measurable impact to the environment from the operations at Fermi 2.

The NRC staff concludes that the cumulative radiological impacts of the proposed license renewal, when combined with other past, present, and reasonably foreseeable future activities, would be SMALL. This conclusion is based on the NRC staff’s review of REMP data, radioactive effluent release data, DTE's expected continued compliance with Federal radiation protection standards during continued operation of Fermi 2, decommissioning of Fermi 1, proposed construction and operation of Fermi 3, use of an independent spent fuel storage installation to store spent nuclear fuel, and regulation of any future development or actions in the vicinity of the Fermi site by the NRC and the State of Michigan.

4.16.9 Environmental Justice

The environmental justice cumulative impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from past, present, and reasonably foreseeable future actions, including the continued operational effects of Fermi 2 during the renewal term. Everyone living near Fermi experiences the operational effects of Fermi 2, including minority and low-income populations. As explained in Section 4.12, the NRC addresses environmental justice matters for license renewal by identifying the location of minority and low-income populations, determining whether there would be any potential human health or environmental effects to these populations, and determining if any of the effects may be disproportionately high and adverse.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and that appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas presented in preceding sections of Chapter 4 in this SEIS. As previously discussed in this chapter, the impact from license renewal for all resource areas (e.g., land, air, water, ecology, and human health) would be SMALL.

As explained in Section 4.12 of this SEIS, there would be no disproportionately high and adverse impacts on minority and low-income populations from the continued operation of Fermi 2 during the license renewal term. Because DTE has no plans to hire additional workers during the license renewal term, employment levels at Fermi 2 would remain relatively constant, and there would be no additional demand for housing or increased traffic. Based on this information and the analysis of human health and environmental impacts presented in the preceding sections, disproportionately high and adverse contributory effects on minority and low-income populations from the continued operation of Fermi 2 during the license renewal term are unlikely. Therefore, the only contributory effects would come from the other reasonably foreseeable future planned activities at Fermi 2, unrelated to the proposed action (license renewal), and other reasonably foreseeable planned offsite activities.

<u>Fermi 1 Decommissioning</u>

Full decommissioning of Fermi 1 is expected to be complete before initiation of Fermi 3 construction. DTE has not determined whether to remove the Fermi 1 external structure after the site is decommissioned and after its NRC license is terminated (NRC 2013a). Potential effects from decommissioning Fermi 1 would mostly consist of environmental effects (e.g., noise, dust, traffic, and housing impacts). If the external structure were to be demolished, noise and dust impacts during demolition would be temporary and would be limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased truck and commuter vehicle traffic as decommissioning workers commute to the site and as material is removed for disposal. Increased demand for inexpensive temporary housing by decommissioning workers could disproportionately affect low-income populations; however, given the availability of rental housing in the region, impacts to minority and low-income populations would be limited. Radiation doses during decommissioning are expected to remain within regulatory limits.

Based on this information and the analysis of human health and environmental impacts presented in this section of the SEIS, the decommissioning of Fermi 1 would not have disproportionately high and adverse human health and environmental cumulative effects on minority and low-income populations residing in the vicinity of the Fermi site.

Construction and Operation of Fermi 3

Potential impacts to minority and low-income populations from the construction of Fermi 3 would mostly consist of environmental effects (e.g., noise, dust, traffic, and housing impacts). Noise and dust impacts during construction would be temporary and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased truck material and equipment delivery and commuter vehicle traffic especially during shift changes. Increased demand for inexpensive temporary housing by construction workers could disproportionately affect low-income populations; however, given the availability of rental housing in the region, impacts to minority and low-income populations would be limited. Radiation doses during power plant operations are expected to remain within regulatory limits.

Based on this information and on the analysis of human health and environmental impacts presented in this section of the SEIS, construction and operation of Fermi 3 would not have disproportionately high and adverse human health and environmental cumulative effects on minority and low-income populations residing in the vicinity of the Fermi site.

4.16.9.1 Conclusion

When combined with other past, present, and reasonably foreseeable future activities (e.g., the decommissioning of Fermi 1 and the construction and operation of Fermi 3), the contributory effects of continued reactor operations at Fermi 2 would not likely cause disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of Fermi 2. The contributory effects from the construction and operation of Fermi 3 on minority and low-income populations in the 50-mi (80-km) region are described in greater detail in NUREG–2105 (NRC 2013a), which is incorporated by reference.

