Appendix D

Technical Specification Changes

Fermi 2
License Renewal Application

10 CFR 54.22 requires that an application for license renewal include any technical specification changes or additions necessary to manage the effects of aging during the period of extended operation. A review of the information in this License Renewal Application and the Fermi 2 Technical Specifications determined that no changes to the Technical Specifications are required.

Appendix E

Applicant's Environmental Report

Operating License Renewal Stage

Fermi 2

INTRODUCTION

DTE Electric Company (DTE), a wholly owned subsidiary of DTE Energy, submits this environmental report (ER) in conjunction with the application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Fermi 2 for 20 years beyond the end of the current license term. In compliance with applicable NRC requirements, this ER analyzes potential environmental impacts associated with renewal of the Fermi 2 operating license (OL). This ER is designed to assist the NRC staff with the preparation of the Fermi 2 specific supplemental environmental impact statement (SEIS) required for license renewal.

The Fermi 2 ER is provided in accordance with 10 CFR 54.23, which requires license renewal applicants to submit a supplement to the Operating License Stage Environmental Report that complies with the requirements of Subpart A of 10 CFR Part 51. This report also addresses the more detailed requirements of NRC environmental regulations in 10 CFR 51.45 and 10 CFR 51.53(c), as well as the intent of the National Environmental Policy Act (NEPA) [42 USC 4321 et seq]. For major federal actions, NEPA requires federal agencies to prepare a detailed statement that evaluates environmental impacts, alternatives to the proposed action, and irreversible and irretrievable commitments of resources associated with implementation of the proposed action.

DTE used Revision 1 to NRC Regulatory Guide 4.2, *Preparation of Environmental Reports for License Renewal Applications*, as guidance on the format and content of this ER. In addition, DTE used the *Generic Environmental Impact Statement (GEIS) for License Renewal for Nuclear Plants* (NUREG-1437, Revision 1) and Appendix B to 10 CFR Part 51 in preparation of this report. The level of information provided on the various topics and issues in this ER are commensurate with the environmental significance of the particular topic or issue.

Based upon the evaluations discussed in this ER, DTE concludes that the environmental impacts associated with renewal of the Fermi 2 OL would result in no significant adverse effects. No refurbishment or other license-renewal-related construction activities have been identified. Ongoing plant operational and maintenance activities will be performed during the license renewal period, but no significant environmental impacts associated with such activities are expected, because established programs and procedures are in place to ensure that proper environmental monitoring continues to be conducted throughout the renewal term, as discussed in Chapter 9.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym	Definition
§	section
Δt	temperature difference
°F	degrees Fahrenheit
μg/L	micrograms per liter
ACHP	Advisory Council on Historic Preservation
AD	anno Domini—with respect to time period
ADT	average daily traffic
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
APE	area of potential effect
AQCR	air quality control region
ATF	after the fact
AUID	assessment unit identification
BC	before Christ—with respect to time period
BIA	U.S. Bureau of Indian Affairs
BMP	best management practice
BP	before present
Btu	British thermal unit
Btu/hr	British thermal unit per hour
BWR	boiling water reactor
CAA	Clean Air Act
CAES	compressed air energy storage
CCR	coal combustion residuals
CCRG	Commonwealth Cultural Resources Group Inc.
CDC	U.S. Centers for Disease Control and Prevention

Acronym	Definition
Ce/kWh	carbon equivalents per kilowatt hour
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
cfu/100mL	colony-forming units per 100 milliliters
CH_4	methane
CMA	census metropolitan area
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COL	combined license
COLA	combined license application
CSP	concentrating solar power
CSX	CSX Transportation, Inc.
CT	combustion turbine
CW	circulating water
CWA	Clean Water Act (Federal Water Pollution Control Act)
CWR	circulating water reservoir
DAW	dry active waste
dBA	A-weighted decibel
DDT	dichlorodiphenyltrichloroethane
DECON	dismantling and decontamination, one of three NRC decommissioning strategies
DOD	U.S. Department of Defense
DRIWR	Detroit River International Wildlife Refuge
DSM	demand-side management

Acronym	Definition
DTE	DTE Electric Company
DTE Energy	DTE Energy Company
DTM	Detroit, Toledo & Monroe Railroad
DWSD	Detroit Water and Sewage District
E	east
E. coli	*Escherichia coli*
EAB	exclusion area boundary
EF	enhanced Fujita (tornado scale ranging from 0 to 5)
EFH	essential fish habitat
EIS	environmental impact statement
EMF	electromagnetic fields
EMS	environmental management system
ENE	east-northeast
ENTOMB	permanent entombment on site, one of three NRC decommissioning strategies
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPRI	Electric Power Research Institute
ER	environmental report
ERDS	emergency response data system
ESA	Endangered Species Act
ESBWR	economic simplified boiling water reactor
ESE	east-southeast
FAA	Federal Aviation Administration
FDC	floor drain collector
FDCT	floor drain collector tank
FEIS	final environmental impact statement

Acronym	Definition
FEMA	Federal Emergency Management Agency
Fermi 1	Enrico Fermi Atomic Power Plant Unit 1
FES	final environmental statement
fish/m^3	number of fish per cubic meter
fps	feet per second
FPS	fire protection system
g	gram
GE	General Electric Company
GEIS	NUREG 1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
GHG	greenhouse gas
GLC	Great Lakes Commission
GLSW	Great Lakes surface water
gpd	gallons per day
gpm	gallons per minute
GPI	Groundwater Protection Initiative
GPS	global positioning system
GSW	general service water
GW	groundwater
GWh/yr	gigawatt hours per year
H	homestead (e.g., residential)
HABS	harmful algal blooms
HAP	hazardous air pollutant
HIC	high integrity container
HLW	high-level waste
hp	horsepower
HRSG	heat recovery steam generator

Acronym	Definition
HUC	hydrologic unit code
HUD	U.S. Department of Housing and Urban Development
I-75	Interstate 75
I-94	Interstate 94
I-96	Interstate 96
I-275	Interstate 275
IGCC	integrated gasification combined cycle
IPCS	integrated plant computer system
IPE	individual plant examination
IPEEE	individual plant examination for external events
ISD	intermediate school district
ISFSI	independent spent fuel storage installation
ITC *Transmission*	International Transmission Company
kv	kilovolt
kW	kilowatt
kWh	kilowatt hour
$kWh/m^2/day$	kWh of solar insolation per square meter per day
L_{90}	sound level exceeded 90 percent of the time (residual sound level or background level)
lb/hr	pound per hour
L_{dn}	day-night average sound level
L_{eq}	equivalent continuous sound level
LLD	lower limit of detection
LLW	low-level waste
L/min	liter per minute
LOS	level of service

Acronym	Definition
LRA	license renewal application
mA	milliamperes
MACR	maximum averted cost-risk
MBTA	Migratory Bird Treaty Act of 1918
MCL	maximum contaminant level
MDA	minimum detectable activity
MDEQ	Michigan Department of Environmental Quality
MDHS	Michigan Department of Human Services
MDNR	Michigan Department of Natural Resources
MEI	maximally exposed individual
mg/l	milligram per liter
MGD	million gallons per day
MIOSHA	Michigan Occupational Safety and Health Administration
MNFI	Michigan Natural Features Inventory
MOA	memorandum of agreement
mph	miles per hour
MPSC	Michigan Public Service Commission
mrem	millirem
MSA	metropolitan statistical area
msl	above mean sea level
MSW	municipal solid waste
MWd/MTU	megawatt-days per metric ton of uranium
MWe	megawatts electric
MWh	megawatt hour
MWt	megawatts thermal
N	north

Acronym	Definition
N_2O	nitrous oxide
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NACD	Native American Consultation Database
NAGPRA	Native American Graves Protection and Repatriation Act
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NE	northeast
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NGCC	natural gas combined-cycle
ng/l	nanograms per liter
NH	non-homestead
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMFS	National Marine Fisheries Service
NML	noise monitoring location
NNE	north-northeast
NNW	north-northwest
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service

Acronym	Definition
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSPS	New Source Performance Standard
NW	northwest
NWI	National Wetland Inventory
NWIS	National Water Information System
ODCM	Offsite Dose Calculation Manual
OL	operating license
OSA	Office of the State Archaeologist
OSSF	onsite storage facility
OSW	other surface water
PAP	personnel access portal
PCB	polychlorinated biphenyl
pCi/L	picocuries per liter
PEM	palustrine emergent marsh
PEMC	palustrine, emergent, seasonally flooded
PEM1C	palustrine, emergent, persistent, seasonally flooded
PEMFh	palustrine, emergent, semipermanently flooded, diked/impounded
PFO	palustrine forested
PFO1A	palustrine, forested, broad-leaved deciduous, temporarily flooded
PFO1C	palustrine, forested, broad-leaved deciduous, seasonally flooded
PILOT	payment in lieu of taxes
PLSS	Public Land Survey System
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter

Acronym	Definition
PM_f	total filterable particulates
PMP	pollutant minimization program
POTW	publicly owned treatment works
ppb	parts per billion
ppm	parts per million
PRE	principal residences exception
PSS	palustrine scrub-shrub
PTE	potential to emit
PTS	post treatment system
PV	photovoltaic
RACTS	regulatory action and commitment tracking system
RCRA	Resource Conservation and Recovery Act
rem	Roentgen in man
REMP	radiological environmental monitoring program
RHR	residual heat removal
ROP	renewable operating permit
ROW	right-of-way
S	south
SAFSTOR	safe storage, one of three NRC decommissioning strategies
SAMA	severe accident mitigation alternative
SCPC	supercritical pulverized coal
SCR	selective catalytic reduction
SE	southeast
SEIS	supplemental environmental impact statement
SEMCOG	Southeast Michigan Council of Governments
SESC	soil erosion and sedimentation control

Acronym	Definition
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPCC	spill prevention, control, and countermeasure
SSA	sole source aquifer
SSE	south-southeast
SSW	south-southwest
STG	steam turbine generator
STU	shovel test unit
SW	southwest
SWPPP	stormwater pollution prevention plan
TAC	technical assistance center
TCP	traditional cultural property
TCSD	Toledo, Canada Southern & Detroit Railroad
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	tribal historic preservation office (or officer)
TMDL	total maximum daily load
TPY	tons per year
TSS	total suspended solids
UDEQ	Utah Department of Environmental Quality
UFSAR	updated final safety analysis report
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCB	U.S. Census Bureau

Acronym	Definition
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
UV	ultraviolet
VOC	volatile organic carbons
W	west
WHC	Wildlife Habitat Council
WHO	World Health Organization
WinMACCS	MELCOR Accident Consequence Code System
WNW	west-northwest
WQC	water quality certification
WSW	west-southwest

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1.0 PURPOSE OF AND NEED FOR ACTION

For license renewal the U.S. Nuclear Regulatory Commission (NRC) has adopted the following definition of purpose and need, stated in Section B of Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications* (NRC 2013a):

> The purpose and need for the proposed action (i.e., issuance of a renewed nuclear plant operating license) is to provide an option that allows for base-load 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 State, utility, and, where authorized, Federal agencies (other than the NRC). Unless there are findings in the safety review required by the Atomic Energy Act or the NEPA environmental review that would lead the NRC to deny a license renewal application, the NRC does not have a role in the energy-planning decisions of whether a particular nuclear power plant should continue to operate.

Nuclear power plants are initially licensed by the NRC to operate up to 40 years, and the licenses may be subsequently renewed [10 CFR 50.51] for periods up to 20 years.

The proposed action is to renew the Fermi 2 operating license (OL), which would preserve the option for DTE Electric Company (DTE) to continue to operate Fermi 2 to provide reliable base-load power throughout the 20-year license renewal period. For Fermi 2 (Facility OL NPF-43), the requested renewal would extend the existing license expiration date from midnight March 20, 2025, to midnight March 20, 2045.

1.1 Environmental Report

NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document (Appendix E of the application) entitled, "Applicant's Environmental Report—Operating License Renewal Stage." This appendix to the Fermi 2 license renewal application (LRA) fulfills that requirement.

DTE has prepared Table 1.1-1 to document, in checklist form, that the 10 CFR Part 51 requirements for information to be provided in an environmental report (ER) in support of an LRA have been met. The requirements regarding information to be included in an ER are codified at 10 CFR 51.45 and 51.53(c). Table 1.1-1 provides the 10 CFR Part 51 regulatory language and regulatory citation, along with the ER section(s) that satisfy the 10 CFR Part 51 requirements.

1.2 Licensee and Ownership

DTE, a wholly owned subsidiary of DTE Energy Company (DTE Energy), is the owner and licensed operator of Fermi 2, located in Monroe County in southeastern Michigan. DTE is the holder of Fermi 2 Facility OL NPF-43 and is the applicant.

Based on 10 CFR Part 51, Appendix B, Table B-1, Footnote 4, transmission lines subject to evaluation of environmental impacts for license renewal are those that connect the nuclear power plant to the substation where electricity is fed into the regional power system and transmission lines that supply power to the nuclear plant from the grid. These transmission lines are located within the Fermi property as shown in Figure 2.2-7. Ownership of these in-scope transmission lines is as follows (DTE 2012a):

- DTE owns the six transmission lines (two three-phase circuits) that transmit power from Fermi 2 to the electrical grid and extend from the Fermi 2 plant (turbine building) to the disconnect switches at the intermediate switchyard (approximately 325 feet). After combining into three lines via a common bus, International Transmission Company (ITC *Transmission*) owns the lines extending from the intermediate switchyard to the 345-kilovolt (kV) switchyard (approximately 315 feet).

- DTE owns the three transmission lines (one circuit) that provide offsite power to Fermi 2 Division II systems and extend from the 345-kV switchyard to the plant (approximately 640 feet).

- ITC *Transmission* owns the three transmission lines (one circuit) that provide offsite power and extend from the 345-kV switchyard to the Fermi 2 circulating water pump house (approximately 1,550 feet).

Table 1.1-1
Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Environmental Report – General Requirements [10 CFR 51.45]		
Description of the proposed action	10 CFR 51.45(b)	2.1
Statement of the purposes of the proposed action	10 CFR 51.45(b)	1.0
Description of the environment affected	10 CFR 51.45(b)	3.0
Impact of the proposed action on the environment	10 CFR 51.45(b)(1)	4.0
Adverse environmental effects which cannot be avoided should the proposal be implemented	10 CFR 51.45(b)(2)	6.3
Alternatives to the proposed action	10 CFR 51.45(b)(3)	2.6, 7.0, and 8.0
Relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity	10 CFR 51.45(b)(4)	6.5
Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented	10 CFR 51.45(b)(5)	6.4
Analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects	10 CFR 51.45(c)	2.6, 4.0, 7.0, and 8.0
Federal permits, licenses, approvals, and other entitlements which must be obtained in connection with the proposed action and describes the status of compliance with these requirements	10 CFR 51.45(d)	9.1
Status of compliance with applicable environmental quality standards and requirements which have been imposed by federal, state, regional, and local agencies having responsibility for environmental protection, including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements	10 CFR 51.45(d)	9.1

**Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements**

Description	Requirement	ER Section(s)
Alternatives in the report, including a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements	10 CFR 51.45(d)	9.2
Information submitted pursuant to 10 CFR 51.45(b) through (d) and not confined to information supporting the proposed action, but including adverse information	10 CFR 51.45(e)	4.0 and 6.3
Operating License Renewal Stage [10 CFR 51.53(c)]		
Description of the proposed action including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with §54.21. The report must describe in detail the affected environment around the plant, the modifications directly affecting the environment or any plant effluents, and any planned refurbishment activities	10 CFR 51.53(c)(2)	2.1, 2.3, and 2.4
Analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for applicable Category 2 issues, as discussed below	10 CFR 51.53(c)(3)(ii)	4.0
Water Resources		
Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.5.1
Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.5.2
Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	10 CFR 51.53(c)(3)(ii)(C)	4.5.3
Groundwater quality degradation (plants with cooling ponds at inland sites)	10 CFR 51.53(c)(3)(ii)(D)	4.5.4
Radionuclides released to groundwater	10 CFR 51.53(c)(3)(ii)(P)	4.5.5

Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Ecological Resources		
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.6.1
Effects on terrestrial resources (non-cooling system impacts)	10 CFR 51.53(c)(3)(ii)(E)	4.6.2
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.3
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.4
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.6.5
Threatened, endangered, and protected species and essential fish habitat	10 CFR 51.53(c)(3)(ii)(E)	4.6.6
Historic and Cultural Resources		
Historic and cultural resources	10 CFR 51.53(c)(3)(ii)(K)	4.7
Human Health		
Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	10 CFR 51.53(c)(3)(ii)(G)	4.9.1
Electric shock hazards	10 CFR 51.53(c)(3)(ii)(H)	4.9.2
Environmental Justice		
Minority and low-income populations	10 CFR 51.53(c)(3)(ii)(N)	4.10.1
Cumulative Impacts		
Cumulative impacts	10 CFR 51.53(c)(3)(ii)(O)	4.12
Postulated Accidents		
Severe accidents	10 CFR 51.53(c)(3)(ii)(L)	4.9.3

**Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements**

Description	Requirement	ER Section(s)
All Plants		
Consideration of alternatives for reducing adverse impacts for all Category 2 license renewal issues	10 CFR 51.53(c)(3)(iii)	4.0 and 6.2
New and significant information regarding the environmental impacts of license renewal of which the applicant is aware	10 CFR 51.53(c)(3)(iv)	4.0 and 5.0

2.0 PROPOSED ACTION AND DESCRIPTION OF ALTERNATIVES

2.1 The Proposed Action

The proposed action is to renew the Fermi 2 OL, which would preserve the option for DTE to continue to operate Fermi 2 to provide reliable base-load power throughout the 20-year license renewal period. For Fermi 2 (Facility OL NPF-43), the requested renewal would extend the license expiration date from midnight March 20, 2025, to midnight March 20, 2045.

In summary, as explained in this ER, there are no changes related to license renewal with respect to operation of Fermi 2 that would significantly change the plant's effects on the environment during the period of extended operation. In addition, no refurbishment or other license-renewal-related construction activities have been identified.

2.2 General Plant Information

The principal structures at Fermi 2 consist of the reactor building, turbine building, auxiliary building, radwaste building, 120-kV and 345-kV switchyards, residual heat removal 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 (Fermi 2012a, Section 1.2.2.4). Figure 3.0-1 shows the general features of the facility and the exclusion area boundary (EAB). No residences are permitted within the Fermi 2 EAB.

2.2.1 Reactor and Containment Systems

2.2.1.1 Reactor System

Fermi 2 uses a General Electric Company (GE) single-cycle, forced-circulation boiling water reactor (BWR) of the BWR 4 Class, with a pressure-suppression Mark I containment. Fermi 2 is similar in design to the following nuclear power plants: Browns Ferry Nuclear Plant Units 1, 2, and 3; Cooper Nuclear Station; Edwin I. Hatch Unit No. 1; and Brunswick Steam Electric Plant Units 1 and 2 (Fermi 2012a, Section 1.1).

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 2014). This measurement uncertainty recapture will increase the net electrical capacity from 1,150 megawatts-electric (MWe) to approximately 1,170 MWe. For purposes of this ER, the discussion of impacts in Chapter 4 and the alternatives analysis in Chapter 7 are based on 1,170 MWe.

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. (Fermi 2012a, Section 1.2.2.5.2)

The reactor core is cooled by demineralized water that enters the lower portion of the core and boils as it flows upward around the fuel rods. The steam leaving the core is dried by steam separators and dryers located in the upper portion of the reactor pressure vessel. The steam is then directed through four steam lines to the turbine. Each steam line is provided with three isolation valves in series: one inside the primary containment, and two outside the primary containment. (Fermi 2012a, Section 1.2.2.5.2)

The reactor recirculation system consists of two recirculation pump loops external to the reactor vessel but 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. (Fermi 2012a, Section 1.2.2.5.3)

The reactor core includes an array of fuel rods that creates heat from a controlled nuclear reaction that occurs when control rods are withdrawn. Fuel for the reactor core consists of enriched uranium dioxide pellets sealed in Zircaloy-2 tubes (Fermi 2012a, Section 1.2.2.5.1). 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 (MWd/MTU), respectively (Fermi 2012a, Section 15.7.4.5.4). As discussed in Section 2.5, reactor refueling occurs on an 18-month cycle.

2.2.1.2 Containment System

The containment consists of dual barriers: the primary containment and the secondary containment. The primary containment surrounds the reactor vessel and also houses the reactor coolant recirculation pumps and piping loops. The secondary containment is the structure that encloses the reactor and its primary containment, and spent fuel storage pool areas.

The primary containment (Mark I containment) is a steel plate pressure vessel consisting of a light bulb-shaped drywell and a torus-shaped pressure suppression chamber. The purpose of the primary containment system is to limit releases of radioactive material to the environment in the event of a nuclear accident so that the offsite doses are below the values stated in 10 CFR 50.67 or 10 CFR Part 100. (Fermi 2012a, Section 1.2.2.9.6)

The primary containment design employs the drywell/pressure-suppression features. If a failure should occur, reactor vessel water and steam would be released into the air space of the drywell. The resulting increase in drywell pressure would force the air/water/steam mixture to be vented into the suppression pool. The steam would be condensed in the pool to limit the pressure increase inside the primary containment.

Cooling systems remove heat from the reactor core, the drywell, and from the suppression pool, thus providing continuous cooling of the primary containment under accident conditions. The release of radioactive materials to the environment is minimized through systems provided to maintain the primary containment integrity and through isolation valves that are actuated to close off potential leakage of radioactive materials through the process lines that are connected to the primary containment structure.

Leakage from the primary containment system is contained within the secondary containment system. The secondary containment system is designed to minimize the release of airborne radioactive materials, and to provide for the controlled, filtered release of the secondary containment atmosphere under accident conditions.

The primary containment, which includes the drywell and suppression pool, has been designed, fabricated, and erected so as to accommodate, without failure, the pressures and temperatures resulting from the double-ended rupture (or equivalent failure) of any coolant pipe within the primary containment. The primary containment encloses the reactor coolant system and associated instrumentation and controls. During accident conditions, valves which isolate systems that penetrate the primary containment become part of the containment barrier.

The secondary containment, a building that contains the primary containment as well as portions of the reactor process systems and refueling facilities, is maintained at a negative pressure under accident conditions to preclude leakage from within secondary containment to external areas. The interior atmosphere is processed to control emissions to the environs so that offsite dose levels are maintained well below the requirements of 10 CFR 50.67 or 10 CFR Part 100.

2.2.2 Cooling and Auxiliary Water Systems

2.2.2.1 General Service Water System

The GSW system provides Lake Erie water to the plant heat exchanger equipment for use in waste heat removal and other plant systems. The equipment supplied by GSW is divided into two major groups: those requiring continuous flow and those requiring intermittent flow. The GSW system is designed to handle all of the continuous flow and 50 percent of the intermittent flow at any given time. (Fermi 2012b, Section 1.1)

The GSW system provides continuous flow to the biocide injection system, the reactor building closed cooling water heat exchangers, the turbine building closed cooling water heat exchangers, the main generator hydrogen coolers, and the main turbine lube oil coolers. The continuous water flow from these heat exchangers is discharged into the CWR for makeup usage. The GSW system also provides intermittent flow to the auxiliary boiler house, the traveling screen backwashing system, the fire protection system (FPS), the lawn sprinkling system, and the residual heat removal (RHR) complex. (Fermi 2012b, Section 1.1) The GSW system is treated with a biocide (sodium hypochlorite) to inhibit slime and algae growth and to control organic and inorganic fouling of heat exchanger and piping surfaces (Fermi 2012a, Section 9.2.1.2).

The GSW system consists of two sluice gates and five GSW pumps; two CWR makeup pumps to provide additional makeup water to the CWR; five strainers on the discharge of the GSW pumps; two traveling screens to remove debris from Lake Erie water before it enters the GSW pump house pit; and piping, valves, instrumentation, and controls necessary for the operation of the system. (Fermi 2012b, Section 1.1) With four GSW pumps operating, the GSW system withdraws an approximate average daily flow of 4.4×10^7 gallons per day (gpd) (31,000 gallons per minute [gpm]) from Lake Erie via the GSW pump house during normal operation (DTE 2013a).

The cooling water intake for Fermi 2 is a shoreline structure (Fermi 2012a, Section 2.2.3.1). Water is withdrawn from the intake channel through a concrete intake canal (Figure 2.2-1), the entrance measurements of which are 33 feet wide and 22.5 feet high. The bottom elevation of the intake canal is 560.0 feet, referenced to the mean Lake Erie water level elevation of 572.5 feet, which results in an average water depth at the entrance to the intake canal of 12.5 feet. The intake canal has a north-south orientation, with intake flow to the north. The intake canal runs approximately 61 feet from the entrance to the submerged opening into the GSW pump house; the last 25 feet of the canal is separated into two channels by a center concrete pier; each of the channels is 15.5 feet wide. The depth of the intake canal gradually increases, reaching a bottom elevation of 554.0 feet, which results in a maximum water depth of 18.5 feet at mean lake level. (LMSE 1993, Section 3.2) Due to silt deposits, the channel is occasionally dredged to maintain adequate water flow (Fermi 1978, Section 5.1.1).

As a note, the GSW intake structure is designed for operation during low lake levels (i.e., less than elevation 568 feet) by drawing water through a 54-inch line from the CWR. On low lake level, if necessary, GSW can be supplied from the CWR by opening the normally closed valve in the 54-inch connecting line between the CWR and the GSW pump intake pit, and simultaneously closing the sluice gates to isolate the intake canal from the intake pit. The GSW and circulating water systems can be operated for a limited period of time in this mode to support plant load reduction and shutdown. (Fermi 2012a, Section 9.2.1.3)

Upon entering the GSW pump house through the two submerged intake openings, water passes through two large, stationary, steel bar trash racks (3-inch clear opening) located in the GSW intake canal and is cleaned of large debris by a pivoted steel rake to prevent damage to the traveling screens (Figure 2.2-2). The traversing trash rake slides down the rack in steel channel guides and is pulled back up again by steel cables connected to electrically driven hoisting machinery. Debris is removed by lowering the rake in the open position to any desired level. On its upward travel, the closed rake collects the trash from the rack and discharges it into the trash cart. The cart is removed from the trash rack assembly and the trash is appropriately disposed off site. (Fermi 1978, Section 3.4.2; Fermi 2010a, page 12)

After passing through the trash racks, the water enters two separate screen bays each measuring 11.75 feet in width. A conventional vertical traveling screen is located at the mid-point end of each bay. (LMSE 1993, Section 3.2) The traveling screens prevent small debris and fish from entering the GSW pump pit. The two traveling screens consist of a series of flat wire woven screens with a 0.375-inch weave mounted on two strands of endless roller chains. The roller chains are rotated by a sprocket wheel. A speed reducer driven by a two-speed motor rotates the chain drive. In the event a traveling water screen becomes jammed, a shear pin protects the drive mechanism. The traveling screens can be operated in either an automatic or manual mode. (Fermi 2010a, pages 12 and 13) In addition, a screen deicing line, tapped off the GSW discharge header just prior to its connection into the main condenser circulating water line, provides warm water to keep ice from forming around the screens. (Fermi 2012a, Section 9.2.1.2)

Intake water velocity surveys were conducted three times at the intake forebay and traveling screens during the 1991–1992 time frame. The surveys corresponded to three-pump (winter, spring) and four-pump (summer) intake flow conditions, respectively. Based on these surveys, no average velocity exceeded 0.5 feet per second (fps) at these two locations (LMSE 1993, Section 7.1), which has typically been considered by the U.S. Environmental Protection Agency (EPA) to adequately minimize the potential for aquatic organisms to become impinged.

As the traveling screens collect debris, the traveling screen backwash system removes the debris from the screens. A smaller traveling screen filters this debris. The water is then directed back to the east and west GSW pits upstream of the larger traveling screens. An auger system removes the debris from the backwash screen and deposits it in a local collection container, which is manually emptied. The backwash screen also filters the water from the GSW pump strainers. (Fermi 2010a, page 16)

The GSW discharge header provides high pressure water to each of the two traveling screens for backwashing. The water is sprayed out through the screens, while they are rotating, to clean them. Debris can be directed to the GSW backwash system or the Fermi 1 overflow canal. (Fermi 2010a, page 15)

The GSW backwash screen system removes debris in the water used to backwash the GSW traveling screens. The clean water is directed back to the inlet of the traveling screen instead of being discharged directly to Lake Erie. This system allows the GSW system to be treated with chemicals to prevent the establishment of zebra mussel colonies. In previous chemical addition systems, only the discharge headers were treated, allowing the formation of zebra mussels in piping upstream of the chemical addition point. Because the system returns the filtered water back to the inlet of the GSW traveling screens and not to Lake Erie, the GSW pump pit also may be treated with chemicals. (Fermi 2010a, page 16)

After passing through the traveling screens, the water then enters the GSW pump pit. The sluice gates provide isolation of the GSW pump pit and Lake Erie. Each sluice gate is a motor-operated sliding gate that is controlled locally. The gates may also be manually operated if the motor fails. (Fermi 2010a, page 13)

The GSW pumps take suction from the pump pit and develop the discharge pressure necessary to maintain flow to all GSW loads. The five GSW pump assemblies are vertical, motor-driven centrifugal pumps. Normal operation varies seasonally. Two GSW pumps are typically in service with three in standby in winter months, and four GSW pumps are typically in service with one in standby in summer months. (DTE 2013a)

The GSW pump discharge strainers remove any remaining debris in the GSW to prevent fouling of the heat transfer surfaces in the continuous loads. Located in the discharge of each GSW pump is a motor-operated, single basket strainer that can be backwashed internally using GSW pump discharge. The strainers can be controlled locally or function automatically on high differential pressure across the strainer. (Fermi 2010a, page 13)

The circulating water makeup system provides makeup water for losses when evaporation exceeds the normal makeup rate from GSW. Two circulating water makeup pumps take suction from the GSW pump pit and discharge through a pipeline connecting the GSW pump pit to the CWR. The GSW pump pit is normally treated with biocide; therefore, when the circulating water makeup pumps are in operation, treated water is being transferred to the CWR. (Fermi 2010a, pages 15 and 16)

2.2.2.2 Circulating Water System

The circulating water system supplies the main condenser with the necessary cooling water at temperatures ranging from nominal 55°F to 94°F. In the winter, the water temperature may be as low as 35°F; however, if that is the case, the cooling towers are bypassed. The circulating water system consists of the main condenser, cooling towers, CWR, and circulating water pumps. (Fermi 2012a, Section 10.4.5.2) A simplified diagram of the circulating water system is shown in Figure 2.2-3.

During normal plant operating conditions, one to five circulating water pumps are in operation depending upon plant heat load and weather conditions. The circulating water pumps are each rated at 180,000 gpm design flow. Each circulating water pump draws water from the CWR through a stationary screen (0.375-inch square mesh) and provides the pressure for water flow through the circulating water system. (Fermi 2011a, page 11)

The stationary stainless steel screens are designed to prevent debris from entering the suction of the circulating water pumps. Water level is measured on either side of the screens. If the difference is too great, less water is available for the circulating water pumps, which could result in pump cavitation and/or a decrease of circulating water flow and possibly condenser vacuum. (Fermi 2011a, page 15) These stationary screens are cleaned, as needed, via a trolley-mounted hoist (crane) that runs on rail car tracks, lifts the screens, and takes them to the screen wash area (Fermi 2011a, page 16).

The circulating water pump pit, inboard of the stationary screens, is designed to be the low point of the CWR where the circulating water pumps are mounted and take suction. The water level is monitored in the circulating water pump pit. A low level could indicate the stationary screens are becoming blocked or that there is a low level in the CWR, which could result in loss of suction and a lowering of condenser vacuum. If CWR level is low, a CWR makeup pump would be started (Fermi 2005; Fermi 2007). A high level would be an indication of possible overfilling of the CRW with the CWR pumps. (Fermi 2011a, page 15) If CWR level is high, the CWR makeup pumps would be shut down and a decant pump started if available (Fermi 2005; Fermi 2007).

Two 12-foot diameter, underground concrete pipes direct circulating water pump discharge flow to the condenser inlet water boxes (Fermi 2011a, page 11). The main condenser is a single pressure, single pass, de-aerating, shell and tube-type heat exchanger. The main condenser shell is provided with two 50-percent capacity tube bundles, which are arranged such that each tube bundle serves half (east or west) of the condenser. The east (or west) section is provided with two inlet connections, one located at each end, and one outlet connection located in the center of the condenser. Circulating water flows into the inlet connections, through the tubes, and exits to the cooling towers from the outlet connections. The condenser is designed for an 18°F circulating water temperature rise from inlet to outlet. (Fermi 2011a, page 12)

Circulating water leaves the condenser via two underground 12-foot concrete pipes that are connected by a 12-foot-diameter equalizing line just before the cooling towers. This equalizing header allows for two cooling towers to be operated with the condenser half isolated and performs the following functions (Fermi 2011a, page 12):

- Allows the use of either cooling tower when the plant is operating at low loads and less than or equal to three circulating water pumps are running.
- Allows circulating water to be equally distributed to each cooling tower.

Circulating water is directed to the two hyperbolic natural draft cooling towers through the cooling tower fill area. Heat is transferred to the air in the cooling tower. Some water evaporates during this process, and the rest is collected in a cold water basin. (Fermi 2011a, page 10)

Fermi 2 has two 50-percent capacity, hyperbolic, natural draft, concrete cooling towers (Fermi 2011a, page 12). The natural draft cooling towers are designed for a wet-bulb temperature of 74°F. The design range (which is the amount the water is cooled) and the design approach (which is the difference between cooled water temperature and air wet-bulb temperature) are both 18°F. (Fermi 2012a, Section 10.4.5.2) The towers each are 400 feet high and 454 feet wide at the base. The towers are the cross-flow type in which air flow is perpendicular to the downward flow of water. The cross-flow fill structure surrounds the bottom portion of the shell. It receives circulating water through two 8-foot-diameter reinforced concrete riser pipes. An open hot water flume then directs the water around the circumference of the structure. Flow from the hot water flume goes to an inner and outer hot water distribution basin. (Fermi 2011a, pages 12 and 13)

Flow through the inner hot water basin is controlled by adjustable weirs. Flow through the outer basin is via plastic radial piping. A two-position flow control valve is located at the outboard end of each pipe and is normally at a minimum setting to direct the design flow (approximately 30 percent) to the outer hot water distribution basin. (Fermi 2011a, page 13)

Water gravity flows to the fill splash surface through metering orifices located in the floor of the hot water distribution basin. This allows the warm circulating water to be properly distributed to the fill splash surface. The fill splash surface consists of a series of baffles, also called splash bars, which interrupt the circulating water as it gravity flows from the cooling tower hot water distribution basin to a cold water basin below. The splash bars serve to break the falling water into a fine spray, allowing the heat in the circulating water to be transferred to the air. As the warmed air rises through the cooling tower shell, it is replaced with cooler, denser air that enters the tower through the louvers. (Fermi 2011a, page 13)

Drift eliminators, located around the inner circumference of the fill area, ensure that the falling water is directed downward and outward rather than into the interior of the tower. In addition, widely spaced concrete louvers are positioned vertically around the external circumference of the fill area to deflect water droplets back into the tower area. (Fermi 2011a, page 13)

A concrete canopy deck closure between the fill structure and the shell serves as a walkway around the flume, but was designed to separate and direct the warm air to the tower shell to create an upward air flow path. Two mud valves are on either side of the hot water flume partition wall. The mud valves are located 180 degrees from the inlet risers. They remain open during tower operation to remove silt buildup that tends to accumulate in this area. (Fermi 2011a, page 13) The silt buildup is periodically removed and disposed off site as nonhazardous waste in accordance with company and site-specific waste management practices discussed in Section 2.2.8.1.

A sloped, reinforced concrete cold water basin is located beneath the shell and flume structures. The cooled water droplets are collected in the cold water basin, which is sloped to assist in tower drainage to the CWR and silt removal. Water then flows to the circulating water pump house located at the south end of the reservoir. (Fermi 2011a, pages 10 and 13)

The CWR is sized to support limited operation of Fermi 2 following loss of makeup water, which might occur with simultaneous conditions of sustained strong westerly winds and low Lake Erie water level; or damage to or blockage of the intake structure. The reservoir base area is nominally 5.5 acres with a mean depth of approximately 17 feet. Approximately 23×10^6 gallons are available at sufficient head for the circulating water pumps and are sufficient for the evaporative losses expected during a limited period of operation and plant shutdown. Following this, if makeup water is still not available, approximately 7.9×10^6 gallons would still remain in the reservoir to supply GSW following shutdown of the circulating water pumps. (Fermi 2012a, Section 10.4.5.2) A makeup water system replaces the circulating water losses caused by evaporation and blowdown. Makeup water is fed into the circulating water system from the GSW system discharge or from the circulating water makeup pumps (normal and standby). (Fermi 2012a, Section 10.4.5.2) The average daily evaporative losses associated with the cooling towers (1.9×10^7 gpd) and CWR (115,200 gpd) as shown in Figure 2.2-4 equates to approximately 13,274 gpm. Of the evaporative losses from the cooling towers, approximately 900 gpm is associated with drift losses (Fermi 1978, Figure 3.3-1).

A decanting blowdown system is provided on the circulating water system. This is required to maintain water quality because the evaporative process in the cooling tower tends to increase the dissolved solids in the circulating water. Blowdown (approximately 10,000 to 30,000 gpm) is taken from the CWR by one, two, or three decanting pumps, monitored in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements as specified in Table 2.2-1 (Outfall 001), and discharged to Lake Erie through the 3-foot-diameter decanting line. (Fermi 2012a, Section 10.4.5.2)

Approximately 22,000 to 28,000 gpm of makeup water are required, depending upon the season of the year. Biocide (typically sodium hypochlorite) is added to the circulating water to retard growth of algae and slime on the inner surfaces of the condenser tubes. Regular monitoring of residual halogens at the decanting line is done to comply with NPDES permit monitoring requirements. A chemical scale inhibitor that has been evaluated to be compatible with materials in the circulating water system is added to minimize formation of scale on internal system surfaces. Sulfuric acid is also added, as needed, to clean/descale the condenser and adjust the system pH. (Fermi 2012a, Section 10.4.5.2) As needed, the condenser is also cleaned mechanically using carbon steel scrapers driven by water.

2.2.2.3 Thermal Discharges

Blowdown water that has been de-chlorinated (sodium bisulfite) is continuously discharged to Lake Erie from the Fermi 2 CWR to control the reservoir water level and the total dissolved solids concentration. Blowdown from the reservoir is discharged to the lake through a buried pipe 3 feet in diameter. This decant line conveys the blowdown water to the on-shore discharge structure (Figure 2.2-5) located at the edge of the vegetation along the lake shore. Exiting the discharge structure, the blowdown water flows east down a gentle riprap-protected slope. (Fermi 1978, Section 5.1.2)

Blowdown associated with the CWR, which is also inclusive of other plant effluents, is discharged via NPDES Outfall 001 (Attachment A, page 3 of 29). The average heated discharge flow is very small compared with the volume of Lake Erie water in the vicinity of Fermi 2; the temperature of the discharge water is typically about 18°F higher than that of the intake water. (NRC 1981, page iv) There are no numerical temperature limits established in the NPDES permit for this outfall other than daily reporting (Attachment A, page 3 of 29). However, there is a cold shock prevention requirement in the NPDES permit which requires the cessation of Fermi 2 thermal inputs to the receiving water to occur gradually so as to avoid fish mortality due to cold shock during the winter months of November through March (Attachment A, Section A.11). This requirement is implemented by the Fermi 2 Circulating Water System operating procedure 23.101 (Fermi 2011b).

2.2.2.4 Residual Heat Removal Complex

The ultimate heat sink is provided by the RHR complex, which consists of a single, highly reliable water supply (reservoir); a means for heat rejection (cooling towers); a standby power source comprising four emergency diesel generators; a makeup and decanting system; and associated pumps, piping, and instrumentation (Fermi 2012a, Section 9.2.5.2). In addition to the CWR, the RHR complex provides cooling for 7 days in conformance with NRC Regulatory Guide 1.27 (Fermi 2012a, Section 2.2.3.1).

The RHR complex reservoir consists of two one-half-capacity reinforced concrete structures, each with a capacity of 3.41 x 10^6 gallons of water at elevation 583 feet. The reservoirs are connected by redundant valved lines to permit access to the combined inventory of the two reservoirs to either RHR division in the event of a mechanical failure in one of the RHR divisions. Each line contains two isolation valves that are remotely operable from the plant main control room. (Fermi 2012a, Section 9.2.5.2.1)

Normal reservoir water level is at elevation 583 feet (New York Mean Tide, 1935). Waterproof construction of the walls is provided to elevation 590 feet (New York Mean Tide, 1935) for protection against flooding from Lake Erie. Each division of the reservoir is fitted with a flood-proof non-siphon overflow to eliminate excess water. Makeup water delivery ports are designed to prevent siphon losses in the event of a break in makeup water supply piping. (Fermi 2012a, Section 9.2.5.2.1)

A two-cell induced-draft cooling tower is located over each division reservoir. Each tower is designed to cool one division of the plant load (one RHR heat exchanger, one emergency equipment cooling water heat exchanger, and two emergency diesel generators), thus providing complete redundancy. Each RHR service water cooling tower cell fan is driven by a 150-horsepower (hp) two-speed motor. The motor is connected to the engineered safety features bus of the emergency diesel generators for a redundant power supply, and is manually started and stopped from the main control room. (Fermi 2012a, Section 9.2.5.2.2)

The GSW system provides makeup water to replace evaporation and blowdown losses during normal shutdown cooling. Normal water level in each division of the reservoir is maintained automatically by regulating supply valves. (Fermi 2012a, Section 9.2.5.2.4)

The blowdown system is provided to control the buildup of solids in the reservoir water during normal shutdown cooling. The piping is designed to prevent siphoning from the reservoirs in the case of a line break or other incident. Decanting pumps route blowdown from the RHR reservoir to the CWR. (Fermi 2012a, Section 9.2.5.2.4)

2.2.2.5 Potable Water System

The potable water system for Fermi 2 consists of an underground distribution header with branches to the various facilities that require service. Fermi 2 demand is supplied by the Frenchtown Water System, which is normally transferred to the 100,000-gallon elevated storage tank on site. Potable water is used at Fermi 2 to supply the demineralized water makeup system; sanitary plumbing; drinking fountains; washrooms; kitchen facilities; safety showers; and the turbine building heating, ventilation, and air conditioning evaporative coolers. (Fermi 2012a, Section 9.2.4.2)

2.2.2.6 Fire Protection Water System

The dedicated fire protection water supply is obtained from a 2,500-gpm electric-driven fire pump and a 2,500-gpm diesel-driven fire pump located in the GSW pump house. Either fire pump supplies the required fire protection water demands. The diesel- and electric-driven fire pumps are normally on standby, because the fire mains are supplied with makeup water and pressurization from the FPS jockey pump which takes suction from the GSW pump header. The FPS jockey pump operates continuously, maintaining pressure in the fire main. If fire header pressure falls below GSW header pressure, makeup water is also supplied via the cross-tie line between GSW and the FPS. (Fermi 2012a, Section 9.5.1.2.1)

The distribution fire main in the yard surrounding the plant is a 12-inch underground header, which is buried below the frost line to prevent freezing. This 12-inch fire main is designed to provide the required water demands for the automatic sprinkler systems and 500 gpm for all hose demands. (Fermi 2012a, Section 9.5.1.2.1)

Underground branches from the fire main loop supply water to standpipes and hose stations in the reactor, turbine, radwaste, auxiliary, RHR complex, service, ISFSI equipment storage, and warehouse buildings within the protected area. A separate branch with an isolation valve supplies warehouses, fire hydrants, and other buildings. (Fermi 2012a, Section 9.5.1.2.1)

2.2.3 Radioactive Waste Management

2.2.3.1 Liquid Radwaste System

The liquid radwaste system 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 re-collected in the system. The system is capable of handling anticipated quantities of liquid radwaste without affecting the normal operation or availability of the plant. (Fermi 2012a, Section 11.2)

At times, the liquid radwaste system may produce water that may not be required for reuse in the station's water balance, in which case the system 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 2012a, Section 11.2.2)

Sections 2.2.3.1.1, 2.2.3.1.2, and 2.2.3.1.3 below provide a description of the liquid radwaste system. However, there are three subsystems that are not presently being used, and have not officially been retired, or abandoned, and they could be made operational at some time in the future. Therefore, the full description and usage for these subsystems have been provided. The discussion below regarding these subsystems is all technically correct; however, these items (and therefore their flow paths) are not considered operational at this time. These three subsystems or components (Fermi 2012a, Section 11.2.1) are as follows:

- Radwaste evaporator and supporting components.
- Two radwaste etched-disc filters and supporting components.
- Two radwaste oil coalescers and supporting components.

2.2.3.1.1 Floor Drain Collector Subsystem

The floor drain collector (FDC) subsystem receives periodic and uncontrolled inputs from a variety of plant floor drain sources. The sources to this subsystem have been segregated from the waste collector subsystem because their water quality is probably poor, has high conductivity, and normally contains higher contents of suspended and dissolved solids. The activity content is generally lower than that of the waste collector subsystem. (Fermi 2012a, Section 11.2.2.1)

The chemical nature of the FDC subsystem inputs is also highly variable. The effluent from the chemical waste tank is particularly important to the overall stream process requirements because it is a source of high concentrations of dissolved solids. Periodic and variable quantities of oil and grease are also accommodated by this subsystem. Most of this type of contaminant is removed by the FDC oil coalescer when it is in service. Otherwise, but to a lesser extent, removal is accomplished by the precoat filters. (Fermi 2012a, Section 11.2.2.1)

Evaporators, when they are in service, can be used to separate the FDC subsystem low-purity liquid by evaporation and condensation into a concentrated liquid that is fed to the solid radwaste system and a high-purity distillate that is fed to the FDC and waste collector demineralizers. Both the FDC and waste collector streams are normally passed through both demineralizers in series. Both subsystems offer independent etched-disk filters and oil coalescers, when they are in service, to remove suspended solids and oil from the input liquids. In addition, precoat filters are provided for each stream but are not as volume-efficient because of the larger amount of solid radwaste they generate. The two streams are connected by a cross tie to allow the precoat filter or the etched-disk filter (when in service) in the other stream to be used as a backup. (Fermi 2012a, Section 11.2.2.1)

The estimated design-basis daily volume inputs for the FDC subsystem total 15,219 gallons, whereas the maximum daily volume input to this subsystem is calculated to be 42,284 gallons. For the maximum volume input, it is assumed that the probability of the simultaneous occurrence of two or more volume input maximums is extremely low. Thus, the maximum is assumed to be the largest of the individual stream maximums plus the design daily inputs of the other streams. For this subsystem, the largest maximum daily volume input is estimated as 28,800 gallons from the drywell floor drain sump. This amount, when added to the design daily volume inputs from the other FDC subsystem inputs, yields the maximum daily volume input value of 42,284 gallons. (Fermi 2012a, Section 11.2.2.1)

The normal collection point of the inputs to the FDC subsystem is the FDC tank, which has a working volume of about 20,000 gallons. The design basis daily input of 15,219 gallons can be accommodated for 1 day in the unlikely event of simultaneous failure of the redundant tank pumps. During the infrequent periods of anticipated maximum inputs, the waste surge tank serves as an alternative collection point. This tank has a working volume of 65,700 gallons and could contain the entire volumetric input (42,284 gallons) to the FDC subsystem for 1 day during the maximum anticipated operational occurrence. Flow to the waste surge tank is accomplished by pumping from the FDC tank using the FDC pumps and the cross tie between the FDC subsystem and the waste collector subsystem. (Fermi 2012a, Section 11.2.2.1)

Liquid radwaste system processing is normally expected to be performed any time of day, 7 days a week; thus, for the design daily input case, an average FDC subsystem process rate of only 10.5 gpm would be required. For periods of maximum inputs, the FDC subsystem is capable of processing at a rate of at least 30 gpm. The processing rates account for periods of equipment unavailability during filter backwashes, resin replacement, and equipment maintenance. Generous liquid radwaste system subsystem interconnects, process equipment redundancy, and bypass capabilities provide maximum operational flexibility during periods of large input surges or unexpected equipment failures. (Fermi 2012a, Section 11.2.2.1)

2.2.3.1.2 Waste Collector Subsystem

The waste collector subsystem receives periodic 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 waste collector inputs are probably of a higher purity (lower conductivity and suspended solids) than the FDC inputs. The activity concentration in the waste collector subsystem tends to be higher than in the FDC subsystem. (Fermi 2012a, Section 11.2.2.2)

Like the FDC subsystem, the chemical nature of the waste collector subsystem inputs are variable, but should not be subject to the large fluctuations that may occur in the FDC subsystem. It is assumed that oil and grease is present in the waste collector subsystem input, although this should occur much less frequently than in the FDC subsystem. Oil coalescers are included to provide for oil removal before ion exchange when they are in service. (Fermi 2012a, Section 11.2.2.2)

The waste collector subsystem process equipment is designed to also handle liquid input from the solid radwaste system. This consists of the discharge from the waste surge tank, whose primary function is to collect clarified liquid from the waste clarifier tank. Most of the clarified liquid is produced by the phase separator tank decant operation within the solid radwaste system. The solid radwaste system input to the waste collector subsystem enters downstream of the waste collector tank and, therefore, has no bearing on the size of the waste collector tank. (Fermi 2012a, Section 11.2.2.2)

The combined result of all equipment drain inputs to the waste collector subsystem is represented by the waste collector tank effluent (Fermi 2012a, Section 11.2.2.2).

The estimated design-basis daily volume inputs for the waste collector subsystem total 28,805 gallons. The maximum daily equipment drain volume input to this subsystem is calculated to be 48,846 gallons. It is assumed that the probability of the simultaneous occurrence of two or more input maximums is extremely low; therefore, the maximum input is assumed to be the largest of the individual stream maximums plus the design daily volume inputs of the other streams. For this subsystem, the largest maximum daily equipment drain volume input is 28,800 gallons from the drywell equipment drain sump. This amount, when added to the design daily volume inputs from the other waste collector subsystem inputs, yields the maximum daily volume input value of 48,846 gallons. (Fermi 2012a, Section 11.2.2.2)

The collection point for the equipment drain volume input to the waste collector subsystem is the waste collector tank, which has a working volume of about 23,400 gallons. The waste surge tank (which has a working volume of about 65,700 gallons) serves as the backup collection point for excessive equipment drain volume input to the waste collector subsystem. (Fermi 2012a, Section 11.2.2.2)

2.2.3.1.3 Side Stream Liquid Radwaste Processing Subsystem

The side-stream liquid radwaste processing subsystem processes primarily chemical waste tank contents prior to forwarding to the floor drain collector tank (FDCT). In addition, it processes liquids, such as sludge from various building sumps, water collected in 55-gallon drums from the standby liquid control system rinses during refueling outages, and water from mopping the building floors. (Fermi 2012a, Section 11.2.2.3)

The side-stream liquid radwaste processing subsystem includes two 45-kilowatt (kW) evaporators and two 20-gpm trains of post-treatment system (PTS). Each train of PTS consists of a granulated active charcoal filter; an ultraviolet (UV) total organic carbon reducing system; a mixed bed filter; and associated tanks, pumps, and other system components. (Fermi 2012a, Section 11.2.2.3)

Each evaporator processes liquids in 55-gallon batches at a nominal rate of 0.2 gpm when it is in service. The vapor from the evaporator is condensed in a water-cooled condenser and collected in the post-treatment inlet batch tank. The evaporator bottoms are processed and shipped as solid radwaste. Liquids from the post-treatment inlet batch tank are processed in one or both trains of the PTS, at a nominal rate of 20 gpm per train. PTS can process FDCT liquids at a nominal 40 gpm rate when needed, using both streams of the system. (Fermi 2012a, Section 11.2.2.3)

The PTS processes consist of carbon adsorption columns, photochemical oxidation of soluble organics using UV light reactors and mixed-bed filtration in succession. Particles above 5 microns in size and approximately 90 percent of the total organic carbon are removed by the carbon filters. The effluents from the carbon bed filters flow through one or both of the UV reactors. The UV reactors oxidize soluble organics into organic acids that can be more effectively removed by adsorption or ion exchange. The UV also kills bacteria, if present, in the liquid stream. The effluents from either of the UV reactors flow through one or both mixed bed filters. The mixed bed filters remove the soluble organic acids generated by the UV reactors via adsorption and ion exchange. (Fermi 2012a, Section 11.2.2.3)

The processed liquid is collected in the sample batch tank and returned to the FDCT via radwaste building basement floor drain system (Fermi 2012a, Section 11.2.2.3).