4.16.10 Waste Management and Pollution Prevention

This section describes waste management impacts during the license renewal term when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. For the purpose of this cumulative impacts analysis, the area within a 50-mi (80-km) radius of Fermi 2 was considered. In Section 4.13 of this SEIS, the NRC staff concluded that the environmental impacts from Fermi 2's radioactive and nonradioactive wastes generated during the license renewal term would be SMALL.

As discussed in Sections 3.1.4 and 3.1.5 of this SEIS, DTE maintains waste management programs for radioactive and nonradioactive waste generated at Fermi 2 and is required to comply with Federal and State permits and other regulatory requirements for the management of waste material. Current waste management activities at the Fermi site (i.e., Fermi 1 and Fermi 2) would likely remain unchanged during the license renewal term, and continued compliance with Federal and State requirements for radioactive and nonradioactive waste is expected. The NRC staff evaluated the potential cumulative impacts from the construction and operation of Fermi 3 in NUREG–2105 (NRC 2013a). The NRC staff concluded that the cumulative impacts from radioactive and nonradioactive wastes from all sources (i.e., Fermi 1, Fermi 2, and Davis-Besse) would be SMALL (NRC 2013a).

Based on the above, the NRC staff concludes that the potential cumulative impacts from radioactive and nonradioactive waste from multiple sources during the license renewal term would be SMALL. Continued compliance with Federal and State requirements for radioactive and nonradioactive waste management by Fermi 2 is expected.

4.16.11 Global Climate Change

This section addresses the impact of GHG emissions resulting from continued operation of Fermi 2 on global climate change when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The impacts of climate change on air, water, and ecological resources are discussed in Section 4.15.3. Climate is influenced by both natural and human-induced factors; the observed global warming (increase in the Earth's surface temperature) in the 21st century has been attributed to the increase in GHG emissions resulting from human activities (USGCRP 2009, 2014). Climate model projections indicate that future climate change is dependent on current and future GHG emissions (IPCC 2007c; USGCRP 2009, 2014). As described in Section 4.15.3, operations at Fermi Unit 2 emit GHG. Therefore, it is recognized that GHG emissions from continued Fermi Unit 2 operation may contribute to climate change.

The cumulative impact of a GHG emission source on climate is global. GHG emissions are transported by wind and become well mixed in the atmosphere as a result of their long atmospheric residence time; therefore, the extent and nature of climate change is not specific to where GHGs are emitted. In April 2014, EPA published the official U.S. inventory GHG emissions, which identifies and quantifies the primary anthropogenic sources and sinks of GHGs. The EPA's GHG inventory is an essential tool for addressing climate change and participating with the United Nations Framework Convention on Climate Change to compare the relative global contribution of different emission sources and GHGs to climate change. In 2012, the United States emitted 6,525.6 teragrams (Tg) of CO_{2eq} (6,525.6 million MT of CO_{2eq}); total U.S. emissions have increased by 4.7 percent from 1990 to 2012 (EPA 2014e). In 2012 and 2011, the total amount of CO_{2eq} emissions related to electricity generation was 2,022.7 Tg (2,022.7 million MT) and 2,158.5 Tg (2,158.5 million MT), respectively (EPA 2014e). The Energy Information Administration (EIA) reported that, in 2011, electricity production alone in Michigan was responsible for 64.5 million MT of CO_{2eq} (EIA 2014). Facilities that emit 0.025 million MT of CO_{2eq} or more per year are required to annually report their GHG emissions to the EPA. These facilities are known as direct emitters, and the data are publicly available in EPA's Facility Level Information on Green House Gases Tool (FLIGHT). In 2012, FLIGHT identified six facilities in Monroe County, Michigan, where the Fermi Unit 2 is located, that emitted a total of 17 million MT of CO_{2eq} (EPA 2014f). In 2012, FLIGHT identified 224 facilities in Michigan that emitted a total of 92 million MT of CO_{2eq} (EPA 2014f).