2.2.3.1.4 Liquid Effluent Releases

All normal liquid release pathways to the environment are continuously monitored to ensure that potential doses to the general public would be well within the allowable limits of 10 CFR Part 20 and 10 CFR Part 50, Appendix I (Fermi 2012a, Section 11.2.3).

Controls for limiting the release of radiological liquid effluents are described in the Fermi 2 Offsite Dose Calculation Manual (ODCM). Controls are based on (1) concentrations of radioactive materials in liquid effluents and (2) doses to members of the public. (Fermi 2010b, Section 3/4.11.1)

Radioactive liquid wastes are subject to the sampling and analysis program described in the Fermi 2 ODCM (Fermi 2010b, Table 4.11.1.1.1-1).

As a note, the last time a planned liquid effluent radwaste discharge occurred at Fermi 2 was in 1994 (Fermi 2012c, page 9). Since that time, Fermi 2 has operated as a zero-discharge liquid effluent radwaste release facility with a goal to continue operating in this manner in the future.

2.2.3.2 Gaseous Radwaste System

The design objectives of the gaseous radwaste system are to process and control the release of gaseous radioactive effluents to the site environs so that offsite concentrations are a small fraction of the concentration limits as defined in 10 CFR Part 20, Appendix B, and are as low as reasonably achievable (ALARA), as required by 10 CFR Part 50, Appendix I; and to operate within the controls established in the ODCM radiological effluent controls. (Fermi 2012a, Section 11.3.1)

2.2.3.2.1 Offgas System

The noncondensibles removed from the main condenser are a source of radioactive gaseous waste from the plant. To reduce the releases from this source, the offgas system has been incorporated into the plant. (Fermi 2012a, Section 11.3.2.7) These releases result in dose rates that are a small fraction of the plant's offsite dose limits.

Above low power, the offgas system processes the condenser offgas by delaying the offgas so that significant decay of radionuclides is allowed before it is released from the plant. The delay is provided by charcoal, which impedes the flow of all gases; however, heavy gases such as krypton and xenon are affected more than are lighter gases. The charcoal provides about a 1-day delay for krypton and about a 16-day delay for xenon. (Fermi 2012a, Section 11.3.2.7.5)

During plant operation, offgas discharged from the steam-jet air ejectors is diluted with steam to keep hydrogen concentrations below 4 percent. The gas is heated by steam in the preheater, and enters the recombiner, where the hydrogen and oxygen are recombined catalytically into water. Diluting the gas with steam controls the hydrogen concentration and also provides control over temperature rise during the recombination. After recombination, the gases are cooled and dehumidified. The gas then enters a 2.2 minute (nominal) delay pipe, which is followed by a sand filter. The gas is further cooled and enters the ambient temperature charcoal adsorbers. Chilling and drying the air improves the charcoal adsorbers' performance. The discharge from the adsorber system is filtered mainly to remove any charcoal fines that may have been carried out of the last charcoal bed. The gas is then pumped into the offgas discharge piping. The system vacuum pump is used to maintain a slightly negative pressure throughout the system, thus ensuring that any leakage would be into the system. The effluent from the offgas system is discharged from the plant after dilution in the reactor building ventilation system exhaust. (Fermi 2012a, Section 11.3.2.7.5)

The condenser offgas system removes most of the activity from activation gases and reduces the activity due to fission gases by a factor of at least 90 (when compared to the 30-minute mixture). Essentially all of the hydrogen is removed from the offgas. (Fermi 2012a, Section 11.3.2.7.5)

The ability to continuously process condenser offgas in the case of equipment failure is ensured by providing redundant standby equipment for each component in the offgas system, except for the six charcoal beds. Because the charcoal beds are passive equipment at ambient temperature and are at a slightly negative pressure, failure of a charcoal bed is unlikely. (Fermi 2012a, Section 11.3.2.7.5)

The hydrogen concentration in the system is controlled by the addition of dilution steam upstream of the recombiner. Oxygen is injected into the 18-inch offgas manifold to ensure that hydrogen injected into the feedwater system via the hydrogen water chemistry system is recombined. Free hydrogen is essentially nonexistent at the outlet of the recombiner. Increased hydrogen concentration, which is measured in the 2.2-minute delay pipe, and the lack of a temperature difference (ΔT) across the recombiner would provide indication of a recombiner failure. In the event of a recombiner failure, a switchover to the redundant hydrogen recombiner subsystem would be made. (Fermi 2012a, Section 11.3.2.7.5)

2.2.3.2.2 Gaseous Effluent Releases

Controls for limiting the release of radiological gaseous effluents are described in the ODCM. The gaseous radwaste system is used to reduce radioactive materials in gaseous effluents before discharge to meet the dose design objectives in 10 CFR Part 50, Appendix I. In addition, the limits in the ODCM are designed to provide reasonable assurance that radioactive material discharged in gaseous effluents would not result in the exposure of a member of the public in an unrestricted area in excess of the limits specified in 10 CFR Part 20, Appendix B. (Fermi 2010b, Section 3/4.11.2)

Radioactive gaseous wastes are subject to the sampling and analysis program described in the Fermi 2 ODCM (Fermi 2010b, Table 4.11.2.1.2-1).

2.2.3.3 Solid Radwaste System

The objectives of the solid radwaste system are to collect, process (solidify or dewater), and package liquid and wet solid wastes and slurries from the liquid radwaste system, the reactor water cleanup system, the fuel pool cooling and cleanup system, and the condensate demineralizer system. The solid radwaste system can collect and process the increased volumes of wastes and slurries produced during anticipated operational occurrences without affecting the operation or availability of the plant. It processes, packages, handles, and temporarily stores radioactive wastes and provides a means to transfer solidified or dewatered wastes to vehicles for transport ultimately to an offsite burial facility. (Fermi 2012a, Section 11.5.1)

A subsystem also packages, stores, and prepares for transport compressible dry wastes generated during operation of the plant. These wastes include paper, rags, and other disposables normally processed conveniently by compaction. The process equipment and disposable containers prevent the release of significant quantities of radioactive material, and keep the radiation exposure of plant personnel and the general public ALARA. (Fermi 2012a, Section 11.5.1)

Currently, full-time "solid radwaste" processing takes place in the onsite storage facility (OSSF) with a vendor-supplied system (Fermi 2012a, Section 11.5).

2.2.3.3.1 Vendor-Supplied Solidification or Dewatering System

The Fermi 2 solid radwaste system has been set up and hard-piped so that a full-time (mobile) vendor system can be used. The portable solid waste management system is supplied and operated by the vendor. The types and quantities of waste to be processed are the same as for the Fermi solidification system. (Fermi 2012a, Section 11.5.6)

Depending upon the particular system and the expected radiation levels, portable (vendor) radwaste processing in the OSSF can take place in the pallet-loading room, in the storage bays, in the laydown areas immediately adjacent to the truck bay, or in the shielded container-processing room. It is expected that primarily this latter room is to be used for such processing. If large bulk cement and chemical containers are used for such processing, however, they may be located outside of the truck bay door. These areas of the OSSF were specifically designed and constructed to contain and handle mobile process systems. Concrete floors and walls of this region are coated, and drains are routed back to the liquid radwaste system. The remote-operated overhead crane is available to move equipment onto or from trucks located in the truck bay. The basic design of these areas and the methods of system operation have incorporated features to maintain operator exposures ALARA. Permanent piping installed in the shielded OSSF pipe tunnel transports the radioactive process fluid directly to the vendor's equipment. (Fermi 2012a, Section 11.5.6)

If solidification of waste is performed, pretreatment of the waste with chemical additives may be conducted in accordance with values derived from a process control program. Solidification agents are then added and the waste is allowed to cure to complete the solidification process. (Fermi 2012a, Section 11.5.6)

If dewatering of the waste is performed, the waste is transferred into a steel liner or high integrity container (HIC) containing an internal underdrain assembly. Vacuum is applied to the underdrain system. Liquid from the underdrain system is sent back to the liquid radwaste system by a dewatering pump while the solids are trapped in the container. Some vendors provide additional accelerated dewatering capability. This accelerated capability is achieved by recirculating air at high velocity through a liner or HIC. Procedures ensure no drainable liquid at the time of shipment and < 1 percent drainable liquid in HICs or < 0.5 percent drainable liquid in steel liners upon receipt at the burial site. (Fermi 2012a, Section 11.5.6)

The liners or HICs are suitable for transportation and burial at an approved burial facility. Additionally, the liners and HICs are compatible with numerous approved shipping casks if the liner or HIC requires shipment in a cask. (Fermi 2012a, Section 11.5.6)

2.2.3.3.2 Onsite Storage Facility

The OSSF is essentially an above-grade structure for holding low-level waste (LLW). It provides interim storage capacity for an amount of waste estimated to be generated in 5 years of plant operation. This surge capacity is primarily intended to be used to allow Fermi 2 to continue operating during a period when no offsite disposal facilities are available. Under normal conditions, when offsite disposal is available, a portion of the storage facility is used as a staging area for waste. The OSSF also includes space for a dry active waste compactor, offices, a control room, and rooms for housing the radwaste solidification system's asphalt storage tank and pumps. Provision is also made to allow processing of radwaste by transportable vendor-supplied equipment inside the facility. (Fermi 2012a, Section 11.7.1)

Normally, the radioactive wastes to be stored in this facility are of three general types: dry active wastes, processed wastes, and miscellaneous unprocessed wastes. Storage containers for processed waste could be liners, HICs, or drums. HICs are used for processed waste that is potentially corrosive. Containers for dry active wastes could be drums, low-specific activity boxes, or other appropriate containers. Waste with the potential for gas generation is stored in either vented containers, or containers that are vented at least every 5 years within the OSSF. (Fermi 2012a, Section 11.7.1.2)

The dry wastes, which are generally of low radioactivity, can normally be handled by direct contact. These wastes normally are collected in containers or bags located in various zones around the plant. The filled containers are closed and then transferred to the OSSF. These wastes are of two types: compressible and noncompressible. The compressible wastes are normally processed and packaged. The noncompressible wastes are manually packaged into containers meeting transportation criteria and stored until shipment. (Fermi 2012a, Section 11.7.1.2)

This facility is also used for the storage of mixed wastes, hazardous wastes, and radioactive wastes in accordance with applicable regulations and requirements (Fermi 2012a, Section 11.7.1.2).

2.2.3.4 <u>Low-Level Mixed Wastes</u>

Low-level mixed wastes generated at Fermi 2 may consist of paint debris, oil laboratory waste, halogenated oil, grease, solvents, parts cleaner filters, and aerosol cans. Prior to storage, these wastes are managed appropriately in accordance with Fermi 2's waste management procedure to ensure compliance with applicable regulatory requirements and good practices (Fermi 2010c). Once the wastes are moved to the OSSF, they are managed in accordance with Fermi 2's low-level mixed waste management procedure which prescribes the storage and disposal requirements. Fermi 2 operates under the conditional exemption for low-level mixed waste storage and disposal per Michigan Administrative Code R299.9822. (Fermi 2012d) Liquid phase wastes are transported to an offsite facility licensed to accept and manage the wastes. Solid and semi-solid wastes are typically stored until shipped offsite for disposal.

2.2.3.5 Radwaste Storage-License Renewal Term

Fermi 2 has developed long-term plans which would ensure that radwaste 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. Long-term plans, including during the license renewal term, do not include the need to construct additional OSSFs to accommodate generated radwaste.

LLW is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both dry active waste (DAW) and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated hardware. The majority of LLW generated would be Class A waste and can be shipped to licensed processors, such as Energy Solutions in Oak Ridge, Tennessee, for reduction, and repackaging, or shipped directly to a Class A disposal facility such as Energy Solutions LLC in Clive, Utah. Classes B and C wastes constitute a low percentage by volume of the total LLW generated and are currently stored in the OSSF at Fermi 2. The Waste Control Specialist LLC Facility in Texas is licensed for disposal of Classes A, B, and C wastes; therefore, this facility could be utilized for disposal of Fermi 2 Class B and Class C wastes as needed in the future. (DTE 2013b) Disposal of greater than Class C waste is the responsibility of the federal government.

2.2.3.6 Spent Fuel Storage

The Fermi 2 ISFSI storage pad is a 141-foot x 141-foot square reinforced concrete structure that is 2 feet thick and designed to accommodate 64 dry storage casks. (Fermi 2012a, Section 9.1.2.2.3) However, four of the positions will remain empty to accommodate cask movements, so actual capacity is limited to 60 dry storage casks. There is a subsurface drainage system surrounding the pad to help prevent the soil under the pad from being displaced as a result of freeze and thaw cycles. The subsoil in the area to the north of the pad has also been prepared for possible future expansion of the pad to allow additional placement of up to 32 dry storage casks (Fermi 2012a, Section 9.1.2.2.3), which would accommodate spent fuel generated during the license renewal period. There is currently no spent fuel being stored on the ISFSI pad (DTE 2012b).

Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS): Addendum to Main Report (NUREG-1437, Volume 1, Addendum 1) (NRC 1999) noted that 10 CFR 51.23 codifies the NRC's generic determination that storage and disposal of spent fuel during the licensed life for operation of nuclear power plants (which may include the term of a renewed license) can be accomplished safely and without significant environmental impact. In accordance with this determination, the GEIS concluded that no discussion of environmental impacts of spent fuel storage for the period following the term of a reactor operating license, including a renewed license, was required. In 2010, the Commission updated and continued the provisions in 10 CFR 51.23 (referred to as the Waste Confidence Decision Update and Temporary Storage Rule, or Waste Confidence Decision Update and Rule) based on experience in the storage of spent nuclear fuel and the uncertainty in the siting and construction of a permanent geologic repository for the disposal of spent nuclear fuel (75 FR 81031). On June 8, 2012, the D.C. Circuit Court of Appeals vacated and remanded the Waste Confidence Decision Update and Rule (DC Circuit 2012). In response, the NRC Commissioners suspended the issuance of licenses if the associated National Environmental Policy Act (NEPA) review depended on the Waste Confidence Decision Update and Rule. Because the NRC considers this a generic issue that is best addressed through rulemaking, the staff was directed to conduct a rulemaking to address the D.C. Circuit Court's concerns. This effort by the NRC staff is ongoing. The updated rule and supporting environmental impact statement (EIS) will provide the NEPA analyses of waste-confidence-related human health and environmental impacts needed to support renewal of nuclear power plant operating licenses, including Fermi 2.

2.2.4 Transportation of Radioactive Materials

Fermi 2 radioactive waste shipments are packaged in accordance with NRC [10 CFR Part 71] and U.S. Department of Transportation (USDOT) [49 CFR Parts 173 and 178] requirements. The type and quantities of solid radioactive waste generated at and shipped from Fermi 2 vary from year to year, depending on plant activities. Fermi 2 currently transports radioactive waste directly for disposal at a facility such as the Energy Solutions facility in Clive, Utah, or to a licensed processing facility such as that owned by Energy Solutions in Oak Ridge, Tennessee, where the wastes are further processed prior to being sent to a disposal facility. Fermi 2 may also receive Fermi 2-generated material from an offsite processing facility back to the plant site for reuse or storage.

2.2.5 Radiological Environmental Monitoring Program

The Fermi 2 Radiological Environmental Monitoring Program (REMP) is designed for the following:

- Analyzing important pathways for anticipated types and quantities of radionuclides released into the environment.
- Considering the possibility of a buildup of long-lived radionuclides in the environment and identifying physical and biological accumulations that may contribute to human exposures.
- Considering the potential radiation exposure to plant and animal life in the environment surrounding Fermi 2.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

The Fermi 2 REMP was established in 1978 prior to the station becoming 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 (Fermi 2012c, Tables A-1 through A-9). The REMP utilizes 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 only naturally occurring radioactivity. Fermi 2 personnel compare indicator results with control and preoperational results to assess any impact Fermi 2 operation might have had on the surrounding environment.

2.2.6 Groundwater Protection Program

In May 2006, the Nuclear Energy Institute (NEI) approved the Groundwater Protection Initiative (GPI), an industry-wide voluntary effort to enhance nuclear power plant operators' management of their groundwater protection program (NEI 2007). Industry implementation of the GPI identifies actions to improve utilities' management and response to instances where the inadvertent release of radioactive substances may result in detectable levels of plant-related materials in subsurface soils and water, and also describes communication of those instances to external stakeholders. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, onsite groundwater monitoring, and remediation. In August 2007, NEI published updated guidance on implementing the GPI as NEI 07-07, *Industry Ground Water Protection Initiative-Final Guidance Document* (NEI 2007). The goal of the GPI is to identify leaks of licensed material as soon as possible.

In conjunction with the GPI, Fermi 2 performs groundwater monitoring from 87 onsite locations, as shown in Figure 2.2-6, to monitor for potential radioactive releases via groundwater pathways at the site in accordance with site procedures (Fermi 2010d; Fermi 2010e). Results and impacts associated with this program are evaluated in Section 4.5.5, with current site groundwater conditions described in Section 3.5.

Elements of the GPI related to site characterization, risk evaluation, groundwater monitoring program, precipitation studies, remediation protocols, voluntary reporting, and briefings to external stakeholders of accidental releases of licensed material to the environment are conducted and implemented in accordance with Fermi 2's Integrated Groundwater Protection Program procedure (Fermi 2010d).

In addition to the GPI, the Underground Piping and Tanks Integrity Initiative, published as NEI 09-14, *Guideline for the Management of Underground Piping and Tank Integrity*, was developed and is being implemented by the industry to proactively manage the reliability of underground piping and tanks with a goal of protecting structural integrity and preventing leaks (NEI 2010). Fermi 2 initiated compliance with this initiative in accordance with the schedule and program elements cited in NEI 09-14 (Revision 1). Fermi 2 has completed the risk ranking of buried piping segments, developed an inspection plan for underground piping and tanks, and is currently implementing inspections in accordance with the schedule outlined in the Underground Piping and Tanks Integrity Initiative.

2.2.7 Meteorological System

The onsite meteorological open-latticed tower has a height of 60 meters (197 feet) above plant grade. The influence of terrain near the base of the tower on temperature measurements is minimal. The tower is situated in a relatively flat area. A small climate-controlled instrument shelter is located at the base of the onsite meteorological tower. The tower is located sufficiently close to the shoreline of Lake Erie such that it can measure the dynamic onshore flow conditions that could affect gaseous effluent releases. This effect on the dispersion conditions is representative of the site, because the facility itself is located along the western shoreline of Lake Erie. (DTE 2013c)

2.2.7.1 Meteorological Sensors

The instrumentation on the meteorological tower consists of the following: horizontal wind speed and horizontal wind direction sensors at the 10- and 60-meter levels, mechanically aspirated air temperature sensors at the 10- and 60-meter levels, vertical wind speed sensors at the 10-meter level, a 10- to 60-meter vertical air ΔT translator, and a dew point temperature sensor at the 10-meter level. In addition, a heated tipping bucket rain gauge monitors precipitation at ground level near the base of the meteorological tower, and a pyranometer intended for routine total global solar irradiance measurements is located on the southeast corner of the instrument shelter. Table 2.2-2 provides a listing of the meteorological parameters monitored on the Fermi onsite meteorological tower, the sampling height(s), as well as the sensing technique for the primary and secondary systems. (DTE 2013c)

To minimize data loss due to freezing conditions, external heaters are installed on the primary and secondary wind sensors. The heaters are thermostatically controlled and are of the slip-on/ slip-off design for easy attachment. The wind sensor specifications are not affected by these heaters. A windscreen is mounted around the precipitation gauge to minimize the wind-caused loss of precipitation catch. (DTE 2013c)

2.2.7.2 Data Recording Equipment

After the data are collected by the sensors, the output is routed through signal conditioning equipment and directed to the control room computer system and digital data recorders. The digital recorders sample the data at least once every 5 seconds. The signal conditioning equipment and digital recorders are located at the base of the 60-meter meteorological tower in an environmentally controlled instrument shelter. The signal conditioning equipment in the instrument shelter collects and sends data continuously to the control room computer system for analysis and archiving. The digital recorders sample the data at least once every 5 seconds and serve as a backup in the event the data path to the control room computer system is not available. (DTE 2013c)

Electrical power is supplied to the primary and secondary instrument trains by independent power supplies. One source of power is Fermi 2; the other is an offsite source. If one supply fails, the other automatically supplies the necessary power for both instrument trains. Precautions are taken to minimize lightning damage to the system. Two of the three legs of the tower are grounded, and the signal cables are routed through a lightning protection panel. Each signal line is protected by transient protection diodes specifically designed to stay below the individual line voltage breakdown point. (DTE 2013c)

2.2.7.3 Instrument Calibration

The sensors, electronics, and recording equipment are calibrated on a 6-month basis. More frequent onsite calibrations are performed if the past operating history of the sensor indicates it is necessary. Any necessary adjustments are made and the equipment that malfunctioned is either corrected on site or replaced with similar spare equipment. After any adjustments or repairs, the calibration is repeated. Electronic calibrations are performed by simulating the output of each of the sensors with precision test equipment and monitoring the recorded values for each parameter. The resistance response to specified temperatures for the temperature thermistors is performed in the meteorology laboratory using calibrated measurement equipment. The calibrated temperature thermistor is then used to replace the existing sensor installed on the meteorological tower. The response of the calibrated temperature thermistor is compared to an ambient temperature measurement taken at the sensor with a calibrated thermometer. (DTE 2013c)

The dew point sensor is calibrated by comparing the result reported by the dew point sensor against the dew point measured by a calibrated, portable dew point hygrometer at the aspirator inlet (DTE 2013c).

The precipitation sensor is calibrated by comparing the result reported by the precipitation sensor to a known volume of liquid (DTE 2013c).

The calibration of the wind speed sensors is performed in a wind tunnel by an outside vendor using calibrated measurement equipment and a National Institute of Standards and Technology (NIST) traceable wind tunnel anemometer. In the wind tunnel, the wind velocity is calibrated at specific points and the starting threshold is determined. The calibrated wind speed sensor is then used to replace the existing sensor installed on the meteorological tower. (DTE 2013c)

The calibration of the wind direction sensor is performed by an outside vendor using calibrated measurement equipment. The calibration does not include a specific test of the starting threshold for wind direction. The starting threshold of the calibrated wind direction sensor is assessed at the time of installation by rotating the wind direction sensor body with the shaft in the horizontal plane and observing that the vane remains stationary. A new bearing is installed in the wind direction sensor if required. After installation of the new wind direction sensor, the directional alignment of the wind direction sensor is checked by sighting a known alignment point and comparing the result reported by the wind direction sensor to a known response. The records documenting results of calibrations, drift from calibrations, and corrective action taken for the digital instrumentation are kept and filed on site. (DTE 2013c)

2.2.7.4 Instrument Service and Maintenance

Visits are made monthly to the 60-meter tower to make a visual inspection of the sensors, as well as the data output and recording equipment in the instrument shelter, to see if they are damaged and need maintenance. In the event the sensors or monitoring equipment is found damaged or malfunctioning, the equipment is replaced or corrected in a timely fashion. A stock of spare parts and equipment is maintained to minimize and shorten the periods of outages. After components are replaced, the same precision test equipment used for calibration is used to check the instrument to ensure reliable operation. Records documenting results of major causes of instrument sensor outages and other malfunctions of the meteorological monitoring system are kept and filed on site. A similar inspection and maintenance program is in place for the computers and equipment located in the control room. (DTE 2013c)

2.2.7.5 Data Reduction and Transmission

The Fermi 2 meteorological system consists of two independent meteorological trains of instrumentation: a primary train and a secondary train mounted on a 60-meter tower. Both trains feed the data acquisition equipment of the integrated plant computer system (IPCS) located in the Fermi 2 control center. The IPCS has the capability to share the meteorological data with other plant computers, display the data on IPCS terminals at various plant locations, and perform straight-line plume dispersion analysis in support of emergency plan activities. The NRC also receives selected meteorological data through the emergency response data system (ERDS) interface on IPCS. (DTE 2013c)

Signal Conditioning and Data Reduction

Inside the environmentally controlled instrument shelter, sensor signals are conditioned. Each sensor signal requires a single, printed-circuit board to perform the necessary conversion, amplification, and scaling to provide a pair of analog outputs for each parameter. Zero and full-scale test switches are front-panel mounted on each printed-circuit board to facilitate parameter testing. (DTE 2013c)

After conditioning through their respective printed-circuit boards, the 10-meter horizontal wind direction and vertical wind speed signals pass into Standard Deviation Computer boards to compute the 15-minute average sigma theta and sigma phi. The primary and secondary signal conditioner and standard deviation computer boards are independent of each other. (DTE 2013c)

Data Transmission

The outputs of the instrument signal conditioning equipment are transmitted to the Control Room via two independent transmission lines. One line incorporates a phone line between the shelter and the Nuclear Operations Center, where information is microwaved to the Office Service Building. From the Office Service Building, the signals are transmitted to the Control Room. The second line uses a separate phone line from the shelter to the Nuclear Operations Center, where the data are transmitted to the Office Service Building via a single-mode fiber optic circuit. From the Office Service Building, the signals are transmitted to the Control Room. The two signals are electrically separated from one another from the 60-meter tower to the Control Room. The instrumentation at the 60-meter tower is electrically isolated from the equipment in the computer room of the Control Room. (DTE 2013c)

2.2.7.6 Data Acquisition and Processing

The redundant IPCS data acquisition multiplexers accept two trains of data from the meteorological system primary and secondary data acquisition equipment. These data are provided to the IPCS computers to screen data for validity and quality, perform meteorological calculations, update the data archive, display the information on the man-machine interface, and output the data to communication devices. The IPCS provides redundant computers that provide a primary backup capability. The redundant computers in conjunction with the two trains of data acquisition provide two independent paths of data. The IPCS system monitors available error signals to determine equipment status. If an instrument input malfunctions, if data are suspect, or an instrument input is manually removed from service, the IPCS substitutes the reading from the next level of redundancy as listed in Table 2.2-3 and indicates the substitution on the IPCS computers. In the event that a data path to IPCS is unavailable, a digital recorder is available on each train of instrumentation at the meteorological instrument shelter to archive the raw data. Meteorological data are generally reviewed each day by personnel to identify possible data problems. The meteorological data are also validated to ensure that the amount of data retained in the master record meets the regulatory requirements for minimum recovery rates as outlined in NRC Regulatory Guide 1.23. During the validation process, the following steps are followed (DTE 2013c):

- Utilize software to review raw data.
- Identify and edit questionable or invalid data.
- Recover data from backup sources.
- Adjust data to reflect calibration sources.

After the validation process is completed, the processed data are archived. The objective for the meteorological monitoring program is to maintain annual data recovery rates of at least 90 percent on an annual basis for all meteorological parameters in order to assess the relative concentrations and doses resulting from accidental or routine releases. (DTE 2013c)

Meteorological data are available in five different formats: instantaneous values, 1-minute blocked averages, 15-minute rolling averages, 15-minute blocked averages, and 1-hour blocked averages. In addition, radiation protection personnel calculate off-line joint frequency distributions of wind speed and wind direction for each Pasquill stability category created from the 1-hour blocked averages. The format of the annual onsite meteorological data summaries and joint frequency distribution tables conforms to the recommended format found in NRC Regulatory Guide 1.23. (DTE 2013c)

2.2.8 Nonradioactive Waste Systems

2.2.8.1 Resource Conservation and Recovery Act Wastes

The Resource Conservation and Recovery Act (RCRA) governs the disposal of solid waste. Michigan's RCRA regulations are administered by the Michigan Department of Environmental Quality (MDEQ) and address the identification, generation, minimization, transportation, and final treatment, storage, or disposal of hazardous and nonhazardous waste. MDEQ has received authorization from the EPA to administer and enforce the hazardous waste management program in Michigan. As a generator of hazardous wastes, Fermi 2 is required to maintain a hazardous waste generator identification number that is issued by the MDEQ in accordance with this program. There are no nonradioactive hazardous waste storage or treatment permits related to Fermi 2.

Fermi 2 generates nonradioactive waste as a result of plant maintenance, cleaning, and operational processes that occur at the site. Because Fermi 2 is typically classified as a small quantity generator, hazardous wastes routinely make up only a small percentage of the total wastes generated, consisting of paint wastes, aerosol cans, solvent waste, off-specification (e.g., shelf-life expired) chemicals, and occasional spill cleanup debris. Universal wastes generated typically consist of circuit boards (state-specific), batteries, fluorescent bulbs, mercury devices and ethylene glycol (state-specific). Recycled wastes typically consist of ferrous metal, paper, wood, plastic, and cardboard. Nonradioactive wastes are collected in central collection areas and managed in accordance with appropriate regulatory requirements and good practices that are specified in company and site-specific waste management procedures (Fermi 2010c; DTE Energy 2013a). Waste materials are received in various forms and are packaged to meet all regulatory requirements prior to final disposition at an offsite facility licensed to receive and manage the material. Typical hazardous waste, universal waste, and recycled waste quantities generated at the facility are shown in Table 2.2-4.

Although waste quantities generated each year may vary due to outages or specific project activities, Fermi 2 has successfully minimized waste generation. Waste minimization measures such as material control, process control, waste management, and feedback are considerations that are an integral part of all work planning and implementation at the facility to reduce, to the extent feasible, waste generated, accumulated, or disposed (Fermi 2010c; DTE Energy 2013a). Fermi 2's chemical control program (MCE02, Chemical Controls) also works in conjunction with site waste minimization efforts to minimize waste generation to the maximum extent practicable (Fermi 2009a).

2.2.8.2 Wastewater Discharges

2.2.8.2.1 NPDES Permitted Discharges

Chemical additives approved by MDEQ are used to control the pH, scale, and corrosion in the circulating water system, and to control biofouling of plant equipment. Discharges containing water treatment additives at or below MDEQ-approved concentrations are monitored and discharged to Lake Erie via NPDES Outfall 001 and Outfall 013 (during dredging activities) in accordance with the site's NPDES Permit No. MI0037028 (Attachment A). The current Fermi 2 NPDES permit authorizes permitted discharges for four external outfalls (001, 009, 011, and 013). The outfalls (Figure 3.5-1) and effluent limits associated with their monitoring points are listed in Table 2.2-1.

In conjunction with the stormwater pollution prevention requirements specified in Part I, Section A.13 of NPDES Permit No. MI0037028, Fermi 2 also performs visual observations at six stormwater outfalls (Outfalls 002, 004, 005, 007, 012, and 014) as shown in Figure 3.5-1 to monitor for any unusual characteristics associated with the discharge such as unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits. As a note, there are two additional stormwater outfalls (003 and 008) as shown on Figure 3.5-1. However, these outfalls are unused.

Onsite ponds that are clay lined and receive NPDES-authorized wastewater discharges consist of the CWR and chem waste pond. The CWR receives cooling tower blowdown, treated chemical and nonchemical metal cleaning wastes, and residual heat removal system service water that are permitted for discharge via NPDES Outfall 001. The chem waste pond (NPDES Outfall 009) receives low-volume wastes, chemical metal cleaning wastes, nonchemical metal cleaning wastes, and stormwater. The dredge basin (NPDES Outfall 013), which is unlined, is utilized for the discharge of dredging dewatering water associated with dredging activities at the intake structure. No imposed NPDES permit groundwater monitoring requirements are associated with these areas. Therefore, no shallow groundwater sampling has been conducted in the vicinity of these areas as it relates to monitoring of nonradiological constituents.

Although Outfall 001 and the chem waste pond (Outfall 009) are permitted to receive chemical metal cleaning wastes, these authorized discharges were thought to initially be in place to accommodate potential discharges during the Fermi 2 construction time frame, and have not been utilized since that time based on best available knowledge. Nonchemical metal cleaning wastes permitted for discharge at Outfall 009 consist of water only, which is used for the periodic spraying of the main unit transformers for cooling and cleaning purposes and eventually discharged from the transformer containment structure to this outfall. No nonchemical metal cleaning wastes are discharged to Outfall 001 because this authorized discharge was initially put in place to accommodate potential discharges during Fermi 2 construction. In summary, although there may be periodic discharges of nonchemical metal cleaning wastes from the transformer wash-downs to Outfall 009, there are no chemical metal cleaning wastes anticipated to be discharged through Outfalls 001 and 009 in the future. (DTE 2013d)

2.2.8.2.2 Sanitary Wastewaters

Effluent from the auxiliary boiler's blowdown sump, diesel fuel storage tank berm, and diesel fuel offloading station with associated oil water separator discharge to the open clay-lined waste basin (also referred to as chem basin). Domestic sewage, effluent from several oil water separators, and effluent from the chem basin are collected in an aboveground concrete-lined holding tank (also referred to as the sewage forwarding station), which forwards the combined effluent flow to the Monroe Metropolitan Water Pollution Control Facility for treatment and disposal. (Fermi 2012e) Prior to discharging to this publicly owned treatment works (POTW), the sanitary effluent must meet the pretreatment effluent limitations and other conditions specified in the Fermi 2 Industrial/Non-Domestic User Discharge Permit No. 1020. Limits associated with the wastewater are shown in Table 2.2-5.

2.2.8.3 Air Emissions

In November 2013, Fermi 2's Air Permit 462-99B was replaced by Renewable Operating Permit (ROP) MI-ROP-B4321-2013 (Fermi 2013a). Therefore, Air Permit 462-99B is considered inactive. With the exception of Table 2.2-6 and Table 2.2-7, the discussion below is related to Fermi 2's ROP MI-ROP-B4321-2013. The emissions information presented in Table 2.2-6 and Table 2.2-7 was based on reporting performed under Air Permit 462-99B.

Actual emissions as shown in Table 2.2-6 from Fermi 2 are less than those associated with a "major source" (100 tons/year or greater of any air pollutant) as defined in the Clean Air Act (CAA). Nonradioactive emissions at Fermi 2 are primarily associated with periodic utilization of auxiliary boilers in support of plant operations, portable generator(s) utilized during outages, testing of emergency generators as required by the NRC, and combustion turbines for peaking purposes. MDEQ regulation R 336.1280 does not require water-cooling towers that are not used for evaporative cooling of process water to be permitted as emission sources as specified in R 336.1280(d); therefore, the Fermi 2 cooling towers are currently exempt from MDEQ permitting requirements (DTE 2012c).

To protect Michigan's ambient air quality standards and ensure that impacts are maintained at acceptable levels from facilities that generate air emissions, MDEQ governs the discharge of regulated pollutants by establishing specific conditions in the air permit. Permitted emission sources and conditions established in the Fermi 2 Air Permit MI-ROP-B4321-2013 are shown in Table 2.2-8. Greenhouse gas emissions associated with these sources, in addition to onsite vehicles and non-road equipment fueled by gasoline or diesel fuel, workforce transport, and loss of freon-containing hydrofluorocarbons are shown in Table 2.2-7.

DTE's review has not identified any expected upgrade or replacement activities for equipment or operation (e.g., diesel generators, diesel pumps) that would increase air emissions over the license renewal period.

2.2.8.4 Nonradioactive Spills

There are several industrial practices at Fermi 2 involving the use of chemicals such as those activities typically associated with painting, cleaning of parts/equipment, refueling of onsite vehicles/generators, and the use of water treatment additives. The use and storage of chemicals at Fermi 2 are controlled in accordance with the site's chemical control procedure and site-specific spill prevention plans (Fermi 2008a; Fermi 2009a). In addition, as previously discussed in Section 2.2.8.1, nonradioactive wastes are managed in accordance with company and site-specific waste management procedures, which contain preparedness and prevention control measures (DTE Energy 2013a; Fermi 2010c). These procedures and plans are designed to prevent and minimize the potential for a chemical release to the environment.

2.2.9 Maintenance, Inspection, and Refueling Activities

Various programs and activities at the site maintain, inspect, test, and monitor the performance of plant equipment. These programs and activities include, but are not limited to, those implemented to achieve the following:

- Meet the requirements of 10 CFR Part 50, Appendix B (Quality Assurance), Appendix R (Fire Protection), Appendices G and H (Reactor Vessel Materials).
- Meet the requirements of 10 CFR 50.55a Codes and Standards, which invoke the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section XI, In-service Inspection and Testing Requirements.
- Meet the requirements of 10 CFR 50.65, the maintenance rule.
- Maintain water chemistry in accordance with Electric Power Research Institute (EPRI) guidelines.

Additional programs include those implemented to meet technical specification surveillance requirements; those implemented in response to NRC generic communications; and 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, while others are performed during scheduled refueling outages.

2.2.10 Power Transmission Systems

There are two switchyards located on site, one being a 120-kV switchyard and the other a 345-kV switchyard, and both are owned by ITC *Transmission* (Fermi 2012a, Section 8.2.1.1). The 120-kV switchyard, located at Fermi 1, is about 0.25 miles from Fermi 2. The 120-kV switchyard was originally built to service the Fermi 1 liquid metal fast breeder reactor, which has been permanently shut down. This switchyard now services the four diesel fuel-fired GE 18.8-MW combustion turbine generator peaking units located near Fermi 1 on the Fermi site (Fermi 2012a, Section 8.2.1.2) and provides the source of power for the Fermi 2 Division I systems. The 345-kV switchyard, located approximately 220 yards from the plant (turbine building), is the connection point where electricity produced by Fermi 2 is fed into the ITC *Transmission* regional power system.

2.2.10.1 <u>In-Scope Transmission Lines</u>

Based on 10 CFR Part 51, Appendix B, Table B-1, Footnote 4, transmission lines subject to evaluation of environmental impacts for license renewal are those that connect the nuclear power plant to the substation where electricity is fed into the regional power system and transmission lines that supply power to the nuclear plant from the grid. The following transmission lines associated with Fermi 2, designated as in-scope transmission lines for the environmental review, are subject to evaluation (Figure 2.2-7):

- Six transmission lines (two three-phase circuits) that transmit power from Fermi 2 to the electrical grid and extend from the Fermi 2 plant (turbine building) to the disconnect switches at the intermediate switchyard (approximately 325 feet). After combining into three lines via a common bus, these lines extend from the intermediate switchyard to the 345-kV switchyard (approximately 315 feet).

- Three transmission lines (one circuit) that provide offsite power to Fermi 2 Division II systems and extend from the 345-kV switchyard to the plant (approximately 640 feet).

- Three transmission lines (one circuit) that provide offsite power and extend from the 345-kV switchyard to the Fermi 2 circulating water pump house (approximately 1,550 feet).

All in-scope transmission lines listed above are located completely within the Fermi site owner-controlled area.

2.2.10.2 Out-of-Scope

The following are not within the scope of this environmental review, as defined in Section 2.2.10.1 above:

- Transmission lines that exit the 120-kV switchyard, because Fermi 2 does not utilize this switchyard for transmitting electricity from the plant into the regional power system.

- Transmission lines that exit the 345-kV switchyard, because the connection point where electricity produced by Fermi 2 is fed into the regional power system is at the switchyard.

- Three underground 13.2-kV medium voltage cables that provide offsite power for Division I systems, GSW Pump House, and the cooling tower circulating water pumps, and extend from the 120-kV switchyard to Fermi 2.

2.2.10.3 Transmission Line Ownership

Ownership of transmission lines that are considered within scope for the environmental review, as identified in Section 2.2.10.1, is discussed in Section 1.2 of this ER.

2.2.10.4 Vegetation Management Practices

Because areas under the in-scope transmission lines are devoid of any type of vegetation (i.e., concrete, asphalt, or gravel), there is no associated right-of-way (ROW) to maintain. Therefore, even though Fermi 2 has procedural measures in place to manage herbicide applications as discussed in Section 9.1.3.10, there is no need for herbicide applications under these lines. In addition, although Fermi 2 has administrative controls in place to protect cultural resources as discussed in Section 9.1.4, the areas under the in-scope transmission lines were extensively disturbed during construction; therefore, it is anticipated that any potential cultural resources located under these lines are no longer present.

2.2.10.5 Avian Protection

Based on a review of records, there has not been the need to implement avian protection measures with the in-scope transmission lines (DTE 2012d).

2.2.10.6 Induced Shock Hazards

As stated in Section 2.2.10.1 above, all in-scope transmission lines are located completely within the Fermi site owner-controlled area. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

The Michigan Occupational Safety and Health Administration (MIOSHA) governs the occupational safety and health of operations staff. It was determined in NUREG-1437 that occupational safety and health hazard issues are generic to all types of electrical generating stations, including nuclear power plants, and are of small significance if the workers adhere to safety standards and use protective equipment (NRC 2013b, Section 3.9.5.1).

Operational requirements associated with MIOSHA are incorporated into Fermi 2's occupational health and safety program. Specifically, as it relates to transmission lines and acute shock hazards, Fermi 2 has implemented the following practices which limit the potential for workers to receive an "induced" current from an object becoming capacitively charged:

- 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 (Fermi 2009b, Section 4.1.1).
- 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 (Fermi 2009b, Section 4.10.2).
- Vehicles or mechanical equipment are properly grounded before approaching the limited approach distance (Fermi 2009b, Section 4.10.3).
- Materials to be stored near the 345-kV energized lines must be stored at a distance of 19 feet 10 inches, plus an amount that provides for maximum sag and swing of the line (Fermi 2008b, Section 5.2).

Table 2.2-1
NPDES Permitted Outfalls

Outfall	Monitoring Point	Description	Parameter	Permit Requirement
001	001A	Circulating water (CW) decant	Flow	Report daily and monthly flow in MGD 45.1 MGD daily maximum
			Intake temperature	Report daily maximum °F
			Discharge temperature	Report daily maximum °F
			Total residual chlorine	38 µg/l daily maximum
			Spectrus CT-1300	15 µg/l daily maximum
			pH	6.5–9.0 S.U.
			Outfall observation	Daily visual
	001B	RHRSW prior to Outfall 001 (CW decant)	Flow	Report daily and monthly flow in MGD 1.44 MGD daily maximum
			Spectrus CT-1300	Report daily maximum µg/l
	001D	Radwaste discharge prior to Outfall 001 (CW decant)	Flow	Report daily and monthly flow in MGD 0.216 MGD daily maximum
			Total suspended solids	30 mg/l monthly maximum 100 mg/l daily maximum
			Oil and grease	15 mg/l monthly maximum 20 mg/l daily maximum
	001E	Treated chemical and non-chemical metal cleaning wastes from the condenser water box prior to Outfall 001	Flow	Report daily and monthly flow in MGD 0.5 MGD daily maximum
			Total suspended solids	30 mg/l monthly maximum 100 mg/l daily maximum
			Oil and grease	15 mg/l monthly maximum 20 mg/l daily maximum
			Total copper	1.0 mg/l daily maximum
			Total iron	1.0 mg/l daily maximum

Table 2.2-1 (Continued)
NPDES Permitted Outfalls

Outfall	Monitoring Point	Description	Parameter	Permit Requirement
009	009A	Chem waste pond	Flow	Report daily and monthly flow in MGD 0.72 MGD daily maximum
			Total suspended solids	30 mg/l monthly maximum 100 mg/l daily maximum
			Oil and grease	15 mg/l monthly maximum 20 mg/l daily maximum
			Total iron	1.0 mg/l daily maximum
			Total residual chlorine	38 µg/l daily maximum
			pH	6.5–9.0 S.U.
			Outfall observation	Daily visual
011[a]	011A	Fermi 1 stormwater system PAP/north of TAC parking lot Storm sewer system Fermi 1 GSW/fire protection system Fermi 2 GSW traveling screen and pump strainer backwash	Flow	Report daily and monthly flow in MGD 0.216 MGD daily maximum
			Total selenium	Report daily maximum µg/l
			Total mercury	Report monthly maximum lbs/day Report monthly maximum ng/l
			Total mercury[b]	0.00005 monthly maximum lbs/day 27 ng/l monthly maximum
			pH	6.5–9.0 S.U.
			Outfall observation	Daily visual
	011C	Fermi 1 peaker oily water system discharging to Outfall 011	Flow	Report daily and monthly flow in MGD 0.216 MGD daily maximum
			Total suspended solids	30 mg/l monthly maximum 100 mg/l daily maximum
			Oil and grease	15 mg/l monthly maximum 20 mg/l daily maximum

Table 2.2-1 (Continued)
NPDES Permitted Outfalls

Outfall	Monitoring Point	Description	Parameter	Permit Requirement
013[c]	013A	Dredge basin	Flow	Report daily and monthly flow in MGD 450 million gallons per year maximum
			Total suspended solids (TSS):	
			-Intake TSS	Report monthly maximum mg/l Report daily maximum mg/l
			-Discharge TSS	Report monthly maximum mg/l Report daily maximum mg/l
			-Net discharge TSS	35 mg/l monthly maximum 70 mg/l daily maximum
			pH	6.5–9.0 S.U.
			Outfall observation	Daily visual

(Attachment A)

a. Monitoring only required when discharging oily waste through monitoring point 011C.
b. 12-month rolling average.
c. Monitoring is only required during dredging activities.

Table 2.2-2
Meteorological Parameters Monitored

Parameter	Sampling Height (meters)	Sensing Technique
Primary Monitoring System		
Wind speed	10 and 60	Cups/light chopper
Wind direction	10 and 60	Vane/potentiometer
Vertical wind speed	10	Propeller
Differential temperature	10 to 60	Matched thermistors
Ambient temperature	10	Thermistor
Dew point	10	Lithium chloride type
Precipitation	1.5	Tipping bucket
Secondary Monitoring System		
Wind speed	10 and 60	Cups/light chopper
Wind direction	10 and 60	Vane/potentiometer
Vertical wind speed	10	Propeller/light chopper
Differential temperature	10 to 60	Matched thermistors
Ambient temperature	10	Thermistor

(DTE 2013c)

Table 2.2-3
Method for Substituting Redundant Parameters of Critical Meteorological Measurements

Level of Redundancy	10-Meter Level Wind Speed	10-Meter Level Wind Direction	Stability Indicator
0	Primary WS10	Primary WD10	Primary delta T
1	Secondary WS10	Secondary WD10	Secondary delta T

(DTE 2013c)

Table 2.2-4[a]
Nonradioactive Waste Generation (Typical Pounds)

Waste Stream	2008	2009	2010	2011	2012
Hazardous Waste	3,746	2,023	2,767	2,612	7,121[b]
Universal Waste	5,649	8,359	15,044	106,110[c]	22,090
Recycled Waste	17,706	6,460	NA	414,272[d]	286,104[d]

(DTE 2013e)

a. Inclusive of Fermi 1 (decommissioned) and Fermi 2 generated wastes because both units ship waste under a common hazardous waste generator identification number (DTE 2013f).

b. Increase due to disposition of expired chemical products.

c. Increase due to larger than normal plant lead-acid battery changeout, which accounted for greater than 87,000 pounds.

d. Increase due to the fact that ferrous metal, wood, and cardboard were not tracked prior to 2011.

NA: Not available.

Table 2.2-5
Industrial Non-Domestic User Discharge Permit Limits

Parameter	Limit
pH	5.0–9.5 S.U.
Oil and grease	200 mg/l maximum daily
Cadmium	0.04 mg/l maximum daily
Copper	1.0 mg/l maximum daily
Mercury	< 0.0002 mg/l maximum daily
Lead	0.75 mg/l maximum daily
Zinc	2.61 mg/l maximum daily
Alpha beta	None
Biological oxygen demand	600 mg/l maximum daily
Total suspended solids	750 mg/l maximum daily

(Fermi 2012e)

Table 2.2-6
Annual Emissions Inventory Summary, 2008–2012[a]

Year	Annual Emissions (tons/year)					
	CO	NO_x	PM_{10}[b]	SO_x	VOCs	HAPs[c]
2008	3.27	21.62	0.82	1.34	0.24	0.0056
2009	2.43	34.37	0.92	1.84	0.16	0.0112
2010	4.25	46.39	1.47	1.27	0.26	0.0144
2011	2.70	44.85	1.01	0.47	0.20	0.0113
2012	2.83	21.40	0.65	0.07	0.24	0.0017

(DTE 2013g)

a. Emissions based on those reported under Air Permit 462-99B.
b. Because the cooling towers are exempt from MDEQ permitting requirements (Section 2.2.8.3), PM_{10} emissions are not tracked; therefore, PM_{10} emissions shown in the table are not inclusive of the cooling towers. However, based on calculations performed by DTE, it was determined that annual PM_{10} emissions associated with each tower would be 0.10 tons per year, assuming that the towers operate year-round (DTE 2013g).
c. HAPs also inclusive of lead emissions reported in the Section 313 toxic release inventory reports.

Table 2.2-7
Fermi 2 Greenhouse Gas Emissions, 2012

Emission Source	Carbon Dioxide[a]	Methane[a]	Nitrous Oxide[a]	Hydrofluorocarbons[a]
Auxiliary boilers and diesel generators[b]	3,667.8	3.12	9.22	—
Combustion turbines (peakers)[b]	21,491.3	18.31	54.05	—
Vehicles and non-road equipment (gasoline)[c]	158.9	—	—	—
Vehicles and non-road equipment (diesel fuel)[c]	126.3	—	—	—
Passenger vehicles[c]	3,412.0	—	—	—
Devices containing freons[c]	—	—	—	0
Total	28,856.3	21.43	63.27	0

(DTE 2013h)

a. Measurements are in carbon dioxide equivalent (CO_{2e}) metric tons.
b. Emissions based on those reported under Air Permit 462-99B.
c. Fermi 2 is not required under 40 CFR Part 98 (Mandatory Greenhouse Gas Reporting Rule) to account for greenhouse gas emissions associated with this source.