Appendix E provides a list of present and reasonable foreseeable projects that could contribute to GHG emissions. Permitting and licensing requirements and other mitigative measures can minimize the impacts of GHG emissions. For instance, in 2012, the EPA issued a final GHG Tailoring Rule (77 FR 41051) to address GHG emissions from stationary sources under CAA permitting requirements; the GHG Tailoring Rule establishes when an emission source will be subject to permitting requirements and control technology to reduce GHG emissions. On June 25, 2013, the Climate Action Plan was set forward to reduce carbon pollution. The Climate Action Plan will reduce carbon pollution, prepare the United States for the impacts of climate change, and lead international efforts to combat global climate change. Under the

Climate Action Plan, EPA has proposed rules to reduce carbon pollution from new and existing power plants. For instance, on August 3, 2015, EPA finalized the Clean Power Plan Rule (EPA 2015b) whereby EPA proposes to reduce carbon pollution from the power sector by 32 percent from 2005 levels (870 million tons less). The Clean Power Plan sets forth carbon dioxide emission performance rate standards for power plants that should be achieved by 2030. Furthermore, the Michigan Department of Community Health (MDCH) has received grants to develop and implement a strategic plan for responding to public health effects of climate change in Michigan. The plan has identified strategies to prevent, prepare for, and respond to, health impacts (MDCH 2010, 2011). Future actions and steps taken to reduce GHG emissions will lessen the impacts on climate change.

The EPA's U.S. inventory of GHG emissions illustrates the diversity of GHG sources emitters, such as electricity generation, industrial processes, and agriculture. As discussed in Section 4.15.3, GHG emissions resulting from operations at Fermi 2 for the 2009 to 2013 timeframe ranged between 9,600 and 14,600 MT of CO_{2eq}. In comparing Fermi 2 GHG emission contributions to different emissions sources, whether it is total U.S. GHG emissions, emissions from electricity production in Michigan, or emissions on a County level, GHG emissions from Fermi 2 are relatively minor, which is evident from the information presented in Table 4–23. Climate models indicate that short-term climate change (through the year 2030) is dependent on past GHG emissions. Therefore, climate change is projected to occur with or without present and future GHG emissions from Fermi 2. The NRC staff concludes that the impact from the contribution of GHG emissions from continued operation of Fermi 2 on climate change would be SMALL. As discussed in Section 4.15.3.2, climate change and climate-related changes have been observed on a global level and climate models indicate that future climate change will depend on present and future GHG emissions. The USGCRP concludes that climate change and related impacts are happening. Climate models indicate that, even if GHG emissions were to be completely eliminated, the Earth's average surface temperature will continue to increase and climate-related changes will persist over the next few decades (USGCRP 2014). The magnitude of continued increase in GHG emission rates will determine the amount of additional future warming. In summary, the cumulative impact of GHG emissions on climate change during the license renewal timeframe (2025 to 2045) is noticeable but not destabilizing. The NRC staff concludes that the cumulative impacts on climate change from the proposed license renewal and other past, present, and reasonably foreseeable projects would be MODERATE.

Table 4–23. Comparison of GHG Emission Inventories

Source	CO_{2eq} (million MT/year)
Global emissions (2011)[a]	45,450
U.S. emissions (2012)[b]	6,525.6
Michigan (2012)[c]	92
Monroe County, Michigan (2011)[d]	17
Fermi 2 emissions[4]	0.015

[a] Source: WRI (2011)

[b] Source: EPA (2014g)

[c] GHG emissions account only for direct emitters, those facilities that emit 25,000 MT (0.025 million MT) or more a year (EPA 2014h).

[d] Emissions include direct and indirect emissions from operation of Fermi 2, and the highest emission from 2009 to 2013 is presented (DTE 2014c).

Key: million MT/year = million metric tons per year

4.16.12 Summary of Cumulative Impacts

The NRC staff considered the potential impacts resulting from the operation of Fermi 2 during the period of extended operation and other past, present, and reasonably foreseeable future actions near Fermi 2. The preliminary determination is that the potential cumulative impacts would range from SMALL to LARGE, depending on the resource. Table 4–24 summarizes the cumulative impacts on resource areas.