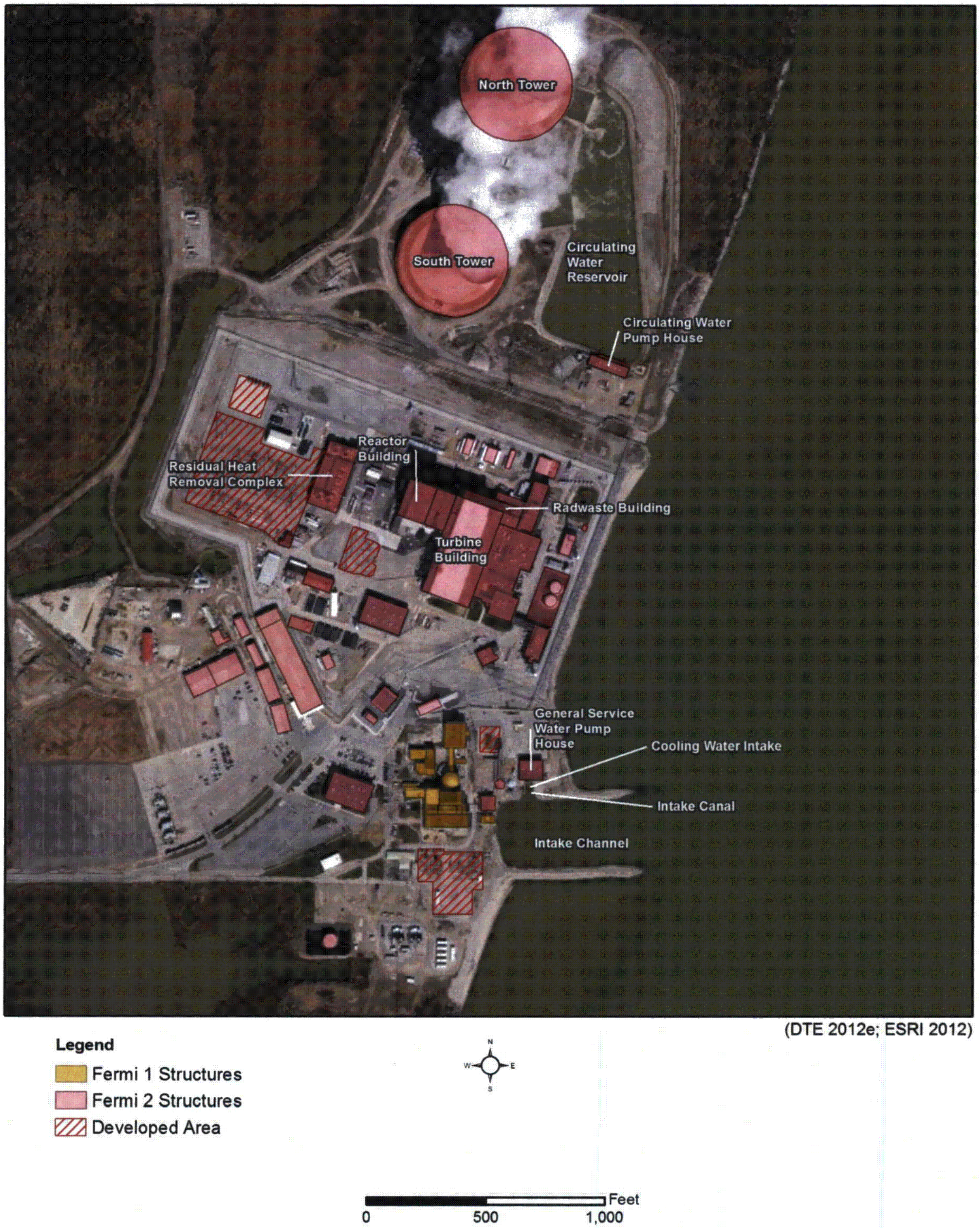
Table 2.2-8
Air Permitted Emission Sources

Emission Unit ID	Emission Unit Description	Material/Operational Conditions	Emission Limitations
EU-AUXBLR1	Diesel Fuel-Fired Auxiliary Boiler (50,000 lb/hr)	Opacity Fuel sulfur limit No. 2 diesel fuel use only	SO_2: 89.4 TPY NO_x: 89.4 TPY Individual HAP: 9 TPY Aggregate HAP: 22.4 TPY
EU-AUXBLR2	Diesel Fuel-Fired Auxiliary Boiler (50,000 lb/hr)		
EU-EDG 11	Emergency Diesel Engine and Generator Set (2,850 kW)		
EU-EDG 12	Emergency Diesel Engine and Generator Set (2,850 kW)		
EU-EDG 13	Emergency Diesel Engine and Generator Set (2,850 kW)		
EU-EDG 14	Emergency Diesel Engine and Generator Set (2,850 kW)		
EU-BSE-STANDBYDG	Emergency Diesel Engine and Generator Set (1,785 kW)		
EU-CTG11-1	GE Frame 5 Diesel Fuel-Fired Peaking Turbine (16,000 kW)		
EU-BSE-CTG11-1	Diesel Engine to Black Start EU-CTG 11-1 (350 hp)		
EU-CTG11-2	GE Frame 5 Diesel Fuel-Fired Peaking Turbine (16,000 kW)		
EU-CTG11-3	GE Frame 5 Diesel Fuel-Fired Peaking Turbine (16,000 kW)		
EU-CTG11-4	GE Frame 5 Diesel Fuel-Fired Peaking Turbine (16,000 kW)		
EU-SECEDG-01	Rule 285(g) exempt Security Emergency Diesel Generator #1 (100 kW)	Opacity Fuel sulfur limit Operational hours	
EU-SECEDG-02	Rule 285(g) exempt Security Emergency Diesel Generator #2 (100 kW)		

Table 2.2-8 (Continued)
Air Permitted Emission Sources

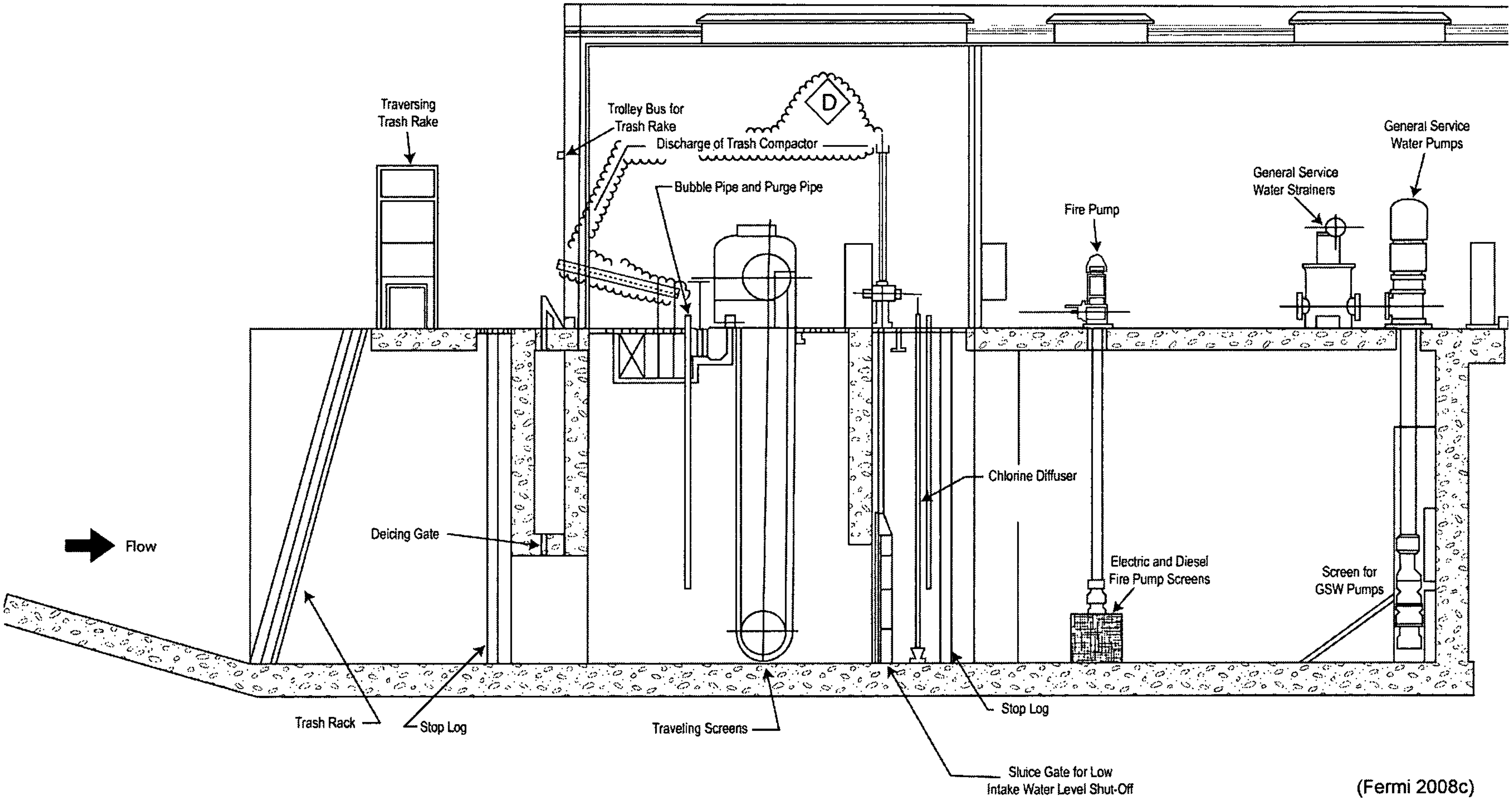
<table>
<tr><th>Emission Unit ID</th><th>Emission Unit Description</th><th>Material/Operational Conditions</th><th>Emission Limitations</th></tr>
<tr><td>EU-NOCEMERGEN</td><td>Rule 285(g) exempt NOC Emergency Generator Set (3.42 × 10^{6} Btu/hr)</td><td rowspan="2">Opacity
Fuel sulfur limit</td><td rowspan="2">SO_2: 89.4 TPY
NO_x: 89.4 TPY
Individual HAP: 9 TPY
Aggregate HAP: 22.4 TPY</td></tr>
<tr><td>EU-EMERGFIREPUMP</td><td>Rule 285(g) exempt Fire Pump Emergency Diesel Engine (340 hp)</td></tr>
<tr><td>EU-COLDCLEANER</td><td>Cold Cleaner Units (In service on or after July 1, 1979)</td><td>$\leq$ 5 percent halogenated compounds.
Cleaned parts drained until dripping ceases.
Routine maintenance as recommended by manufacturer.</td><td>Not applicable</td></tr>
</table>

(Fermi 2013a)



(DTE 2012e; ESRI 2012)

Figure 2.2-1
Intake Channel and Canal



(Fermi 2008c)

Figure 2.2-2
Fermi 2 Intake Structure

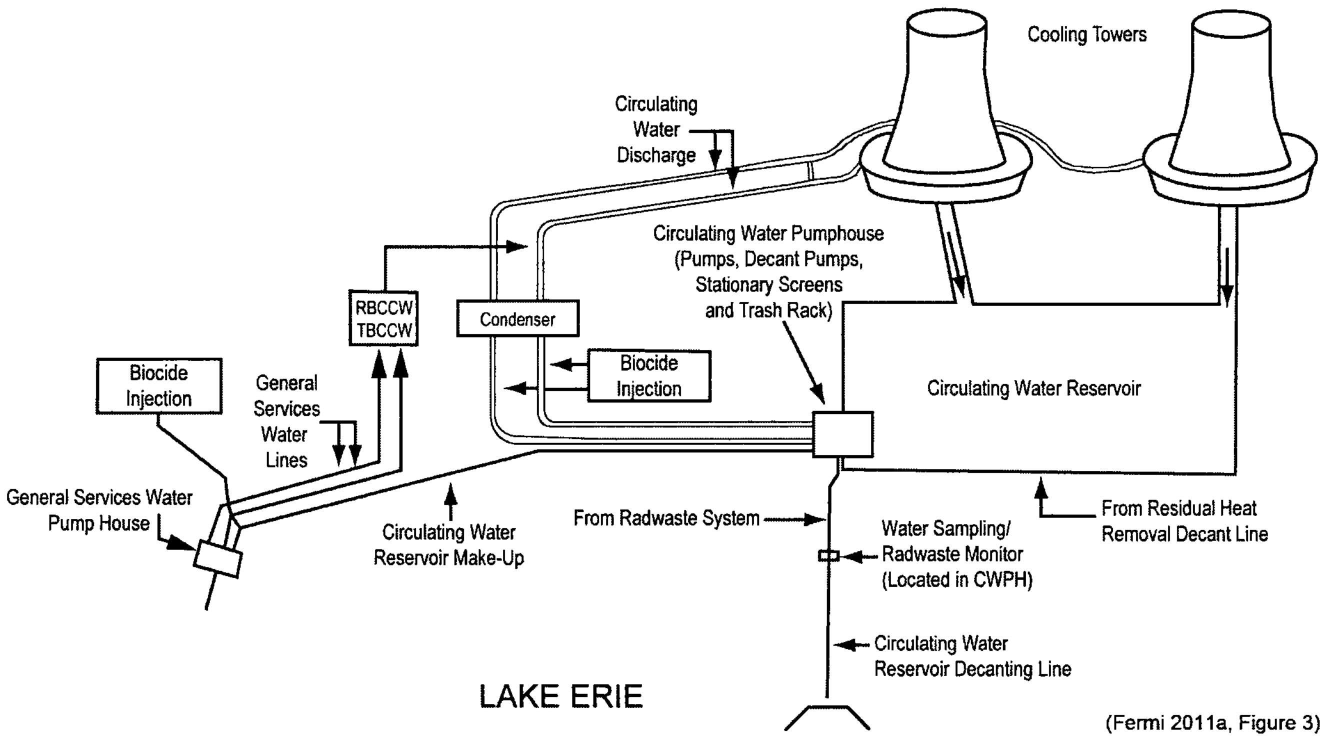
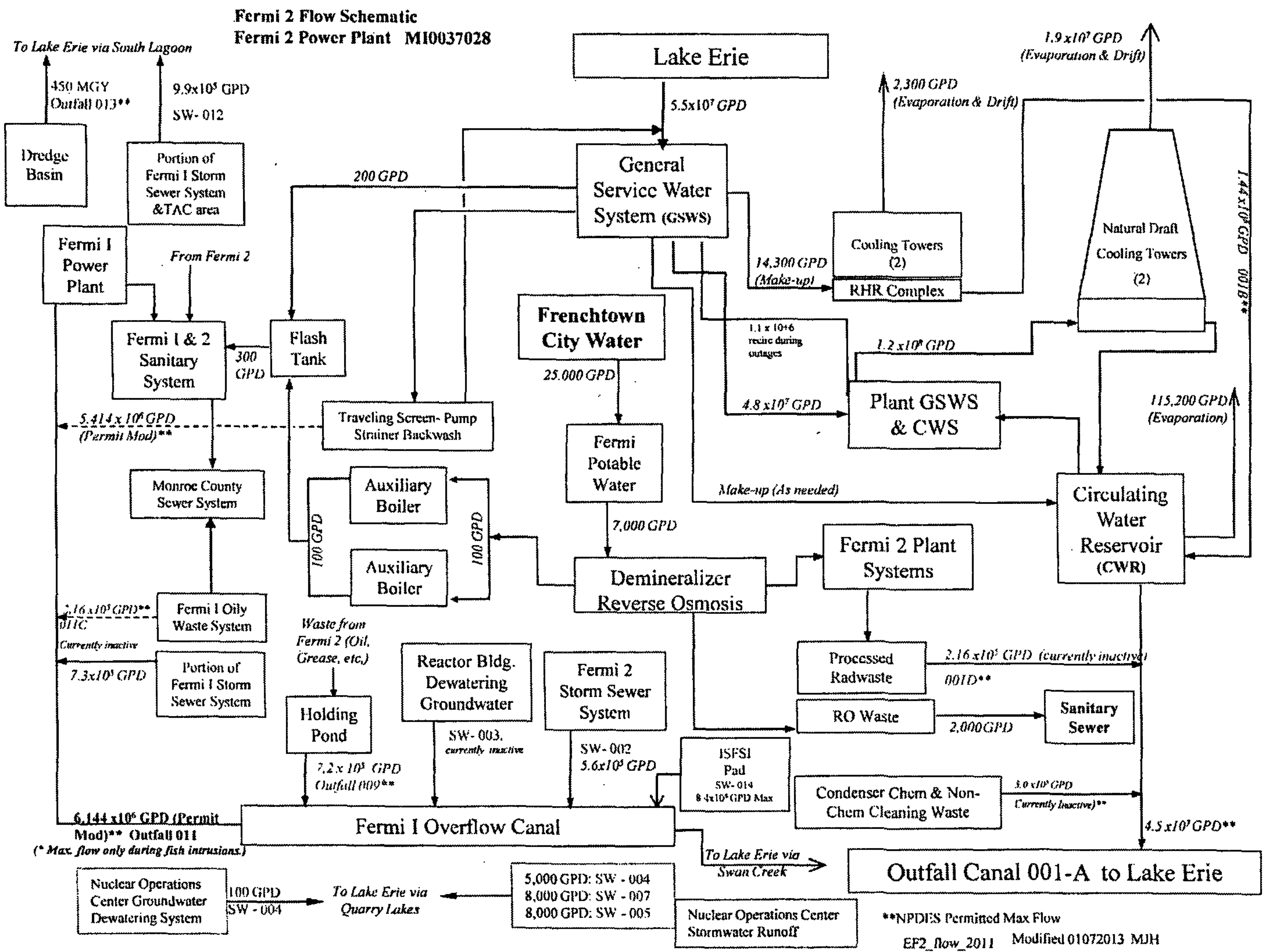
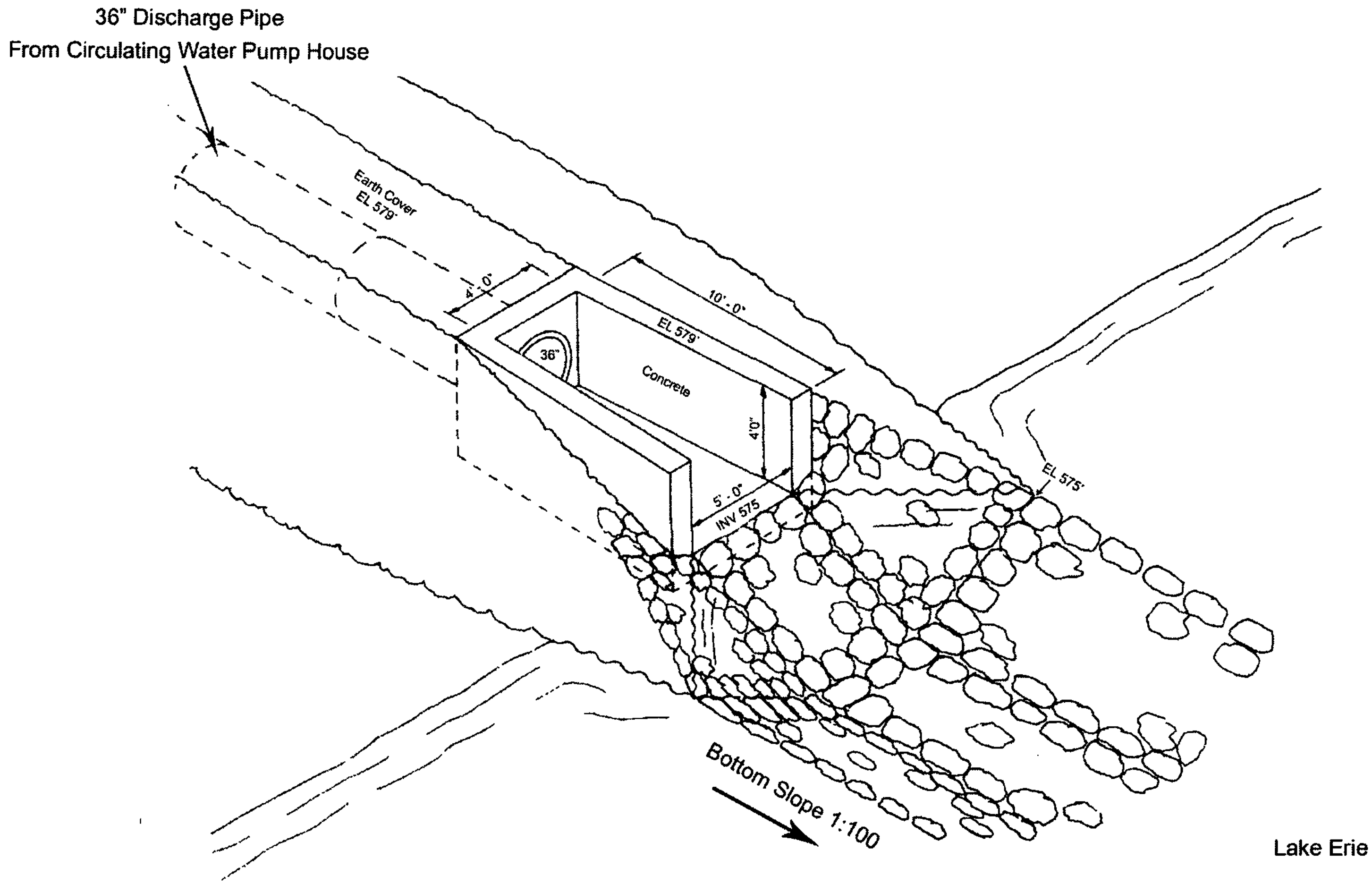


Figure 2.2-3
Circulating Water System Simplified Diagram



(DTE Energy 2011a)

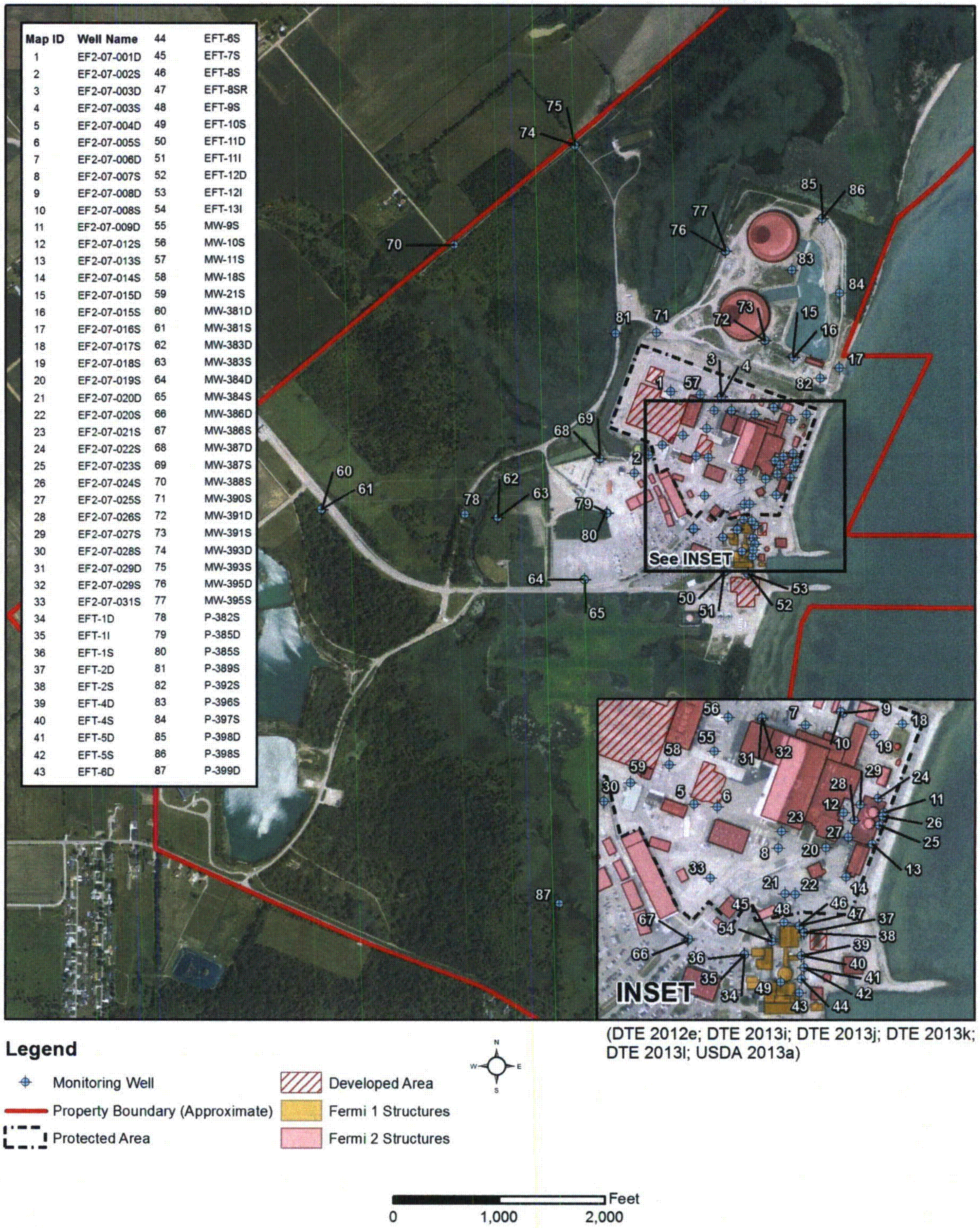
Figure 2.2-4
NPDES Permit Schematic Flow Diagram



(Fermi 1978, Figures 3.4-1 and 3.4-2)

Figure 2.2-5
Fermi 2 Discharge Structure

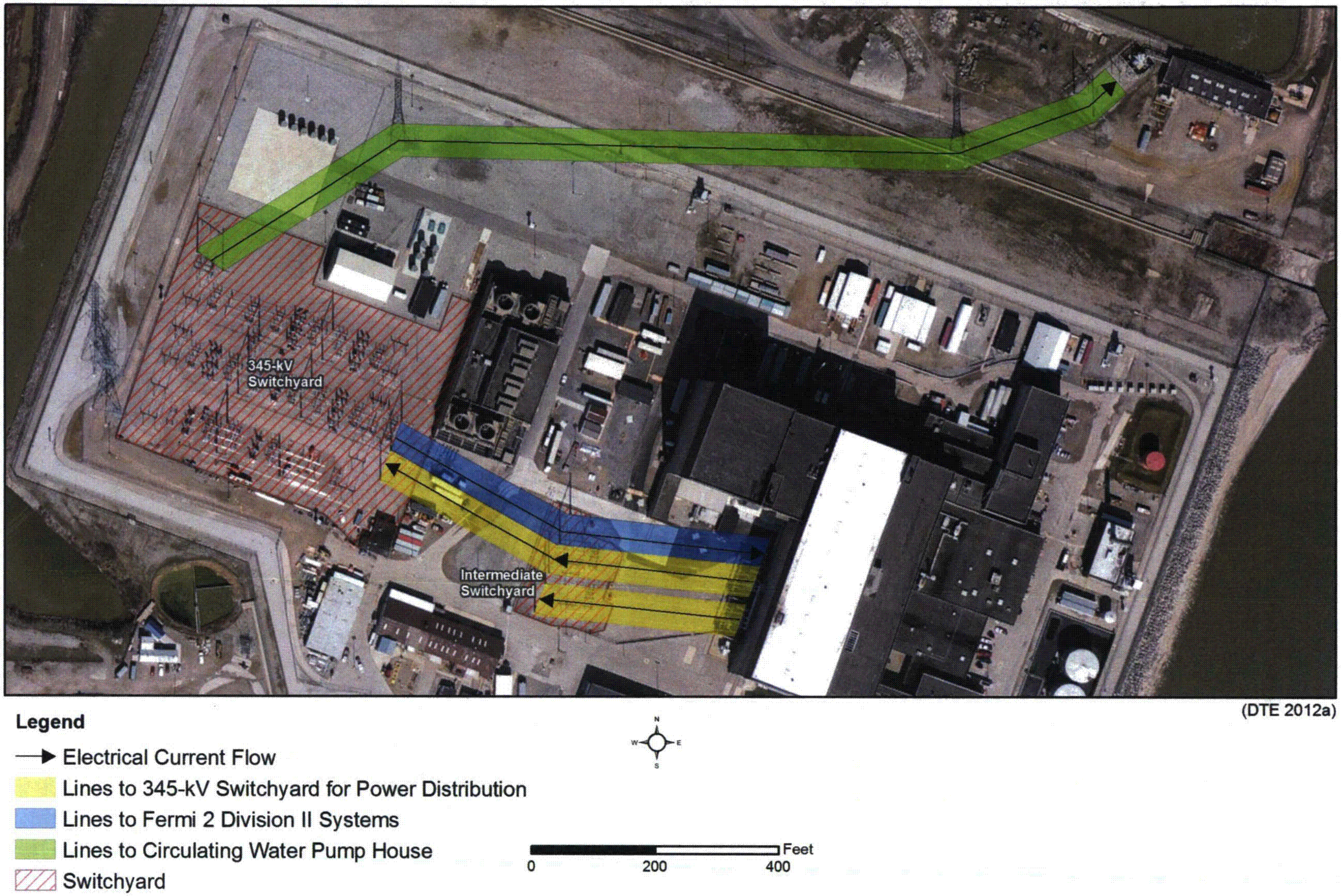
Note: Figure 2.2-5 is based on figures contained in the 1978 Fermi 2 Environmental Report. Based on these figures, the armored slope east of the discharge pipe was graded as a shallow concave channel that sloped downward toward Lake Erie and extended a short distance along the bottom of the lake. Although the riprap is still present, the concave shape shown in Figure 2.2-5 no longer exists.



Map ID	Well Name	Map ID	Well Name
1	EF2-07-001D	44	EFT-6S
2	EF2-07-002S	45	EFT-7S
3	EF2-07-003D	46	EFT-8S
4	EF2-07-003S	47	EFT-8SR
5	EF2-07-004D	48	EFT-9S
6	EF2-07-005S	49	EFT-10S
7	EF2-07-006D	50	EFT-11D
8	EF2-07-007S	51	EFT-11I
9	EF2-07-008D	52	EFT-12D
10	EF2-07-008S	53	EFT-12I
11	EF2-07-009D	54	EFT-13I
12	EF2-07-012S	55	MW-9S
13	EF2-07-013S	56	MW-10S
14	EF2-07-014S	57	MW-11S
15	EF2-07-015D	58	MW-18S
16	EF2-07-015S	59	MW-21S
17	EF2-07-016S	60	MW-381D
18	EF2-07-017S	61	MW-381S
19	EF2-07-018S	62	MW-383D
20	EF2-07-019S	63	MW-383S
21	EF2-07-020D	64	MW-384D
22	EF2-07-020S	65	MW-384S
23	EF2-07-021S	66	MW-386D
24	EF2-07-022S	67	MW-386S
25	EF2-07-023S	68	MW-387D
26	EF2-07-024S	69	MW-387S
27	EF2-07-025S	70	MW-388S
28	EF2-07-026S	71	MW-390S
29	EF2-07-027S	72	MW-391D
30	EF2-07-028S	73	MW-391S
31	EF2-07-029D	74	MW-393D
32	EF2-07-029S	75	MW-393S
33	EF2-07-031S	76	MW-395D
34	EFT-1D	77	MW-395S
35	EFT-1I	78	P-382S
36	EFT-1S	79	P-385D
37	EFT-2D	80	P-385S
38	EFT-2S	81	P-389S
39	EFT-4D	82	P-392S
40	EFT-4S	83	P-396S
41	EFT-5D	84	P-397S
42	EFT-5S	85	P-398D
43	EFT-6D	86	P-398S
		87	P-399D

(DTE 2012e; DTE 2013i; DTE 2013j; DTE 2013k; DTE 2013l; USDA 2013a)

Figure 2.2-6
Groundwater Protection Initiative Wells



(DTE 2012a)

Figure 2.2-7
In-Scope Transmission Lines

2.3 Refurbishment Activities

In accordance with 10 CFR 51.53(c)(2), a license renewal applicant's ER must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with 10 CFR 54.21. The ER must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment.

The objective of the review required by 10 CFR 54.21 is to determine whether the detrimental effects of aging could preclude certain systems, structures, and components from performing in accordance with the current licensing basis during the additional 20 years of operation requested in the LRA.

The evaluation of structures and components as required by 10 CFR 54.21 has been completed and is described in the body of the Fermi 2 LRA. This evaluation identified no license-renewal-related refurbishment activities as described in NUREG-1437.

2.4 Programs and Activities for Managing the Effects of Aging

The programs for managing the effects of aging on certain structures and components within the scope of license renewal at the site are described in the body of the LRA (see Appendix B of the Fermi 2 LRA). The evaluation of structures and components required by 10 CFR 54.21 identified the activities necessary to manage the effects of aging on structures and components during the period of extended operation beyond the initial license term. The necessary activities are consistent with normal plant inspection and monitoring activities and therefore are not expected to cause significant environmental impact.

2.5 Employment

The non-outage work force at the site consists of approximately 889 full-time workers (Table 2.5-1). There are no plans to add workers to support plant operations during the extended license renewal period and, as discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. During refueling outages, which occur on an 18-month cycle and historically have lasted approximately 42 days on average, there are typically an additional 1,400 to 1,500 contractor workers on site. The number of workers required on site for normal plant outages during the period of extended operation is expected to be consistent with the number of additional workers used for past outages at the site.

Table 2.5-1
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
MICHIGAN	
Allegan County	***1***
Plainwell	1
Berrien County	***3***
Stevensville	2
St. Joseph	1
Crawford County	***1***
Grayling	1
Genesee County	***1***
Mt Morris	1
Lenawee County	***17***
Adrian	2
Blissfield	3
Britton	1
Brooklyn	2
Deerfield	2
Onsted	2
Riga	2
Tecumseh	3
Livingston County	***1***
Howell	1
Macomb County	***9***
Clinton Township	2
Eastpointe	1
Harrison Township	1
Lenox	1

Table 2.5-1 (Continued)
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
Sterling Heights	1
Warren	3
Monroe County	***526***
Carleton	26
Dundee	19
Erie	13
Flat Rock	1
Frenchtown Township	1
Ida	16
La Salle	23
Lambertville	28
Luna Pier	2
Maybee	10
Milan	2
Monroe	229
Newport	62
Ottawa Lake	7
Petersburg	14
Rockwood	2
Samaria	1
South Rockwood	5
Temperance	65
Oakland County	***30***
Bloomfield Township (Bloomfield Hills)	3
Clawson	1
Commerce Township	3

Table 2.5-1 (Continued)
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
Farmington Hills	2
Ferndale	1
Highland	1
Milford	1
Novi	5
Ortonville	1
Rochester Hills	1
Royal Oak	2
South Lyon	3
Southfield	1
Troy	1
Walled Lake	1
Waterford	1
West Bloomfield	2
Presque Isle County	***1***
Posen	1
Saginaw County	***1***
Saginaw	1
Saint Clair County	***1***
East China	1
Washtenaw County	***25***
Ann Arbor	13
Saline	2
Willis	1
Ypsilanti	9

Table 2.5-1 (Continued)
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
Wayne County	***167***
Allen Park	6
Belleville	10
Brownstown Township	14
Canton	10
Dearborn	3
Dearborn Heights	2
Detroit	5
Ecorse	1
Flat Rock	8
Gibraltar	7
Grosse Ile	5
Harper Woods	1
Huron Township	1
Lincoln Park	6
Livonia	6
New Boston	10
Northville	2
Plymouth	4
Riverview	7
Rockwood	9
Romulus	6
Southgate	11
Taylor	6
Trenton	12
Wayne	1

Table 2.5-1 (Continued)
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
Westland	3
Woodhaven	6
Wyandotte	5
OHIO	
Fulton County	***2***
Swanton	2
Lucas County	***74***
Maumee	2
Oregon	8
Sylvania	9
Toledo	55
Ottawa County	***6***
Curtice	3
Genoa	1
Graytown	1
Oak Harbor	1
Sandusky County	***2***
Fremont	1
Woodville	1
Seneca County	***1***
Tiffin	1
Wood County	***15***
Millbury	1
Northwood	4
Perrysburg	9
Rudolph	1

Table 2.5-1 (Continued)
Worker Residence Information, July 2012

State, County/Province, and City/Towns	Workers (DTE and Baseline Contractors)
GEORGIA	
Carroll County	***1***
Villa Rica	1
Cherokee County	***1***
Canton	1
ONTARIO PROVINCE	
Ontario	***2***
Windsor	2
NEW YORK	
Oswego County	***1***
Oswego	1
TOTAL	***889***

(DTE 2013m)

2.6 Alternatives to the Proposed Action

The proposed action is to renew the Fermi 2 OL, which would preserve the option for DTE to continue to operate Fermi 2 to provide approximately 1,170 MWe of reliable base-load power throughout the 20-year license renewal period. The review of environmental impacts required by 10 CFR 51.53(c)(3)(ii) is provided in Chapter 4. Based on this review, DTE concludes that impacts to the environmental resource areas evaluated in Chapter 4 would be minor and that further mitigation measures beyond those currently discussed in Section 6.2.2 and listed in Table 6.1-1 of this ER to avoid, reduce the severity of, or eliminate adverse impacts are not warranted as a result of the renewal of the Fermi 2 OL.

2.6.1 Alternatives Evaluation Process

The "no-action alternative" to the proposed action is to not renew the Fermi 2 OL. In this alternative, it is expected that Fermi 2 would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin (see Section 7.3.3). Because Fermi 2 constitutes reliable long-term base-load capacity, it is reasonable to assume that a decision to not renew the Fermi 2 OL would necessitate the replacement of its approximately 1,170 net MWe capacity with another generation source. The environmental impacts of the no-action alternative would be from decommissioning Fermi 2 as discussed in Chapter 7 and providing a replacement power source or sources.

In reviewing alternative energy sources, DTE utilized the following criteria to determine a reasonable set of alternatives for purposes of evaluating the no-action alternative under NEPA requirements and NRC environmental regulations.

- The purpose of the proposed action (license renewal) is the continued production of approximately 1,170 net MWe of reliable base-load generation.
- The time frame for the needed generation is 2025–2045.
- Alternatives considered must be available (constructed, permitted, and connected to the grid) by the time the current Fermi 2 OL expires in 2025.
- Alternatives must be electric generation sources that are technically feasible and commercially viable.
- The annual capacity factor of Fermi 2 based on a 3-year average of 2010–2012 is 76.7 percent (DTE 2013n). The capacity factor is targeted to remain near or above this value throughout the plant's operating life.
- All necessary federal permits, licenses, approvals, and other entitlements would be obtained.

2.6.2 Alternatives Considered

Based on the criteria identified in Section 2.6.1, DTE evaluated those alternatives not requiring new generating capacity and those that did require new generating capacity.

Alternatives not requiring new generating capacity that are evaluated in Chapter 7 included power purchases, reactivating retired power plants, extending the operating life of existing power plants, and implementing conservation or demand-side management (DSM) programs. As discussed in Chapter 7, none of these are determined to be reasonable alternatives to renewal of the Fermi 2 OL. This conclusion is consistent with the Fermi Unit 3 combined license application (COLA) ER and NUREG-2105, *Environmental Impact Statement for Combined License (COL) for Enrico Fermi Unit 3.*

Alternatives requiring new generating capacity that are discussed in Chapter 7 can be categorized as those that are determined to not be reasonable to renewal of the Fermi OL and those that were considered reasonable, albeit with greater environmental impacts.

As stated in NUREG-1437, the NRC has determined that a reasonable alternative must be commercially viable on a utility scale and operational prior to the expiration of the reactor's OL, or expected to become commercially viable on a utility scale and operational prior to the expiration of the reactor's OL (NRC 2013b, Section 2.3). Accordingly, the following alternatives were not considered as reasonable replacement base-load power generation. Although several of these alternatives were considered in combination for replacement power generation as discussed in Chapter 7, they do not generally provide reliable base-load generation and would entail greater environmental impacts. Additional details on the evaluation of these alternatives are provided in Chapter 7.

- Wind
- Solar (photovoltaic and concentrated solar power)
- Hydroelectric
- Geothermal
- Wood waste
- Municipal solid waste
- Other biomass-derived fuels
- Oil
- Fuel cells

These technologies were also eliminated as reasonable replacement power alternatives for one or more of the following reasons.

- High land-use impacts: Some of the technologies listed above (wind, solar, hydroelectric) would require a large area of land and would thus require a siting plan. This would result in a greater environmental impact than continued operation of Fermi 2.
- Emerging technology: Some of the technologies have not been proven as reliable and cost-effective replacements for a large generation facility (fuel cells, biomass derived fuels, municipal solid waste). Therefore, these technologies are typically used with smaller (lower MWe) generation facilities.
- Cost: Some of the technologies above are very expensive and are not a cost-effective way to produce reliable base-load power (solar, fuel cells, oil).

The alternatives considered reasonable and which are discussed in greater detail in Chapter 7 are as follows:

- Super-critical coal-fired generation at the Fermi site consisting of multiple boiler/steam turbine generator units with a net electricity generation approximately equivalent to the 1,170 MWe generated by Fermi 2.
- Natural gas-fired combined-cycle generation at the Fermi 2 site assuming that appropriately sized combustion turbines, heat recovery steam generator, and steam turbine generator are assembled in appropriate power train configurations to produce net electrical power virtually equivalent to the 1,170 net MWe generated by Fermi 2.
- New nuclear generation at the Fermi 2 site with a net electricity generation approximately equivalent to Fermi 2.
- Combination of alternatives that consists of a natural gas-fired combined-cycle plant, energy conservation and DSM, and wind and solar power coupled with energy storage.

Although the super-critical coal-fired power plant alternative, natural gas-fired plant alternative, and the new nuclear plant alternative are the only alternatives that individually could be reasonably expected to produce the amount of base-load power represented by the proposed action, DTE also considered a hypothetical combination of alternatives involving natural gas combined-cycle, energy conservation and DSM, and wind and solar coupled with energy storage in Chapter 7. A summary comparison of the environmental impacts of the selected representative base-load power replacement alternatives evaluated in Chapter 7 is provided in Chapter 8.

2.6.3 Alternatives for Reducing Adverse Impacts

The review of the environmental impacts required by 10 CFR 51.53(c)(3)(ii) provided in Chapter 4 identified no significant adverse effects that would warrant consideration of additional alternatives to reduce or avoid those impacts. Based on this review, DTE concludes that the impacts of renewing the Fermi 2 OL do not warrant additional consideration of alternatives for reducing adverse impacts, as specified in Section 7.2 of Regulatory Guide 4.2, Revision 1 (NRC 2013a), because existing mitigation measures specified in Section 6.2.2 to avoid, reduce the severity of, or eliminate adverse impacts are adequate for minimizing adverse impacts. Although future regulations always have the potential to affect plant operations based on the scope of the regulation and applicability, Fermi 2 would comply with these regulations regardless of license renewal.

3.0 AFFECTED ENVIRONMENT

Chapter 3 draws from the original licensing documents and other documents addressing the regional, local, and site characteristics of the Fermi 2 site and its environment. Preparation of this ER included reviews and citations, where needed, of other documents, including the following:

- 1972 U.S. Atomic Energy Commission's (AEC's) *Final Environmental Statement (FES), related to the operation of Enrico Fermi Atomic Power Plant Unit 2*, Detroit Edison Company, Docket No. 50-341 (FES for construction)

- 1977 *Enrico Fermi Atomic Power Plant Unit 2, Applicant's Environmental Report Operating License Stage*, Docket No. 50-341

- 1981 NRC's F*inal Environmental Statement, related to the operation of Enrico Fermi Atomic Power Plant, Unit No. 2*, Docket No. 50-341 (NUREG-0769)

- 2012 *Fermi 2 Updated Final Safety Analysis Report* (UFSAR), Revision 18, October 2012

In addition to the original licensing document for Fermi 2, this ER cites portions of application documents related to regional, vicinity, and site characteristics previously submitted to the NRC for the Fermi 3 COLA, and NRC's associated environmental impact statement, as follows:

- 2011 *Fermi 3 Combined License Application, Part 3: Environmental Report*, Revision 2

- 2012 Fermi 3 Combined License Application, Part 2: *Final Safety Analysis Report*, Revision 4

- 2013 *Final Environmental Impact Statement for Combined License (COL) for Enrico Fermi Unit 3* (NUREG-2105)

3.0.1 Location and Features

The Fermi 2 site is located on the western shore of Lake Erie, at Lagoona Beach in Frenchtown Township, Monroe County, Michigan. (Fermi 2012a, Section 2.1.1) As shown in Table 3.10-1, Monroe, Michigan, the largest population center in Monroe County, is approximately 8 miles west-southwest of the Fermi site. The city of Detroit, the largest population center in the region, is approximately 28 miles north-northeast of the Fermi site. The second largest population center in the region, Toledo, Ohio, is approximately 26 miles southwest of the site.

The coordinates of the Fermi 2 containment structure are latitude 41°57'48"N, and longitude 83°15'31"W. The Universal Transverse Mercator (UTM) coordinates are 4,647,950 meters north and 312,930 meters east, Zone 17T. The Fermi site comprises approximately 1,260 acres of land solely owned by DTE (Figure 3.0-1). (Fermi 2012a, Section 2.1.1)

The Fermi 2 site falls within the Public Land Survey System (PLSS) and includes portions of Sections 16, 17, 19, 20, 21, 28 and 29, Township 6S, Range 10E (Figure 3.0-2) (Earth Point 2012; USDA 2012a).

3.0.2 Vicinity and Region

The vicinity of the Fermi site is defined as the area within a 6-mile radius from the center of the Fermi 2 containment structure and includes segments of Monroe County and Wayne County, Michigan, and a portion of Lake Erie (Figure 3.0-3). As described in Section 3.1, land within the vicinity of the Fermi site is primarily rural and zoned agricultural by both Monroe County and Frenchtown Township. In addition to Lake Erie, natural features in the vicinity of the Fermi site include Stony Point, a distinctively shaped landform projecting into Lake Erie south of the Fermi site, and several other bodies of water, including Swan Creek and the Huron River to the north and Stony Creek to the south (Figure 3.0-4). Outside the vicinity, the River Raisin runs through the city of Monroe southwest of the site. (NRC 2013c, Section 2.2.1)

The region is defined as the area within a 50-mile radius (Figure 3.0-5) centered on the Fermi 2 containment structure. The region includes portions of Essex County and Chatham-Kent census divisions in the province of Ontario, Canada. It also includes portions of the following counties in the states of Michigan and Ohio:

- Michigan (nine counties): Jackson, Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne
- Ohio (eight counties): Erie, Fulton, Henry, Lucas, Ottawa, Sandusky, Seneca, and Wood

As shown in Table 3.10-1, Monroe County had a population of 152,021 persons in 2010, up from 145,945 persons in 2000. Neighboring Wayne County, Michigan, which includes a significant portion of metropolitan Detroit, had a population of 1,820,584 in 2010, down from 2,061,162 in 2000. To the south, neighboring Lucas County, Ohio, where Toledo is located, had a population of 441,815 in 2010, dropping from 455,054 in 2000. (USCB 2012a) While Monroe County grew in population between 2000 and 2010, Frenchtown Township in Monroe County, where Fermi 2 is located, dropped in population from 20,777 in 2000 to 20,428 in 2010 (USCB 2012b).

A portion of the Canadian province of Ontario falls within the 50-mile radius. Ontario's population grew from 11,410,045 in 2001 to 12,851,821 in 2011. The population of Essex County dropped from 393,402 in 2006 to 388,782 in 2011. The population of the Chatham-Kent census division dropped from 108,589 in 2006 to 104,075 in 2011. The largest Canadian census metropolitan area (CMA) that partially falls within a 50-mile radius is Windsor, Ontario, which is located next to Detroit, Michigan. Windsor's CMA population declined from 323,342 in 2006 to 319,246 in 2011. (Statistics Canada 2012a)

Table 3.10-3 provides 2010 U.S. Census data for cities that are located totally or partially within a 50-mile radius of the Fermi site. The village of Estral Beach, located approximately 2 miles northeast of the site, had a population of 418 in 2010, down from a population of 486 in 2000. The city of Monroe is the largest city in Monroe County and had a population of 20,733 in 2010, down from a population of 22,076 in the year 2000. Within a 50-mile radius of the site, there are 27 cities in Michigan with a population greater than 25,000, four of which have populations greater than 100,000. The city of Detroit, Michigan, is the largest of these communities with a population of 713,777 in 2010, down from a population of 951,270 in 2000. Within a 50-mile radius of the site, there are three cities in Ohio with populations greater than 25,000, one of which (Toledo) has a population greater than 100,000. The city of Toledo had a population of 287,208 in 2010, down from a population of 313,619 in 2000. (USCB 2012c)

The region has a highly developed roadway network (Figures 3.0-3 and 3.0-5). Interstate 75 (I-75), which extends through Monroe County and Frenchtown Charter Township, is situated 2 miles west of the Fermi site and provides access from the Fermi site north to Detroit and south to Toledo. Interstate 275 (I-275) splits from I-75 north of the Fermi site and continues in a northwesterly direction, providing a western bypass around the Detroit metropolitan area and access to Detroit Metropolitan Wayne County Airport, western Wayne County, and Oakland County. It connects to Interstate 94 (I-94) and Interstate 96 (I-96), which are the primary east-west interstate highways in Michigan. (NRC 2013c, Section 2.5.2.3)

Because of its central location between Detroit and Toledo, three major railway systems provide service near the site: Canadian National Railway, CSX Transportation, Inc. (CSX), and Norfolk Southern Corporation. A rail spur from the main line Canadian National Railway extends into the Fermi site parallel to Enrico Fermi Drive. This rail spur allows large and heavy equipment to be transported to the plant. (NRC 2013c, Section 2.5.2.3)

Two natural gas pipelines are located in the vicinity of the Fermi site, running roughly southwest to northeast, about 10 miles to the west of the site (NRC 2013c, Section 2.2.1). Barges, freighters, and bulk cargo ships use Lake Erie in the vicinity of the Fermi site. Most of the barge traffic on Lake Erie near the Fermi site occurs to and from the ports of Toledo, Detroit, and Monroe, which are part of the Great Lakes-St. Lawrence Seaway system that connects shipments from the Atlantic Ocean to the American Midwest. (NRC 2013c, Section 2.5.2.3)

Within 10 miles of the Fermi site, there are two private heliports, three private airfields, and three general aviation airports open to the public. As illustrated in Figure 3.0-3, the three private air fields (Newport Woods, Mills Field, and Carls) are located within 6 miles of the site. The Detroit Metropolitan Wayne County Airport is a full-service commercial airport approximately 18 miles north-northwest of the plant, as shown in Figure 3.0-5. (AirNav 2012)

3.0.3 Station Features

The principal structures at Fermi 2 are identified in Section 2.2. In addition to the principal structures, the northwestern portion of the Fermi site also contains the security firing range. The protected area is completely enclosed by a security fence, with access to the area controlled at a security access portal. A plant security system monitors the protected area, as well as the buildings within the station. Figure 3.0-1 illustrates the general features of the Fermi 2 site. On the same site is Fermi 1, originally a fast breeder reactor, and later also a conventional oil-fired power plant. Both the reactor and power plant are decommissioned. (Fermi 2012a, Section 1.2.2.1)

The land portion of the exclusion area for Fermi 2 is entirely within the Fermi site (Figure 3.0-1). DTE has the authority to determine all activities within the land portion of the exclusion area, including authority for the exclusion of personnel and property. No public roads, waterways, or railroads traverse the land portion of the exclusion area. The Lake Erie shoreline along the Fermi site is unsuitable for beach activities. The limited beach area available is inaccessible to the public from the land side and is posted as private property. Few activities unrelated to the plant are expected to take place on Lake Erie adjacent to the plant site due to the permanent security zone established by the U.S. Coast Guard in a portion of Lake Erie around the Fermi 2 plant, which restricts water vessel traffic, and the fact that the Fermi 2 property boundary (i.e., owner-controlled area) encompasses a portion of Lake Erie. (Fermi 2012a, Section 2.1.2.1; 67 FR 46385)

There are no residences within the Fermi property boundary. The nearest residence is approximately 0.72 miles west-northwest of the Fermi 2 reactor. (Fermi 2012c) Figure 3.0-1 shows the EAB as defined by 10 CFR 100.3. No residences are permitted within the Fermi 2 EAB.

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 Toll Road/Fisher Street. The main entrance to the site is from the west by way of Enrico Fermi Drive, a private road owned by DTE. Rail service to the site is furnished by a spur line from the main line Canadian National Railway, located 4 miles west of the site. (Fermi 2012a, Sections 1.2.2 and 2.1.2)

The northern and southern areas of the site are dominated by large lagoons. The western areas are dominated by wooded wetlands and a series of quarry lakes. Site elevation ranges from approximately 25 feet above the lake level on the western edge of the site to lake level on the eastern edge. (Fermi 2012a, Section 2.1.2)

DTE is the licensed owner and operator of the Fermi site and currently controls the site for the purpose of generating electricity. However, some of the area within the site boundary is used for other purposes, such as occasional ecological studies by the U.S. Fish and Wildlife Service (USFWS) and habitat restoration activities by state agencies or nonprofit groups. (DECo 2011, Section 2.2.1.1) This area, referred to as the Detroit River International Wildlife Refuge (DRIWR), encompasses approximately 650 acres of the existing 1,260-acre site; the approximate boundaries of the refuge are shown in Figure 3.6-1 (DTE 2013o).

3.0.4 Federal, Native American, State, and Local Lands

A number of state and federal lands are located within the vicinity of Fermi 2, as listed in Table 3.0-1 and illustrated in Figure 3.0-4. In addition to onsite DRIWR parcels, there are several DRIWR parcels within a 6-mile radius of the plant. The state lands within the vicinity include Sterling State Park, Pointe Aux Peaux State Wildlife Area, Pointe Mouillee State Game Area, and Pointe Mouillee State Natural Area. There are five county parks in Monroe County; Heck Park and Nike Park are closest to Fermi, bordering the 6-mile radius. (MCRP 2008)

As shown in Table 3.0-1, there is a mixture of federal, state, and locally managed lands and Canadian public lands within a 50-mile radius of Fermi 2 (Figure 3.0-6). The state of Michigan has seven federal land parcels in the region. The one closest to the site is the DRIWR, which extends from the Ohio state line north into Wayne County, Michigan. The state of Ohio has six federal land parcels within the region. Monroe County, Michigan, has a well-developed natural resource-based park and recreation system. Many of Monroe County's tourist attractions are related to outdoor recreation. The many marinas and boat ramps along the Lake Erie and River Raisin shorelines attract people from throughout the region, as do the fishing and hunting opportunities of the coastal wetlands. The *Monroe County 5-Year Recreation Plan 2008–2012* provides a county-wide comprehensive recreation inventory that includes state and county facilities, local parks by city and township, school playgrounds, neighborhoods, and private recreational facilities. (MCRP 2008)

There are no Indian reservations or Native American controlled areas within the U.S. portion of the 50-mile radius of the site. As illustrated in Figure 3.0-6, a small portion of the Walpole 46 First Nation Reserve northeast of the Fermi site in Ontario, Canada, lies just inside the 50-mile radius. The Walpole Reserve is a 17,050-acre parcel that extends beyond the region, approximately 10 miles northeast. (DECo 2011, Section 2.2.3) As listed in Table 3.0-1, there are four military installations within the 50-mile radius, including the U.S. Army Garrison–Detroit Arsenal, the U.S. Army Garrison–Selfridge, and Selfridge Air National Guard Base in Michigan, and the Camp Perry Training Site in Ohio. (USDA 2012a)

Table 3.0-1
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
MICHIGAN					
Detroit River International Wildlife Refuge (multiple sites)	Federal	Onsite	Onsite	Estral Beach	Monroe and Wayne
Pointe Aux Peaux State Wildlife Area	State	1	SSW	Estral Beach	Monroe
Pointe Mouillee State Game Area	State	5	NE	Estral Beach	Monroe and Wayne
Pointe Mouillee Natural Area	State	5	NNE	Estral Beach	Monroe
Sterling State Park	State	5	SW	Monroe	Monroe
Heck Park	Local	6	WSW	Monroe	Monroe
Nike Park	Local	6	WNW	Carleton	Monroe
NIKE D-57/58 Newport (National Guard/FAA property)	State/federal	6	WNW	Carleton	Monroe
River Raisin National Battlefield Park	Federal	7	SW	Monroe	Monroe
Pointe Mouillee State Game Area Celeron Island Unit	State	9	NNE	Gibraltar	Wayne
Bolles Harbor	State	9	SW	Monroe	Monroe
Pointe Mouillee State Game Area Stoney Island Unit	State	13	NNE	Trenton	Wayne
Stony Island	State	13	NNE	Trenton	Wayne
Brownstown Prairie State Wildlife Area	State	14	N	Woodhaven	Wayne
Erie State Game Area	State	16	SW	Luna Pier	Monroe
Petersburg State Game Area	State	23	WSW	Petersburg	Monroe

**Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2**

Name	Management	Distance[c][d]	Direction	Nearest Town	County
Minong-Petersburg Prairie Natural Area	State	23	WSW	Petersburg	Monroe
Sassafras Trails Nature Center	State	24	NNW	Wayne	Wayne
TriCentennial State Park & Harbor	State	28	NNE	Detroit	Wayne
Matthaei Botanical Gardens, University of Michigan	State	31	NW	Ann Arbor	Washtenaw
Nichols Arboretum, University of Michigan	State	32	NW	Ann Arbor	Washtenaw
Michigan State Fair Grounds	State	34	NNE	Hazel Park	Wayne
Maybury State Park	State	35	NNW	Northville	Wayne
U.S. Army Garrison, Detroit Arsenal	Federal	38	NNE	Center Line	Macomb
Island Lake State Recreation and Natural Area	State	44	NNW	Brighton	Livingston and Oakland
Proud Lake Nature Study Area	State	43	NNW	Wolverine Lake	Oakland
Orchard Lake MDNR Public Access	State	43	N	Keego Harbor	Oakland
Wolverine Lake Access	State	43	NNW	Wolverine Lake	Oakland
Apple Island Access Site	State	43	N	Keego Harbor	Oakland
Hidden Lake Gardens, Michigan State University	State	44	W	Onsted	Lenawee
Federal Forest Reserve	Federal	45	NW	Brighton	Livingston
Chelsea State Game Area	State	45	NW	Chelsea	Washtenaw
Dodge #4 State Park	State	45	N	Keego Harbor	Oakland
Proud Lake State Recreation Area	State	45	NNW	Wolverine Lake	Oakland

Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
Hayes State Park	State	46	W	Onsted	Lenawee
Long Lake Access	State	46	N	Wolverine Lake	Oakland
Union Lake Access	State	46	N	Wolverine Lake	Oakland
Brighton State Recreation Area	State	48	NW	Brighton	Livingston
River Bend Township Park	State	48	NNE	Utica	Macomb
Sharonville State Game Area	State	48	WNW	Manchester	Jackson and Washtenaw
Cedar Island Access	State	48	NNW	Wolverine Lake	Oakland
Crescent Lake Access	State	48	N	Keego Harbor	Oakland
Waterloo Recreation Area[c]	State	48	WNW	Jackson	Jackson and Washtenaw
Pinckney State Recreation Area	State	49	NW	Pinckney	Livingston and Washtenaw
Shadbush Tract Nature Study Area	State	49	NNE	Utica	Macomb
Goose Lake State Game Area	State	49	WNW	Chelsea	Washtenaw
Highland State Recreation Area	State	49	NNW	Milford	Oakland
Little Cedar Lake Natural Area	State	49	WNW	Chelsea	Washtenaw
Pontiac Lake Recreation Area[c]	State	49	NNW	Pontiac	Oakland
U.S. Army Garrison, Selfridge	Federal	50	NNE	Mount Clemens	Macomb
Selfridge Air National Guard Base	Federal	50	NNE	Mount Clemens	Macomb
Cambridge State Historic Park	State	50	W	Onsted	Lenawee

Table 3.0-1 (Continued)
Federal, State, and Local[(a)] Lands[(b)] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[(c)(d)]	Direction	Nearest Town	County
Haven Hill Natural Area	State	50	NNW	Milford	Oakland
Loon Lake Access	State	50	N	Pontiac	Oakland
Pontiac Lake Access	State	50	N	Keego Harbor	Oakland
Pontiac Lake State Recreation Area	State	51	N	Keego Harbor	Oakland
Onsted State Wildlife Management Area[(c)]	State	51	W	Cement City	Lenawee
Waterloo State Recreation Area	State	52	WNW	Chelsea	Jackson and Washtenaw
St. Clair Flats State Wildlife Area	State	52	NNE	Mount Clemens	St. Clair
OHIO					
West Sister Island National Wildlife Refuge[(c)] (West Sister Island Wilderness)	Federal	16	SE	Oak Harbor	Ottawa
Cedar Point National Wildlife Refuge	Federal	19	SSW	Harbor View	Lucas
Maumee Bay State Park	State	20	SSW	Harbor View	Lucas
Mallard Club Marsh Wildlife Area	State	20	SSW	Harbor View	Lucas
Metzger Marsh Wildlife Area	State	22	S	Rocky Ridge	Lucas
Ottawa National Wildlife Refuge	Federal	23	S	Rocky Ridge	Lucas
Crane Creek State Park	State	23	S	Rocky Ridge	Lucas
Magee Marsh Wildlife Area	State	25	S	Rocky Ridge	Lucas and Ottawa
Toussaint Wildlife Area	State	27	S	Rocky Ridge	Ottawa
Honey Point Wildlife Area	State	29	SE	Put-in-Bay	Ottawa

Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
Camp Perry Training Site	Federal	30	SSE	Port Clinton	Ottawa
Kuehnle Wildlife Area	State	30	SE	Put-in-Bay	Ottawa
Green Island Wildlife Area	State	30	SE	Put-in-Bay	Ottawa
South Bass Island State Park	State	31	SE	Put-in-Bay	Ottawa
Put-in-Bay Aquatic Visitor Center	State	31	SE	Put-in-Bay	Ottawa
Perry's Victory and International Peace Memorial	Federal	31	SE	Put-in-Bay	Ottawa
Wildlife Habitat Restoration Program (Taylor)	State	33	SSW	Walbridge	Wood
Audubon Islands Nature Preserve	State	34	SW	Perrysburg	Lucas
Irwin Prairie Nature Preserve	State	34	SW	Holland	Lucas
Little Portage Wildlife Area	State	34	SSE	Port Clinton	Ottawa
Catawba Island State Park	State	34	SE	Put-in-Bay	Ottawa
Portage River Wildlife Access	State	34	SSE	Port Clinton	Ottawa
Wildlife Habitat Restoration Program (Pickeral Bay)	State	35	SSE	Port Clinton	Ottawa
Wildlife Habitat Restoration Program (Koenig)	State	35	SSE	Oak Harbor	Ottawa
Fallen Timbers Battlefield National Historical Site	Local/federal	36	SW	Maumee	Lucas
Aldrich Pond Wildlife Area	State	36	S	Lindsey	Sandusky
Campbell Nature Preserve	State	37	SW	Holland	Lucas

Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
East Harbor State Park	State	37	SE	Marblehead	Ottawa
West Harbor Area Refuge	State	37	SE	Bay View	Ottawa
North Shore Alvar Nature Preserve	State	37	SE	Kelleys Island	Erie
Kelleys Island State Park	State	38	SE	Kelleys Island	Erie
North Pond Nature Preserve	State	38	SE	Kelleys Island	Erie
Mazuriks Lake Erie Access	State	39	SE	Marblehead	Ottawa
Wildlife Habitat Restoration Program (Murray, P.)	State	40	SSE	Fremont	Sandusky
Wildlife Habitat Restoration Program (Reed)	State	40	S	Lindsey	Sandusky
Wildlife Habitat Restoration Program (Ohms)	State	40	SSE	Fremont	Sandusky
Dempsey's Sandusky Bay Access	State	40	SE	Marblehead	Ottawa
Lakeside Daisy Nature Preserve	State	40	SE	Marblehead	Ottawa
Pickerel Creek Wildlife Area	State	41	SSE	Port Clinton	Sandusky
Marblehead Lighthouse State Park	State	41	SE	Marblehead	Ottawa
Willow Point Wildlife Area	State	41	SSE	Bay View	Erie and Sandusky
Missionary Island Wildlife Area	State	42	SW	Haskins	Lucas
Wildlife Habitat Restoration Program (Knepper)	State	43	S	Helena	Sandusky
Miller Blue Hole Wildlife Area	State	43	SSE	Castalia	Sandusky
Fulton Pond Wildlife Area	State	43	SW	Swanton	Fulton

Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
Resthaven Wildlife Area	State	44	SSE	Castalia	Erie and Sandusky
Castalia Fish Hatchery	State	44	SSE	Castalia	Sandusky
Maumee River Weir Rapids Wildlife Access	State	44	SW	Tontogany	Wood
Wildlife Habitat Restoration Program (Euller)	State	44	SW	Tontogany	Lucas
Maumee State Forest	State	44	SW	Neapolis	Fulton and Lucas
Wildlife Habitat Restoration Program (Ritter)	State	45	S	Helena	Sandusky
Sandusky Wildlife Office	State	45	SE	Sandusky	Erie
Maumee State Forest	State	46	SW	Whitehouse	Fulton, Henry, and Lucas
Wildlife Habitat Restoration Program (Bingle)	State	47	S	Risingsun	Sandusky
Pipe Creek Wildlife Area	State	47	SE	Sandusky	Erie
Van Tassel Wildlife Area	State	47	SW	Grand Rapids	Lucas and Wood
Lanker Wildlife Area	State	48	SW	Grand Rapids	Lucas
Sandusky Scenic River Wolf Creek Access	State	48	S	Bettsville	Sandusky
Green Springs State Nursery	State	49	S	Green Springs	Sandusky
Wildlife Habitat Restoration Program (Baker)	State	49	S	Burgoon	Sandusky
Wildlife Habitat Restoration Program (Chamberlain)	State	49	SSW	Portage	Wood
Wildlife Habitat Restoration Program (Ferrell, R.)	State	49	SW	Grand Rapids	Wood

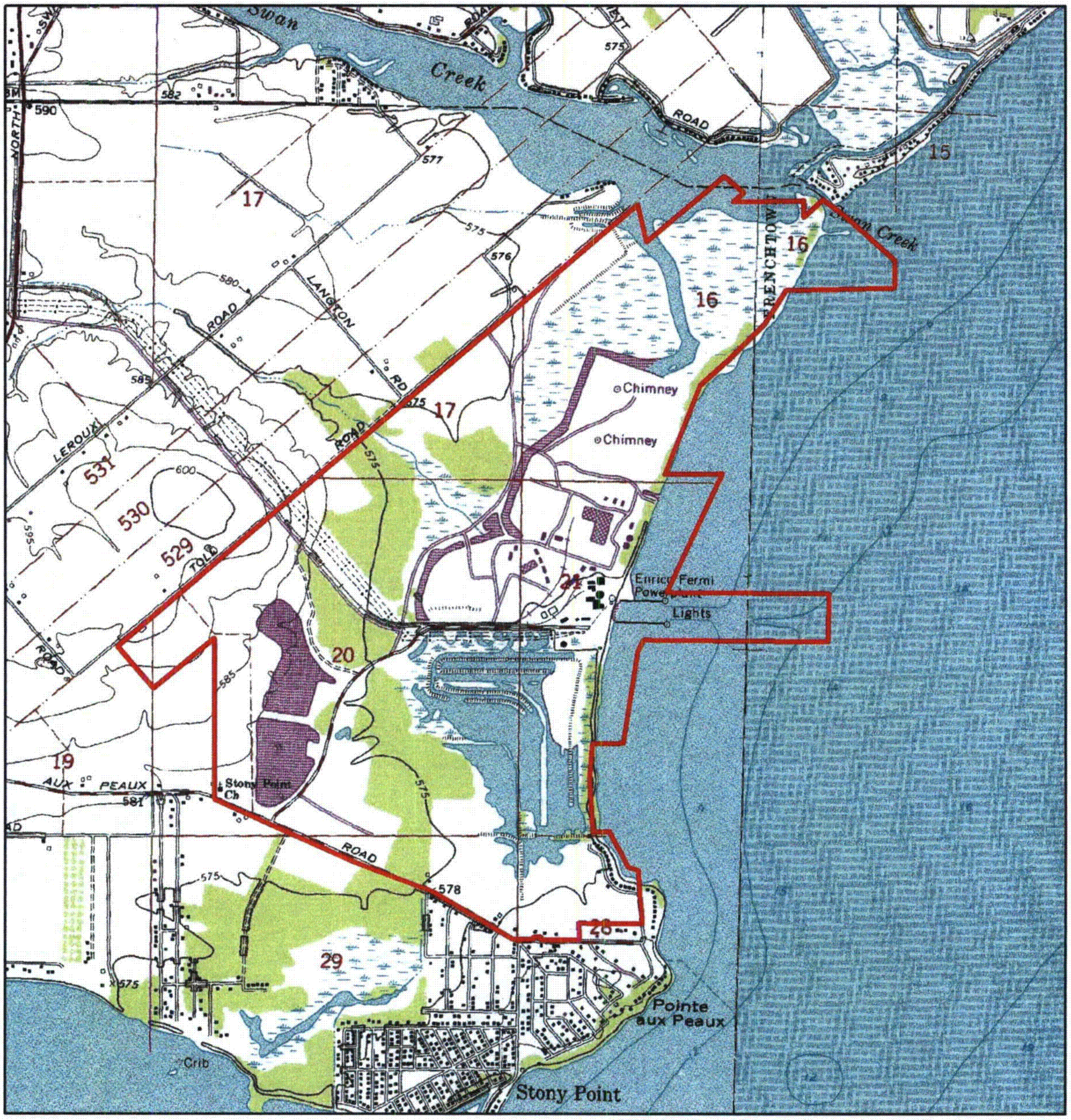
Table 3.0-1 (Continued)
Federal, State, and Local[a] Lands[b] within a 50-Mile Radius of Fermi 2

Name	Management	Distance[c][d]	Direction	Nearest Town	County
Wildlife Habitat Restoration Program (Murray, M.)	State	50	SSE	Green Springs	Sandusky
Mary Jane Thurston State Park	State	50	SW	Grand Rapids	Henry and Wood
Sheldon Marsh Nature Preserve	State	50	SE	Sandusky	Erie
Lake Hudson Recreation Area	State	50	W	Hudson	Lenawee
ONTARIO, CANADA					
Fort Malden National Historic Site[c]	Canada	12	NE	Amherstburg	Essex
Bois Blanc Lighthouse[c]	Canada	12	NE	Amherstburg	Essex
East Sister Island National Wildlife Refuge[c]	Canada	15	ESE	Pelee Island	Essex
Ojibway Prairie Nature Reserve[c]	Canada	22	NNE	Windsor	Essex
Lighthouse Point[c]	Canada	33	SE	Pelee Island	Essex
Fish Point (southern Pelee Island)[c]	Canada	34	SE	Pelee Island	Essex
Point Pelee National Park	Canada	38	E	Leamington	Essex
Two Creeks Conservation Area[c]	Canada	42	ENE	Wheatley	Chatham-Kent Division
Wheatley Provincial Park[c]	Canada	42	ENE	Wheatley	Chatham-Kent Division
Walpole 46 First Nation Reserve[c]	Canada	50	NE	Wallaceburg	Chatham-Kent Division

(DECo 2011; MCRP 2008; USDA 2012a; USDOT 2012; USFWS 2012a)

a. Only locally operated lands within a 6-mile radius are included in the table. A complete list of Monroe County recreation sites is available in the Monroe County 5-year recreation plan (MCRP 2008).
b. Listed lands are based on best available public information.
c. These Canadian provincial and American federal/state sites are based on DECo 2011, Table 2.2-9; Walpole 46 First Nation Reserve is based on DECo 2011, Section 2.2.3.
d. Distances are approximate miles (rounded to nearest whole number and based on Fermi 2 and land centroid data). Therefore, although the distances for some of the state and federal lands shown in the table are greater than 50 miles, the nearest property boundaries for these lands are within 50 miles (USDA 2012a; USDOT 2012).

Figure 3.0-1
Fermi 2 Site Map



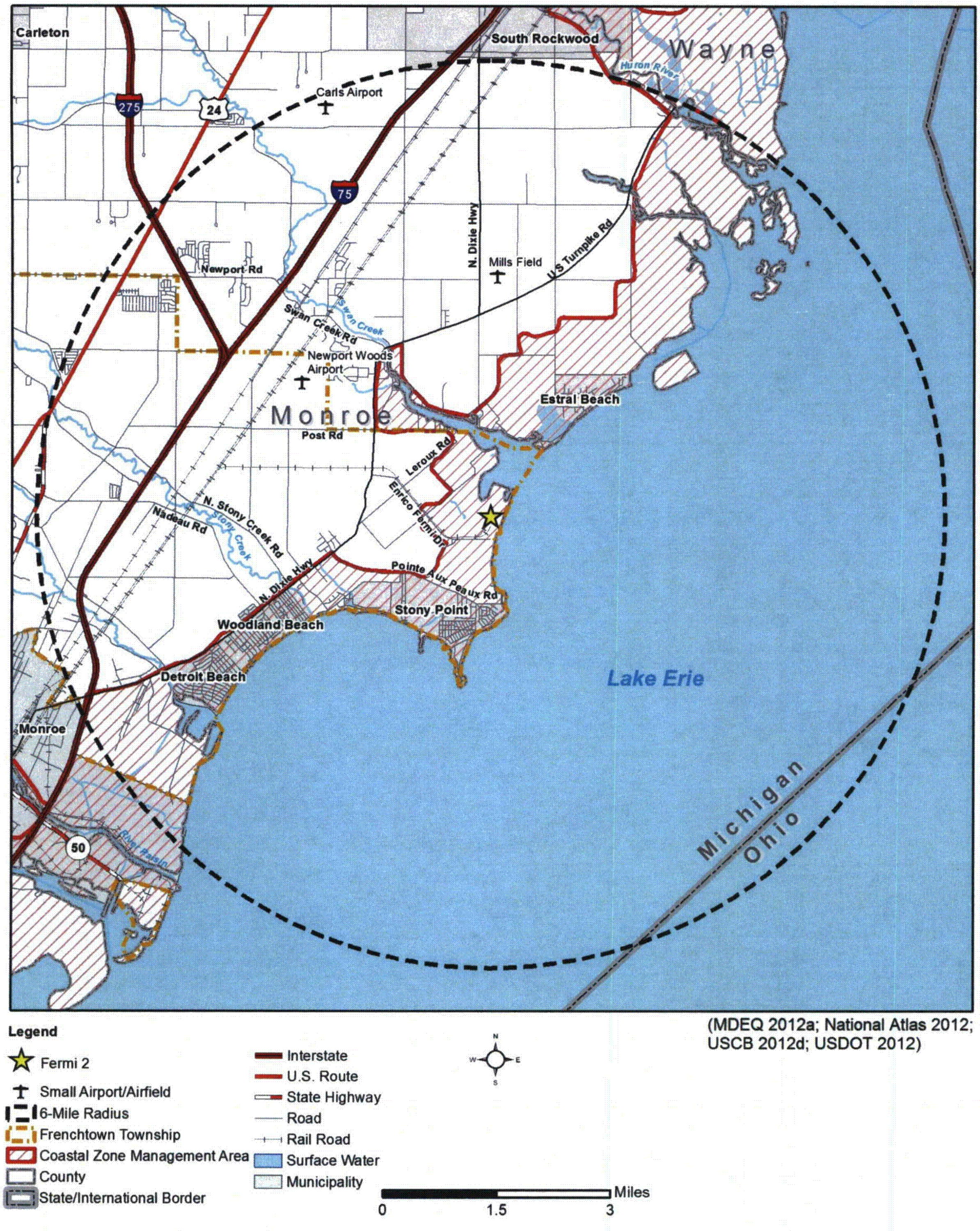
(DTE 2013j; USDA 2012a; USGS 1967a; USGS 1967b)

Legend

Property Boundary (Approximate)

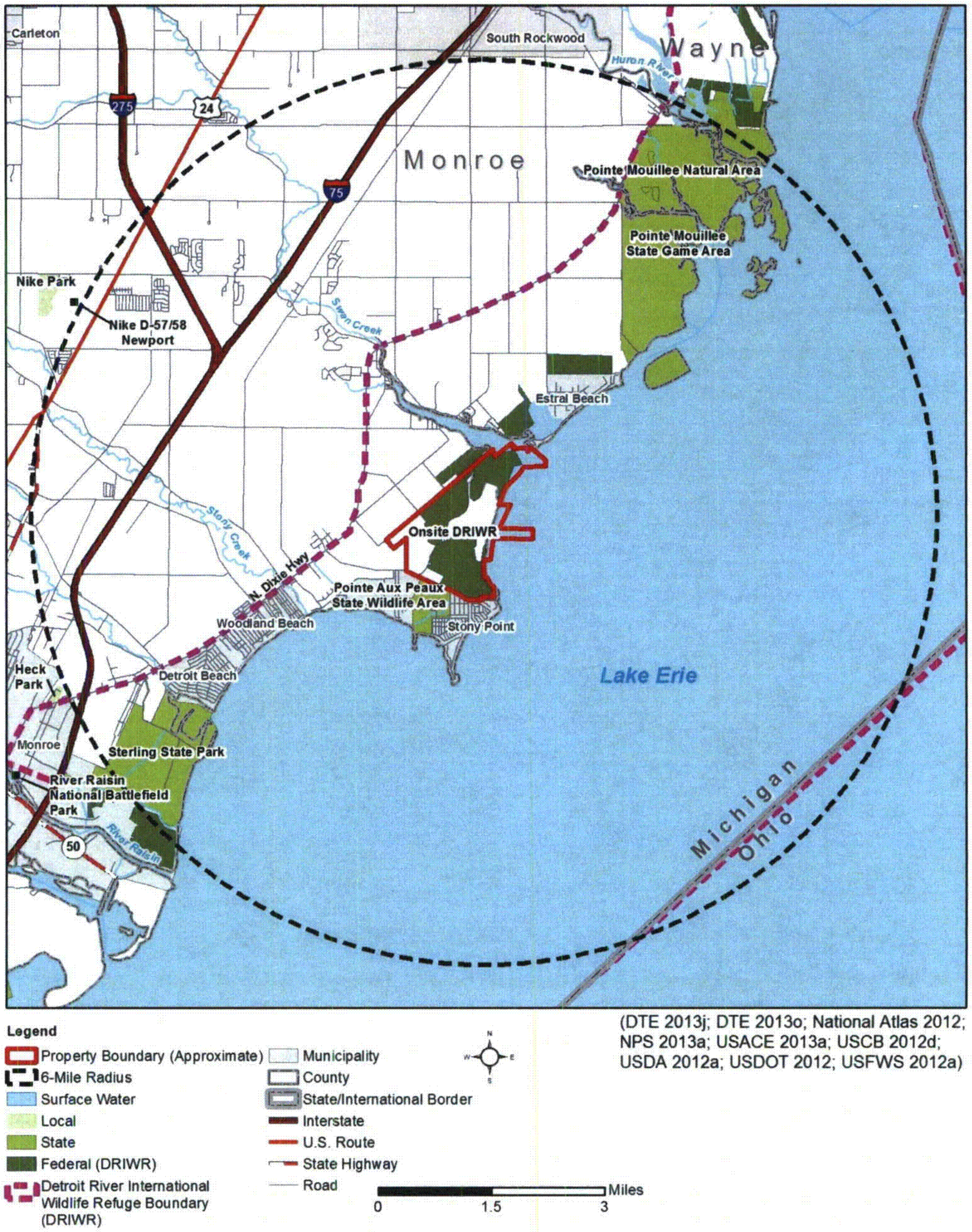
0 0.5 1 Miles

Figure 3.0-2
Fermi 2 Site Property and Area Topography



(MDEQ 2012a; National Atlas 2012; USCB 2012d; USDOT 2012)

Figure 3.0-3
6-Mile Radius of Fermi 2

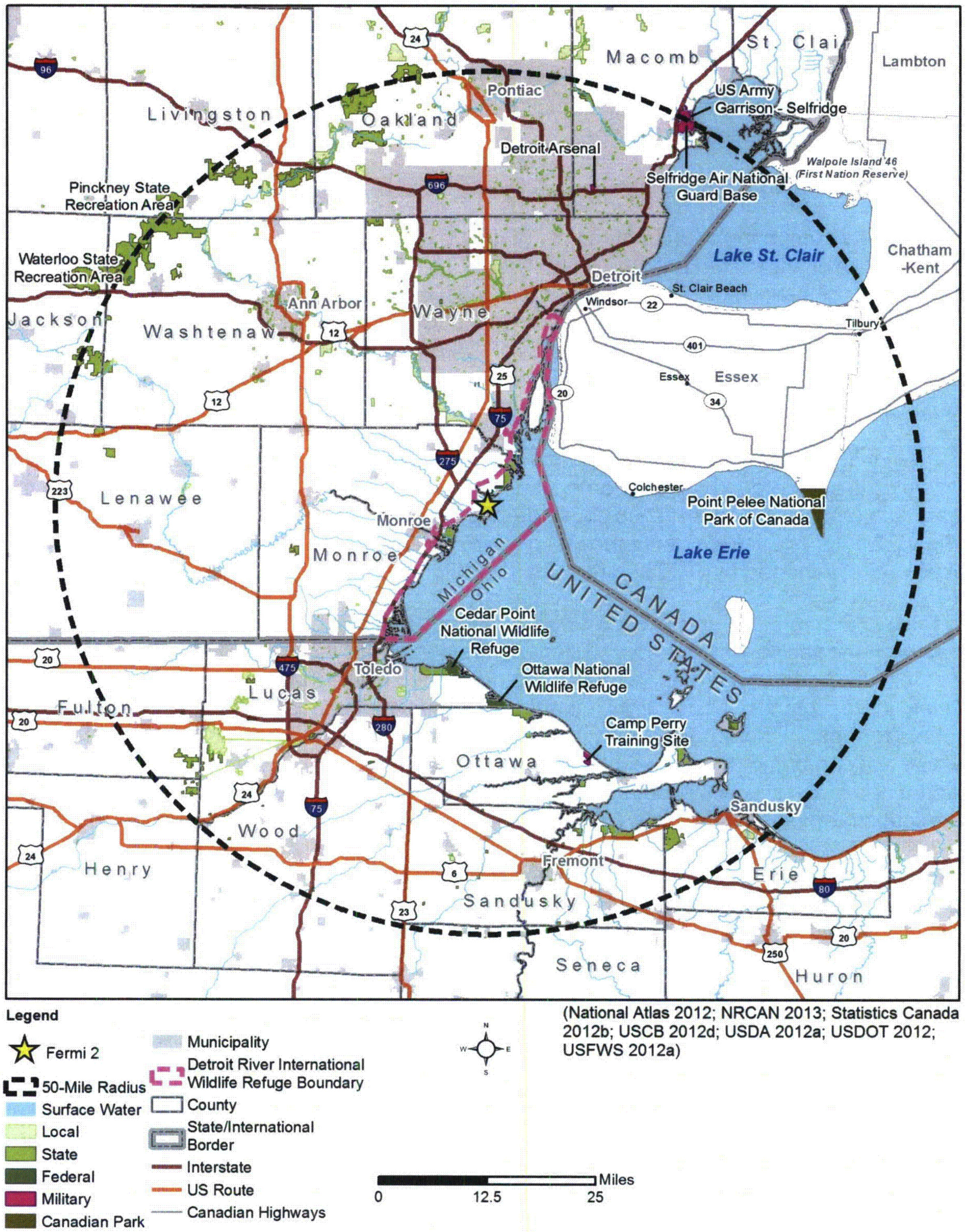


(DTE 2013j; DTE 2013o; National Atlas 2012; NPS 2013a; USACE 2013a; USCB 2012d; USDA 2012a; USDOT 2012; USFWS 2012a)

Figure 3.0-4
Federal, State, and Local Lands within a 6-Mile Radius of Fermi 2

(National Atlas 2012; NRCAN 2013; Statistics Canada 2012b; USCB 2012d; USDOT 2012)

Figure 3.0-5
50-Mile Radius of Fermi 2



(National Atlas 2012; NRCAN 2013; Statistics Canada 2012b; USCB 2012d; USDA 2012a; USDOT 2012; USFWS 2012a)

Figure 3.0-6
Federal, State, and Local Lands within a 50-Mile Radius of Fermi 2

3.1 Land Use and Visual Resources

Land-use descriptions are focused on Monroe and Wayne counties in Michigan because approximately 78 percent of Fermi 2 employees live in these two counties and because Fermi 2 pays property taxes to Monroe County.

3.1.1 Onsite Land Use

The Fermi site comprises approximately 1,260 acres and is owned by DTE. The site is located in Frenchtown Township, in an unincorporated portion of Monroe County, Michigan. (NRC 2013c, Section 2.2.1) As shown in Table 3.10-3, the largest cities near the site are Detroit, Michigan, approximately 28 miles north-northeast, and Toledo, Ohio, about 26 miles southwest. The site is approximately 7 miles from the United States-Canada border (Figure 3.0-5). As shown in Figure 3.0-1, the eastern portion of the site, adjacent to Lake Erie, contains the existing power plant structures.

Land use on the Fermi site is divided primarily into wetland and developed areas. Wetland and open water are the predominant land-use/land-cover types. Most of the forested areas on the site are subject to flooding and thus considered forested or woody wetlands. (DECo 2011, Section 2.2.1.1) The DRIWR encompasses approximately 650 acres of the Fermi site and is cooperatively managed by DTE and the USFWS (Figure 3.6-1) (DTE 2013o).

As shown in Figure 3.1-1 and Table 3.1-1, the majority of the site—744 acres or 59.1 percent of site acreage—consists of vegetated wetlands, forested areas, and open water. Approximately 212 acres (16.8 percent) of the Fermi site are developed areas that include existing Fermi 2 facilities, the decommissioned Fermi 1 plant, and associated support facilities. Onsite grassland accounts for approximately 168 acres (13.3 percent), and the site contains approximately 136 acres of shrubland and thicket (10.8 percent). The quarry lakes, located in the western portion of the site, include two adjacent quarries that were previously used to provide construction materials for Fermi 2. (NRC 2013c, Section 2.2.1)

Land on the Fermi site is designated as "industrial" by Monroe County and zoned as "public service" by Frenchtown Township. Projected land-use maps produced by both planning agencies indicate that industrial and utility uses are anticipated to continue on the Fermi property. (NRC 2013c, Section 2.2.1)

DTE has acquired and will maintain surface ownership of all land within the Fermi site property boundary. DTE owns and controls 99.93 percent of the mineral rights within the Fermi property, including all of the mineral rights within the EAB. A third party, the Michigan Department of Natural Resources (MDNR), owns 0.88 acres of mineral rights in the far southeastern portion of the Fermi site. There are no activities at the Fermi site or in adjacent areas that involve exploration for, drilling for, or otherwise extracting minerals. The geological character of the subsurface structure and the land use in the vicinity of the Fermi site indicate that commercial mineral production appears unlikely in the foreseeable future. (DECo 2011, 2.2.1.1)

3.1.2 Offsite Land Use

As discussed in Section 3.10, Monroe County has seen an increase in total population since 2000, and the county population is anticipated to continue increasing through 2045. In contrast, Wayne County, where the city of Detroit is located, has seen a substantial decrease in population since 2000 (see Table 3.10-1).

Monroe County lies on the southeastern edge of Michigan and is bordered on the east by Lake Erie; on the north by Washtenaw County and Wayne County, Michigan; on the west by Lenawee County, Michigan; and on the south by Lucas County, Ohio (Figure 3.0-5). Monroe County can be characterized as a predominantly agricultural county, with substantial urban areas. The land-use pattern of the county is described as having two major residential areas connected by I-75, and a major utility corridor, with agricultural lands, small scattered towns, forested lands and wetlands surrounding them. (Monroe County 2012, page 37) As shown in Figure 3.0-3, there are several residential neighborhoods and beach communities located outside the plant property boundary along North Dixie Highway. Two major residential areas in Monroe County are the city of Monroe and Bedford Township (adjacent to Toledo). Growth within the county has become decentralized in recent years, with a large amount of rural and farmland being converted to residential uses. Specifically, Frenchtown Township, where the Fermi site is located, is one of three townships that have seen the most residential development in the last 20 years. (Monroe County 2012, pages 37 and 41)

The 6-mile vicinity surrounding the Fermi site falls primarily within Monroe County; however, a small portion includes land area in Wayne County and a portion of Lake Erie that falls within the State of Ohio. The land-use/land-cover categories within the vicinity are illustrated in Figure 3.1-2. The largest land-use/land-cover category is open water at approximately 37,765 acres (approximately 52.2 percent), composed primarily of Lake Erie. The second largest category is cultivated crops at approximately 14,850 acres (approximately 20.5 percent). Developed land, which includes open space, low intensity, medium intensity, and high intensity categories, totals approximately 8,149 acres (approximately 11.3 percent). These three categories compose the majority (84 percent) of land-use/land-cover types within the vicinity (Table 3.1-2). (MRLC 2012; USDA 2012a)

Monroe County occupies approximately 549 square miles of land (351,614 acres) (USCB 2012e; USDA 2012b). The U.S. Department of Agriculture (USDA) indicates approximately 207,812 acres, or 59.1 percent of the land area in Monroe County, was used for agricultural purposes in 2007. The county had 1,119 farms with 91.2 percent of the land in farms devoted to cropland, and the remaining 8.8 percent devoted to other uses. Major agricultural crops produced in the county included corn, soybeans, wheat, vegetables, and forage. Some of the major livestock commodities were laying hens, cattle and calves, horses and ponies, and sheep and lambs. (USDA 2012b) Based on the Southeast Michigan Council of Governments (SEMCOG) 2008 digital parcel data, land use in Monroe County was predominantly designated as agricultural (54.2 percent), and 31.0 percent of parcels are designated as single-family residential (SEMCOG 2012a).

Wayne County occupies approximately 612 square miles of land (391,716 acres) (USCB 2012e; USDA 2012b). Approximately 17,443 acres (4.5 percent) of the land in Wayne County was used for agricultural purposes in 2007. The county had 313 farms, with most of the agricultural land in farms devoted to cropland (75.04 percent), woodland (11.64 percent), pasture (6.37 percent), and other uses (6.95 percent). Major agricultural crops produced in the county included soybeans, corn, forage, vegetables, and sod. Major livestock commodities were laying hens, horses and ponies, broilers and other meat-type chickens, ducks, and rabbits and their pelts. (USDA 2012b) SEMCOG 2008 digital parcel data show that Wayne County was predominantly single-family residential at 43.1 percent, followed by 19.3 percent of county land use dedicated to transportation, communication, and utilities; and 10.7 percent of lands designated as industrial (SEMCOG 2012a).

The Michigan Planning Enabling Act, Public Act 33 of 2008, states that a master plan:

> (1) shall guide and accomplish development that is coordinated, adjusted, harmonious, efficient, and economical; (2) shall consider the character of the planning jurisdiction and its suitability for particular uses, judged in terms of factors such as trends in land and population development; and (3) will, in accordance with present and future needs, best promote public health, safety, morals, order, convenience, prosperity, and general welfare (Monroe County 2012).

Monroe County, Wayne County, and the nearby City of Detroit all have master plans with active zoning regulations.

SEMCOG projection models based on the interaction between land use, transportation, and public policy (i.e., community master plans and sewer service district) indicate the Monroe County population, households, and employment are all expected to increase through the year 2040 (SEMCOG 2012b). The amount of land used for agriculture has been in decline, while the amount used for residential purposes has increased. The county comprehensive plan states that Monroe County's overall goal for the future is to maximize the economic and efficient use of land to enhance the quality of life. Monroe County objectives for future land-use planning include the following (Monroe County 2012, page 172):

- Promote planning cooperation between all units of government to assure the efficient use of public facilities and easy access to work, recreation, and community services.
- Discourage urban sprawl and the premature extension of public utilities such as water and sanitary sewers.
- Preserve unique natural and cultural resources.
- Protect the environment from hazardous influences.

Southeastern Michigan, specifically Wayne County and the city of Detroit, experienced a significant decline in both population and jobs during the recent multi-year recession, specifically in manufacturing and retail trade. SEMCOG projection models indicate Wayne County and Detroit will continue to decline in population and households through 2040, although employment is expected to show limited growth in future years. (SEMCOG 2012b)

In an effort to address abandoned and foreclosed properties throughout Wayne County, the Wayne County Neighborhood Stabilization Program has purchased and rehabilitated more than 100 homes for residents who earn less than 50 percent of area median income. The program also planned the demolition of more than 700 blighted structures and the redevelopment of several vacant properties that resulted in the creation of several hundred jobs. (Wayne County 2012) At the city level, Detroit updated its master plan in 2009 (City of Detroit 2012), which recognized that priorities of land-use regulation should include reducing conflicts between adjacent land uses while accommodating a diversity of complementary uses. From this, Detroit established a number of zoning policies and goals, including the following:

- Alleviate land-use conflicts by strengthening and enforcing regulations buffering residential areas from commercial and industrial land uses.
- Provide flexible guidelines to accommodate diverse land use (e.g., allow uses such as agricultural or open space) within residential, commercial, and industrial areas containing significant amounts of vacant land.
- Encourage desirable development through incentives, such as density bonuses to encourage the creation of additional green space.

3.1.3 Visual Resources

The 1,260-acre Fermi site is located on the western shore of Lake Erie. Figure 3.0-1 shows the building site layout and property boundary in association with Lake Erie. The existing site arrangement includes Fermi 1 and Fermi 2. Fermi 1 is decommissioned, in SAFSTOR status. The transmission lines associated with Fermi 2 that are within the scope of this evaluation are located in the developed and industrialized area of Fermi 2 and within the property boundary. The buildings for Fermi 2 have a natural concrete exterior, neutral gray in color, which tends to reduce visual impact. The Fermi site grade elevation is approximately 581.8 feet North American Vertical Datum of 1988 (NAVD88)[1]. Figure 3.0-2 provides a topographical map of the site in which the property boundary is identified. Two concrete natural draft cooling towers are used for heat dissipation for Fermi 2. Each tower is approximately 450 feet in diameter at its base; the maximum elevation is 400 feet above the grade elevation. The natural draft cooling towers for

1. The Fermi 2 UFSAR references elevations in the New York Mean Tide (1935) datum, which is also referred to as the Fermi 2 datum. This LRA ER uses the NAVD88 datum which has a difference in elevation of -1.211 feet from the Fermi 2 datum. Therefore, elevations noted in this report will be 1.211 feet less than those listed in the Fermi 2 UFSAR.

Fermi 2 are the tallest and most predominant structures on the site and are visible from outside the property boundary. (DECo 2011, Section 3.1.1)

The land within 5 miles of the Fermi site is primarily agricultural with the exception of the neighboring residential areas and small beach communities as depicted in Figure 3.0-3. Visual impacts on these areas (from the Fermi site) are limited to the adjacent residents and traffic associated with the Dixie Highway and smaller arterial roads, and the cooling towers can also be seen sporadically from I-75 and I-275. Locally, the cooling towers are also visible from locations in Sterling State Park and Pointe Mouilee State Game Area, but overall the site does not visually impact areas that have a high degree of visitor use or recreational areas. (DECo 2011, Section 3.1.2; NRC 2013c, Section 2.5.2.4)

Table 3.1-1
Onsite Land Use at Fermi Site

Land Use	Acres	Percent
Developed areas[(a)]	212	16.8
Coastal wetlands[(b)]	273	21.7
Forest	256	20.3
Water	215	17.1
Grassland (including onsite agricultural land and onsite transmission corridors)	168	13.3
Shrubland and thicket	136	10.8
Total	**1,260**	**100**

(NRC 2013c, Table 2-1 and Figure 2-10)

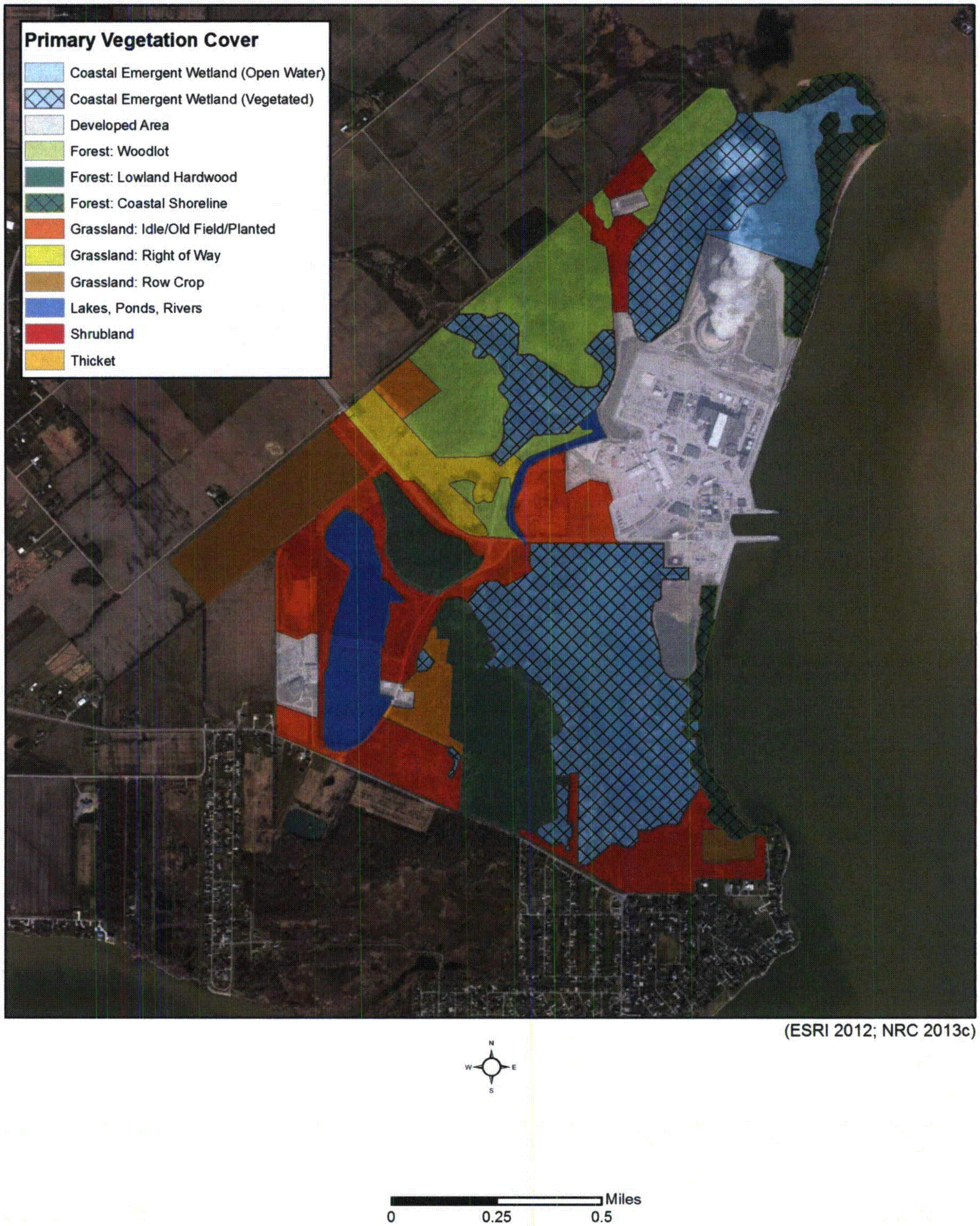
a. Developed land includes existing power generation facilities and associated infrastructure.

b. Includes coastal emergent wetlands only. Other wetlands are a subcomponent of the other land uses shown in the table.

Table 3.1-2
Land Use/Land Cover within a 6-Mile Radius of Fermi 2

Category	Acres	Percent
Open water	37,765.4	52.2
Developed	8,149.4	11.3
Open space	1,758.0	2.4
Low intensity	4,916.9	6.8
Medium intensity	1,138.0	1.6
High intensity	336.5	0.5
Barren land (rock/sand/clay)	784.8	1.1
Deciduous forest	1,906.1	2.6
Evergreen forest	2.2	0.0
Mixed forest	7.6	0.0
Shrub/scrub	53.4	0.1
Grassland/herbaceous	1,122.4	1.6
Pasture/hay	4,590.7	6.3
Cultivated crops	14,850.4	20.5
Woody wetlands	1,848.5	2.6
Emergent herbaceous wetlands	1,321.0	1.8
Total	**72,402.0**	**100.0**

(MRLC 2012; USDA 2012a)



(ESRI 2012; NRC 2013c)

Figure 3.1-1
Primary Vegetation Cover Types on the Fermi 2 Site

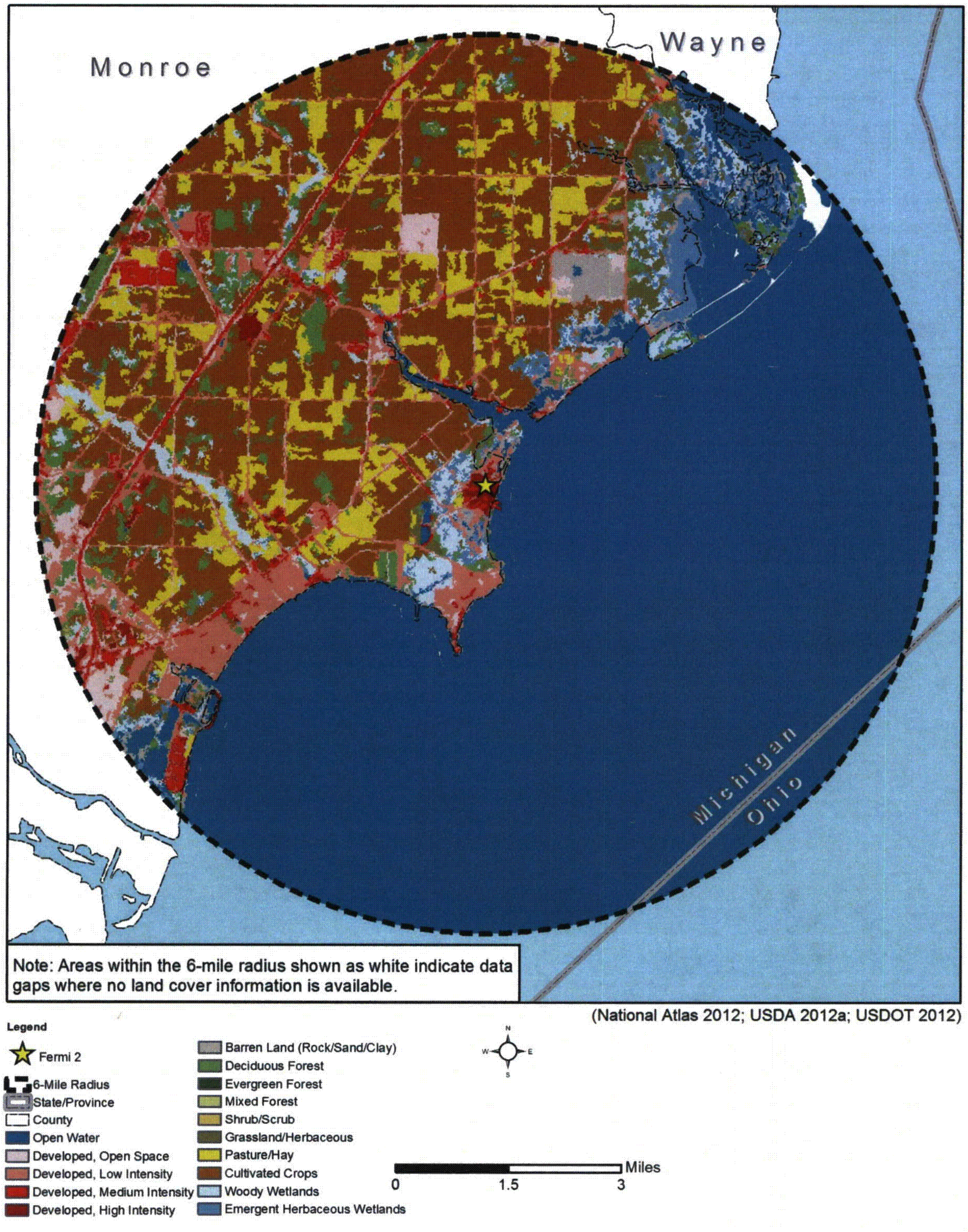


Figure 3.1-2
Land Use and Land Cover within a 6-Mile Radius of Fermi 2

3.2 Meteorology and Air Quality

3.2.1 General Climate

The general climate of the region surrounding the Fermi site is humid continental, with the region experiencing both warm and humid summers and severe winters. The overall temperature, wind, and precipitation characteristics of the surrounding region are largely influenced by Lake Erie. Higher thermal capacity of the lake moderates the daily temperature extremes that are found further inland, especially during the spring, summer, and severe winters. (DECo 2011, Section 2.7.1.1) The temperature contrast of the coastal boundary also produces lake and land breezes that are most prominent during the summer. During the late spring and summer seasons, the lake breezes generally form by afternoon and bring cooler air from above the lake to locations along the shoreline, effectively lowering daily maximum temperature. During the late summer and fall, land breezes continue the moderating effect by bringing cooler air located further inland to the shoreline areas. At night during the spring, summer, and fall, the lake moderates low temperatures along the shoreline due to its greater heat capacity. (DECo 2011, Section 2.7.1.1)

The meteorological conditions in the Fermi region are also influenced by the high frequency of surface low-pressure systems and cloudiness during the late fall and winter, as well as early spring. During the latter half of spring and summer, the mean track of surface low-pressure systems shifts north of the region, and the Fermi region experiences an increase in sunshine and warmer monthly temperatures. (DECo 2011, Section 2.7.1.1) The lake effect produced by the Great Lakes creates excess cloudiness and moderates the extreme arctic temperatures during the winter (DECo 2011, Section 2.7.1.2.2). Michigan's solar potential (3 to 4.5 kilowatt hours [kWh] per square meter) (NREL 2007) is low compared to other regions of the United States, where the potential is up to 7 to 8 kWh per square meter (DECo 2011, Section 9.2.2.1.2).