Table 4–24. Summary of Cumulative Impacts on Resource Areas

Resource Area	Cumulative Impact
Air Quality and Noise	Past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local for noise and local and regional for criteria pollutants) that could affect air quality and noise resources. However, the incremental contribution of impacts on air quality and noise resources from plant operations at Fermi 2 would be minimal. The NRC staff concludes that cumulative impacts from Fermi 2-related actions and other past, present, and reasonably foreseeable future actions on air quality and noise resources in the geographic areas of interest would be SMALL.
Geology and Soils	Any use of geologic materials, such as aggregates to support operation and maintenance activities, would be procured from local and regional sources. These materials are abundant in the region, and geologic conditions are not expected to change during the license renewal term. Thus, activities associated with continued operations are not expected to affect the geologic environment. Considering ongoing activities and reasonably foreseeable actions, the NRC staff concludes that the cumulative impacts on geology and soils during the Fermi 2 license renewal term would be SMALL.
Water Resources	The Fermi 2 facility does not use groundwater nor discharge to it; therefore, the availability and quality of groundwater resources would not be affected by Fermi 2 license renewal activities. Consumptive surface water use from Fermi 2 operations would continue to be a very small percentage of the total water available in the western basin of Lake Erie, and ongoing and future surface water demands by users are expected to be supported. Surface water discharges to Lake Erie by Fermi 2 and other industrial users would be monitored and kept at acceptable limits via NPDES permits. The cumulative impact on surface water is further dependent on future climate change considerations, with SMALL impacts associated with minimal climate change conditions and with MODERATE impacts associated with more extensive conditions. Therefore, considering ongoing activities and reasonably foreseeable actions, the NRC staff concludes that cumulative impact of the proposed license renewal when combined with other past, present, and reasonably foreseeable future activities would be SMALL on groundwater use and quality and would be SMALL to MODERATE on surface water resources.
Terrestrial Resources	The NRC staff concludes that the cumulative impacts on terrestrial resources in the vicinity of the Fermi site are MODERATE to LARGE based on past, present, and reasonably foreseeable future actions. This level of impact is primarily the result of past habitat alteration and loss on the Fermi site and within the larger region. The environmental effects of these actions are clearly noticeable and have destabilized important attributes of certain terrestrial communities. The incremental site-specific impact from the continued operation of Fermi 2 during the license renewal period would be an unnoticeable or minor contributor to cumulative impacts on terrestrial resources.

Resource Area	Cumulative Impact
Aquatic Resources	The Great Lakes aquatic ecosystem has been destabilized for decades by the cumulative effects of chemical contamination, nutrient pollution that results in eutrophication and low dissolved oxygen levels, and invasive non-native species. Lake Erie has undergone cycles of degradation and remediation, and these lake-wide effects affect the aquatic resources near the Fermi site. Continued releases of nutrients, introductions of invasive non-native species, Federal and State remediation efforts, and changes in temperature and rainfall due to climate change will prevent stabilization over the period of license renewal. The direct and indirect effects of Fermi 2 on aquatic ecology are SMALL. However, because the cumulative impacts of all stressors combined are readily observable and have destabilized the aquatic ecosystem, the NRC staff concludes that the level of cumulative impact on the aquatic ecology is LARGE.
Historical and Cultural Resources	As described in Section 4.9, no cultural resources would be adversely affected by Fermi 2 license renewal activities because no associated changes or ground-disturbing activities would occur. DTE has established site procedures and work instructions to ensure that cultural resources are considered in project planning during normal operation of Fermi 2. Therefore, the NRC staff concludes that the cumulative impact of the proposed license renewal when combined with other past, present, and reasonable foreseeable future activities on historic and cultural resources would be SMALL.
Socioeconomics	When combined with other past, present, and reasonably foreseeable future activities, the contributory effects from the continued operation of Fermi 2 during the license renewal period would have no new or increased impact on socioeconomic conditions beyond what is currently being experienced.
Human Health	The NRC staff concludes that the cumulative radiological impacts of the proposed Fermi 2 license renewal when combined with other past, present, and reasonably foreseeable future activities would be SMALL.
Environmental Justice	The NRC staff concludes that the contributory effects of continued reactor operations at Fermi 2 when combined with other past, present, and reasonably foreseeable future activities would not likely cause disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of Fermi 2.
Waste Management and Pollution Prevention	NRC staff concludes that the potential cumulative impacts from radioactive and nonradioactive waste from multiple sources during the license renewal term would be SMALL. Continued compliance with Federal and State requirements for radioactive and nonradioactive waste management by Fermi 2 is expected.
Global Climate Change	Climate change and climate-related changes have been observed on a global level, and climate models indicate that future climate change will depend on present and future GHG emissions. Climate models project that the Earth's average surface temperature will continue to increase and climate-related changes will persist. Therefore, the cumulative impact of GHG emissions on climate change during the Fermi 2 license renewal timeframe would be noticeable but not destabilizing. The NRC staff concludes that the cumulative impacts from the proposed license renewal and other past, present, and reasonably foreseeable projects would be MODERATE.