3.2.2 Meteorology

A discussion of Fermi 2's onsite meteorological monitoring program and meteorological data monitoring system is included in Section 2.2.7.

3.2.2.1 Wind Direction and Speed

The annual prevailing wind direction is southwest based on data obtained from the Detroit Metropolitan Airport. Monthly prevailing winds in Detroit are generally southwest during all months except during the spring, when they are northwest. At Flint and Toledo, the annual prevailing wind direction is also southwest, but both stations have different monthly variations when compared to Detroit. Monthly winds for Toledo, like Detroit, are southwest during all but the spring season, when they become east-northeast. Monthly wind directions for Flint are also southwest during the majority of the year; however, winds become westerly during February and March, east-northeasterly during April, and more southerly during May. The differences in the late winter and spring prevailing wind directions between Detroit and the Flint and Toledo stations can be attributed to the transition of the mean track of surface low-pressure systems to the north. (DECo 2011, Section 2.7.1.2.1)

The winds at the Fermi site change due to lake breezes and the shift of the Bermuda High. Because the Fermi site is located along the western shoreline of Lake Erie, the site is influenced by onshore and offshore lake breezes. During the spring, summer, and early fall, onshore lake breezes occur frequently at the Fermi site. The Bermuda High develops over the southeast United States during the summer months; thus the mean track of surface low-pressure systems shifts north of the Fermi region during this time. As this high-pressure system travels north, the wind direction at the site transitions from northwesterly and northerly winds during the spring months to southwesterly winds during the summer through fall months. (DECo 2011, Section 2.7.4.2)

Based on Detroit Metropolitan Airport data, the annual mean wind speed is 9.9 miles per hour (mph). In comparison, Flint and Toledo have slightly lower annual mean wind speeds, 9.3 and 9.1 mph, respectively. Seasonally, the highest seasonal mean wind speed for all three stations is during the winter and spring months. The lowest seasonal mean wind speed occurs during the summer months for Detroit (8.4 mph), Flint (7.7 mph), and Toledo (7.2 mph). The highest monthly mean wind speed for Detroit occurs in January with a value of 11.6 mph. Flint and Toledo also have their highest monthly mean wind speed during January; however, their values are slightly lower (10.8 mph). During January, the mean track of surface low-pressure systems is positioned over the Fermi region, thus increasing the frequency of surface low-pressure systems and the subsequent wind speeds. The overall variation of monthly wind speeds is consistent among these stations; therefore, these values represent wind speeds characteristic of locations in the Fermi 2 area. (DECo 2011, Section 2.7.1.2.1)

Annual wind rose data for the Fermi 2 site covering the period of 2008–2012 are presented in Figures 3.2-1, 3.2-2, 3.2-3, 3.2-4, and 3.2-5.

Michigan is a Class 2 wind power region (DECo 2011, Section 9.2.2.1.1). According to the Department of Energy's Office of Energy Efficiency and Renewable Energy and its National Renewable Energy Laboratory (NREL), a large geographic area of the state along the western shore of Lake Huron (in Huron, Tuscola, and Sanilac counties) known as the "Thumb," possesses wind resources of sufficient value to support utility-scale wind generation. Similarly valued wind resource areas also exist in the western part of the state along the eastern shoreline of Lake Michigan; however, only the Thumb is within the DTE service area. (NRC 2013c, Section 9.2.3.2) There are currently 978 MW of installed wind energy in Michigan, with an additional 465.3 MW of installed wind energy potentially available by 2015 (MPSC 2013a).

3.2.2.2 Temperature

Based on temperature measurements at the Fermi meteorological tower, data from the 2001–2007 time period show that the annual average temperature is 50.6°F, with the lowest monthly average temperature of 27.3°F occurring in January and the highest monthly average temperature of 73.5°F occurring in July. During this same period, the absolute minimum temperature was -3.8°F, and the absolute maximum temperature was 94.3°F. (NRC 2013c, Section 2.9.1.2) Based on long-term temperature values recorded at the Detroit Metropolitan Airport, a monthly average minimum of 19.2°F was calculated for January, and a monthly average maximum of 83.5°F was calculated for July during climate-normal years (1980–2010). About 76 days per year have a maximum temperature that is higher than or equal to 80°F, while about 127 days per year have a minimum temperature that is lower than or equal to 32°F. (NOAA 2013a)

3.2.2.3 Precipitation

Overall precipitation amounts vary slightly from month to month throughout the year. During the winter, the mean track of surface low-pressure systems is positioned over or just south of the Fermi 2 region, and thus increases the frequency of precipitation. Surface low-pressure systems come from the west, northwest, and southwest during the winter and bring the possibility of rain, freezing rain, sleet, and snow. Heavy snows are possible throughout the winter and can result in significant accumulations. During the summer, the mean track of surface low-pressure systems shifts north of the region, yet monthly rainfall values are higher than any other season. The number of days per month with thunderstorms is approximately 6 days during June, July, and August, which is higher than any other months. (DECo 2011, Section 2.7.1.1)

Annual precipitation in the region ranges from just under 30 inches in northeastern Michigan to near 40 inches for the remainder of the state. Overall, annual rainfall is uniform across the region. Monthly precipitation amounts are also fairly consistent throughout the year. The highest monthly precipitation for Detroit (3.55 inches) and Toledo (3.80 inches) occurs during June, while for Flint (3.76 inches) it occurs during September. The lowest monthly precipitation occurs in February for these areas when monthly amounts between 1.35 and 1.88 inches are common. The highest amount of precipitation in a 24-hour period was 6.04 inches, occurring at Flint during September of 1950. (DECo 2011, Section 2.7.1.2.4)

The threat of heavy snowfall is present throughout the wintertime for the Fermi region. The maximum 24-hour snowfall reported occurred between the months of November through April. The highest 24-hour snowfall is 24.5 inches at the Detroit City Airport located north-northeast of the Fermi site, occurring during April 1886. The highest 2- and 3-day and maximum monthly snowfall reported is 22.7 inches at Flint. (DECo 2011, Section 2.7.1.2.4) Depending on location, annual snowfall amounts can vary anywhere from 25.3 inches to 52.1 inches (DECo 2011, Table 2.7-5).

Detroit Metropolitan Airport is the nearest station that routinely observes visibility and fog. On an annual basis, heavy fog occurs 17.6 days during a calendar year. The highest monthly heavy fog averages occur between December and March for between 2 and 2.8 days per month. Fog is least frequent during June and July, when fog occurs only 0.5 days per month. (DECo 2011, Section 2.7.4.1.4)

3.2.2.4 Severe Weather

Thunderstorms are observed an average of 33 days per year at Detroit Metropolitan Airport. The highest seasonal rate of occurrence for thunderstorms is during the summertime (June–August) when around 54 percent of all thunderstorm days occur. July specifically has the highest occurrence of thunderstorms with, on average, 6.3 days reported. The mean number of thunderstorm days per month is lowest during the late fall and winter seasons, reaching a minimum of 0.2 days per month in January. The average number of lightning strikes to earth is 10 strikes per square mile per year or nearly four strikes per square kilometer per year for the Fermi region. (DECo 2011, Section 2.7.3.1)

Individual thunderstorms that become linear along a squall line or cold front can cause high-wind events. The five-county area surrounding the Fermi site (Lenawee, Monroe, Washtenaw, and Wayne counties in Michigan, and Lucas County, Ohio) reported 25 high-wind events at 50 knots and above between October 2006 and July 2012 (NCDC 2012). The highest straight-wind speed recorded for Monroe County is 95.5 mph on May 21, 2004 (DECo 2011, Section 2.7.3.2).

The five-county area surrounding the Fermi site reported 386 severe hail (hail diameter ≥ 0.75 inches) events between October 2006 and July 2012 (NCDC 2012). The majority of hail events in the five-county area occur during the months of May, June, and July. The largest hail report was 4.00 inches, occurring in Wayne County on November 13, 1955, and Monroe County on March 27, 1991. (DECo 2011, Section 2.7.3.4)

All tornadoes are categorized as EF0 or stronger on the Enhanced Fujita (EF) scale, thereby containing wind speeds greater than 50 knots (DECo 2011, Section 2.7.3.2). The *Tornado Climatology of the United States* (NUREG/CR-4461, Revision 2) included an assessment of the probability of a tornado striking the Fermi site using National Climatic Data Center (NCDC) data for 1950 through August 2003. Given the distribution of areas associated with the events, it was estimated that the expected probability of a tornado striking the site is approximately 3.87×10^{-4} or a recurrence interval of once every 2,584 years. (DECo 2011, Section 2.7.3.3) Between October 2006 and July 2012, 25 tornadoes were reported in the five-county area surrounding the Fermi site (NCDC 2012). On June 6, 2010, an EF2 tornado with wind speeds between 113 and 157 mph, swept across the Fermi 2 property resulting in some property damage.

Waterspouts can occur near and at the Fermi site, but are not considered to be of frequent occurrence. Waterspouts are also much smaller than an average tornado and contain wind speeds that are typically less than 50 mph. Conditions favorable for waterspout formation are created when a cool air mass passes over the warm waters of Lake Erie. The resulting instability can support the formation of waterspouts, most frequently during the late summer and fall season. (DECo 2011, Section 2.7.3.3) The NCDC online storm database indicates zero waterspouts occurred off the shoreline of Lucas and Monroe counties since 2006 (NCDC 2012). The closest occurrence to the Fermi site was a report of several waterspouts off the shoreline of Stony Point in Monroe County on the morning of July 26, 1998 (DECo 2011, Section 2.7.3.3).

The Fermi site and surrounding region is characterized by frequent ice storms that have the potential of producing significant ice accumulations during the winter and early spring. A study examining freezing rain and ice pellet events for the Fermi region during the period 1976–1990 concluded that the Fermi site averages approximately 4–5 days per year when an observation of freezing rain has occurred, while ice pellets are reported 4 days per year. (DECo 2011, Section 2.7.3.5) A total of six ice storm events were reported in the five-county area surrounding the Fermi site during the period 2006–2012 (NCDC 2012). The highest ice accumulation event occurred January 26–27, 1967, with accumulations of up to 3 inches across northwestern Ohio and parts of southern Michigan. (DECo 2011, Section 2.7.3.5)

3.2.2.5 Atmospheric Stability

On an annual basis, D stability (neutral) is the most prevalent single stability class, accounting for about 31.6 percent of the time. The unstable conditions (A to C) occur approximately 28.2 percent of the time, while the stable conditions (E to G) occur about 40.2 percent of the time. Stability patterns vary from season to season. Stabilities A (extremely unstable), D (neutral), and E (slightly stable) are the most frequent and can occur throughout the year. Stability A occurs more frequently from mid-spring to early fall when solar radiation is the strongest, and Stability D peaks in the winter months. However, frequencies of Stability E remain fairly constant throughout the year. (NRC 2013c, Section 2.9.1.4) Stability class distributions for the Fermi 2 site covering the period of 2008–2012 are presented in Table 3.2-1.

3.2.3 Air Quality

The Fermi 2 site is in Monroe County, Michigan, which along with Lucas and Wood counties in Ohio, is in the Metropolitan Toledo Interstate air quality control region (AQCR). Surrounding AQCRs include the Metropolitan Detroit-Port Huron Intrastate AQCR to the north and the South Central Michigan Intrastate AQCR to the west.

On June 29, 2009, Monroe County, with seven other southeastern counties including the Detroit metropolitan area, was redesignated from a nonattainment area to a maintenance area for the 8-hour ozone standard, and Lucas and Wood counties in Ohio were redesignated on August 9, 2007. (NRC 2013c, Section 2.9.2) The Detroit-Ann Arbor area inclusive of Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne counties are in attainment for the 1997 annual and 2006 24-hour National Ambient Air Quality Standards (NAAQS) for fine particulate matter ($PM_{2.5}$) (78 FR 53272).

In October 2013, EPA designated part of Wayne County as a nonattainment area for the 2010 sulfur dioxide (SO_2) NAAQS with the boundaries recommended by the state of Michigan. The area is bounded on the east by the Michigan-Ontario border; on the south by the Wayne County-Monroe County border; on the west by I-75 north to Southfield Road, Southfield Road to I-94, and I-94 north to Michigan Avenue; and on the north by Michigan Avenue to Woodward Avenue and a line on Woodward Avenue extended to the Michigan-Ontario border. (78 FR 47191) The SO_2 nonattainment area is shown in Figure 3.2-6.

Figure 3.2-6 identifies nonattainment and maintenance areas defined under the CAA, as amended, within a 50-mile radius of the Fermi 2 site. There are no mandatory Class I federal areas in the lower peninsula of Michigan where visibility is an important value. The nearest Class I area is the Otter Creek Wilderness Area in western Virginia, which is located approximately 275 miles southeast of the Fermi site. Given the minor nature of air emissions associated with operations of Fermi 2, this distance is sufficiently far so as to not warrant a concern. (NRC 2013c, Sections 2.9.2 and 5.7.2.1)

A discussion of Fermi 2's onsite stationary emission sources and associated permit conditions is included in Section 2.2.8.3. As discussed in Section 2.2.8.3, MDEQ regulation R 336.1280 does not require water-cooling towers that are not used for evaporative cooling of process water to be permitted as emission sources as specified in R 336.1280(d); therefore, the Fermi 2 cooling towers are currently exempt from MDEQ permitting requirements.

3.2.4 Greenhouse Gas Emissions and Climate Change

Several studies provide qualitative discussions of the potential for nuclear power to ameliorate greenhouse gas (GHG) emissions (Hagen et al. 2001; IAEA 2000; Keepin 1988; MIT 2003; NEA 2002; NIRS/WISE 2005; and Schneider 2000). While these studies sometimes reference and critique the rationale contained in the existing quantitative estimates of GHGs produced by the nuclear fuel cycle, their conclusions are generally based on other factors such as safety, cost, waste generation, and political acceptability. Therefore, these studies are not directly applicable to the evaluation of the GHG emissions associated with license renewal.

A number of studies provide technical life-cycle analyses and quantitative estimates of the amount of GHGs generated by nuclear and other power generation technologies (AEA 2006; Andseta et al. 1998; Dones 2007; Fritsche 2006; Fthenakis and Kim 2007; Mortimer 1990; POST 2006; Spadaro et al. 2000; Storm van Leeuwen 2008; Weisser 2007). Comparison of these quantitative studies is difficult because the assumptions and components of the life cycles (i.e., reactor types, energy sources used in mining and processing fuel, capacity factors, fuel quality) included within each study vary widely. Also, these studies are inconsistent in how they define the life cycle: some include plant construction, decommissioning, and resource extraction (uranium ore, fossil fuel), while others include one or two of these activities. Similarly, the scope of these studies is inconsistent with license renewal because license renewal does not include construction or decommissioning.

License renewal would not involve GHG emissions associated with construction because the facility already exists, nor would it involve additional GHG emissions associated with facility decommissioning because decommissioning must occur whether the facility license is renewed or not. In many of these studies, the contribution of GHG emissions from facility construction and decommissioning cannot be separated from the other life-cycle GHG emissions that would be associated with license renewal. Therefore, these studies overestimate the GHG emissions that would be attributable to renewal of an operating license.

The estimates and projections of the carbon footprint of the nuclear power life cycle provided in the above studies vary widely, and considerable debate exists regarding the relative impacts on GHG emissions of nuclear and other electricity-generating technologies. Nevertheless, the studies indicate a consensus that nuclear power produces fewer GHG emissions than fossil fuel-based electricity-generating technologies. In addition, although the range of estimates in the above studies is wide, the general conclusion is that the GHG emissions from the nuclear fuel cycle are of the same order of magnitude as those for renewable energy sources.

Also, based on the GEIS, life-cycle GHG emissions from the complete nuclear fuel cycle currently range from 1.0 to 288 grams (g) of carbon equivalents per kilowatt hour (Ce/kWh) when compared to coal and natural gas. The comparable life-cycle GHG emissions from the use of coal range from 264 to 1,689 g Ce/kWh, and GHG emissions from the use of natural gas range from 120 to 930 g Ce/kWh. The GEIS also provided estimates of GHG emissions from several renewable energy sources based on current technology. These estimates included hydropower (0 to 64.6 Ce/kWh), wind power (2.0 to 81 g Ce/kWh), solar photovoltaic (PV)/concentrating solar power (CSP)/thermal (5 to 217 g Ce/kWh), biomass (8.4 to 99 g Ce/kWh), biogas digester (11.0 g Ce/kWh), biopower (-633 to 360 g Ce/kWh), ocean energy and wave/tidal (2.0 to 50 g Ce/kWh), and geothermal (6.0 to 79.0 g Ce/kWh). (NRC 2013b, Tables 4.12-4, 4.12-5, and 4.12-6)

Therefore, GHG emissions associated with renewal of an operating license would be similar to the life-cycle GHG emissions from renewable energy sources and lower than those associated with fossil fuel-based energy sources. GHG emissions associated with Fermi 2 plant operations for 2012 are shown in Table 2.2-7.

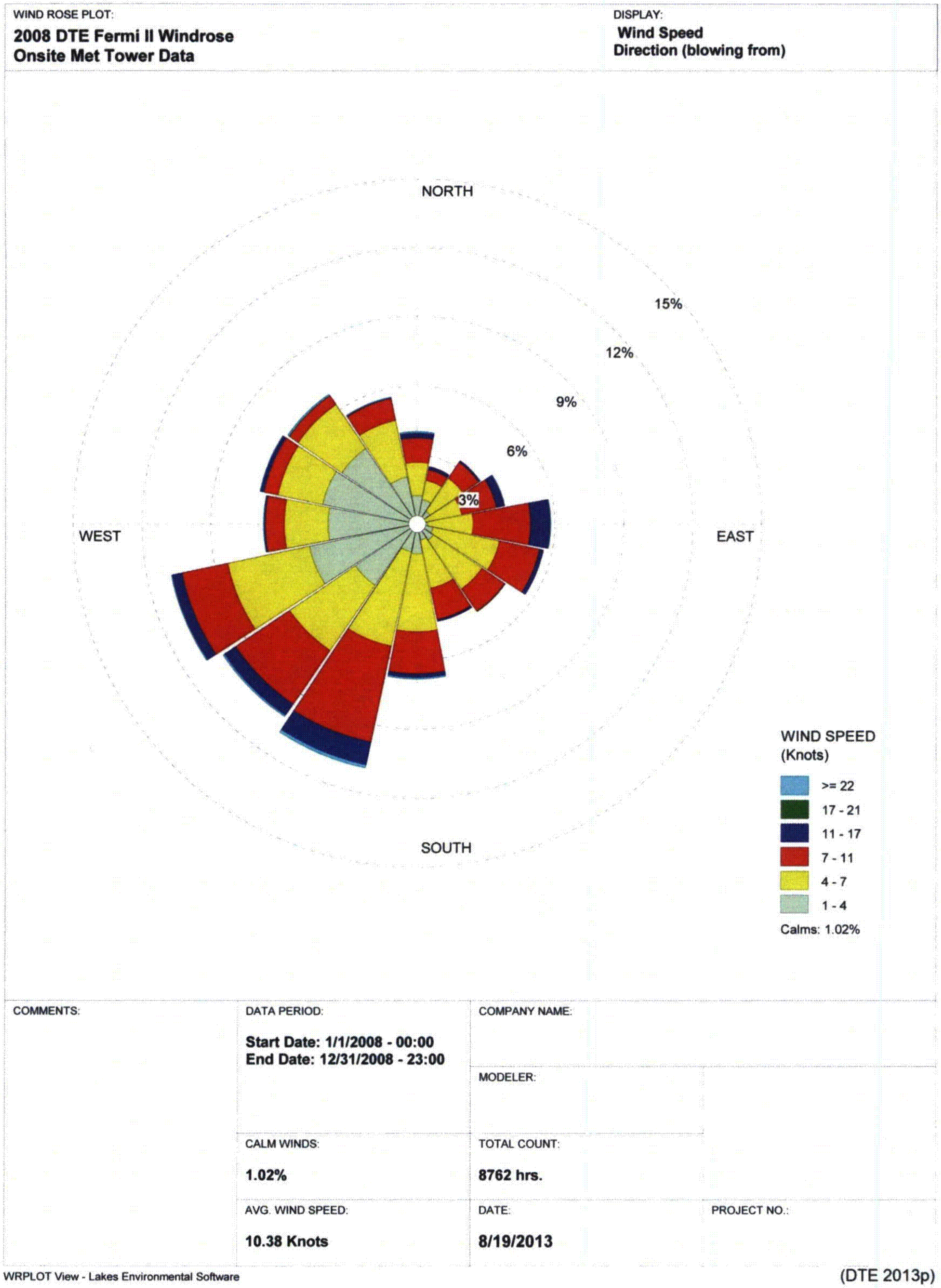
Table 3.2-1
Fermi 2 Stability Class Distributions

Stability	Class	Delta-T Range (°F)	Occurrences (hours)	Percent
2008 DTE Fermi 2 Meteorological Data				
Extremely unstable	A	≤ -1.37	2421	28
Moderately unstable	B	-1.37 < DT ≤ -1.23	269	3
Slightly unstable	C	-1.23 < DT ≤ -1.09	267	3
Neutral	D	-1.09 < DT ≤ -0.37	2400	28
Slightly stable	E	-0.37 < DT ≤ 1.08	2077	24
Moderately stable	F	1.08 < DT ≤ 2.88	819	9
Extremely stable	G	> 2.88	410	5
Missing	M	NA	121	1
2009 DTE Fermi 2 Meteorological Data				
Extremely unstable	A	≤ -1.37	1598	18
Moderately unstable	B	-1.37 < DT ≤ -1.23	264	3
Slightly unstable	C	-1.23 < DT ≤ -1.09	302	3
Neutral	D	-1.09 < DT ≤ -0.37	2604	30
Slightly stable	E	-0.37 < DT ≤ 1.08	2407	28
Moderately stable	F	1.08 < DT ≤ 2.88	984	11
Extremely stable	G	> 2.88	504	6
Missing	M	NA	97	1
2010 DTE Fermi 2 Meteorological Data				
Extremely unstable	A	≤ -1.37	2182	25
Moderately unstable	B	-1.37 < DT ≤ -1.23	342	4
Slightly unstable	C	-1.23 < DT ≤ -1.09	379	4
Neutral	D	-1.09 < DT ≤ -0.37	2600	30
Slightly stable	E	-0.37 < DT ≤ 1.08	1906	22
Moderately stable	F	1.08 < DT ≤ 2.88	795	9
Extremely stable	G	> 2.88	438	5
Missing	M	NA	118	1

Table 3.2-1 (Continued)
Fermi 2 Stability Class Distributions

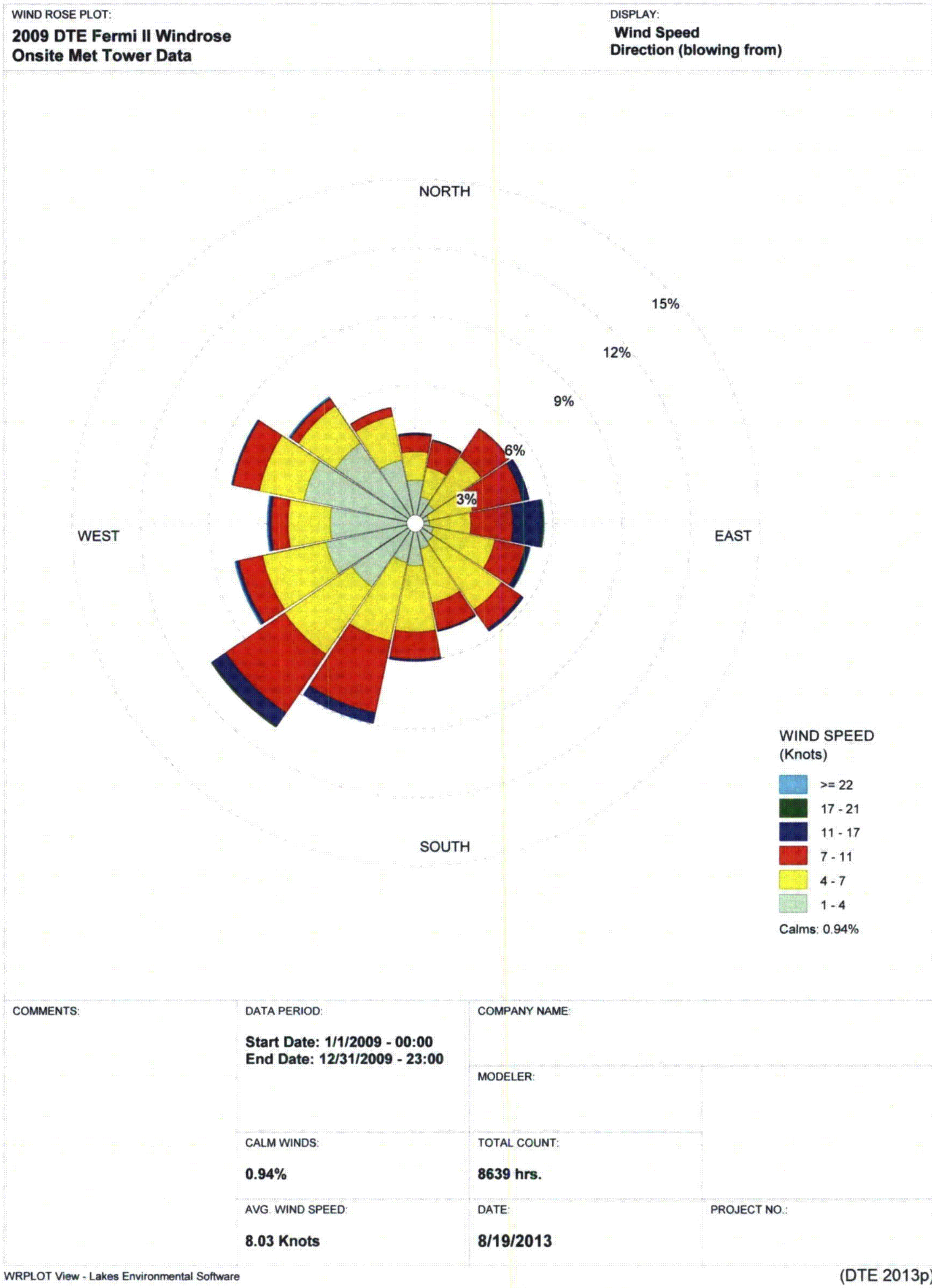
Stability	Class	Delta-T Range (°F)	Occurrences (hours)	Percent
2011 DTE Fermi 2 Meteorological Data				
Extremely unstable	A	≤ -1.37	1909	22
Moderately unstable	B	-1.37 < DT ≤ -1.23	334	4
Slightly unstable	C	-1.23 < DT ≤ -1.09	369	4
Neutral	D	-1.09 < DT ≤ -0.37	3073	35
Slightly stable	E	-0.37 < DT ≤ 1.08	2139	24
Moderately stable	F	1.08 < DT ≤ 2.88	657	8
Extremely stable	G	> 2.88	278	3
Missing	M	NA	1	0
2012 DTE Fermi 2 Meteorological Data				
Extremely unstable	A	≤ -1.37	2171	25
Moderately unstable	B	-1.37 < DT ≤ -1.23	248	3
Slightly unstable	C	-1.23 < DT ≤ -1.09	253	3
Neutral	D	-1.09 < DT ≤ -0.37	2786	32
Slightly stable	E	-0.37 < DT ≤ 1.08	1975	22
Moderately stable	F	1.08 < DT ≤ 2.88	771	9
Extremely stable	G	> 2.88	506	6
Missing	M	NA	74	1

(DTE 2013p)



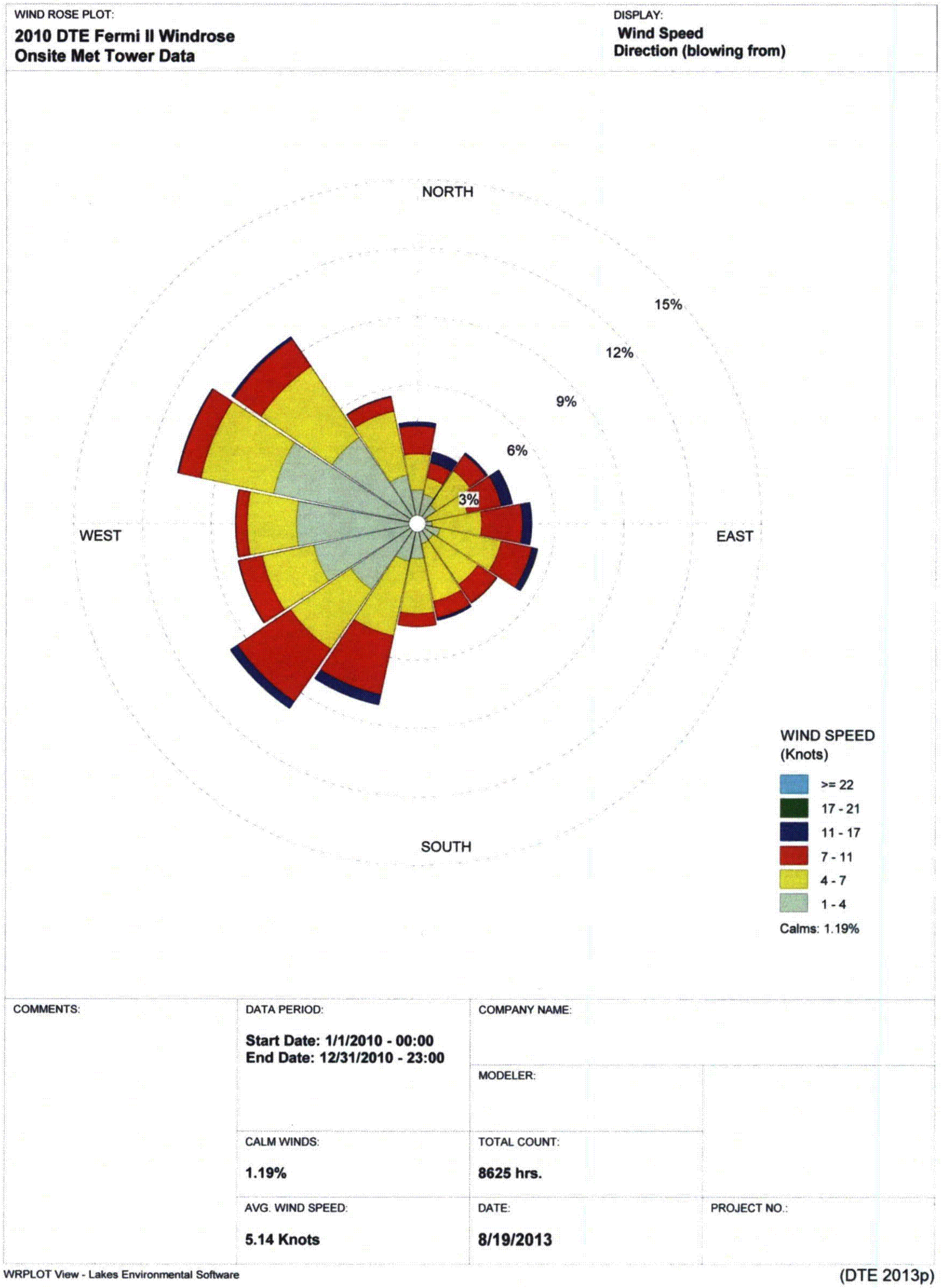
(DTE 2013p)

Figure 3.2-1
Fermi 2 2008 Wind Rose



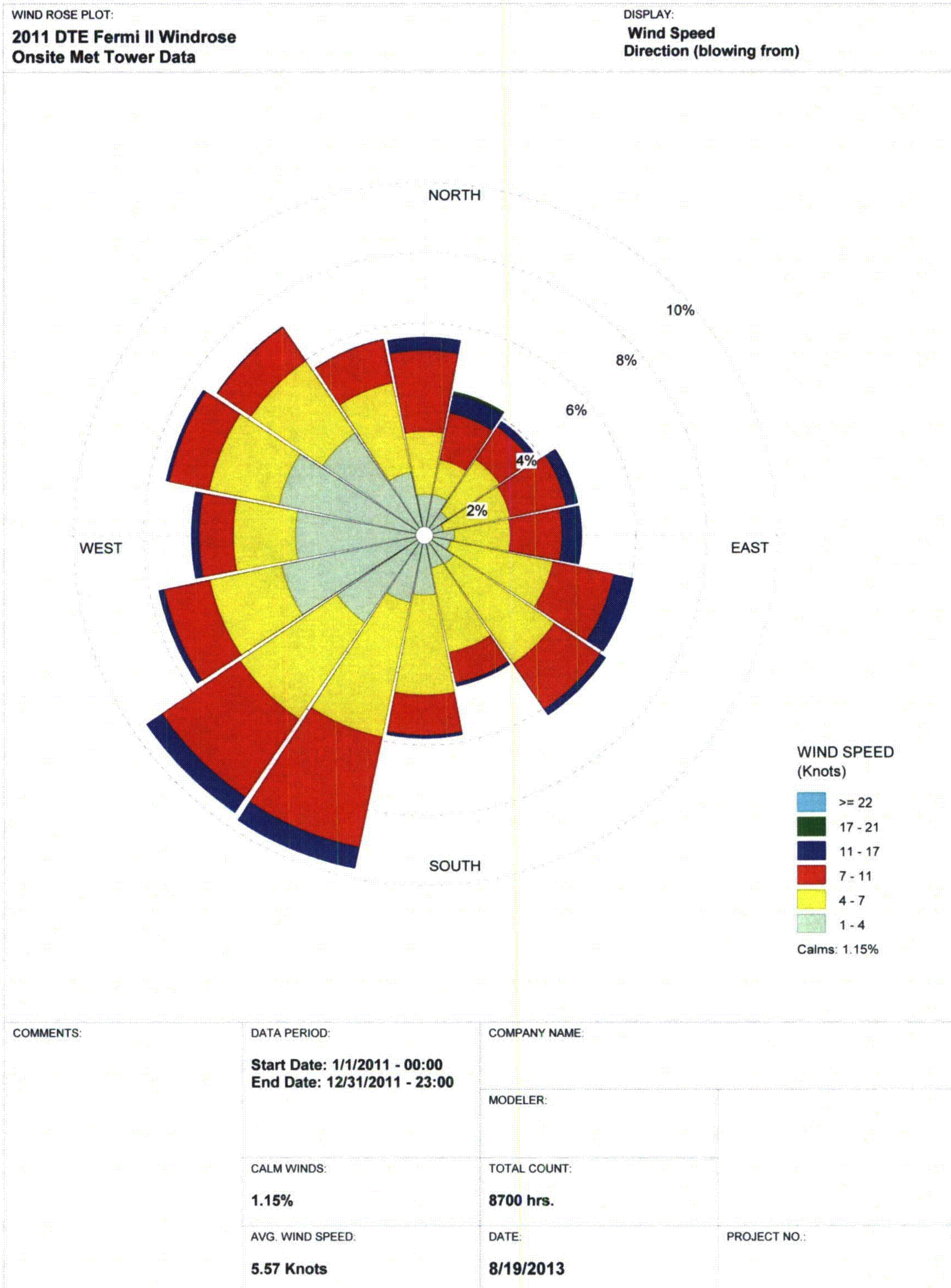
(DTE 2013p)

Figure 3.2-2
Fermi 2 2009 Wind Rose



(DTE 2013p)

Figure 3.2-3
Fermi 2 2010 Wind Rose



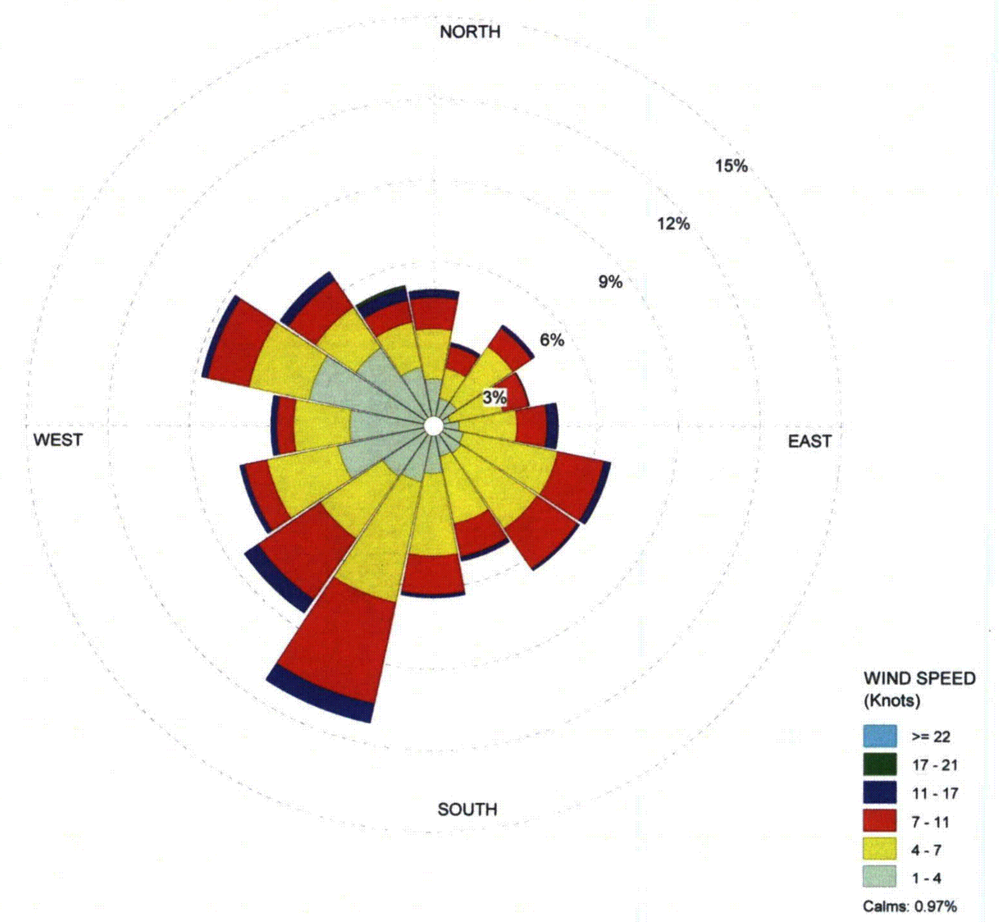
WRPLOT View - Lakes Environmental Software

(DTE 2013p)

Figure 3.2-4
Fermi 2 2011 Wind Rose

WIND ROSE PLOT:
2012 DTE Fermi II Windrose
Onsite Met Tower Data

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2012 - 00:00** **End Date: 12/31/2012 - 23:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.97%**	TOTAL COUNT: **8700 hrs.**	
	AVG. WIND SPEED: **5.48 Knots**	DATE: **8/19/2013**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

(DTE 2013p)

Figure 3.2-5
Fermi 2 2012 Wind Rose

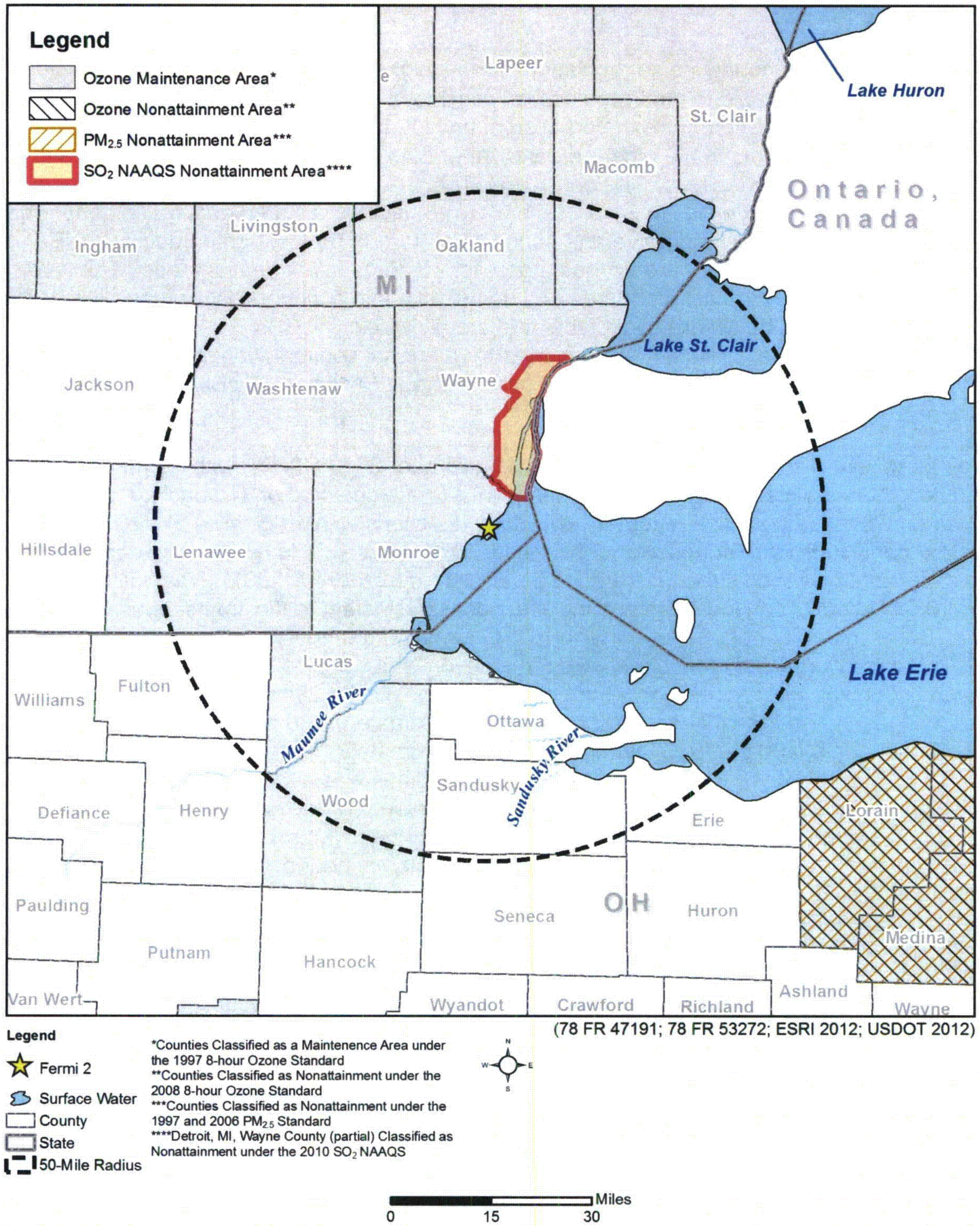


Figure 3.2-6
Nonattainment and Maintenance Areas within a 50-Mile Radius of Fermi 2 Site

3.3 Noise

There are no state or county noise regulations for Michigan or Monroe County. The only local noise regulation applicable to the Fermi site is Frenchtown Charter Township Noise Ordinance No. 184, which generally prohibits the creation of any loud or excessive noise, or construction noise unreasonably annoying to other persons, other than between the hours of 7 a.m. and 7 p.m. (FCT 2012a; NRC 2013c, Section 2.10.2) The U.S. Department of Housing and Urban Development (HUD) guidelines in 24 CFR 51.101(a)(8) include a stated goal that exterior noise levels do not exceed a day-night average sound level (L_{dn}) of 55 A-weighted decibels (dBA). This level is recommended by the EPA as a goal for outdoors in residential areas. The levels recommended by EPA are not standards and do not take into account cost or feasibility. Sites with an L_{dn} of 65 and below are acceptable and are allowable [24 CFR 51.101(a)(8)]. For context, the sound level of a quiet office is 50 dBA, a normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA. (NRC 2013c, Section 2.10.2)

An ambient sound level survey was conducted November 26–28, 2007, with Fermi 2 in operation. Seven noise monitoring locations (NMLs) were selected on the basis of the locations of the nearest noise-sensitive receptors in various directions within 1.5 miles of the Fermi 2 site. Weather conditions were conducive to the measurement of sound levels, except during a period with a high average wind speed (10 a.m. to 3 p.m. on November 27, 2007). The noises observed were typical of suburban locations and included local and distant traffic, trains, birds, and barking dogs. Some intermittent gunshot noise from the Fermi firing range and noise from the Fermi 2 cooling towers were faintly audible at five of the seven NMLs, including the closest residence, located 0.72 miles west-northwest of the Fermi 2 reactor. (DECo 2011, Table 2.5-69; NRC 2013c, Section 2.10.2) The Fermi 2 cooling towers are approximately 0.30 miles from the closest site property boundary, and the Fermi firing range is approximately 200 feet from the property boundary. At two NMLs, noise related to transmission lines was heard. Manned 10-minute equivalent continuous sound level (L_{eq}) measurements were collected at all seven NMLs, and continuous 24-hour noise monitoring was conducted at three NMLs. The L_{dn} values were derived on the basis of 10-minute L_{eq} values measured every hour over a 24-hour period. (DECo 2011, Table 2.5-69; NRC 2013c, Section 2.10.2)

The highest and lowest sound levels occurred between 10 a.m. and 2 p.m. and between 11 p.m. and 3 a.m., respectively. These are typical times for suburban areas due to local and highway traffic volume. Sound level exceeded 90 percent of the time (residual sound level or background level) is referred to as L_{90}. Measured L_{90} values at all NMLs ranged from 32 to 42 dBA, which are typical of suburban areas. Measured L_{dn} values at three NMLs ranged from 54 to 63 dBA. Even including the period of higher wind speed, which could increase sound levels by several dB, the measured L_{dn} values were below 65 dBA. (NRC 2013c, Section 2.10.2)

3.4 Geologic Environment

3.4.1 Geology

3.4.1.1 Regional Geology

The Fermi site is located in the northern portion of the midwestern United States in the Central Lowlands Physiographic Province. Michigan is located in the Eastern Lake Section (Figure 3.4-1). (DECo 2012, Section 2.5.1.1.1)

3.4.1.1.1 Physiography

The Eastern Lake Section is characterized by glacial landforms (including end moraines, ground moraines, outwash plains, kames, eskers, and drumlins) and by beach and lacustrine deposits formed during the fluctuations of the Great Lakes. The glacial deposits overlie maturely dissected bedrock cuestas and broad areas of relatively flat-lying bedrock. The bedrock is exposed locally. The bedrock surface was dissected prior to being covered with glacial drift. The rock surface tends to be gently rolling with well-developed valley systems. (DECo 2012, Section 2.5.1.1.1.1)

The Fermi site is located on a lake plain formed during the high-water stages of Lake Erie. There is little topographic relief on the lake plain, which results in poor surface drainage. It has been dissected by eastward-flowing creeks and rivers. The relief on the lake plain within the vicinity of the project area is approximately 25 feet. (DECo 2012, Section 2.5.1.1.1)

3.4.1.1.2 Stratigraphy

Soil Units

The soil units in the region include Pleistocene-aged deposits consisting of alluvium, lacustrine materials, peats, tills, outwash, glaciofluvial materials, glaciolacustrine materials, and residual soil. Figure 3.4-2 shows the distribution of surface Pleistocene glacial deposits surrounding the Fermi site. The site area is located in a glaciolacustrine section on the western edge of Lake Erie. The soil deposits in Monroe County range in thickness from 0 to more than 150 feet. (Fermi 2012a, Section 2.5.1.1.2.1) The distribution of surface soil units within and surrounding the Fermi site boundary is shown in Figure 3.4-3.

Rock Units

The distribution of the rock units that form the bedrock surface within the region is shown in Figure 3.4-4 and the stratigraphic sequence of the various-aged rock units is shown in the legend. The rock units in the Michigan Basin consist of sedimentary strata of Jurassic, Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, and Cambrian ages, as well as an igneous and/or metamorphic complex of Precambrian-aged rocks. (Fermi 2012a, Section 2.5.1.1.2.2)

The sedimentary sequence in the Monroe County area includes Devonian- through Cambrian-aged strata. The local distribution of these strata is shown in Figure 3.4-5. These strata consist of 2,500 to 3,500 feet of limestones, dolomites, sandstones, and shales. The Precambrian basement in southeastern Michigan consists of crystalline rocks of igneous and metamorphic origin and occurs at a depth of about 3,100 feet. (Fermi 2012a, Section 2.5.1.1.2.2)

3.4.2 Site Geology

The bedrock strata in the site area range in age from Silurian to Precambrian as shown in Figure 3.4-6. The estimated thicknesses of these deeper units are based on logs of boreholes drilled in the general area and on interpretation of regional structural geologic maps. (Fermi 2012a, Section 2.5.1.2.2.2) A geologic cross section of the Fermi site is included as Figures 3.4-7 and 3.4-8.

Bass Islands Group

Dolomite of the Bass Islands Group forms the uppermost bedrock stratum at the site and overlies the Salina Group. Per the Fermi 3 subsurface investigation, the Bass Islands Group is dominantly a light gray, light brownish-gray, to dark gray micritic dolomite. The dolomite can be massive, banded, or mottled and may contain pitted and vuggy zones with some pits and vugs filled with crystalline anhydrite or calcite. The Bass Islands Group also contains minor layers of argillaceous dolomite, dolomitic shale, shale, brecciated dolomite (dolomite layer or layers that have been fractured but the clasts have not significantly moved or rotated), and breccia (rock containing angular gravel and larger size fragments). (DECo 2012, Section 2.5.1.2.3.1.2)

Two marker horizons (distinctive rock layers that can be traced throughout the site location) are recognized in the Bass Islands Group. The upper marker horizon is a light brownish-gray oolitic dolomite that is up to 6.8 feet thick. The other marker horizon is a black to very dark gray shale or dolomitic shale that is up to 0.5 feet thick. (DECo 2012, Section 2.5.1.2.3.1.2)

Cavities or voids were reported and were limited to a depth of 78 feet below ground surface. The cavities or voids were described as narrow and generally no more than 0.1 feet along the fractures. Some of the voids were filled with clay that appeared to be transported into the fracture. (DECo 2012, Section 2.5.1.2.3.1.2)

The thickness of the Bass Islands Group on site ranges from 13.5 feet to 101 feet (Fermi 2012a, Section 2.5.1.2.2.2).

Salina Group

The Salina Group is represented by the following four units at the site (DECo 2012, Section 2.5.1.2.3.1.1):

- Unit F—dolomite, limestone, claystone, shale, breccia, sandstone
- Unit E—dolomite, argillaceous dolomite, limestone, thin shales

- Unit C—claystone, dolomite, anhydrite
- Unit B—dolomite, anhydrite, shale

Beds of the Salina Group in the site area consist of alternating layers of dark gray dolomite and shale (Fermi 2012a, Section 2.5.1.2.2.2). Borings at the site encountered only the lower portion of the Bass Islands Group and extended as deep as Unit B of the Salina. The maximum thickness of Salina Group strata penetrated during drilling was 354 feet. (DECo 2012, Section 2.5.1.2.3.1.1) None of the borings passed through the Salina Group into lower strata. Some brecciation was noted at the Bass Islands-Salina contact. (Fermi 2012a, Section 2.5.1.2.2.2)

No salt beds were encountered in the vicinity of the site. Salt present in Wayne County thins to the south and is absent in Monroe County. The only salt underlying the site is an insignificant quantity in the form of very small salt crystals (1/16 inch in diameter) disseminated through several feet of a dense dolomite in the Salina formations. (Fermi 2012a, Section 2.5.1.2.2.2)

- Unit F: Unit F contains a wide variety of materials and is the most complex bedrock unit encountered at the site. The unit contains dolomite, limestone, claystone, shale, breccia, and sandstone beds, as well as poorly indurated clastic sediments. No halite was encountered. Unit F was observed to an average thickness of 123 feet at the site. (DECo 2012, Section 2.5.1.2.3.1.1)
- Unit E: The unit is composed of pale brown, grayish-brown, gray, and bluish-gray dolomite and argillaceous dolomite with thin shales and claystones. Unit E has thin gray limestone beds near the top, and up to 6-foot zones of interbedded anhydrite and dolomite near the base. The unit is vuggy in places and contains zones with ostracods. In the upper 26 feet of Unit E, occasional beds up to 3 feet thick exist of poorly-indurated claystone with properties comparable to soil. Unit E averages about 93 feet thick in the vicinity of the site. (DECo 2012, Section 2.5.1.2.3.1.1)
- Unit C: The unit is composed of dark greenish-gray to black claystone and dolomite with interbeds of anhydrite. Toward the base, the unit is interbedded with brown to light brownish-gray dolomite. The unit is on average 90 feet thick. (DECo 2012, Section 2.5.1.2.3.1.1)
- Unit B: Based on subsurface investigations at the Fermi site, Unit B is greater than 48 feet. The base of Unit B was not encountered during drilling operations. This unit is composed of brown, pale brown, gray, and dark greenish-gray dolomite with white anhydrite beds up to 3.6 feet thick and some shale beds up to 1 foot thick. (DECo 2012, Section 2.5.1.2.3.1.1)

Niagaran Group

The Niagaran Group consists of buff, gray, and light brown, fossiliferous, finely to coarsely crystalline dolomite. This group is stratigraphically equivalent to the Clinton and Guelph-Lockport

Groups of southeastern Ontario, and has an estimated thickness of 425 feet near the site. (Fermi 2012a, Section 2.5.1.2.2.2)

Cataract Group

This group is a buff to gray, fossiliferous dolomite with thin layers and partings of green to gray shale. Traces of pyrite and glauconite are present. Estimated thickness near the site, based on Michigan well logs, is 100 feet. (Fermi 2012a, Section 2.5.1.2.2.2)

Richmond Group

Based on Monroe County well logs, the Richmond Group contains approximately 625 feet of shale and dolomite. The shale is gray to green with some brick-red units throughout the section. Dolomite occurs as stringers within the shale and as gray to buff, fossiliferous beds containing red and gray shale seams. (Fermi 2012a, Section 2.5.1.2.2.2)

Trenton-Black River Group

The Trenton Group is generally undifferentiable from the underlying Black River Group. These rocks consist of gray-brown to buff, fossiliferous dolomite and dolomitic limestone with noticeable oil stains and gas shows. Estimated thickness near the site is 825 to 850 feet. Several thin layers of metabentonitic clay occur within a 1-foot zone at the bottom of the Trenton Group. These layers have been noticed in drillers' logs of Monroe County. The Trenton-Black River Group unconformably overlies the St. Croixan Series at the site due to the local absence of Lower Ordovician deposits. (Fermi 2012a, Section 2.5.1.2.2.2)

St. Croixan Series

The St. Croixan Series is composed of dolomite, sandstone, and minor amounts of shale in approximately 475 feet of section. The dolomite is buff, white to gray, slightly glauconitic, finely crystalline, and occasionally shaly. The dolomite occurs in the upper section of the series and is underlain by buff, white to gray, fine- to coarse-grained sandstone. Gray shale layers occur throughout the sandstone as partings or more uncommonly as beds several feet in thickness. (Fermi 2012a, Section 2.5.1.2.2.2)

Precambrian

The Precambrian basement is a metamorphic-igneous complex composed of granite and granitic gneiss. Estimated depth near the site to the Precambrian rock is about 3,100 feet. (Fermi 2012a, Section 2.5.1.2.2.2)

3.4.3 Soils

3.4.3.1 Onsite Soils and Site Geology

The general soil map for Monroe County shows that the majority of the lacustrine/till plain that is present in the site vicinity (25-mile radius) is underlain by soils of the Pewamo-Selfridge-Blount and Hoytville-Nappanee associations. These nearly level, very poorly drained to somewhat poorly drained, silty, loamy, and sandy soils formed on till plains, ground moraines, and lake plains. Thicker sandy soils (the Oakville-Tedrow-Granby association) are formed in the glacial outwash plains and delta complexes in the western part of the site vicinity. The floodplains of rivers and streams incised into the lacustrine-till plain are mapped as the Sloan or Ceresco soil series. The Sloan series consists of very poorly drained, moderately or moderately slowly permeable soils formed in waterworked loamy material. The Ceresco series consists of somewhat poorly drained, moderately or moderately rapidly permeable soils on incised floodplains of rivers and large streams. These soils have a coarse-textured B horizon; the underlying parent material is described as fine sandy loam, sandy loam, or silt loam. (DECo 2012, Section 2.5.1.2.3.2.2.4)

Soils in the site location (0.6-mile radius from the site) include the Lenawee ponded and Lenawee-Del Rey associations. The Lenawee ponded association consists of nearly level, very poorly drained silty soils on lake plains near Lake Erie and adjacent to large rivers. In some places, it is formed on sand deposits in beach areas. The Lenawee-Del Rey association consists of nearly level, somewhat poorly drained silty soils formed on lake plains. (DECo 2012, Section 2.5.1.2.3.2.3.4)

Detailed soil units within the Lenawee ponded and Lenawee-Del Rey associations are shown on Figure 3.4-3 and include Lenawee silty clay loam, ponded; Blount loam; Del Rey silt loam; Fulton silty clay loam; Milton clay loam; beaches; Toledo silty clay loam; aquents and pits; and urban land. The Lenawee silty clay loam, ponded, is dark grayish-brown and is formed on lake plains; approximately 5 percent of mapped areas include beach sand. It is a nearly level, poorly drained soil in flat areas and drainageways. The Del Rey silt loam is formed in loamy and clayey lacustrine deposits on lake plains and is nearly level and somewhat poorly drained. Its substratum extends to 60 inches and is mottled silty clay loam with thin, very fine-grained sand layers. The Toledo silty clay loam is a nearly level, very poorly drained soil in low areas and natural drainageways that is formed in clayey, calcareous lacustrine sediments in lake plains. The Blount loam, on 0- to 3-percent slopes is a nearly flat, somewhat poorly drained soil on upland flats, formed on water-reworked glacial till plains. (DECo 2012, Section 2.5.1.2.3.2.3.4)

The Fulton silty clay loam on 0- to 3-percent slopes is a nearly level, somewhat poorly drained soil on slight rises and knolls that is formed in clayey and calcareous lacustrine deposits. The Milton clay loam on 2- to 6-percent slopes is a moderately deep, gently sloping, well-drained soil on knolls. It is formed in loamy, calcareous glacial till underlain by limestone. Some well-drained sandy soils over clayey soils are included in this unit. (DECo 2012, Section 2.5.1.2.3.2.3.4)

In addition to soil units, beach sands thicker than 5 feet are shown as beaches on Figure 3.4-3. Aquents are nearly level and consist of poorly drained soils that have had 8 to 24 inches of soil material removed. Aquents also include low, wet areas that have been filled with non-soil material and then covered with soil material. The Pits-Aquents complex consists of open excavations and pits, the bottoms of which are nearly level aquent soils. Urban land includes level areas covered by streets, parking lots, buildings, and other structures that obscure or alter the soils to the point that identification is not feasible. (DECo 2012, Section 2.5.1.2.3.2.3.4)

Local sand deposits are encountered in an old channel of Swan Creek at the north end of the site, and in the barrier beach, which forms the shoreline of Lake Erie at the site. Other sand deposits are encountered offshore. The maximum thickness of sand encountered in the lake is 25 feet. More recent surficial deposits of silt, peat, and clay are encountered in the lower, swampy areas at the site. A compact, relatively impermeable till mantles the rock throughout the site area. Occasional boulders, up to 3 feet in diameter, are encountered near the bedrock surface. The till is approximately 14 feet thick and is overlain by approximately 7 feet of impermeable stratified lacustrine clay. (Fermi 2012a, Section 2.5.1.2.2.1)

Approximately 5 feet of lacustrine peaty silts and clay had been removed from the site area at the time of the Fermi 2 foundation investigation. The surface of glacial till was exposed at an average elevation of 566 feet, which is approximately 6 feet below the water surface of adjacent Lake Erie. The till consists of nearly impermeable silty to sandy clays with varying amounts of gravel and cobbles. (Fermi 2012a, Section 2.5.1.2.2.1)

The thickness of the till deposit on top of bedrock within the immediate Fermi 2 plant area, as determined from the borings, ranges from a minimum of 8 feet to a maximum of 15.5 feet, and has an average thickness of approximately 14 feet. Wider variations may be present because both the upper and lower surfaces of the till are erosional surfaces. (Fermi 2012a, Section 2.5.1.2.2.1)

During the building of Fermi 2, gravel and cobble aggregate fill was emplaced to provide a structural base for several power plant auxiliary buildings. Some of the fill material came from an onsite quarry that mined the Bass Islands Group carbonate bedrock. The fill extends across most of the area associated with the construction of Fermi 2; however, the bases of the major safety-related buildings are founded on bedrock. Boreholes drilled in the immediate location of proposed Fermi 3 classified the fill as cobbles, well-graded gravel, poorly graded gravel, graded gravel with silt, and boulders. The fill ranges from 10 to 15 feet thick across most developed plant areas; however, for buildings that extend into the bedrock, the annular space between the construction cavity and the building is filled with aggregate. In addition to the fill, a system of clay dikes was installed on the Fermi site prior to construction of the facility. The presence of construction-era dikes, previously used for dewatering the site, limits lateral movement of groundwater within the diked area. Recharge of the fill is through precipitation that flows downward to the underlying geologic units (lacustrine sediments, glacial till, or carbonate bedrock) (NRC 2013c, Section 2.3.1.2), although some infiltration from Lake Erie may occur temporarily during high lake level conditions.

3.4.3.2 Erosion Potential

Because Fermi 2 has been operational since the mid-1980s, stabilization measures are already in place to prevent erosion and sedimentation impacts to the site and vicinity. In accordance with Part I, Section A.13 of NPDES Permit MI0037028, Fermi 2 maintains and implements a stormwater pollution prevention plan (SWPPP) that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies the practices that will be used to prevent or reduce the pollutants in stormwater discharges.

These practices, as they relate to erosion, include non-structural preventative measures and source controls, as well as structural controls to prevent erosion or treat stormwater containing pollutants caused by erosion. In addition, any earth change that disturbs one or more acres or is within 500 feet of a lake or stream requires a soil erosion and sedimentation control (SESC) permit to be obtained from the Monroe County drain commissioner. Although the SESC program is administered by the State of Michigan, the Monroe County drain commissioner has assumed permitting responsibilities within its jurisdiction from the MDEQ. The SESC permit specifies best management practices (BMPs) to reduce erosion caused by stormwater runoff and therefore the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Although there are currently no license-renewal-related construction activities planned, these activities would continue to be managed in adherence to the Fermi 2 SWPPP.

3.4.3.3 Prime Farmland Soils

Natural Resources Conservation Service (NRCS) maps show areas of prime farmland around the southwestern edge of the Fermi site outside the existing power plant fence line, but within the property boundary. This part of the Fermi site is owned by DTE and is used as cropland. Because a large portion of the Fermi site is committed to industrial development and has been previously disturbed by site-related activities, the majority of the site would likely be exempted from the definition of prime farmland. The NRCS classifies most of the undeveloped areas of the Fermi site as "prime farmland if drained." Parts of the approximately 60-acre parcel of agricultural land are designated prime farmland and the parcel is currently used as farmland, so this parcel would most likely still be considered prime farmland even though it is part of the Fermi site. The prime farmland designation continues on a small portion of the Fermi site undeveloped area west of the Nuclear Operations Center and Nuclear Training Center; however, this small area is not farmed. (DECo 2011, Section 2.2.1.1)

3.4.4 Seismic History

3.4.4.1 1968 Seismic Evaluation

The site is located in one of the most seismically stable regions in the United States. No earthquake epicenter has been located closer than about 25 miles, and only seven earthquakes have been reported within 50 miles of the site since the beginning of the 19th century. None of these shocks were greater than Intensity V on the Modified Mercalli Scale. Eleven earthquake epicenters of Intensity V to VIII have been reported within 50 to 100 miles of the site, and another 24 of Intensity V to VII are located at distances between 100 and 200 miles. The closest Intensity VII shock was located at 90 miles, and the closest Intensity VIII shock was located at 100 miles from the site. (Fermi 2012a, Section 2.5.2.5.1)

Since the beginning of the 19th century, twelve earthquakes of Intensity V or greater have been reported within 100 miles of the site, and only 37 earthquakes of Intensity V or greater have been reported within about 200 miles of the site. The 1776 and 1925 events have not been located precisely enough to plot. Few were of high enough intensity to cause structural damage to reasonably well-built structures. None of these shocks were greater than Intensity VIII, and only six can be considered more than minor disturbances. These earthquakes occurred in 1875 (Intensity VII), 1930 (Intensity VI and VII), 1931 (Intensity VII), and two in 1937 (Intensity VII and VIII). The epicenter of the closest of these shocks was about 100 miles from the site. These six earthquakes, along with a number of smaller shocks, are concentrated in a 40-mile-long northeast-southwest-trending zone extending south of Lima, Ohio. This zone of earthquake activity is located near the juncture of the Findlay, Cincinnati, and Kankakee Arches. (Fermi 2012a, Section 2.5.2.5.1)

The earthquakes closest to the site were four Intensity III and IV shocks near Toledo, Ohio (about 30 miles distance), an 1877 Intensity V shock west of Detroit, Michigan (about 30 miles from the site), and a 1961 Intensity V shock in northern Ohio (about 55 miles south of the site). The several Intensity III and IV shocks were reported in the Toledo newspapers. These shocks were not felt at the site. The 1961 earthquake occurred near the Bowling Green Fault and/or the confluence of the Bowling Green Fault with the axis of the Findlay Arch. The 1877 Detroit shock has not been related to any specific geologic structure. Although one or more of these small shocks may have been felt in the vicinity of the site, there were no reports of disturbance near the site, and no damaging effects were experienced. It is estimated that intensities at the site due to these shocks were on the order of III or less. The other five earthquakes within 50 miles of the site were Intensity V or smaller and probably were not felt at the site. (Fermi 2012a, Section 2.5.2.5.1)

3.4.4.2 1986 Seismic Reaffirmation

Six more earthquakes have occurred within 200 miles of the site since 1968. Two of these were minor disturbances located near Colechester, Ontario, with epicentral intensities of III and IV. One occurred in 1968 near Attica, Michigan, with an epicentral intensity of V. The three others were located in Ohio near Celina, Perry, and St. Mary's and had intensities of VI, VI, and V, respectively. (Fermi 2012a, Section 2.5.2.5.2)

Six other earthquakes located 200 or more miles from the site have also occurred since 1968. A 1975 earthquake was located near Wellston, Ohio (Intensity V), about 215 miles from the site. A major earthquake shook Sharpsburg, Kentucky (Intensity VII), in July 1980, about 300 miles from the site. A 1984 earthquake was located near Sudbury, Ontario (Intensity V), about 350 miles from the site. Two other 1984 earthquakes of Intensity V were located about 285 miles from the site near Clay City, Indiana. Finally, one 1985 earthquake near Edgebrook, Illinois, which is located about 250 miles from the site also had an intensity of V. (Fermi 2012a, Section 2.5.2.5.2)

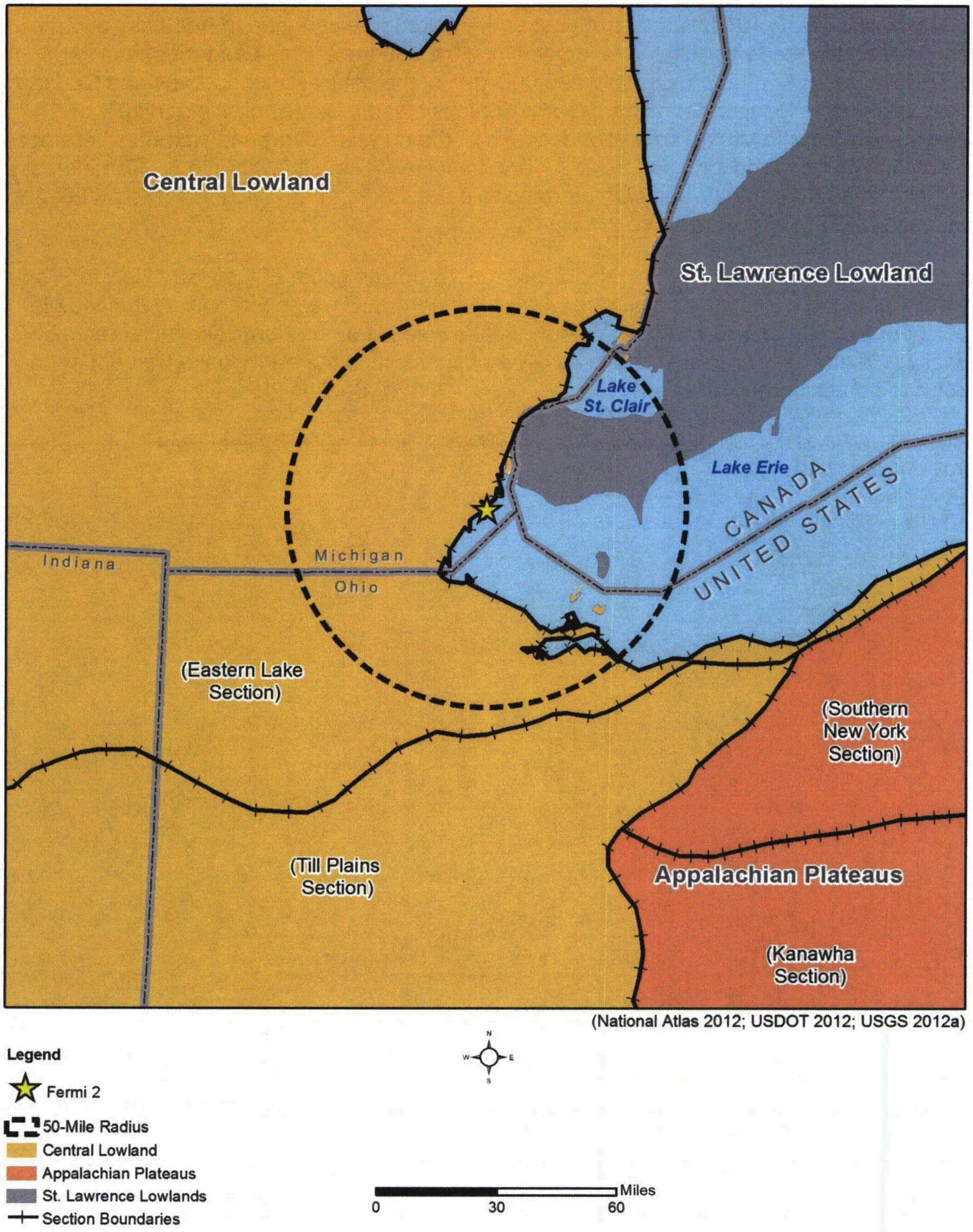
The most significant earthquakes since 1968 are the 1977 Ohio earthquake, the 1980 Kentucky earthquake, and the 1986 Perry earthquake. (Fermi 2012a, Section 2.5.2.5.2)

The June 1977 earthquake was located near Celina, Ohio, and had a Richter magnitude of 3.2. The earthquake was felt over about 550 km^2 of western Ohio from Celina, south to Chickasaw, west to Fort Recovery, and north to Rockford. Several instances of slight damage were reported in the area. The maximum intensity reported was a VI near Celina, Coldwater, Fort Recovery, and Rockford, Ohio. The estimated intensity at the Fermi site was Intensity II. (Fermi 2012a, Section 2.5.2.5.2)

The shock of July 27, 1980, is the strongest earthquake to be centered in Kentucky and the strongest earthquake to be felt in this region since the southern Illinois earthquake of 1968. It was felt over an area of approximately 600,000 km^2 of the central United States and Canada. The epicenter was located near Sharpsburg, Kentucky, and the epicentral magnitude and intensity were 5.1 and VII, respectively. Reports of the duration of ground vibration were about 15 seconds of strong motions and up to several minutes for sensible vibrations. The intensity in Michigan varied from II to IV and was reported to be at II in Monroe, Michigan. (Fermi 2012a, Section 2.5.2.5.2)

The earthquake of January 1986 was located about 11 miles south of the Perry Nuclear Power Plant site and had a Richter magnitude of 4.96. The earthquake was rated as a Modified Mercalli Intensity of VI. The January 1986 Ohio earthquake was felt at the Fermi site as a Mercalli Intensity IV event. No unusual conditions were observed and the earthquake was not strong enough to be designated an event at Fermi. (Fermi 2012a, Section 2.5.2.5.2)

Additional updated seismic information is presented in Section 2.5.2.1.2 of the Fermi 3 COLA FSAR (DECo 2012).



(National Atlas 2012; USDOT 2012; USGS 2012a)

Figure 3.4-1
Physiographic Provinces Associated with the Fermi Site

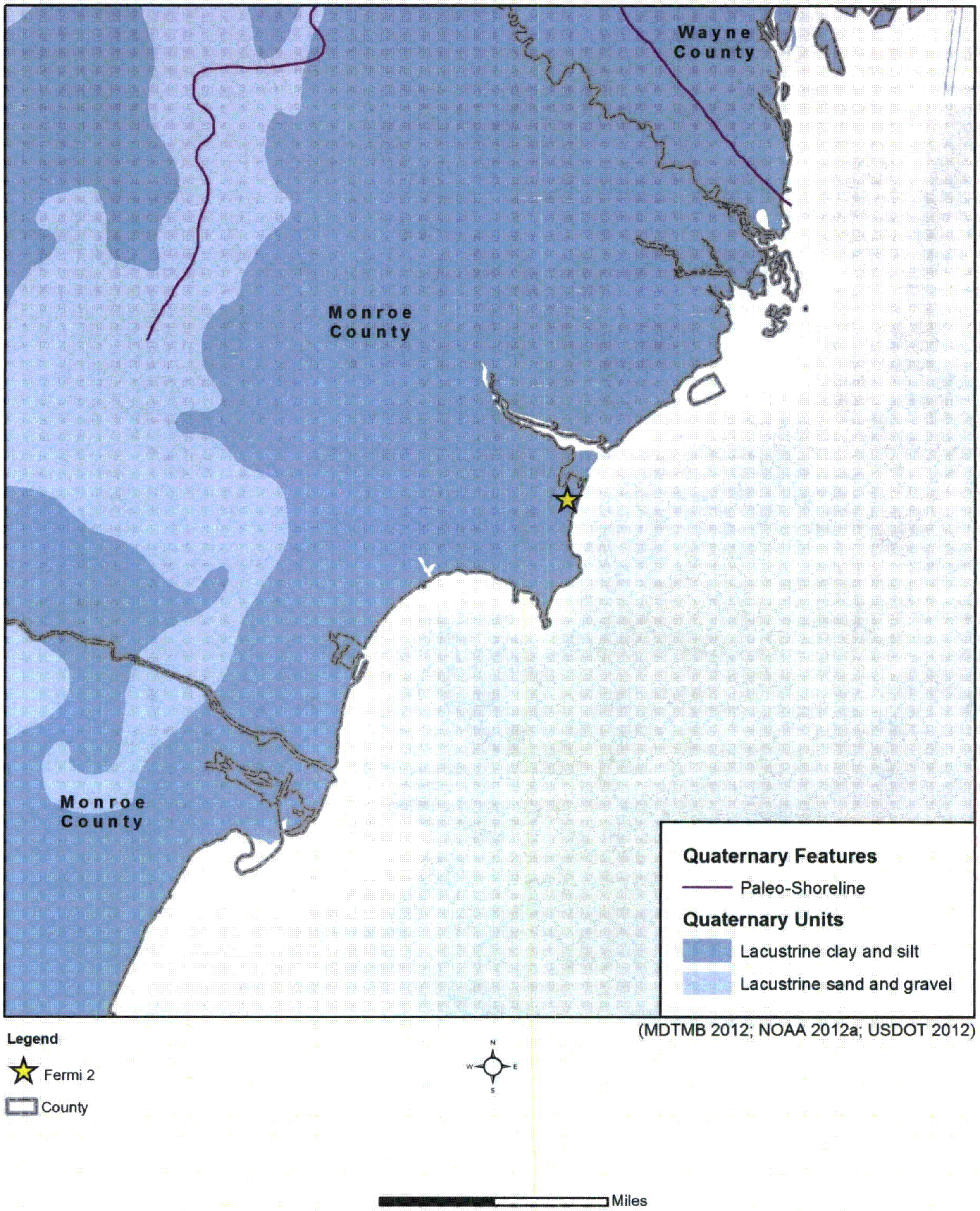


Figure 3.4-2
Distribution of Surface Pleistocene Glacial Deposits Surrounding the Fermi Site

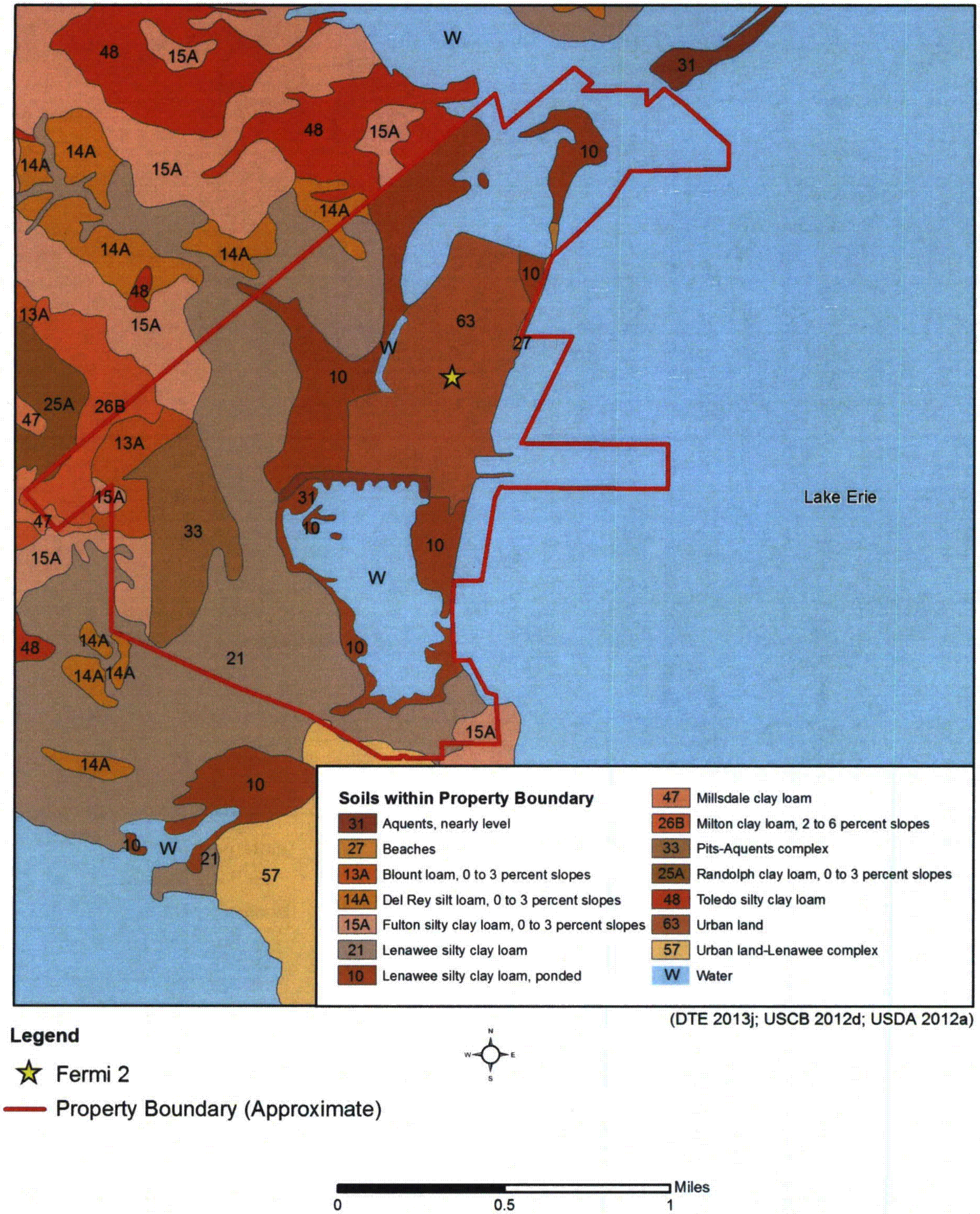


Figure 3.4-3
Distribution of Surface Soil Units within Fermi Property Boundary

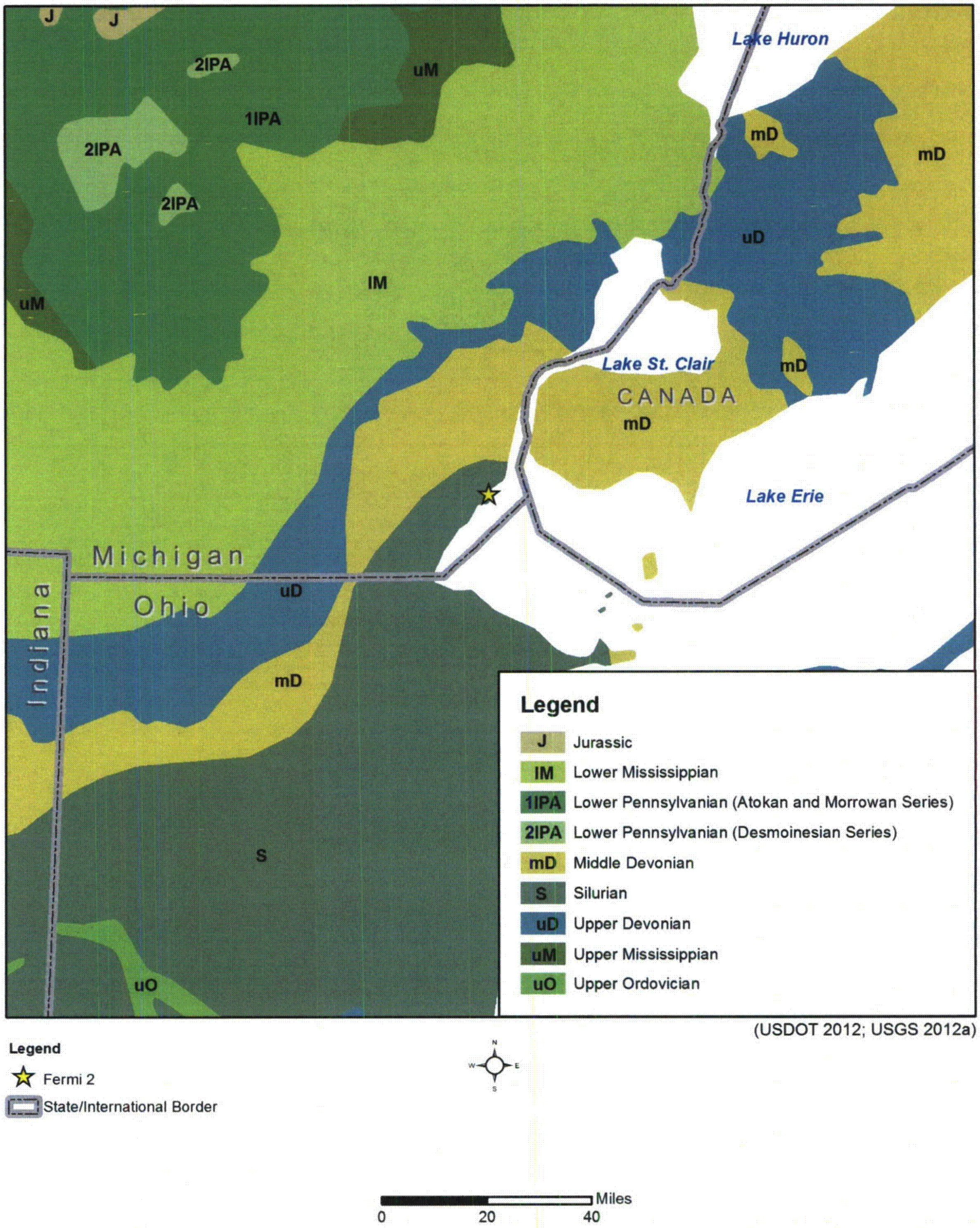
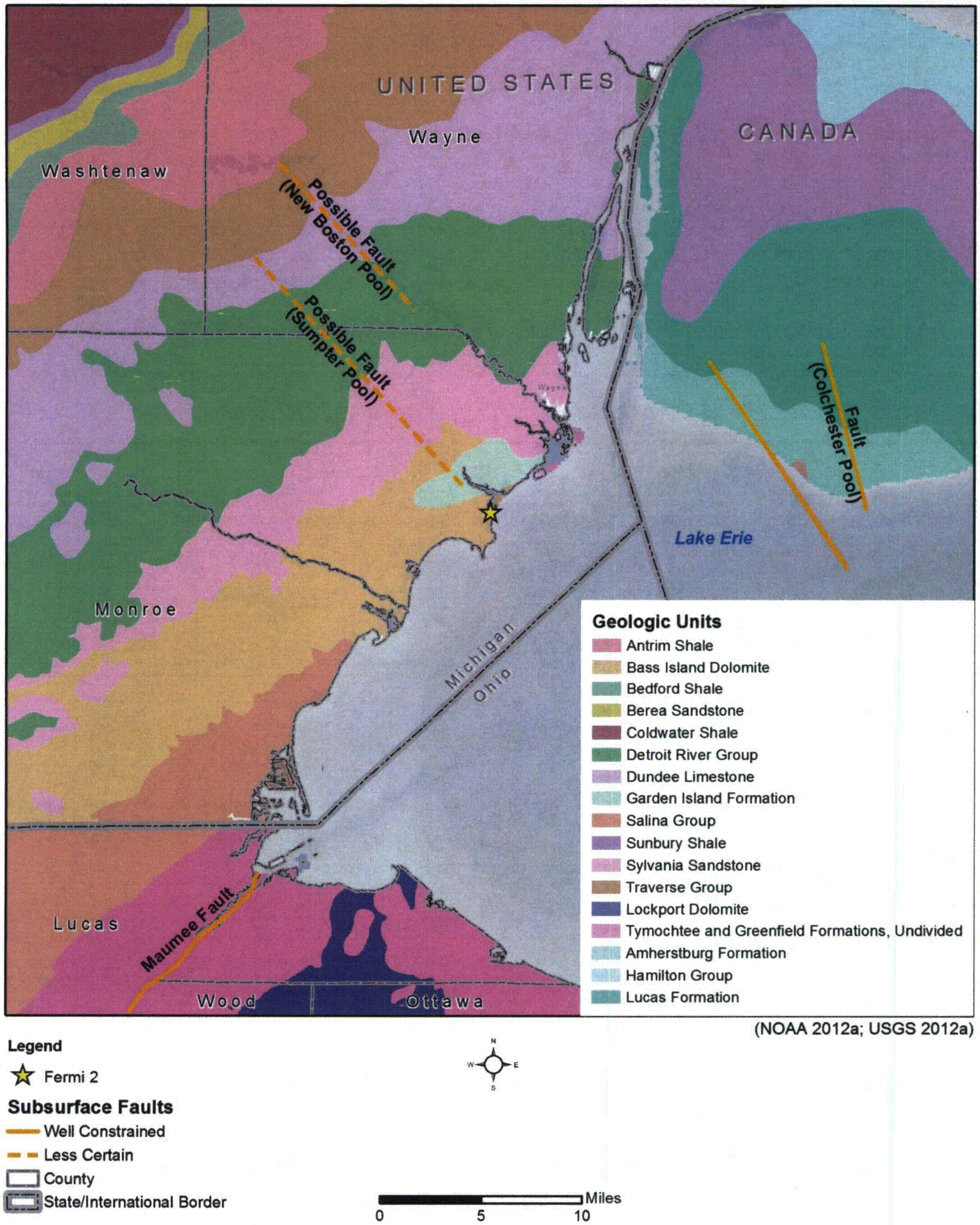


Figure 3.4-4
Bedrock Surface and Stratigraphic Sequence within the Fermi Region



(NOAA 2012a; USGS 2012a)

Figure 3.4-5
Sedimentary Sequence in Monroe County Area

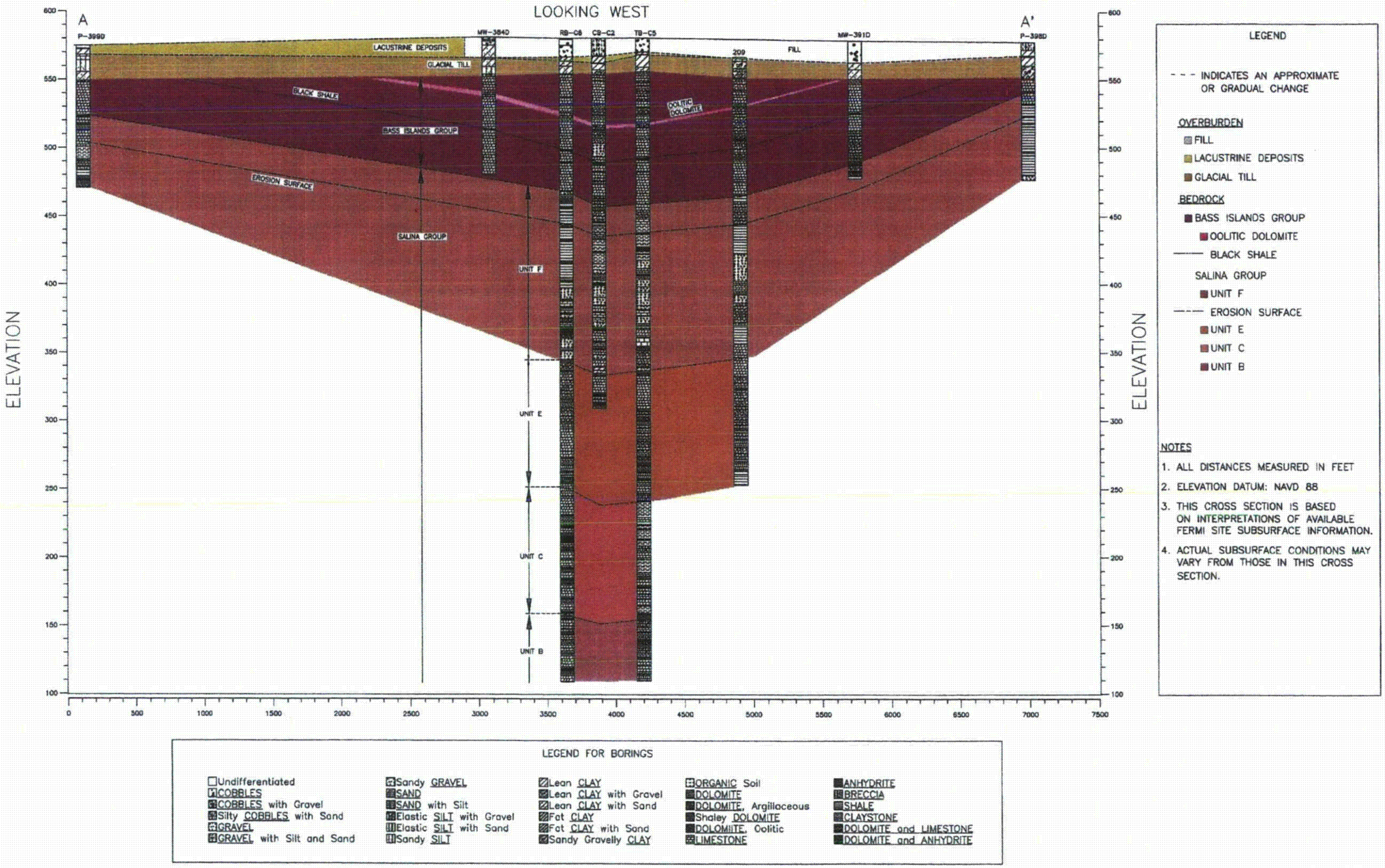
SYSTEM	STRATIGRAPHIC NOMENCLATURE	AVERAGE THICKNESS (FEET)		BEDS	LITHOLOGY
QUAT. (~ 0.075 my)	Recent and Pleistocene	15-30			Lake deposits and glacial till (unconformity)
SILURIAN (~ 405 my)	Bass Islands Group	99			Dolomite
SILURIAN	Salina Group	>354	123	F	Dolomite, limestone, claystone, shale, breccia, sandstone
SILURIAN	Salina Group		93	E	Dolomite, argillaceous dolomite, limestone, thin shales
SILURIAN	Salina Group		90	C	Claystone, dolomite, anhydrite
SILURIAN	Salina Group		>48	B	Dolomite, anhydrite, shale
SILURIAN	Niagaran Group	425			Dolomite
SILURIAN (~ 423 my)	Cataract Group	100			Shale and dolomite (unconformity)
ORDOVICIAN (~ 425 my)	Richmond Group	625			Shale and dolomite
ORDOVICIAN (~ 459 my)	Trenton-Black River Group	825-850			Dolomite and Shale (unconformity)
CAMBRIAN (~ 500 my – ~ 515 my)	St. Croixian Series	475			Sandstone with some dolomite, thin shales (unconformity)
PRE-CAMBRIAN (~ 1000 my – > 2500 my)					Granite gneiss

Ages are approximate and in million years (my) before present.

(AAPG 1985; DECo 2012; Fermi 2012a)

Figure 3.4-6
Fermi Site Stratigraphic Column

Figure 3.4-7
Fermi Site Cross Section Location Map



(DECo 2012)

Figure 3.4-8
Geologic Cross Section A-A

3.5 Water Resources

During operation of Fermi 2, the western basin of Lake Erie would continue to be the source of cooling system makeup water and would receive plant blowdown discharge water. The Frenchtown Water Plant is the source for potable water and is used to produce makeup demineralized water during operations. Sanitary effluent would continue to be discharged to the Monroe Metropolitan Water Pollution Control Facility. (NRC 2013c, pages 2-12 to 2-13)

3.5.1 Surface Water Resources

Figure 3.0-3 shows the location of Fermi 2 on the western edge of Lake Erie. Historically, surface wetlands dominated this coastal area. Much of the wetland area was drained in the 1800s to accommodate the development of local agriculture. Fermi 2 lies entirely on fill material emplaced and graded after significant volumes of natural material were excavated to prepare the site for construction of the plant. Most of the non-industrial areas of the Fermi site are characterized as wetlands. As shown in Figure 3.0-3, much of the Fermi site is located in the coastal zone of Lake Erie. (NRC 2013c, page 2-14)

The Fermi property is bordered by Lake Erie along its eastern edge. The site drains to Lake Erie and to one of its tributaries, Swan Creek. The Fermi site is partially bounded by the 100-year floodplain of these water bodies. Swan Creek forms the northern boundary of the Fermi site (Figure 3.0-3). Other streams near the Fermi site include Stony Creek (about 3 miles southwest), the River Raisin (about 6 miles southwest), the Huron River (about 6 miles north) (Figure 3.0-3), and the mouth of the Detroit River (approximately 6.5 miles northeast). (NRC 2013c, page 2-14)

Lake Erie has an open water surface area of 9,910 square miles and a total watershed area of 30,140 square miles. Lake retention time is approximately 2.6 years. The volume of Lake Erie is approximately 116 cubic miles or about 128 trillion gallons. Because of the lake's large size, there is considerable uncertainty in the estimates of the Lake Erie water balance. The Detroit River, which connects Lake Huron and Lake Erie, contributes to 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. Annual average rainfall over Lake Erie is about 35 inches per year and is estimated to contribute approximately 25,497 cubic feet per second (cfs) (+/- 15 to 45 percent) to the water balance. Runoff from tributaries to Lake Erie is estimated to be 21,189 cfs (+/- 15 to 35 percent). The inflow from the Detroit River is estimated to be 188,333 cfs (+/- 5 to 15 percent), and the outflow to Lake Ontario is estimated to be 206,202 cfs (+/- 4 to 10 percent). The average annual evaporation from Lake Erie is estimated to be 36 inches per year and is estimated to remove approximately 26,027 cfs (+/- 10 percent) from the water balance. (NRC 2013c, page 2-14) Between 2006 and 2010, the average water use in the basin was 56,170 million gallons per day (MGD) or about 20,502 billion gallons per year (DTE 2013q).

Lake Erie is divided into three separate drainage basins: western, central, and eastern basins. The western basin of Lake Erie is situated east of the Fermi site and provides the operations water for Fermi 2. The western basin of Lake Erie is very shallow, with an average depth of 24 feet, and is partially restricted from the rest of Lake Erie by chains of barrier beaches and islands. Major streams that flow into the western basin are the Maumee River, River Raisin, Rouge River, Huron River, and Detroit River. The typical wind current pattern for the western basin is west to east. Flow velocity varies due to wind currents and seasonal climate variations and was measured to be an average of 0.4 fps in the western basin of Lake Erie during an experiment and 0.3 fps between the Detroit River and the Toledo water intake after a salt spill. (NRC 2013c; pages 2-14 to 2-15)

The average water elevation for Lake Erie is 571.6 feet (NAVD88)[2]. A rock barrier is present along the shoreline on the eastern edge of the Fermi site at 581.8 feet (NAVD88), which is also the current plant grade, to protect the Fermi site against high water levels of Lake Erie. According to the Federal Emergency Management Agency (FEMA), the 100-year flood level is 578.5 feet (NAVD88) at the Fermi site. Lake Erie water levels are measured hourly by the National Oceanic and Atmospheric Administration (NOAA) at the Fermi site gauge (ID 9063090). Water levels are typically higher in the spring and summer and lower in the fall and winter. The record low water elevation of Lake Erie at the Fermi gauge is 563.65 feet (NAVD88) on February 16, 1967. (NRC 2013c, page 2-15) The highest recorded water elevation at the Fermi gauge is 576.22 feet (NAVD88) on April 9, 1998 (NOAA 2013b). Winds blowing across the lake can cause lake level increases in down-wind sectors and subsequent seiches, which are oscillations of water levels in response to atmospheric conditions. The U.S. Army Corps of Engineers (USACE) estimates that the maximum 100-year storm-induced surge on Lake Erie is 3.9 feet at the Fermi site. The maximum recorded rise was 6.3 feet and the maximum recorded fall was 8.9 feet for the period from 1941 to 1981. (NRC 2013c, page 2-15)

Over the past 30 years, the Lake Erie shoreline at the Fermi site has remained fairly stable. Erosion and sediment transport in the western basin of Lake Erie near Fermi 2 are dictated primarily by two major streams: the Detroit River to the north and the River Raisin to the south. The Maumee River further south, however, is the major sediment source to Lake Erie and contributes higher amounts of suspended solids per year than any other tributary to the Great Lakes. (NRC 2013c, page 2-15)

The Swan Creek watershed has a drainage area of 106 square miles. The watershed is an elliptically shaped basin trending northwest-southeast. The average slope of the creek is 5.15 feet per mile. The Swan Creek watershed has a maximum elevation of approximately 700 feet (NAVD88) at 25 miles inland, and it drains to Lake Erie to the east, where elevations at the mouth of the creek are approximately 575 feet (NAVD88). The entire Swan Creek watershed is situated within flat to gently rolling plains. In general, the surface soils within the basin are primarily lacustrine clay, with some sand ridges at the head of the watershed. The soils have low infiltration capacity, resulting in poor surface drainage. Floodplains occupy areas along the

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2. The Fermi 2 UFSAR references elevations in the New York Mean Tide (1935) datum, which is also referred to as the Fermi 2 datum. This LRA ER uses the NAVD88 datum which has a difference in elevation of -1.211 feet from the Fermi 2 datum. Therefore, elevations noted in this report will be 1.211 feet less than those listed in the Fermi 2 UFSAR.

creek, and wetlands are well developed at its mouth near Lake Erie. No significant impoundments or reservoirs are present along Swan Creek. (NRC 2013c, page 2-15)

Swan Creek is ungauged; the MDEQ calculates Swan Creek's flow by using data collected from a gauging station installed in a neighboring watershed with similar geologic characteristics. The harmonic mean annual daily flow rate was estimated to be 4.6 cfs. Monthly mean flows were estimated to vary from 6 cfs in August to 140 cfs in March. The 90-day mean low flow rate that occurs, on average, once in 10 years (10 percent chance of occurring in any one year) was estimated to be 0.9 cfs. (NRC 2013c, page 2-15 to 2-16)

Other nearby watersheds include Stony Creek (120 square miles); River Raisin (1,072 square miles; average flow rate of 671 cfs); and Huron River (908 square miles; average flow rate of 565 cfs) (NRC 2013c, page 2-16).