4.17 Resource Commitments Associated with the Proposed Action

4.17.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out any of the energy alternatives considered in this SEIS, including the proposed action, would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur due to emission and release of various chemical and radiological constituents from power plant operations. Nonradiological emissions resulting from power plant operations are expected to comply with EPA emissions standards, although the alternative of operating a fossil fuel-based power plant in some areas may worsen existing attainment issues. Chemical and radiological emissions would not exceed the National Emission Standards for Hazardous Air Pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to radiation and hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and would not exceed standards or administrative control limits. In comparison, the alternatives involving the construction and operation of a nonnuclear power generating facility would also result in unavoidable exposure to hazardous and toxic chemicals to workers and the public.

The generation of spent nuclear fuel and waste material, including low-level radioactive waste, hazardous waste, and nonhazardous waste, would also be unavoidable. In comparison, hazardous and nonhazardous wastes would also be generated at nonnuclear power-generating facilities. Wastes generated during plant operations would be collected, stored, and shipped for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Because of the costs of handling these materials, power plant operators would be expected to carry out all activities and to optimize all operations in a way that generates the smallest amount of waste possible.

4.17.2 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment, as described in this chapter. “Short term” is the period of time that continued power-generating activities take place.

Power plant operations require short-term use of the environment, commitment of resources, and commitment of certain resources (e.g., land and energy) indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including license renewal, than they are under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives require similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from power plant operations introduce small amounts of radiological and nonradiological constituents to the region around the plant site. Over time, these emissions would result in increased concentrations and exposure, but they are not expected to impact air quality or radiation exposure to the extent that public health and long-term productivity of the environment would be impaired.

Continued employment, expenditures, and tax revenues generated during power plant operations directly benefit local, regional, and State economies over the short term. The investment of project-generated tax revenues into infrastructure and other required services by local governments could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste require an increase in energy and consume space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Power plant facilities are committed to electricity production over the short term. After decommissioning these facilities and restoring the area, the land could be available for other future productive uses.

4.17.3 Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable commitment of resources that have been noted in this SEIS. Resources are irreversible when primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources that are neither renewable nor recoverable for future use. Irreversible and irretrievable commitment of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and manmade resources required for power plant operations. In general, the commitment of capital, energy, labor, and material resources are also irreversible.

The implementation of any of the energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitment of energy; water; chemicals; and, in some cases, fossil fuels. These resources would be committed during the license renewal term and over the entire lifecycle of the power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and power plant operations and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems. These resources are readily available, and the amounts required are not expected to deplete available supplies or exceed available system capacities.

4.18 References

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5.0 CONCLUSION

This draft supplemental environmental impact statement (SEIS) contains the environmental review of the application for renewed operating license for Fermi, Unit 2 (Fermi 2), submitted by DTE Electric Company, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51. The regulations at 10 CFR Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.). This chapter presents conclusions and recommendations from the site-specific environmental review of Fermi 2. Section 5.1 summarizes the environmental impacts of license renewal; Section 5.2 presents a comparison of the environmental impacts of license renewal and energy alternatives; and Section 5.3 presents the U.S. Nuclear Regulatory Commission (NRC) staff's conclusions and recommendation.