The North Lagoon and South Lagoon are located on the Fermi 2 site. They are hydraulically connected to Lake Erie through direct contiguous waterways (Figure 3.5-1). There are two manmade canals on the western side of the Fermi site. The overflow canal (also known as the north canal) is located west of Fermi 2 and discharges to Swan Creek via the North Lagoon. The discharge canal (also known as the south canal) is southwest of Fermi 2 and flows to the South Lagoon. A small pond is located between the overflow and discharge canals. Nearby wetlands are hydraulically connected to the canals through culverts, but the small pond is not directly connected to any surface water features. The wetlands, overflow and discharge canals, and lagoons are all hydraulically connected to the western basin of Lake Erie. (NRC 2013c, page 2-16)

There are two quarry lakes and five manmade wastewater treatment basins on the Fermi site (Figure 3.5-1). The quarry lakes are former rock quarries used during the construction of Fermi 2. They are located about 4,400 feet southwest of Fermi 2 in the vicinity of Fermi administrative and training buildings. The first manmade wastewater treatment basin is in the northern part of the Fermi site and is the reservoir for the circulating water system for Fermi 2. (NRC 2013c, page 2-16) The second manmade wastewater treatment basin is an open clay-lined basin (also referred to as chem basin) which accepts sanitary effluents, other than domestic sewage, from several onsite sources prior to being forwarded to the Monroe POTW (Section 2.2.8.2.2). The third manmade wastewater treatment basin is the chem waste pond (NPDES Outfall 009), which receives various NPDES-permitted wastewater streams (Section 2.2.8.2.1). The fourth manmade wastewater treatment basin is in the southern part of the Fermi site and is the dredge basin (NPDES Outfall 013) used to settle out solids during dredging activities. The fifth manmade wastewater treatment basin is located near the southwest corner of Fermi 1 and is known as the Fermi 1 oily waste equalization basin. This basin takes stormwater inputs from the site's peaker units and associated fuel oil tank containment dike. This wastewater stream is authorized to discharge via NPDES Outfall 011C; however, this outfall is no longer used. The processed waste stream is now discharged to the sanitary waste system as authorized by the site's industrial/non-domestic user discharge permit.

The intake from Lake Erie for Fermi 2 is located between the two rock groins that extend into Lake Erie to minimize shoaling and protect the Fermi 2 water intake (Figure 2.2-1). Dredging is periodically performed in the area between the two groins. The current dredge cycle is 4 years. Dredging activities are regulated by permits issued by the USACE and MDEQ as discussed in Section 9.1.3.3.7. Dredge spoils associated with dredging activities at the intake structure are placed in the dredge basin, which is located near the Lake Erie shore to the south of Fermi 2 and is formed by dikes. (NRC 2013c, page 2-16) Periodically the dredge material in the basin is removed, typically on a 10-year cycle which may vary. Representative samples of the dredge material are analyzed to ensure the material meets silviculture requirements as being inert (MDNR 1995). It is then placed elsewhere on the Fermi 2 site, and the area seeded to prevent erosion in accordance with the requirements specified in the SESC permit.

Fermi 2 discharges directly to Lake Erie through a discharge pipe (Outfall 001) and the dredge basin (Outfall 013), and to Swan Creek through the overflow canal (Outfalls 009 and 011) in accordance with the Fermi 2 NPDES permit (Section 2.2.8.2.1). The Fermi 2 cooling water discharge structure (NPDES Outfall 001) is located along the shoreline of Lake Erie, north of Fermi 2 and east of the cooling towers (NRC 2013c, pages 2-16 and 2-18) (Figure 3.5-1). A description of the discharge structure and discharges associated with NPDES Outfall 001 are provided in Section 2.2.2.3.

3.5.2 Groundwater Resources

The Fermi site is located on a glacial plain. The local groundwater system is composed of two zones: a surficial aquifer in unconsolidated overburden and several carbonate bedrock aquifers. The overburden materials consist of the fill material and clay dikes in addition to the native lacustrine and glacial deposits. The uppermost carbonate bedrock formation is the Bass Islands Group, composed of dolomite bedrock. The geology of the Fermi site is discussed in Section 3.4.

Two regional aquifers, the Bass Islands Group aquifer and the Salina Group aquifer, lie beneath the overburden at the Fermi site. There is a weathered zone at the boundary of the Bass Islands Group aquifer and the glacial overburden. The Bass Islands Group aquifer is composed of dolomite bedrock, and the thickness of the aquifer unit varies between approximately 50 and 100 feet beneath the Fermi site. (NRC 2013c, page 2-19)

Unit F of the Salina Group underlies the Bass Islands Group at the site. The unit is primarily composed of dolomite, shale, breccia, claystone, sandstone, poorly indurated clastic sediments, and limestone, and is considered to be an aquifer. The thickness of the unit is more than 100 feet. It is recharged by the Bass Islands Group aquifer. (NRC 2013c, page 2-19)

A total of 93 wells (Figure 3.5-2) are currently installed on site for use in various monitoring and assessment programs, including 17 overburden, 10 Bass Islands Group, and one Salina Group Unit F monitoring wells and/or piezometers installed in support of the Fermi 3 COL application. Monitoring wells on site are used for various programs, including the NEI groundwater protection program (Section 2.2.6), the site REMP (Section 2.2.5), Fermi 1 decommissioning, and the

Fermi 3 COL application. Figure 3.5-3 illustrates the wells that lie within a 2-mile radius of the Fermi site. (DTE 2012e; DTE 2013i; DTE 2013k; MDTMB 2012)

As discussed in Section 2.2.6, Fermi 2 participates in the NEI's industry-wide voluntary GPI to monitor groundwater in the vicinity of nuclear power plants to ensure that any leaks or spills of licensed material are promptly identified. In 2007, Fermi 2 began sampling groundwater to monitor for potential releases of licensed material via groundwater pathways at the site. Results associated with this program are presented in Section 4.5.5.

3.5.2.1 Hydraulic Properties

Slug tests were performed in selected monitoring wells and piezometers screened in both the aggregate fill and the overburden to estimate hydraulic conductivity. Hydraulic conductivity calculated from six slug tests performed on monitoring wells in the aggregate fill was found to be very high and ranged from 251 to 1,776 feet per day. The hydraulic conductivity calculated from five slug tests performed on monitoring wells in the glacial overburden ranged from 0.028 to 16.5 feet per day. (NRC 2013c, page 2-19)

Packer tests were performed at multiple depths in selected wells screened in the Bass Islands Group. Hydraulic conductivity values calculated from the packer tests ranged from 0.11 to 40.1 feet per day. However, the average hydraulic conductivity was calculated to be 3.28 feet per day in wells with no suspected hydraulic connection to zones above or below the zone being tested. Regional estimates of hydraulic conductivities of the Bass Islands Group have ranged from 5 to 36 feet per day. (NRC 2013c, page 2-19)

3.5.2.2 Potentiometric Surfaces

Figure 3.5-4 shows the water table contour map for the overburden at the site between August 29, 2011 and June 12, 2012. Flow in the overburden is primarily toward the surface water bodies. The groundwater flow velocity in the overburden is expected to vary locally because of the complex arrangement of natural and fill material with widely varying hydraulic conductivities. (DTE 2012e; DTE 2013i; NRC 2013c, page 2-20)

Figure 3.5-5 shows the potentiometric surface of the Bass Islands Group aquifer at the site between August 29, 2011 and June 12, 2012. This deeper groundwater flows to the south-southwest and then to the west at the Fermi site. The regional groundwater flow in the bedrock aquifer is dominated by the dewatering operations of two quarries (Rockwood Quarry and Stoneco Denniston) that are located northwest and southwest of the site. The dewatering activities create a groundwater divide in a northwest-southeast direction south of the Fermi site. Although the dewatering wells for the quarries create two regional groundwater discharge zones, the overall regional gradients are historically to the east toward Lake Erie. (DTE 2012e; DTE 2013i; NRC 2013c, page 2-20)

On the basis of an average hydraulic gradient of 0.002 feet per foot and an assumed effective porosity of 0.1 percent, the groundwater flow velocities in the Bass Islands Group at the Fermi site are between 0.2 and 35 feet per day for minimum and maximum hydraulic conductivity, respectively. Groundwater in the aquifer is thought to flow along fractures in the bedrock and the weathered zone near its top. The direction of the vertical gradient in groundwater at the site is downward, so water moves from the overburden to the Bass Islands Group aquifer below. The regional aquifer is recharged from the west and from the glacial overburden from above. (NRC 2013c, page 2-20)

Table 3.5-1 depicts well construction information for the groundwater monitoring wells installed on the Fermi site (DTE 2013l). Table 3.5-2 provides a listing of depths-to-water and water-level elevations for those wells gauged between August 2011 and June 2012 (DTE 2013r).

3.5.2.3 Sole Source Aquifers

A sole source aquifer (SSA), as defined by the EPA, is an aquifer which is the sole or principal source that supplies at least 50 percent of the drinking water consumed by the area overlying the aquifer. The SSA program was created by the U.S. Congress in the Safe Drinking Water Act. The Act allows for the protection of these resources.

The Fermi site is located in EPA Region 5, which covers Minnesota, Wisconsin, Illinois, Michigan, Indiana, and Ohio. The EPA has designated seven aquifers in Region 5 as SSAs, with one additional aquifer pending designation. None of these SSAs are located in the state of Michigan. The closest SSA is the Bass Islands aquifer on Catawba Island in eastern Ottawa County, Ohio, about 35 miles southeast across Lake Erie. (DECo 2011, Section 2.3.1.2.1.1.1)

3.5.3 Water Use

This section describes water use near the Fermi site, including the use of water resources from Lake Erie and groundwater. The total water use is divided into consumptive use and nonconsumptive use. Consumptive use is the portion of water withdrawn or withheld from a water source and assumed to be lost or otherwise not returned to the source as a result of its evapotranspiration, its incorporation into products (e.g., crops), or other processes (e.g., export from the basin). Nonconsumptive use is the portion of water withdrawn from a water source that returns to the source. (NRC 2013c, page 2-20)

3.5.3.1 Surface Water Use

Lake Erie is a major water source in southeastern Michigan. Fermi 2 uses the lake water for cooling. Potable water at the Fermi site is provided by Frenchtown Water System, which withdraws water from Lake Erie. (NRC 2013c, pages 2-20 and 2-24) The Great Lakes Commission (GLC) issues annual reports on use of water withdrawn from Lake Erie, and the annual Lake Erie Basin Total Use for the last seven available reports (2003 to 2009) is provided in Tables 3.5-3 and 3.5-4. (GLC 2006a; GLC 2006b; GLC 2009a; GLC 2009b; GLC 2010a; GLC 2010b; GLC 2011)

Power plants and public water supply are the two largest users of Lake Erie water for each of the years listed in Tables 3.5-3 and 3.5-4. Between 2003 and 2009, the United States and Canadian nuclear power industry withdrew an average of 180 MGD from Lake Erie and consumed an average of 16 MGD, amounting to an average consumptive use rate of approximately 9 percent. (GLC 2006a; GLC 2006b; GLC 2009a; GLC 2009b; GLC 2010a; GLC 2010b; GLC 2011) Different cooling systems account for the variance in consumptive water use among nuclear plants in the Lake Erie basin. Of the amount of water withdrawn from Lake Erie for Fermi 2 daily operations (Section 2.2.2), approximately 60 percent is returned to Lake Erie while 40 percent is consumed through cooling tower evaporative and drift losses. (NRC 2013c, page 2-24)

Mean water withdrawals from Lake Erie in Monroe County, Michigan, from 2005 to 2010 were 1,764 MGD for thermoelectric power and 10 MGD for public water supply. Average Monroe County withdrawals of Lake Erie water for all uses (withdrawing more than 100,000 gpd) between 2005 and 2010 was 1,774 MGD. Average use of other surface water resources (withdrawing more than 100,000 gpd) in Monroe County was 2 MGD between 2005 and 2010. (DTE 2013s)

If it is assumed that per capita water use does not change from present amounts and that the population will increase 74 percent by 2060 (NRC 2013c, page 2-24), the quantity of Lake Erie water used for the public water supply in Monroe County would increase from approximately 12 MGD in 2000 to 23 MGD in 2060. The total surface water used in Monroe County for public water supply, agricultural irrigation, self-supply industrial, and golf course irrigation would increase from 4.4 MGD in 2000 to 7.8 MGD in 2060. If water use for thermoelectric power generation increased linearly at the same rate as population growth in the county, then the total Lake Erie water used in Monroe County for thermoelectric power generation would increase from approximately 1,700 MGD in 2000 to 2,990 MGD in 2060 (NRC 2013c, pages 2-24 to 2-25). Between 2006 and 2010, the average water use in the basin was 56,170 MGD or about 20,502 billion gallons per year, with approximately 1 percent (502 MGD or 183 billion gallons per year) as consumptive use. The total volume of Lake Erie is approximately 128 trillion gallons, so the average annual consumptive use in the Lake Erie basin is approximately 0.14 percent of the total lake volume. (DTE 2013q)

With the passage of the Great Lakes Compact in 2008, any new water withdrawals within the Great Lakes Basin resulting in a consumptive use of 5 MGD or more were made subject to review by all of the states and provinces in the region. (NRC 2013c, page 2-25)

3.5.3.2 Groundwater Use

Fermi 2 does not withdraw water from any site wells for plant-related systems or potable water usage. Groundwater withdrawal in Monroe County is substantially less than withdrawal from Lake Erie. Between 2005 and 2011, groundwater withdrawals ranged from 12.4 to 27.0 MGD and averaged 22.5 MGD. Industrial and manufacturing companies were the largest users of groundwater in Monroe County, accounting for 87 to 94 percent between 2005 and 2011. The remaining water use was for thermoelectric power facilities, public water supply, agricultural irrigation, and golf course irrigation. (DTE 2013t) It is estimated that total freshwater groundwater withdrawals in Monroe County would increase from approximately 28 MGD in 2000 to 49 MGD in 2060. (NRC 2013c, page 2-25)

Although Fermi 2 does not have any onsite wells specifically for dewatering purposes, there is intermittent in-leakage of groundwater into the turbine building basement as a result of a leaking seam between the auxiliary building and turbine building. The in-leakage of groundwater is collected in a bermed area and periodically pumped into 55-gallon drums. The maximum quantity of groundwater that has been collected in a 24-hour period is four 55-gallon drums (220 gallons).

In addition, water is pumped from site cable vaults to keep the cables dry. Some of the vaults are manually pumped on a periodic basis and some are pumped automatically. Typically, this water consists of a mixture of groundwater in-leakage and stormwater runoff. Once the water is pumped from the vaults, it is discharged via stormwater outfalls to waterbodies that are in communication with Lake Erie.

3.5.4 Water Quality

The water quality of Lake Erie, Swan Creek, Fermi site surface water bodies, and the groundwater in the vicinity of the Fermi site is described in the following sections. Shallow groundwater at the Fermi site is hydraulically connected with the surface water, as discussed in Section 3.5.2.

3.5.4.1 Surface Water Quality

Surface water bodies whose quality could be affected by the continued operation of Fermi 2 include Lake Erie, Swan Creek, and various onsite water bodies. Onsite surface water bodies include the North Lagoon, South Lagoon, overflow canal, discharge canal, small pond between the two canals, and the two quarry lakes. However, the primary water body of concern is Lake Erie, which is the sole source of cooling water to Fermi 2 and receives the majority of discharges, in accordance with the NPDES permit, from Fermi 2. Swan Creek and the onsite water bodies also receive some stormwater runoff and other Fermi-related discharges. (NRC 2013c, page 2-26)

Lake Erie water is used for public water supply in Monroe County and many other locations across the Lake Erie Basin. Current water quality concerns with regard to Lake Erie include (1) increased phosphorus loading from regional agricultural activities which cause toxic algal blooms, and (2) elevated concentrations of three bioaccumulative contaminants (mostly from historical industrial activities): dioxin, polychlorinated biphenyls (PCBs), and mercury. In 2005, the EPA's Large Lakes and Rivers Forecasting Research Branch began the Detroit River-Western Lake Erie Basin Indicator Project. The EPA identified the following current challenges to the Detroit River-Western Lake Erie Basin water resources: (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. (NRC 2013c, page 2-26)

The MDEQ is responsible for assessing the support of beneficial uses of surface water bodies in Michigan and subsequently listing water bodies on the Clean Water Act (CWA) Section 303(d) list of impaired waters, if they do not support those beneficial uses. Currently, Lake Erie waters under Michigan jurisdiction are on the final 2012 303(d) list for not supporting fish consumption because of the elevated concentrations of PCBs and dioxins in fish tissue, which are unrelated to Fermi 2 operations. The total maximum daily load (TMDL) determination is scheduled to be completed in 2015. In general, Lake Erie public water supply use was not assessed and neither were total/partial body contact uses. The Lake Erie shoreline from the Detroit River to the Michigan-Ohio border has not been assessed for most beneficial uses, and there is insufficient information on total and partial body contact uses. However, the Lake Erie coastline at Sterling State Park and Estral Beach in Monroe County southwest and north of the Fermi site, respectively, fully supports total and partial body contact recreation, while Luna Pier Beach, in Monroe County south of the Fermi site, is on the Section 303(d) list for not supporting total or partial body contact uses as a result of pathogen (*Escherichia coli [E. coli]*) concentrations. (MDEQ 2012b)

A TMDL for *E. coli* in the Detroit River was issued by MDEQ in August 2008. The TMDL addresses sources of *E. coli* in the U.S. portions of the Detroit River watershed. The Detroit River is also on the Section 303(d) list for dioxin (including 2,3,7,8-Tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD]), dichlorodiphenyltrichloroethane (DDT), PCBs (both fish tissue and water column), and mercury (both fish tissue and water column). (MDEQ 2012b)

Swan Creek and tributaries in HUC 041000010104 (AUID 041000010104-01) are on the Section 303(d) list for not supporting other indigenous aquatic life and wildlife. The MDEQ noted the causes as direct habitat alterations and flow regime alterations. (MDEQ 2012b)

Water quality in the western basin of Lake Erie is monitored at several stations. Surface water quality data for the vicinity of the Fermi site are collected by a number of agencies: EPA maintains the GLENDA and STORET databases; the U.S. Geological Survey (USGS) maintains the National Water Information System (NWIS) database; and MDEQ performs monitoring in many locations. Temperature data are also available from NOAA from four gauges on the coast of Lake Erie, with two stations being located within the western basin: Toledo, Ohio, and Marblehead, Ohio. Monthly average temperatures recorded at Toledo only vary between 50.4°F and 59.0°F annually and reflect temperatures of the Maumee River. Temperatures measured at the Marblehead station are presented in Table 3.5-5, along with the average monthly Lake Erie surface temperatures modeled by the NOAA Great Lakes Environmental Research Laboratory.

As discussed in Section 2.2.8.2.1, effluent discharges from Fermi 2 operations are monitored and regulated in accordance with NPDES Permit No. MI0037028. Figure 3.5-1 shows the locations of the NPDES permitted outfalls, including stormwater discharge outfalls. Section 9.1.3.3.2 discusses Fermi 2's NPDES permit compliance history over the previous 5 years (2009–2013). Also as discussed in Section 9.1.3.1, there have been no notices of violation associated with the NPDES permit over the previous 5 years (2009–2013).

As a part of the COL application for the proposed Fermi 3, a year of quarterly surface water sampling was done at six locations throughout the site, including two locations in Lake Erie. The sampling indicated that the surface water quality at the Fermi site was typical of the area, with elevated levels of nutrients including total phosphorus, orthophosphorus, nitrate and nitrite nitrogen, and total Kjeldahl nitrogen. On average, concentrations of mercury in site surface water exceeded MDEQ Rule 57 for human noncancer values (0.0018 micrograms per liter [μg/L]) and wildlife values (0.0013 μg/L); however, these values are consistent with values measured at the intake to Fermi 2 from Lake Erie. When surface water quality is compared to primary and secondary drinking water standards, color, turbidity, and fecal coliform concentration in most samples exceed drinking water standards. Concentrations of sulfate and total dissolved solids (TDS) exceed secondary drinking water standards in the southern quarry lake. (NRC 2013c, pages 2-28 to 2-29)

Two locations in Lake Erie near the Fermi site reported detectable coliforms (total and fecal) in the samples. Total coliforms were found at concentrations of 200 and 500 colony-forming units per 100 milliliter (cfu/100 mL), and fecal coliforms were not detected in one sample and were detected at 100 cfu/100 mL in the other. Also, quarterly sampling at six surface water locations on the site from July 2008 through April 2009 was done to test for fecal coliform. It was detected at five of the six locations with average concentrations between 8 to 39 cfu/100 mL. One location on Lake Erie reported concentrations between 4 and 17 cfu/100 mL. (NRC 2013c, page 2-29)

Grab samples from Swan Creek in the early 1970s and early 1990s showed that concentrations of nitrate nitrogen, total phosphorus, Kjeldahl nitrogen, and sulfate were elevated when compared with the most recent Fermi site data (NRC 2013c, page 2-29).

3.5.4.2 Groundwater Quality

In 2007, 20 groundwater samples were analyzed in conjunction with the Fermi 3 COL application. Between July 2008 and April 2009, a year of quarterly groundwater sampling was done at four locations throughout the site. When groundwater quality was compared to primary (turbidity) and secondary (color, sulfate, iron, and TDS) drinking water standards, color, turbidity, and concentrations of sulfate, iron, and TDS exceeded drinking water standards in many of the samples. In some cases, the pH values of the samples were more or less than the secondary drinking water standards. (NRC 2013c, page 2-29)

In conjunction with the Fermi 2 groundwater protection program, some occasional low-level positive tritium results have occurred in groundwater from the shallow and deep monitor wells. However, the tritium in groundwater in the shallow aquifer is the result of washout and recapture of tritium in precipitation that has passed through gaseous effluent from monitored plant systems. Low-level tritium activity has rarely been detected in groundwater from the bedrock aquifer at the site. These positive results were deemed spurious because of the following:

- The results were sporadic and did not show any trend.
- There is no credible source for licensed material in the bedrock aquifer.
- The vertical distance between screened intervals on the shallow and deep monitor wells is on the order of 30 feet, with the aquifers separated by approximately 10 feet of inorganic clay.

- None of the adjacent shallow wells had elevated tritium levels sufficient to support the levels seen in the groundwater from the deep wells when accounting for dilution.

Groundwater sampling at the Fermi site in 1969, 1970, and 2007 indicated sulfate concentrations exceeding the EPA secondary standard in most of the samples. In eastern Monroe County, high sulfate is common due to natural sources. (NRC 2013c, page 2-30)

The chloride content of the groundwater, as sampled in 1969, ranged from 21 to 1,164 parts per million (ppm). The random and occasional high chloride contents measured were affected by boring operations in which salt was used as an additive to the boring fluid. Based on the results of measured chloride content of samples that should not have been affected by salt in the boring fluid, the natural groundwater at the Fermi site appears to have a chloride content of less than 100 ppm. (Fermi 2012a, Section 2.5.4.6) Subsequent sampling in 1990 and 2007 showed concentrations of chlorides below the EPA secondary standard in all samples (DECo 2011, Section 2.3.3.2).

In wells within a 5-mile radius of the Fermi site, elevated concentrations of arsenic above the EPA maximum contaminant level (MCL) were found in groundwater samples. Forty-two samples were measured for arsenic between 1985 and 2007 from wells serving single-family dwellings, schools, industrial facilities, and the city of Monroe. The arsenic concentrations are not attributed to Fermi. Elevated concentrations of nitrate as nitrogen were also found in some wells, but these did not exceed the MCL. More than 1,100 samples were measured for nitrate between 1983 and 2007 from wells serving single-family dwellings, golf courses, churches, schools, farms, industrial facilities, and the city of Monroe. Concentrations of volatile organic carbons (VOCs) measured in wells within 5 miles of the Fermi site between 1993 and 1999 were not above water quality standards. (NRC 2013c, page 2-30)

Although there are industrial practices at Fermi 2 involving the use of chemicals such as those activities typically associated with painting, cleaning of parts/equipment, refueling of onsite vehicles/generators, and the use of water treatment additives (Section 2.2.8.4), there are no current or ongoing remediation activities or investigations occurring at the Fermi 2 site (Section 9.1.3.2).

Historically, there have been two releases that resulted in subsurface investigations and associated closure reports as summarized below:

- In 1998, DTE recovered a 1977 drawing that depicted an apparent release of fuel oil in the vicinity of the combustion turbine generator peaking units and the associated diesel fuel storage area. Therefore, an investigation of the area was initiated. Based on the investigation, it was determined that no remediation of contaminated soils or groundwater was required. Per Michigan Part 201 of Act 451, and because the contaminants released at the site were not governed by CERCLA, DTE was not required to report the release to MDEQ. Therefore, MDEQ approval of the closure plan was not required. (Golder Associates 2001) However, because soil and groundwater contamination remains in some areas above generic residential Part 201 criteria, a Due Care Plan has been implemented, as required, to minimize the potential for exposure and to prevent transport off site or exacerbation of the contamination. (EnviroSolutions 2013)

- In 2002, a release of diesel fuel oil occurred as a result of cracks in the drain line from the RHR building to the chem waste pond. The pipe was lined with a polyester resin liner and, in 2007, DTE successfully completed the last of four successive groundwater monitoring events where no free product was encountered, and all groundwater test results were below the most restrictive groundwater cleanup criteria for diesel fuel indicator compounds. A closure report associated with this release was submitted to the MDEQ, and was approved by the agency in August 2008. (EnviroSolutions 2008; MDEQ 2008)

Table 3.5-1
Monitoring Well Construction Details

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
EFT-1S	2	583.68	581.19	579.19	577.19	572.19	571.19	Sch 40 PVC screen and riser
EFT-1I	2	583.69	581.21	566.71	564.71	559.71	559.71	Sch 40 PVC screen and riser
EFT-1D	2	583.69	581.21	553.21	550.71	545.71	545.71	Sch 40 PVC screen and riser
EFT-2S	2	582.17	582.42	580.42	578.42	573.42	572.42	Sch 40 PVC screen and riser
EFT-2D	2	581.88	582.34	551.34	549.34	544.34	543.84	Sch 40 PVC screen and riser
EFT-4S	2	586.17	583.61	580.61	578.61	573.61	573.61	Sch 40 PVC screen and riser
EFT-4D	2	585.99	583.61	550.61	548.61	543.61	543.61	Sch 40 PVC screen and riser
EFT-5S	2	585.47	583.21	581.21	579.21	574.21	573.21	Sch 40 PVC screen and riser
EFT-5D	2	585.72	583.21	552.71	550.71	542.71	542.71	Sch 40 PVC screen and riser
EFT-6S	2	584.46	582.01	579.01	576.01	572.01	571.51	Sch 40 PVC screen and riser
EFT-6D	2	584.54	582.01	557.01	555.01	550.01	549.01	Sch 40 PVC screen and riser
EFT-7S	2	583.77	581.31	579.31	578.81	573.81	573.31	Sch 40 PVC screen and riser
EFT-8S	2	581.69	582.01	579.01	577.01	572.01	571.51	Sch 40 PVC screen and riser
EFT-8SR	2	581.78	582.01	579.01	577.01	572.01	572.01	Sch 40 PVC screen and riser
EFT-9S	2	581.84	582.11	579.11	577.11	572.11	571.61	Sch 40 PVC screen and riser
EFT-10S	1	590.39	587.51	572.51	570.51	567.51	567.51	Sch 40 PVC screen and riser

**Table 3.5-1 (Continued)
Monitoring Well Construction Details**

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
EFT-11I	2	584.21	581.63	560.83	558.83	553.83	553.83	Sch 40 PVC screen and riser
EFT-11D	2	584.28	581.67	540.17	538.17	528.17	528.17	Sch 40 PVC screen and riser
EFT-12I	2	583.77	581.30	561.00	559.00	554.00	554.00	Sch 40 PVC screen and riser
EFT-12D	2	583.82	581.23	540.23	537.73	528.23	528.23	Sch 40 PVC screen and riser
EFT-13I	1	580.96	581.34	572.34	570.34	565.34	565.34	Sch 40 PVC screen and riser
EF2-07-001D	2	580.34	580.39	565.89	537.14	532.14	532.14	Sch 40 PVC screen and riser
EF2-07-002S	2	580.00	580.39	574.39	572.39	567.39	567.39	Sch 40 PVC screen and riser
EF2-07-003D	2	580.70	580.79	539.79	537.79	532.79	531.79	Sch 40 PVC screen and riser
EF2-07-003S	2	580.93	580.79	574.29	572.29	567.29	567.29	Sch 40 PVC screen and riser
EF2-07-004D	2	581.67	580.79	539.79	537.79	532.79	532.79	Sch 40 PVC screen and riser
EF2-07-005S	2	581.66	582.09	576.09	574.09	569.09	569.09	Sch 40 PVC screen and riser
EF2-07-006D	2	581.56	581.99	540.99	538.99	533.99	533.99	Sch 40 PVC screen and riser
EF2-07-007S	2	581.18	581.89	574.89	572.89	567.89	567.89	Sch 40 PVC screen and riser
EF2-07-008D	2	581.34	581.89	540.89	538.89	533.89	533.89	Sch 40 PVC screen and riser
EF2-07-008S	2	581.65	581.89	575.89	573.89	568.89	568.89	Sch 40 PVC screen and riser
EF2-07-009D	2	581.63	581.63	540.63	538.63	533.63	533.63	Sch 40 PVC screen and riser

Table 3.5-1 (Continued)
Monitoring Well Construction Details

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
EF2-07-012S	2	581.28	581.89	575.89	573.89	568.89	568.89	Sch 40 PVC screen and riser
EF2-07-013S	2	581.43	581.43	574.93	572.93	567.93	567.93	Sch 40 PVC screen and riser
EF2-07-014S	2	581.20	582.09	576.09	574.09	569.09	569.09	Sch 40 PVC screen and riser
EF2-07-015D	2	579.00	579.29	537.79	535.79	530.79	530.79	Sch 40 PVC screen and riser
EF2-07-015S	2	579.10	579.39	575.39	573.39	568.39	568.39	Sch 40 PVC screen and riser
EF2-07-016S	2	580.89	581.89	575.39	573.39	568.39	568.39	Sch 40 PVC screen and riser
EF2-07-017S	2	581.54	581.89	574.89	572.89	567.89	567.89	Sch 40 PVC screen and riser
EF2-07-018S	2	581.19	581.49	575.49	573.49	568.49	568.49	Sch 40 PVC screen and riser
EF2-07-019S	2	581.48	581.69	575.69	573.69	568.69	568.69	Sch 40 PVC screen and riser
EF2-07-020D	2	580.10	581.49	540.49	538.49	533.49	533.49	Sch 40 PVC screen and riser
EF2-07-020S	2	580.17	580.59	574.59	572.59	567.59	567.59	Sch 40 PVC screen and riser
EF2-07-021S	2	581.16	581.49	575.49	573.49	568.49	568.49	Sch 40 PVC screen and riser
EF2-07-022S	2	581.69	581.69	574.69	573.69	568.69	568.69	Sch 40 PVC screen and riser
EF2-07-023S	2	581.68	581.68	574.18	573.18	568.18	566.18	Sch 40 PVC screen and riser
EF2-07-024S	2	581.38	581.38	574.63	573.38	568.38	568.38	Sch 40 PVC screen and riser
EF2-07-025S	2	581.70	581.70	574.45	573.20	568.20	568.20	Sch 40 PVC screen and riser

Table 3.5-1 (Continued)
Monitoring Well Construction Details

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
EF2-07-026S	2	581.34	581.34	574.34	573.34	568.34	568.34	Sch 40 PVC screen and riser
EF2-07-027S	2	581.66	581.66	574.16	573.16	568.16	568.16	Sch 40 PVC screen and riser
EF2-07-028S	2	580.75	581.29	575.29	573.29	568.29	568.29	Sch 40 PVC screen and riser
EF2-07-029D	2	581.61	581.69	540.69	538.69	533.69	533.69	Sch 40 PVC screen and riser
EF2-07-029S	2	581.16	581.69	575.69	573.69	568.69	568.69	Sch 40 PVC screen and riser
EF2-07-031S	2	580.31	580.99	574.99	572.99	567.99	567.99	Sch 40 PVC screen and riser
MW-381D	2	582.35	579.78	544.78	543.28	533.28	530.78	Sch 40 PVC screen and riser
MW-381S	2	582.52	579.88	573.88	572.08	571.08	570.38	Sch 40 PVC screen and riser
MW-383D	2	585.16	582.28	553.58	551.28	541.28	539.18	Sch 40 PVC screen and riser
MW-383S	2	584.15	582.38	576.38	574.28	569.28	568.38	Sch 40 PVC screen and riser
MW-384D	2	583.98	581.28	541.28	539.18	529.18	526.28	Sch 40 PVC screen and riser
MW-384S	2	583.66	581.38	576.78	575.28	565.28	564.38	Sch 40 PVC screen and riser
MW-386D	2	583.91	582.28	531.78	529.48	519.48	516.28	304 stainless steel screen and riser
MW-386S	2	584.18	582.38	569.88	565.98	560.98	560.38	304 stainless steel screen and riser
MW-387D	2	582.29	579.68	549.68	547.08	537.08	534.68	304 stainless steel screen and riser
MW-387S	2	582.16	579.28	573.48	571.28	566.28	565.28	304 stainless steel screen and riser

Table 3.5-1 (Continued)
Monitoring Well Construction Details

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
MW-388S	2	577.60	574.78	571.28	569.43	568.43	568.28	Sch 40 PVC screen and riser
MW-390S	2	582.09	578.88	573.88	571.88	566.88	566.38	Sch 40 PVC screen and riser
MW-391D	2	581.17	578.68	537.68	535.88	525.88	523.68	Sch 40 PVC screen and riser
MW-391S	2	581.39	578.58	575.58	570.58	560.58	559.58	Sch 40 PVC screen and riser
MW-393D	2	578.33	576.58	550.58	548.88	538.88	536.23	Sch 40 PVC screen and riser
MW-393S	2	579.35	576.48	572.38	570.28	567.28	566.68	Sch 40 PVC screen and riser
MW-395D	2	579.83	577.28	547.28	545.28	535.28	533.28	Sch 40 PVC screen and riser
MW-395S	2	579.90	577.28	570.88	568.78	563.78	562.88	Sch 40 PVC screen and riser
P-382S	2	578.46	576.38	571.78	569.88	561.98	559.88	Sch 40 PVC screen and riser
P-385D	2	583.13	580.08	514.68	511.78	501.78	501.08	Sch 40 PVC screen and riser
P-385S	2	583.25	580.18	572.18	570.68	565.68	563.18	Sch 40 PVC screen and riser
P-389S	2	579.18	576.88	572.48	570.38	560.38	559.88	Sch 40 PVC screen and riser
P-392S	2	583.19	580.58	575.08	572.88	562.88	562.58	304 stainless steel screen and riser
P-396S	2	581.22	578.38	572.88	570.88	560.88	560.38	Sch 40 PVC screen and riser
P-397S	2	578.95	575.98	567.48	564.98	554.98	554.48	Sch 40 PVC screen and riser
P-398D	2	580.55	577.88	528.88	527.38	517.38	514.98	Sch 40 PVC screen and riser

Table 3.5-1 (Continued)
Monitoring Well Construction Details

Well	Well Diameter (inches)	Elevations (feet msl NAVD88)						Well Construction Material
		Top of Casing	Ground	Top of Filter	Top of Screen	Bottom of Screen	Bottom of Filter	
P-398S	2	580.38	577.98	572.48	570.48	560.48	559.98	Sch 40 PVC screen and riser
P-399D	2	577.46	574.72	532.72	531.22	521.22	518.62	Sch 40 PVC screen and riser
CB-C5	2	580.77	580.98	503.88	496.98	491.98	488.78	Sch 40 PVC screen and riser
EB/TSC-C2	2	581.12	581.37	546.57	544.37	539.37	536.87	Sch 40 PVC screen and riser
GW-01	2	580.34	580.39	553.39	552.39	547.39	547.39	Sch 40 PVC screen and riser
GW-02	2	580.00	580.39	562.39	562.39	557.39	556.39	Sch 40 PVC screen and riser
GW-03	2	580.70	580.79	564.79	563.29	558.29	558.29	Sch 40 PVC screen and riser
GW-04	2	580.93	580.79	568.79	567.79	562.79	562.79	Sch 40 PVC screen and riser
MW-9	2	582.21	582.73	577.73	575.73	570.73	570.73	Sch 40 PVC screen and riser
MW-10	2	580.79	581.26	577.76	575.76	570.76	570.76	Sch 40 PVC screen and riser
MW-11	2	580.37	580.77	577.27	575.27	570.27	570.27	Sch 40 PVC screen and riser
MW-18	2	581.02	581.38	577.88	575.38	570.38	570.38	Sch 40 PVC screen and riser
MW-21	2	581.10	581.65	577.15	575.15	570.15	570.15	Sch 40 PVC screen and riser

(DTE 2013l)

Table 3.5-2
Monitoring Well Depth-to-Water and Groundwater Elevation

Well	TOC Elevation[a] (NAVD88)	8/29/2011		11/15/2011		3/19/2012		6/12/2012	
		Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]
EF2-07-001D	580.34	12.01	568.33	11.74	568.60	10.76	569.58	12.33	568.01
EF2-07-002S	580.00	7.77	572.23	7.94	572.06	7.62	572.38	8.11	571.89
EF2-07-003D	580.70	10.94	569.76	10.51	570.19	9.87	570.83	11.09	569.61
EF2-07-003S	580.93	8.34	572.59	8.14	572.79	8.14	572.79	8.62	572.31
EF2-07-004D	581.67	12.84	568.83	12.05	569.62	11.03	570.64	12.63	569.04
EF2-07-005S	581.66	9.23	572.43	9.08	572.58	9.05	572.61	9.52	572.14
EF2-07-006D	581.56	9.63	571.93	9.10	572.46	9.08	572.48	NM	NM
EF2-07-007S	581.18	8.75	572.43	8.59	572.59	8.55	572.63	9.05	572.13
EF2-07-008D	581.34	12.53	568.81	11.85	569.49	11.02	570.32	12.38	568.96
EF2-07-008S	581.65	8.96	572.69	NM	NM	8.75	572.90	9.25	572.40
EF2-07-009D	581.63	13.18	568.45	NM	NM	11.73	569.90	13.03	568.60
EF2-07-012S	581.28	8.87	572.41	8.68	572.60	8.66	572.62	NM	NM
EF2-07-013S	581.43	9.05	572.38	NM	NM	8.84	572.59	9.34	572.09
EF2-07-014S	581.20	8.77	572.43	NM	NM	8.55	572.65	9.04	572.16
EF2-07-015D	579.00	9.68	569.32	9.26	569.74	8.55	570.45	9.71	569.29
EF2-07-015S	579.10	6.87	572.23	NM	NM	6.68	572.42	NM	NM

Table 3.5-2 (Continued)
Monitoring Well Depth-to-Water and Groundwater Elevation

Well	TOC Elevation[a] (NAVD88)	8/29/2011		11/15/2011		3/19/2012		6/12/2012	
		Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]
EF2-07-016S	580.89	8.48	572.41	8.49	572.40	8.46	572.43	8.67	572.22
EF2-07-017S	581.54	9.12	572.42	8.92	572.62	8.94	572.60	9.42	572.12
EF2-07-018S	581.19	8.78	572.41	8.79	572.40	8.59	572.60	9.07	572.12
EF2-07-019S	581.48	10.07	571.41	8.86	572.62	8.85	572.63	9.32	572.16
EF2-07-020D	580.10	10.11	569.99	9.47	570.63	NM	NM	10.11	569.99
EF2-07-020S	580.17	7.83	572.34	7.99	572.18	7.65	572.52	8.15	572.02
EF2-07-021S	581.16	8.76	572.40	8.58	572.58	8.55	572.61	9.03	572.13
EF2-07-022S	581.69	9.25	572.44	9.02	572.67	9.03	572.66	9.31	572.38
EF2-07-023S	581.68	9.17	572.51	NM	NM	8.95	572.73	9.46	572.22
EF2-07-024S	581.38	8.92	572.46	NM	NM	8.71	572.67	9.21	572.17
EF2-07-025S	581.70	9.17	572.53	9.00	572.70	8.97	572.73	9.46	572.24
EF2-07-026S	581.34	8.90	572.44	8.68	572.66	8.67	572.67	9.17	572.17
EF2-07-027S	581.66	9.22	572.44	9.02	572.64	9.01	572.65	9.49	572.17
EF2-07-028S	580.75	8.37	572.38	8.31	572.44	8.23	572.52	8.75	572.00
EF2-07-029D	581.61	9.32	572.29	9.13	572.48	8.10	573.51	9.62	571.99
EF2-07-029S	581.16	8.82	572.34	8.84	572.32	8.63	572.53	9.11	572.05

Table 3.5-2 (Continued)
Monitoring Well Depth-to-Water and Groundwater Elevation

Well	TOC Elevation[a] (NAVD88)	8/29/2011		11/15/2011		3/19/2012		6/12/2012	
		Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]
EF2-07-031S	580.31	NM	NM	NM	NM	NM	NM	8.26	572.05
MW-381D	582.35	21.06	561.29	17.45	564.90	13.36	568.99	18.73	563.62
MW-383D	585.16	20.08	565.08	17.90	567.26	14.31	570.85	18.44	566.72
MW-386D	583.91	15.19	568.72	14.40	569.51	13.01	570.90	14.84	569.07
MW-386S	584.18	9.25	574.93	9.90	574.28	11.62	572.56	10.63	573.55
MW-387S	582.16	8.74	573.42	8.90	573.26	8.58	573.58	9.07	573.09
MW-390S	582.09	8.49	573.60	8.32	573.77	8.25	573.84	8.77	573.32
MW-391D	581.17	12.75	568.42	12.26	568.91	11.19	569.98	12.64	568.53
MW-391S	581.39	7.94	573.45	7.75	573.64	7.74	573.65	8.23	573.16
MW-393D	579.35	8.69	570.66	NM	NM	4.39	574.96	7.39	571.96
P-385S	583.25	9.77	573.48	9.94	573.31	9.62	573.63	10.11	573.14
P-392S	583.19	9.59	573.60	9.33	573.86	9.36	573.83	9.85	573.34
P-397S	578.95	4.62	574.33	3.22	575.73	3.24	575.71	4.90	574.05
P-398S	580.38	6.93	573.45	6.25	574.13	6.54	573.84	7.13	573.25
MW-10	580.79	8.34	572.45	NM	NM	NM	NM	NM	NM
MW-11	580.37	7.90	572.47	7.72	572.65	7.71	572.66	8.18	572.19

Table 3.5-2 (Continued)
Monitoring Well Depth-to-Water and Groundwater Elevation

Well	TOC Elevation[a] (NAVD88)	8/29/2011		11/15/2011		3/19/2012		6/12/2012	
		Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]	Depth to Water[b]	Groundwater Elevation[a]
MW-18	581.02	8.60	572.42	NM	NM	8.38	572.64	8.90	572.12
MW-21	581.10	8.66	572.44	8.01	573.09	8.45	572.65	8.97	572.13

(DTE 2013r)

a. Feet mean sea level.
b. Feet below top of casing.
NM: not measured.

Table 3.5-3
Annual Lake Erie Water Use in MGD (US), 2003–2009

Year and Category	Withdrawals				Diversions		Consumptive Use
	GLSW[a]	OSW[b]	GW[c]	Total	Intrabasin	Interbasin	
2003[d]							
Public supply	1,242.70	276.54	156.94	1,676.18	0.00	-0.49	220.13
Domestic supply	12.33	0.00	96.28	108.61	0.00	0.00	15.00
Irrigation	1.50	38.91	32.10	72.51	0.00	0.00	36.59
Livestock	1.56	5.06	27.61	34.24	0.00	0.00	17.24
Industrial	680.92	111.23	62.25	854.40	0.00	0.00	104.16
Fossil fuel power	7,060.18	665.43	0.43	7,726.04	0.00	0.00	90.91
Nuclear power	152.37	0.00	0.00	152.37	0.00	0.00	11.44
Hydroelectric power	40,288.00	0.00	0.00	40,288.00	0.00	0.00	0.00
Other	0.74	8.16	0.49	9.39	5,816.39	-13.92	0.00
2004[e]							
Public supply	1,105.82	263.00	152.30	1,521.12	0.00	-1.41	200.22
Domestic supply	12.33	0.00	96.41	108.74	0.00	0.00	15.02
Irrigation	1.42	38.41	32.16	71.99	0.00	0.00	36.14
Livestock	1.56	5.06	27.60	34.23	0.00	0.00	17.23
Industrial	698.31	123.05	61.05	882.42	0.00	0.00	107.41
Fossil fuel power	7,147.98	831.49	0.43	7,979.90	0.00	0.00	94.49

Table 3.5-3 (Continued)
Annual Lake Erie Water Use in MGD (US), 2003–2009

Year and Category	Withdrawals				Diversions		Consumptive Use
	GLSW[(a)]	OSW[(b)]	GW[(c)]	Total	Intrabasin	Interbasin	
Nuclear power	202.90	0.00	0.00	202.90	0.00	0.00	16.02
Hydroelectric power	47,372.00	0.00	0.00	47,372.00	0.00	0.00	0.00
Other	0.68	9.11	0.50	10.29	5,816.39	-10.10	0.00
2005[(f)]							
Public supply	1,234.17	260.13	152.92	1,647.22	0.00	5.31	216.26
Domestic supply	12.70	0.07	95.64	108.41	0.00	0.00	15.10
Irrigation	1.53	40.54	34.48	76.55	0.00	0.00	40.24
Livestock	1.53	3.49	27.86	32.88	0.00	0.00	16.16
Industrial	534.03	246.30	77.32	857.65	0.00	0.00	102.08
Fossil fuel power	7,300.72	898.63	0.39	8,199.75	0.00	0.00	96.85
Nuclear power	107.20	0.00	0.00	107.20	0.00	0.00	6.56
Hydroelectric power	47,777.00	0.00	0.00	47,777.00	0.00	0.00	0.00
Other	0.46	4.68	0.45	5.59	5,816.39	-11.52	2.48
2006[(g)]							
Public supply	1,212.48	258.23	148.46	1,619.16	0.00	6.58	212.17
Domestic supply	12.70	0.07	95.58	108.35	0.00	0.00	15.10
Irrigation	1.52	35.76	31.82	69.10	0.00	0.00	33.52

Table 3.5-3 (Continued)
Annual Lake Erie Water Use in MGD (US), 2003–2009

Year and Category	Withdrawals				Diversions		Consumptive Use
	GLSW[a]	OSW[b]	GW[c]	Total	Intrabasin	Interbasin	
Livestock	1.53	2.65	26.68	30.86	0.00	0.00	14.54
Industrial	438.74	213.28	101.92	753.94	0.00	0.00	93.51
Fossil fuel power	6,987.37	864.01	0.38	7,851.76	0.00	0.00	90.37
Nuclear power	201.54	0.00	0.00	201.54	0.00	0.00	16.18
Hydroelectric power	47,168.00	0.00	0.00	47,168.00	0.00	0.00	0.00
Other	0.27	1.42	0.73	2.42	5,816.39	-9.97	1.36
2007[h]							
Public supply	1,317.98	264.71	146.88	1,729.57	-0.12	7.03	226.69
Domestic supply	23.26	3.43	102.29	128.98	0.00	0.00	17.17
Irrigation	1.60	38.74	34.05	74.39	0.00	0.00	38.29
Livestock	0.93	7.34	29.35	37.62	0.00	0.00	20.41
Industrial	613.63	223.42	88.56	925.61	0.00	0.00	109.40
Fossil fuel power	7,119.81	865.10	0.39	7,985.30	0.00	0.00	92.64
Nuclear power	206.81	0.00	0.00	206.81	0.00	0.00	16.61
Hydroelectric power	0.00	43,224.00	0.00	43,224.00	0.00	0.00	0.00
Other	0.67	9.91	2.44	13.02	5,816.39	-13.10	2.81

Table 3.5-3 (Continued)
Annual Lake Erie Water Use in MGD (US), 2003–2009

Year and Category	Withdrawals				Diversions		Consumptive Use
	GLSW[(a)]	OSW[(b)]	GW[(c)]	Total	Intrabasin	Interbasin	
2008[(i)]							
Public supply	1,266.45	257.78	141.30	1,665.53	-0.10	6.91	218.07
Domestic supply	23.26	3.43	102.73	129.42	0.00	0.00	17.23
Irrigation	1.48	37.91	31.55	70.95	0.00	0.00	35.18
Livestock	0.93	7.77	29.45	38.15	0.00	0.00	20.84
Industrial	550.61	184.10	84.23	818.94	0.00	0.00	96.22
Fossil fuel power	7,118.11	852.31	0.40	7,970.82	0.00	0.00	91.59
Nuclear power	201.62	0.00	0.00	201.62	0.00	0.00	15.90
Hydroelectric power	45,584.00	0.00	0.00	45,584.00	0.00	0.00	0.00
Other	0.69	8.61	1.67	10.97	5,816.39	-12.80	2.05
2009[(j)]							
Public supply	1,192.34	251.12	136.55	1,580.01	-0.09	7.40	206.67
Domestic supply	23.26	3.43	97.48	124.17	0.00	0.00	16.41
Irrigation	3.85	41.84	29.53	75.22	0.00	0.00	39.02
Livestock	0.93	7.72	28.61	37.26	0.00	0.00	20.12
Industrial	577.70	121.07	92.66	791.43	0.00	0.00	91.31
Fossil fuel power	7,399.22	732.02	0.37	8,131.61	0.00	0.00	87.94

Table 3.5-3 (Continued)
Annual Lake Erie Water Use in MGD (US), 2003–2009

Year and Category	Withdrawals				Diversions		Consumptive Use
	GLSW[a]	OSW[b]	GW[c]	Total	Intrabasin	Interbasin	
Nuclear power	184.69	0.00	0.00	184.69	0.00	0.00	32.63
Hydroelectric power	45,584.00	560.31	0.00	46,144.31	0.00	0.00	0.00
Other	0.63	10.26	2.11	13.00	5,816.39	-9.63	4.31

a. Great Lakes surface water.
b. Other surface water.
c. Groundwater.
d. (GLC 2006a).
e. (GLC 2006b).
f. (GLC 2009a).
g. (GLC 2009b).
h. (GLC 2010a).
i. (GLC 2010b).
j. (GLC 2011).