5.1 Environmental Impacts of License Renewal

The NRC staff's review of site-specific environmental issues in this SEIS leads to the conclusion that issuing a renewed license for Fermi 2 would have SMALL impacts for the Category 2 issues applicable to license renewal at Fermi 2. The NRC staff considered mitigation measures for each Category 2 issue, as applicable. The NRC staff concluded that no additional mitigation measure is warranted.

5.2 Comparison of Alternatives

In Chapter 4, the NRC staff considered the following alternatives to the Fermi 2 license renewal:

- no-action alternative;
- natural gas combined-cycle (NGCC) alternative;
- integrated gasification combined-cycle (IGCC) alternative;
- new nuclear alternative; and
- combination alternative (NGCC, wind, and solar).

Based on the summary of environmental impacts provided in Table 2–2, the NRC staff concluded that the environmental impacts of renewal of the operating license for Fermi 2 would be smaller than those of feasible and commercially viable alternatives. The no-action alternative, the act of shutting down Fermi 2 on or before its license expires, would have SMALL environmental impacts in most areas with the exception of socioeconomic impacts, which would have SMALL to LARGE environmental impacts. Continued operations would have SMALL environmental impacts in all areas. The NRC staff concluded that continued operation of Fermi 2 is the environmentally preferred alternative.

5.3 Recommendations

The NRC staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Fermi 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on the following:

- the analysis and findings in NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Volumes 1 and 2;

- the environmental report submitted by DTE Electric Company;
- consultation with Federal, state, tribal, and local agencies;
- the NRC staff's environmental review; and
- consideration of public comments received during the scoping process.

6.0 LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Reactor Regulation (NRR) prepared this supplemental environmental impact statement with assistance from other NRC organizations and support from the Center for Nuclear Waste Regulatory Analysis (CNWRA) and Idoneous Consulting. CNWRA provided support as identified in Table 6–1. Idoneous Consulting provided support for technical editing reviews. Table 6–1 identifies each contributor's name, affiliation, and function or expertise.

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(in alphabetical order)

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Table 7–1. List of Agencies, Organizations, and Persons to Whom Copies of This SEIS Are Sent

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NRC FORM 335
(12-2010)
NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)
NUREG-1437, Supplement 56, Volume 1 Draft

2. TITLE AND SUBTITLE
Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 56, Regarding Fermi 2 Nuclear Power Plant, Chapters 1- 8, Volume 1. Draft for Comment.

3. DATE REPORT PUBLISHED

MONTH	YEAR
October	2015

4. FIN OR GRANT NUMBER

5. AUTHOR(S)
See Chapter 6.

6. TYPE OF REPORT
Technical

7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)
Division of License Renewal
Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)
Same as above.

10. SUPPLEMENTARY NOTES
Docket No. 50-341

11. ABSTRACT (200 words or less)

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by DTE Electric Company (DTE), to renew the operating license for the Fermi 2 Nuclear Power Plant for an additional 20 years.

This SEIS includes the preliminary analysis that evaluates the environmental impacts of the proposed action and the alternatives to the proposed action. Alternatives considered include: (1) natural gas combined cycle (NGCC), (2) coal integrated gasification combined cycle (IGCC), (3) new nuclear power generation, (4) a combination of NGCC, wind, and solar generation, and (5) the no action alternative (i.e., no renewal of the license).

The U.S. Nuclear Regulatory Commission (NRC) staff's preliminary recommendation is that the adverse environmental impacts of license renewal for Fermi 2 are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following factors: the analysis and findings in NUREG–1437 Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Volumes 1 and 2; the Environmental Report submitted by DTE; consultation with Federal, state, tribal, and local government agencies; and the NRC staff's independent environmental review; and consideration of public comments received during the scoping process.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)
DTE Electric Company
DTE
Fermi 2
Supplement to the Generic Environmental Impact Statement, SEIS
Generic Environmental Impact Statement, GEIS
National Environmental Policy Act, NEPA,
NUREG-1437, Supplement 56

13. AVAILABILITY STATEMENT
unlimited

14. SECURITY CLASSIFICATION
(This Page)
unclassified
(This Report)
unclassified

15. NUMBER OF PAGES

16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

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NUREG-1437
Supplement 56
Volume 1

Generic Environmental Impact Statement for License Renewal of Nuclear Plants
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October 2015