Table 3.5-4
Annual Lake Erie Water Use Summaries in MGD (US), 2003–2009

Year	Total Withdrawals	Total Consumptive	Power Plant Withdrawal	Power Plant Consumptive	Public Supplies Withdrawal	Public Consumptive	Industrial Withdrawal	Industrial Consumptive
2003	49,440	495	47,501	102	1,243	220	681	104
2004	56,543	487	54,723	111	1,106	200	698	107
2005	56,969	496	55,185	103	1,234	216	534	102
2006	56,024	477	54,357	107	1,212	212	439	94
2007	52,509	524	50,551	109	1,318	227	614	109
2008	54,747	497	52,904	107	1,266	218	551	96
2009	54,967	498	53,168	121	1,192	207	578	91
Average	54,457	496	52,627	109	1,224	214	585	100

(GLC 2006a; GLC 2006b; GLC 2009a; GLC 2009b; GLC 2010a; GLC 2010b; GLC 2011)

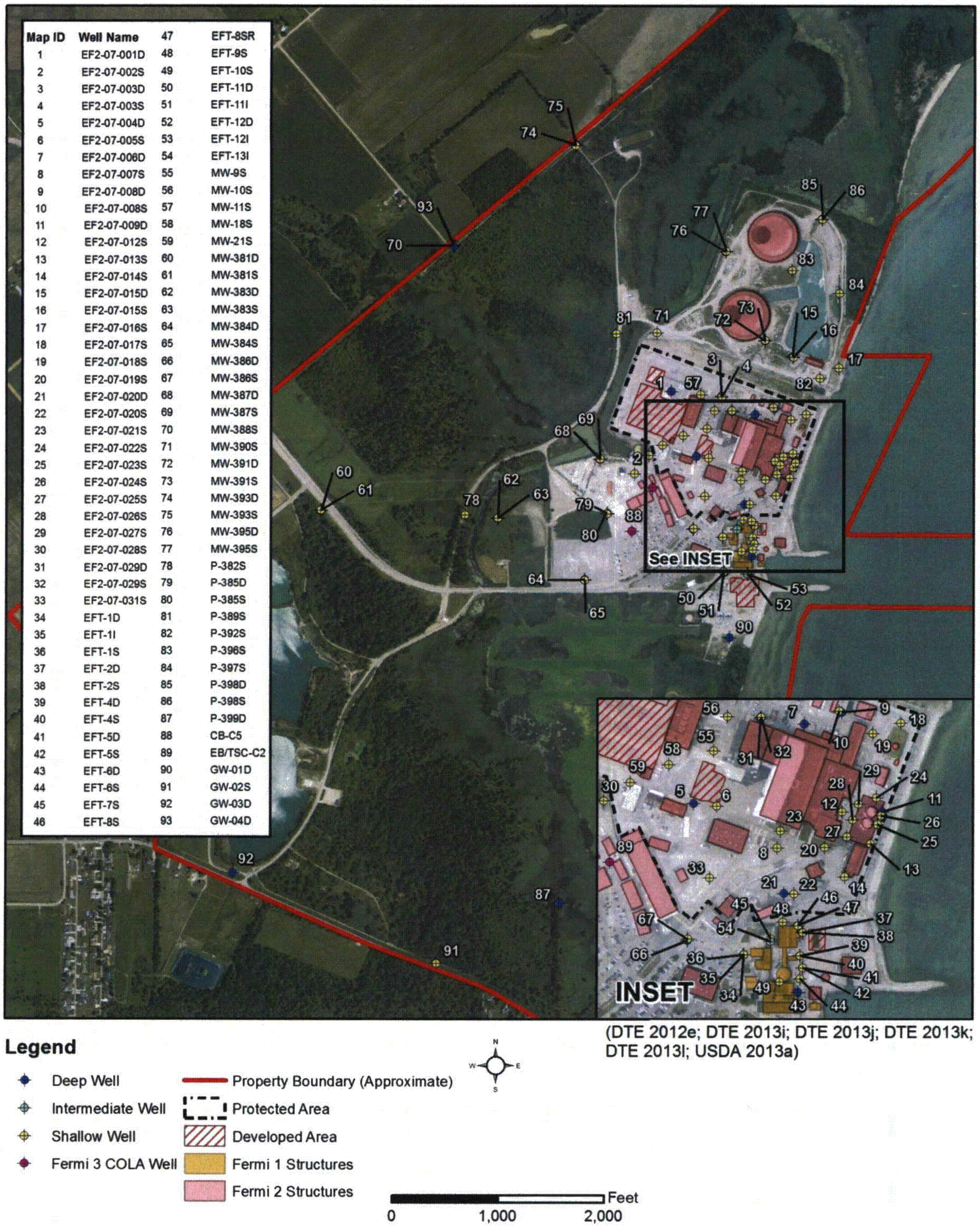
Table 3.5-5
Measured and Modeled Lake Erie Monthly Average Temperatures

Month	Measured Temperature at Marblehead, OH (°F)	Modeled Water Surface Temperature (°F)
January	34.2	33.5
February	33.8	32.3
March	37.2	32.7
April	49.3	36.6
May	59.5	49.6
June	72.3	63.4
July	75.2	72.1
August	77.0	74.2
September	68.2	71.2
October	55.4	63.2
November	45.2	52.8
December	39.0	41.5

(NRC 2013c, Table 2-5)

(ESRI 2012; Fermi 2008d; Fermi 2012f)

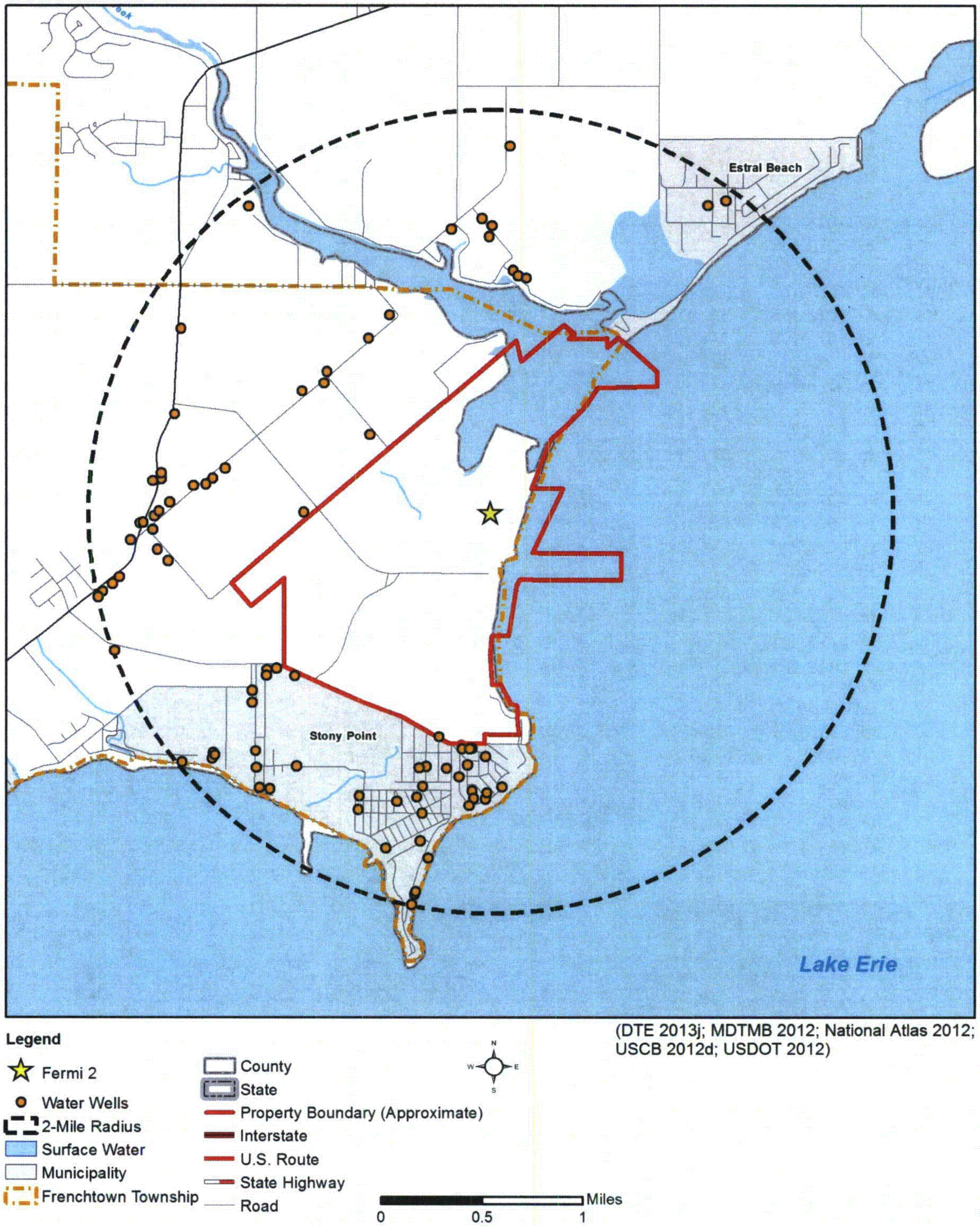
Figure 3.5-1
Fermi 2 NPDES Permitted Outfalls



Map ID	Well Name	Map ID	Well Name
1	EF2-07-001D	47	EFT-8SR
2	EF2-07-002S	48	EFT-9S
3	EF2-07-003D	49	EFT-10S
4	EF2-07-003S	50	EFT-11D
5	EF2-07-004D	51	EFT-11I
6	EF2-07-005S	52	EFT-12D
7	EF2-07-006D	53	EFT-12I
8	EF2-07-007S	54	EFT-13I
9	EF2-07-008D	55	MW-9S
10	EF2-07-008S	56	MW-10S
11	EF2-07-009D	57	MW-11S
12	EF2-07-012S	58	MW-18S
13	EF2-07-013S	59	MW-21S
14	EF2-07-014S	60	MW-381D
15	EF2-07-015D	61	MW-381S
16	EF2-07-015S	62	MW-383D
17	EF2-07-016S	63	MW-383S
18	EF2-07-017S	64	MW-384D
19	EF2-07-018S	65	MW-384S
20	EF2-07-019S	66	MW-386D
21	EF2-07-020D	67	MW-386S
22	EF2-07-020S	68	MW-387D
23	EF2-07-021S	69	MW-387S
24	EF2-07-022S	70	MW-388S
25	EF2-07-023S	71	MW-390S
26	EF2-07-024S	72	MW-391D
27	EF2-07-025S	73	MW-391S
28	EF2-07-026S	74	MW-393D
29	EF2-07-027S	75	MW-393S
30	EF2-07-028S	76	MW-395D
31	EF2-07-029D	77	MW-395S
32	EF2-07-029S	78	P-382S
33	EF2-07-031S	79	P-385D
34	EFT-1D	80	P-385S
35	EFT-1I	81	P-389S
36	EFT-1S	82	P-392S
37	EFT-2D	83	P-396S
38	EFT-2S	84	P-397S
39	EFT-4D	85	P-398D
40	EFT-4S	86	P-398S
41	EFT-5D	87	P-399D
42	EFT-5S	88	CB-C5
43	EFT-6D	89	EB/TSC-C2
44	EFT-6S	90	GW-01D
45	EFT-7S	91	GW-02S
46	EFT-8S	92	GW-03D
		93	GW-04D

(DTE 2012e; DTE 2013i; DTE 2013j; DTE 2013k; DTE 2013l; USDA 2013a)

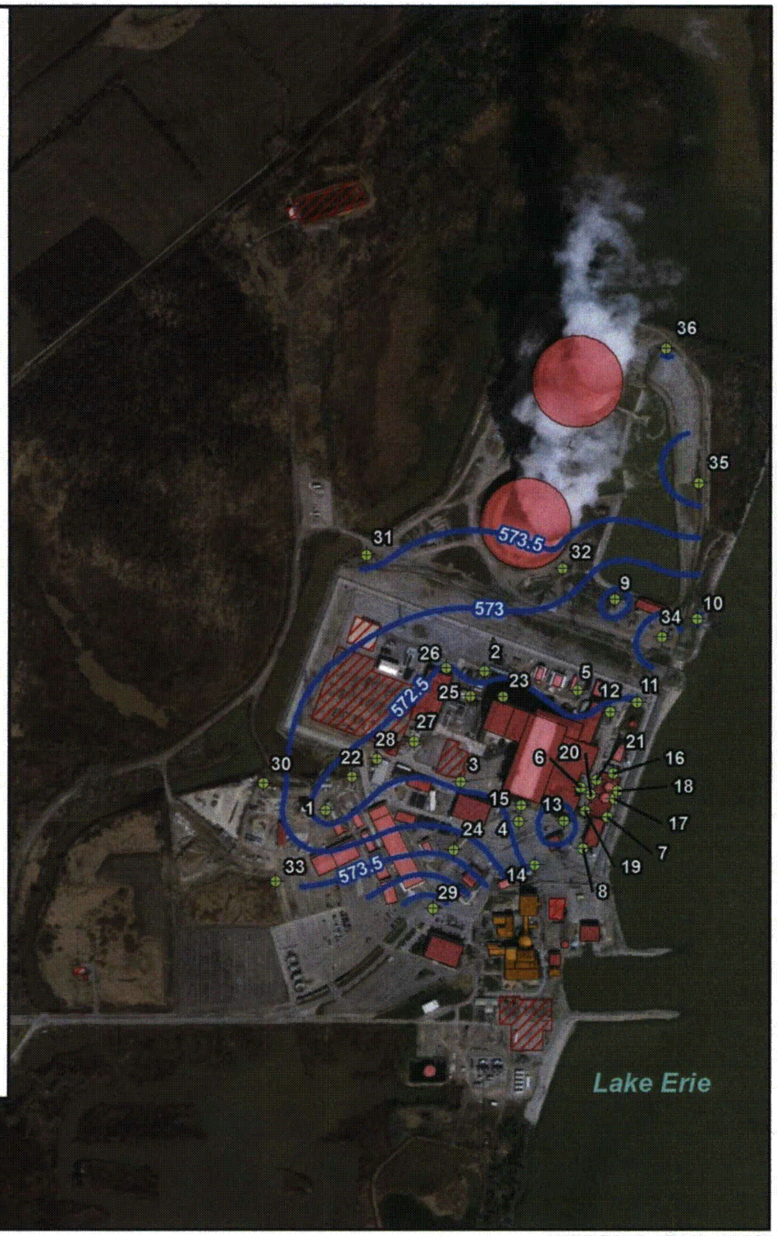
Figure 3.5-2
Fermi 2 Onsite Wells



(DTE 2013j; MDTMB 2012; National Atlas 2012; USCB 2012d; USDOT 2012)

Figure 3.5-3
State Database Wells within a 2-Mile Radius of Fermi 2

Map ID	Well Name	Elevation
1	EF2-07-002S	572.23
2	EF2-07-003S	572.59
3	EF2-07-005S	572.43
4	EF2-07-007S	572.43
5	EF2-07-008S	572.69
6	EF2-07-012S	572.41
7	EF2-07-013S	572.38
8	EF2-07-014S	572.43
9	EF2-07-015S	572.23
10	EF2-07-016S	572.41
11	EF2-07-017S	572.42
12	EF2-07-018S	572.41
13	EF2-07-019S	571.41
14	EF2-07-020S	572.34
15	EF2-07-021S	572.40
16	EF2-07-022S	572.44
17	EF2-07-023S	572.51
18	EF2-07-024S	572.46
19	EF2-07-025S	572.53
20	EF2-07-026S	572.44
21	EF2-07-027S	572.44
22	EF2-07-028S	572.38
23	EF2-07-029S	572.34
24	EF2-07-031S	NM*
25	MW-10S	572.45
26	MW-11S	572.47
27	MW-18S	572.42
28	MW-21S	572.44
29	MW-386S	574.93
30	MW-387S	573.42
31	MW-390S	573.6
32	MW-391S	573.45
33	P-385S	573.48
34	P-392S	573.6
35	P-397S	574.33
36	P-398S	573.45



(DTE 2013r; ESRI 2012)

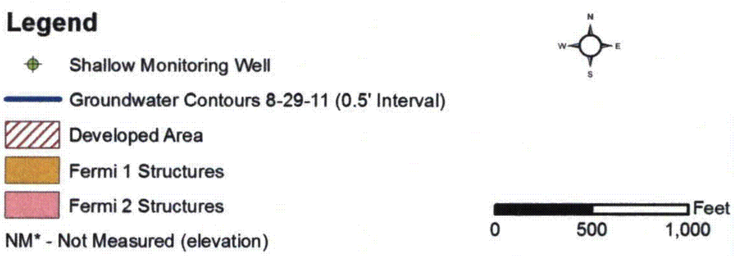
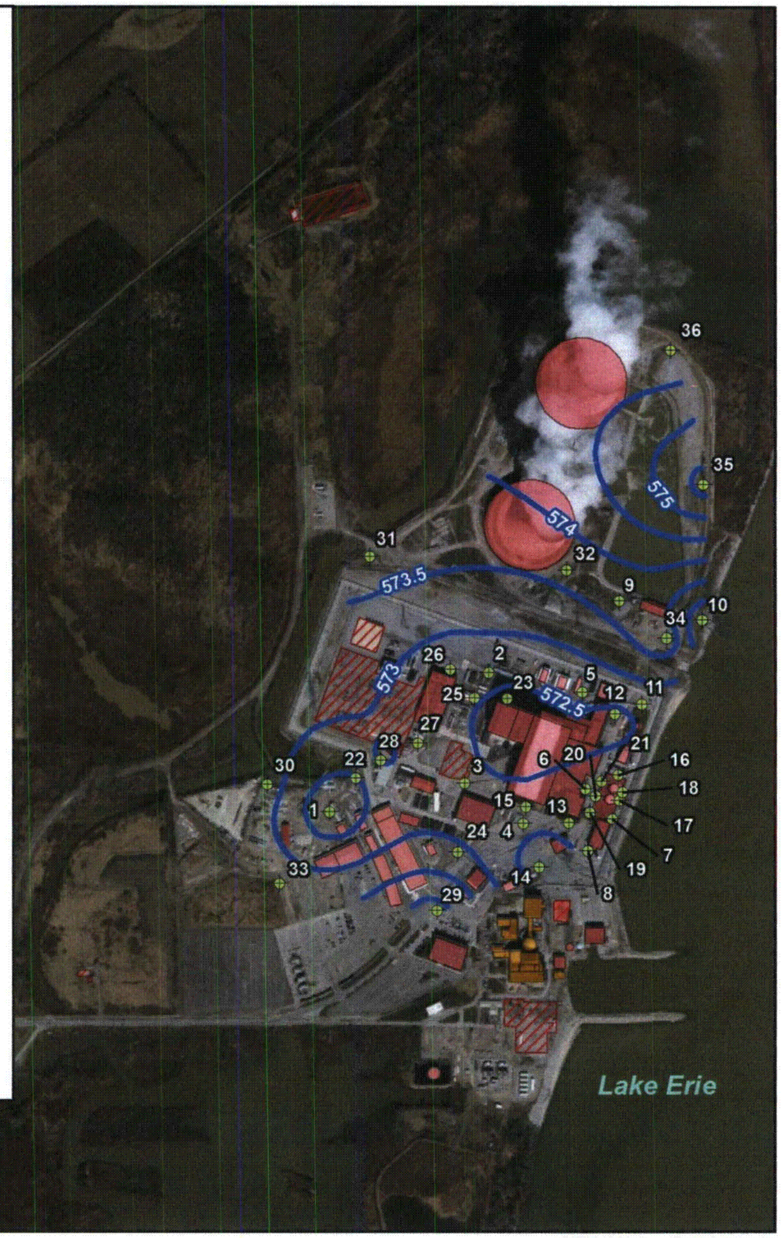


Figure 3.5-4
Fermi 2 Potentiometric Surface Maps (Shallow Monitoring Wells)
(Sheet 1 of 4)

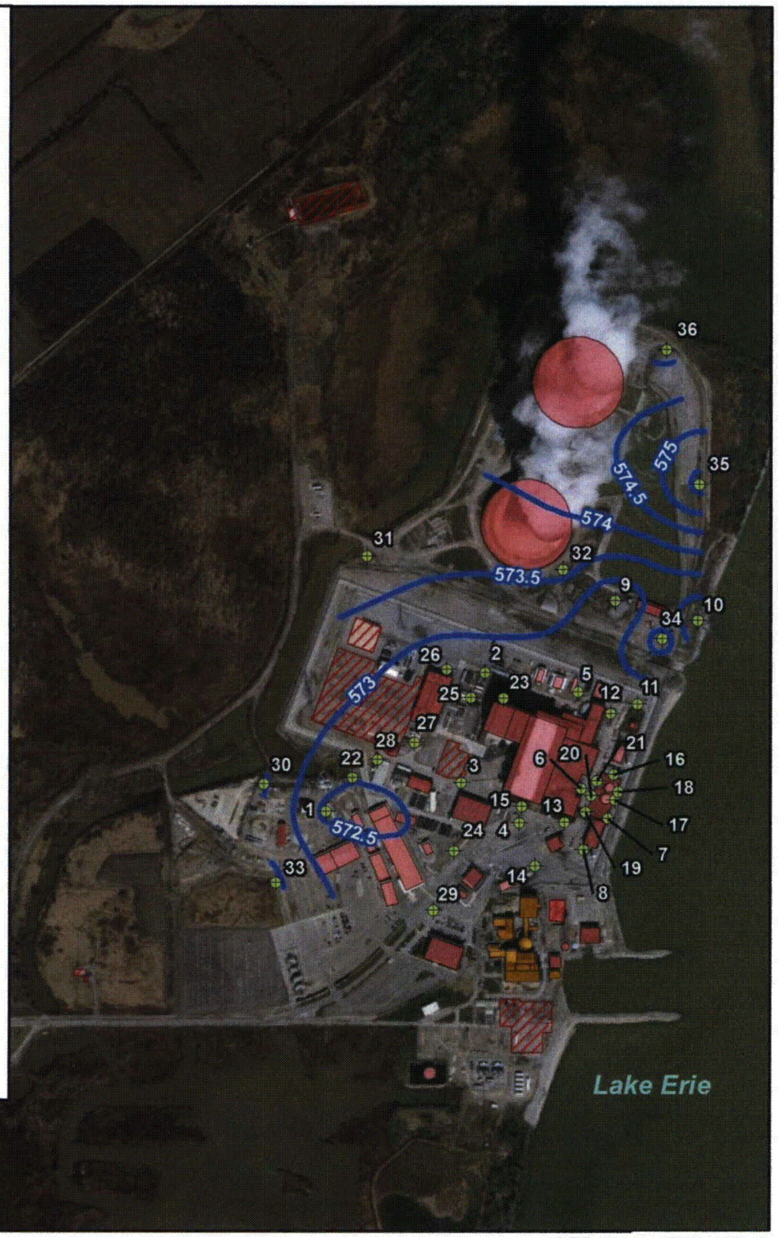


Map ID	Well Name	Elevation
1	EF2-07-002S	572.06
2	EF2-07-003S	572.79
3	EF2-07-005S	572.58
4	EF2-07-007S	572.59
5	EF2-07-008S	NM*
6	EF2-07-012S	572.60
7	EF2-07-013S	NM*
8	EF2-07-014S	NM*
9	EF2-07-015S	NM*
10	EF2-07-016S	572.40
11	EF2-07-017S	572.62
12	EF2-07-018S	572.40
13	EF2-07-019S	572.62
14	EF2-07-020S	572.18
15	EF2-07-021S	572.58
16	EF2-07-022S	572.67
17	EF2-07-023S	NM*
18	EF2-07-024S	NM*
19	EF2-07-025S	572.70
20	EF2-07-026S	572.66
21	EF2-07-027S	572.64
22	EF2-07-028S	572.44
23	EF2-07-029S	572.32
24	EF2-07-031S	NM*
25	MW-10S	NM*
26	MW-11S	572.65
27	MW-18S	NM*
28	MW-21S	573.09
29	MW-386S	574.28
30	MW-387S	573.26
31	MW-390S	573.77
32	MW-391S	573.64
33	P-385S	573.31
34	P-392S	573.86
35	P-397S	575.73
36	P-398S	574.13

(DTE 2013r; ESRI 2012)

Figure 3.5-4
Fermi 2 Potentiometric Surface Maps (Shallow Monitoring Wells)
(Sheet 2 of 4)

Map ID	Well Name	Elevation
1	EF2-07-002S	572.38
2	EF2-07-003S	572.79
3	EF2-07-005S	572.61
4	EF2-07-007S	572.63
5	EF2-07-008S	572.90
6	EF2-07-012S	572.62
7	EF2-07-013S	572.59
8	EF2-07-014S	572.65
9	EF2-07-015S	572.42
10	EF2-07-016S	572.43
11	EF2-07-017S	572.6
12	EF2-07-018S	572.6
13	EF2-07-019S	572.63
14	EF2-07-020S	572.52
15	EF2-07-021S	572.61
16	EF2-07-022S	572.66
17	EF2-07-023S	572.73
18	EF2-07-024S	572.67
19	EF2-07-025S	572.73
20	EF2-07-026S	572.67
21	EF2-07-027S	572.65
22	EF2-07-028S	572.52
23	EF2-07-029S	572.53
24	EF2-07-031S	NM*
25	MW-10S	NM*
26	MW-11S	572.66
27	MW-18S	572.64
28	MW-21S	572.65
29	MW-386S	572.56
30	MW-387S	573.58
31	MW-390S	573.84
32	MW-391S	573.65
33	P-385S	573.63
34	P-392S	573.83
35	P-397S	575.71
36	P-398S	573.84



(DTE 2013r; ESRI 2012)

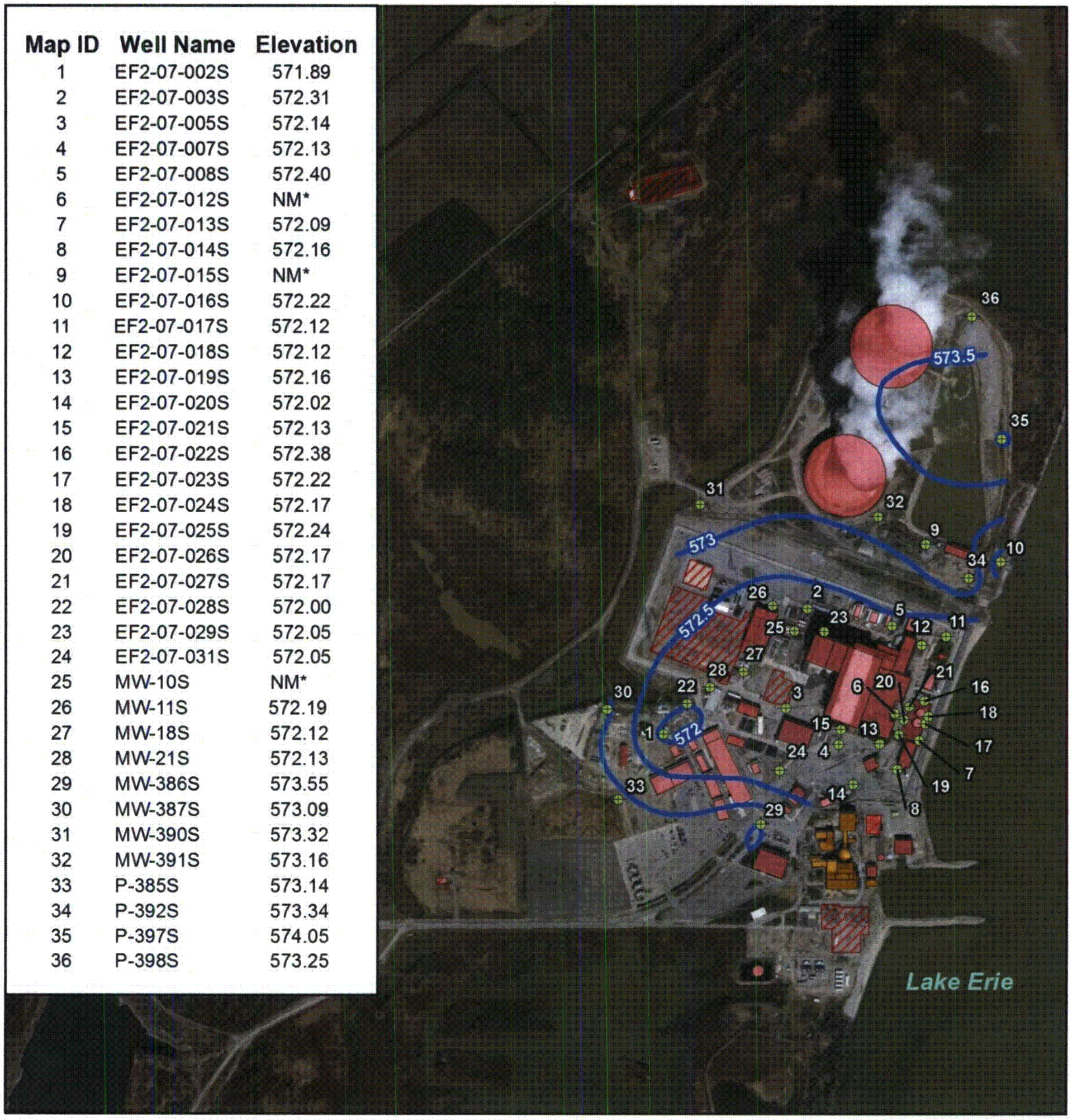
Legend

- Shallow Monitoring Well
- Groundwater Contours 3-19-12 (0.5' Interval)
- Developed Area
- Fermi 1 Structures
- Fermi 2 Structures

NM* - Not Measured (elevation)

Feet 0 500 1,000

Figure 3.5-4
Fermi 2 Potentiometric Surface Maps (Shallow Monitoring Wells)
(Sheet 3 of 4)



Map ID	Well Name	Elevation
1	EF2-07-002S	571.89
2	EF2-07-003S	572.31
3	EF2-07-005S	572.14
4	EF2-07-007S	572.13
5	EF2-07-008S	572.40
6	EF2-07-012S	NM*
7	EF2-07-013S	572.09
8	EF2-07-014S	572.16
9	EF2-07-015S	NM*
10	EF2-07-016S	572.22
11	EF2-07-017S	572.12
12	EF2-07-018S	572.12
13	EF2-07-019S	572.16
14	EF2-07-020S	572.02
15	EF2-07-021S	572.13
16	EF2-07-022S	572.38
17	EF2-07-023S	572.22
18	EF2-07-024S	572.17
19	EF2-07-025S	572.24
20	EF2-07-026S	572.17
21	EF2-07-027S	572.17
22	EF2-07-028S	572.00
23	EF2-07-029S	572.05
24	EF2-07-031S	572.05
25	MW-10S	NM*
26	MW-11S	572.19
27	MW-18S	572.12
28	MW-21S	572.13
29	MW-386S	573.55
30	MW-387S	573.09
31	MW-390S	573.32
32	MW-391S	573.16
33	P-385S	573.14
34	P-392S	573.34
35	P-397S	574.05
36	P-398S	573.25

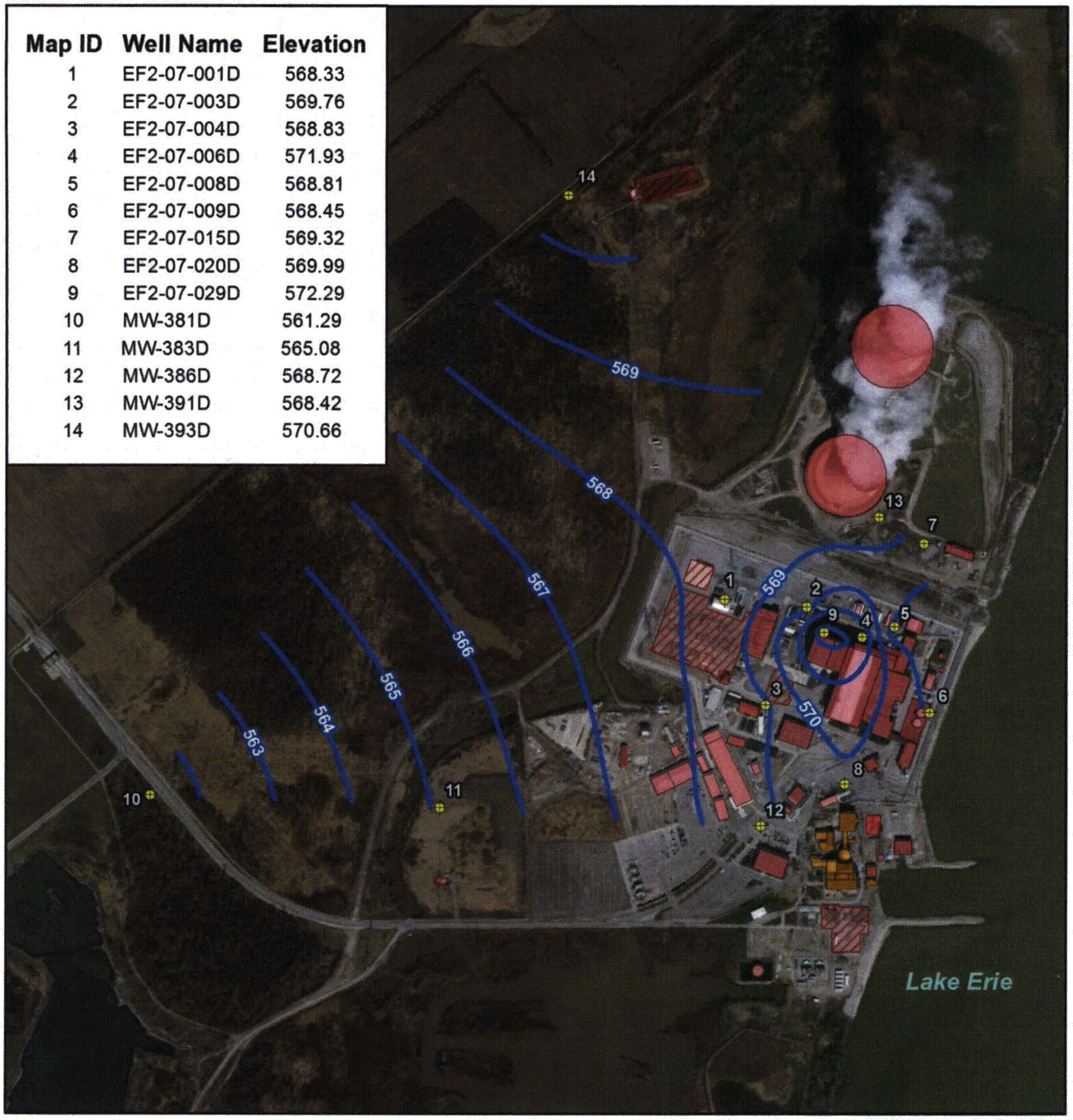
Legend

- Shallow Monitoring Well
- Groundwater Contours 6-12-12 (0.5' Interval)
- Developed Area
- Fermi 1 Structures
- Fermi 2 Structures

NM* - Not Measured (elevation)

Feet 0 500 1,000

Figure 3.5-4
Fermi 2 Potentiometric Surface Maps (Shallow Monitoring Wells)
(Sheet 4 of 4)



Map ID	Well Name	Elevation
1	EF2-07-001D	568.33
2	EF2-07-003D	569.76
3	EF2-07-004D	568.83
4	EF2-07-006D	571.93
5	EF2-07-008D	568.81
6	EF2-07-009D	568.45
7	EF2-07-015D	569.32
8	EF2-07-020D	569.99
9	EF2-07-029D	572.29
10	MW-381D	561.29
11	MW-383D	565.08
12	MW-386D	568.72
13	MW-391D	568.42
14	MW-393D	570.66

(DTE 2013r; ESRI 2012)

Legend

- Deep Monitoring Well
- Groundwater Contour 8-29-11 (1.0' Interval)
- Developed Area
- Fermi 1 Structures
- Fermi 2 Structures

Feet
0 500 1,000

Figure 3.5-5
Fermi 2 Potentiometric Surface Maps (Deep Monitoring Wells)
(Sheet 1 of 4)

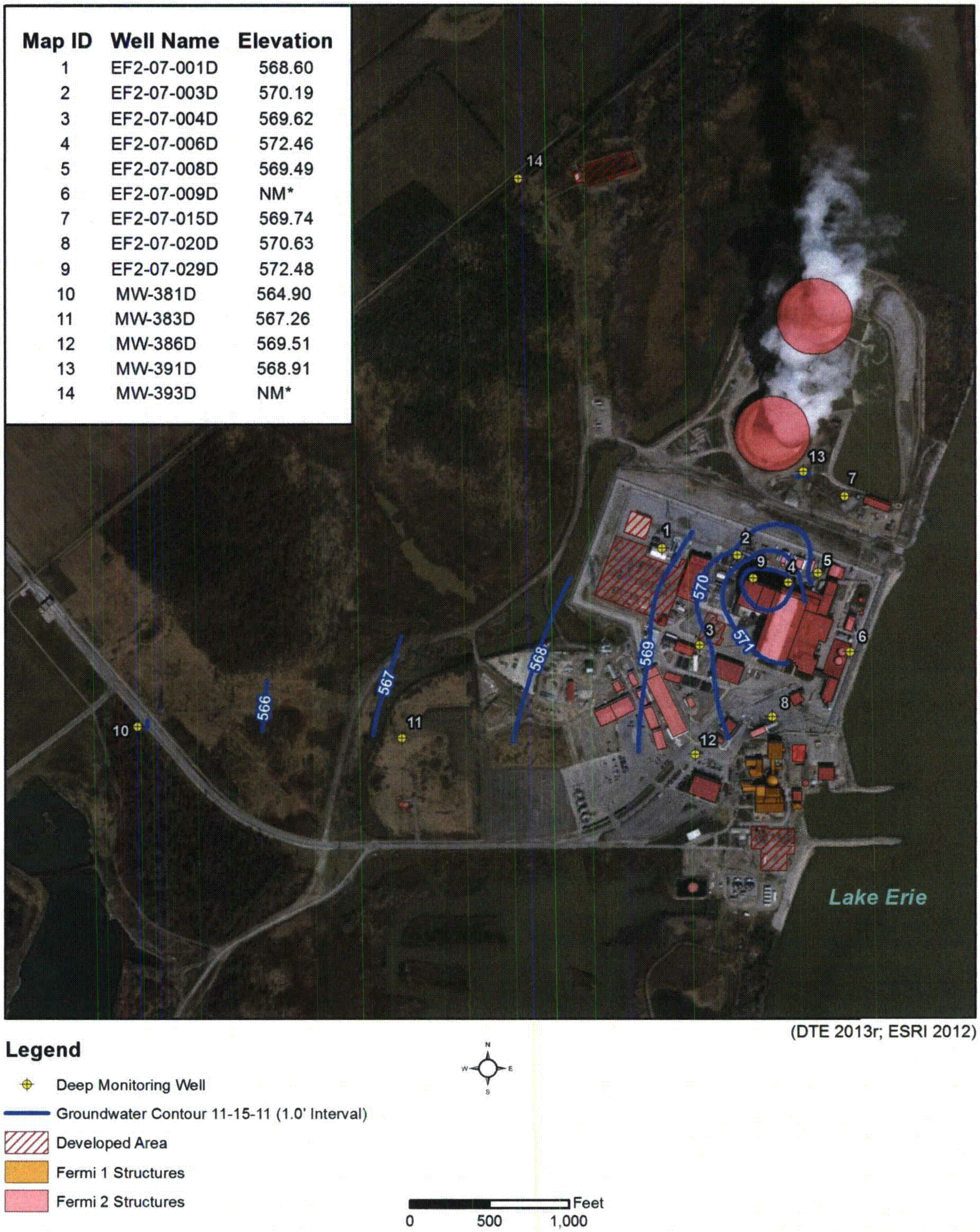
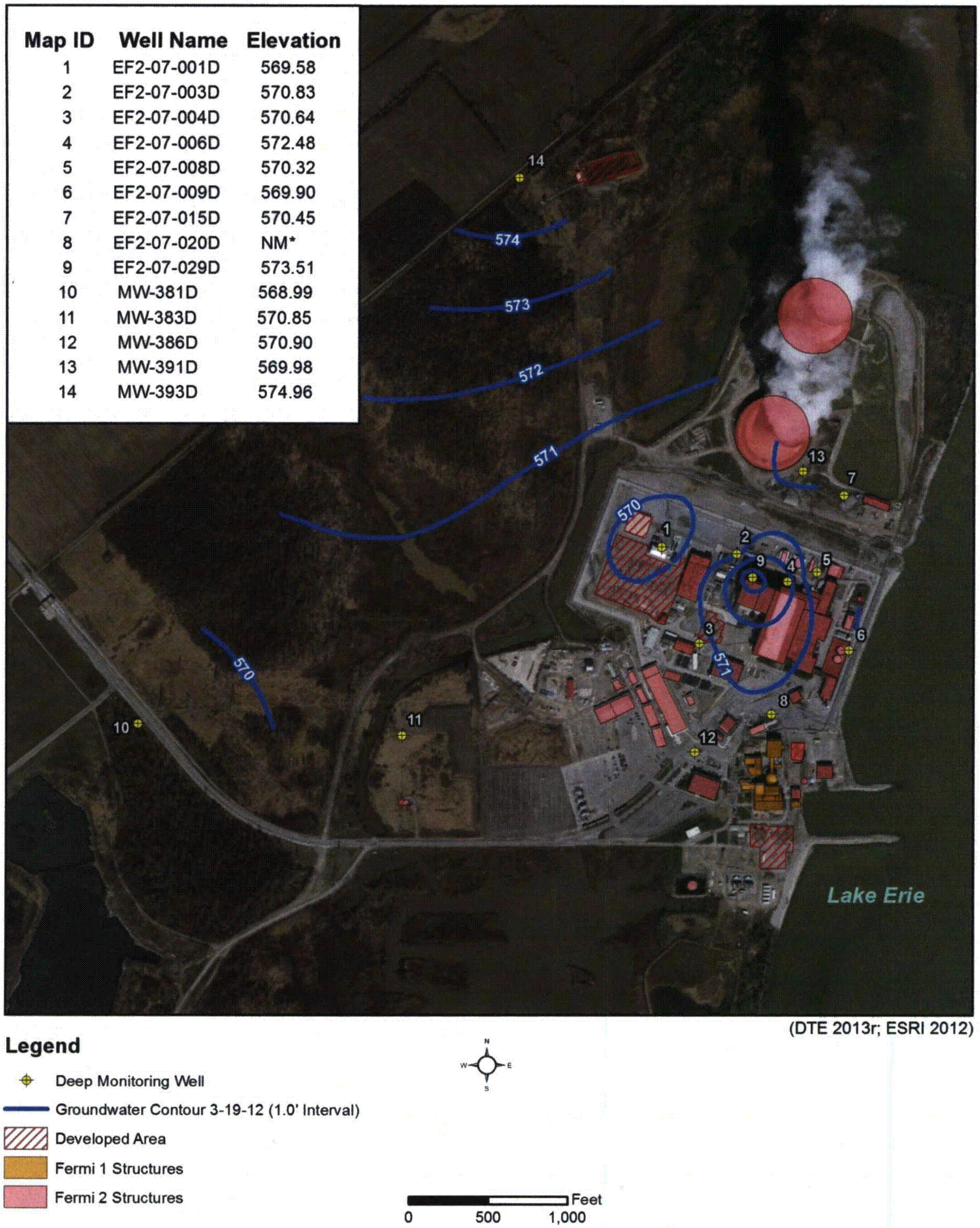
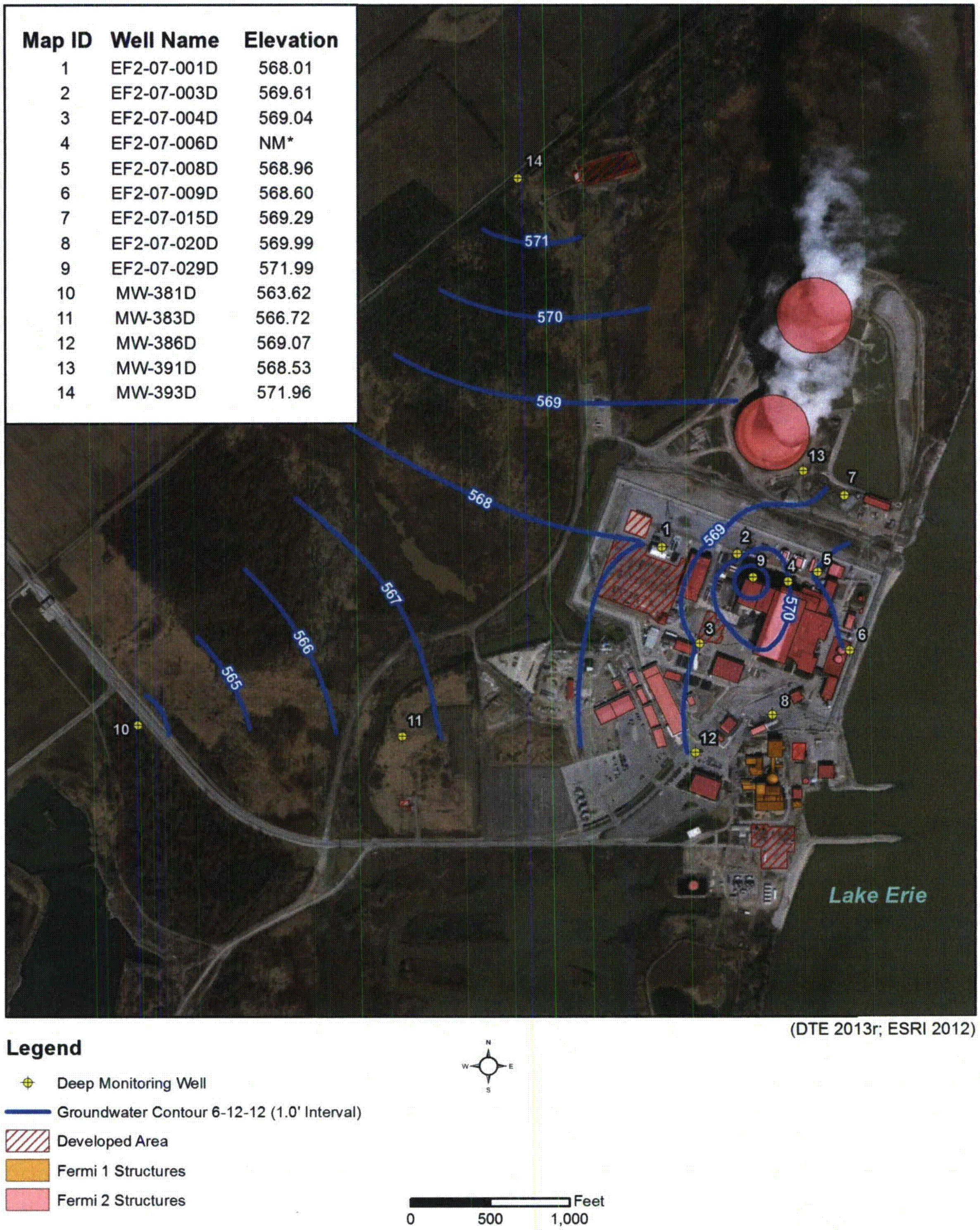


Figure 3.5-5
Fermi 2 Potentiometric Surface Maps (Deep Monitoring Wells)
(Sheet 2 of 4)



Map ID	Well Name	Elevation
1	EF2-07-001D	569.58
2	EF2-07-003D	570.83
3	EF2-07-004D	570.64
4	EF2-07-006D	572.48
5	EF2-07-008D	570.32
6	EF2-07-009D	569.90
7	EF2-07-015D	570.45
8	EF2-07-020D	NM*
9	EF2-07-029D	573.51
10	MW-381D	568.99
11	MW-383D	570.85
12	MW-386D	570.90
13	MW-391D	569.98
14	MW-393D	574.96

Figure 3.5-5
Fermi 2 Potentiometric Surface Maps (Deep Monitoring Wells)
(Sheet 3 of 4)



Map ID	Well Name	Elevation
1	EF2-07-001D	568.01
2	EF2-07-003D	569.61
3	EF2-07-004D	569.04
4	EF2-07-006D	NM*
5	EF2-07-008D	568.96
6	EF2-07-009D	568.60
7	EF2-07-015D	569.29
8	EF2-07-020D	569.99
9	EF2-07-029D	571.99
10	MW-381D	563.62
11	MW-383D	566.72
12	MW-386D	569.07
13	MW-391D	568.53
14	MW-393D	571.96

Figure 3.5-5
Fermi 2 Potentiometric Surface Maps (Deep Monitoring Wells)
(Sheet 4 of 4)

3.6 Ecological Resources

3.6.1 Region

Regional ecology is greatly influenced by the geomorphic and physiographic characteristics of the region. Soils determine the basic fertility of the region and what types of plants may grow. Climatological factors, such as temperature and precipitation, further refine the plants and animals that may live in a locale. Monroe County, where the Fermi site is located, is in the southeastern part of Michigan's lower peninsula and lies adjacent to the western shore of Lake Erie (Figure 3.0-5). The regional ecology is described below.

Geomorphology

The region is underlain by Paleozoic bedrock and was completely glaciated during the Late Wisconsinan period. The bedrock, which was deposited in marine and near-shore environments, includes sandstone, shale, limestone, and dolomite. Typically, 100–400 feet of loamy glacial drift covers the bedrock. Glacial and postglacial landforms cover the entire land surface of the region. Glacial landforms include lake plain, outwash, ground moraine (till plain), and end moraine. Broad lacustrine plains occur along all of the Great Lakes; these lake plains extend more than 20 miles inland along Lake Michigan and more than 50 miles inland along the Lake Huron shoreline at Saginaw Bay. Postglacial sand dunes form a 1- to 5-mile band along much of the Lake Michigan shoreline. The interior of the region consists of a relatively low plain of ground and end moraines, with narrow outwash channels throughout. A broad interlobate outwash plain occupies the southern half of the region. (MDNR 2012a)

Soils

Soils are important for defining the general ecological characteristics of the region. Soils in the region generally contain higher amounts of clay, which allows water to stand at or near the surface and, in turn, influences vegetation (Bowman 1981, page 3). The soil units in the region are discussed in Section 3.4 and include Pleistocene-aged deposits consisting of alluvium, lacustrine materials, peats, tills, outwash, glaciofluvial materials, glaciolacustrine materials, and residual soil. The site area is located in a glaciolacustrine section on the western edge of Lake Erie, which supports a variety of forest, grassland, and wetland ecosystems. The soil deposits in Monroe County range in thickness from 0 to more than 150 feet. The distribution of surface soil units within and surrounding the Fermi site boundary is shown in Figure 3.4-3.

Climate

The climate is strongly influenced by the Maritime Tropical air mass and the proximity of Lake Michigan to the west, which induces lake-effect snow and moderates inland temperature fluctuations. Compared to the rest of the state, this region experiences more warm, humid air masses from the Gulf of Mexico and fewer cold, dry air masses of continental origin. In addition, this region has the highest average annual temperature and the longest growing season. The average length of the growing season is 154 days. Intensive agriculture in Michigan is concentrated in this region because of its comparatively mild climate. (MDNR 2012a)

Regional Water Systems

The drainage basin of Lake Erie includes portions of Indiana, Michigan, Ohio, Pennsylvania, New York, and Ontario and is the most densely populated of the five lake basins. The fertile soils associated with the Lake Erie watershed support intense agricultural production throughout the entire drainage basin. In the latter half of last century, decades of cultural eutrophication and toxic contamination caused severe degradation of the system. By the 1980s, recovery of Lake Erie's water quality was observed due to implementation of remediation plans through the NPDES program. In addition to pollution abatement programs, colonization of Lake Erie by invasive zebra mussels (*Driessena polymorpha*) has helped return the lake to more mesotrophic conditions. (DECo 2011, pages 2-348 to 2-349)

In the northeastern part of the county, the Saline River runs south to meet the River Raisin, which flows principally east through the central part of the county into Lake Erie and its tributaries. This region is important for the drainage of agricultural land. The largest inland bodies of water in the county are contained in old quarries. The only large natural lake is Lake Ottawa. Many small ponds, formed from borrow pits near highways and other areas where sand was commercially mined, provide important wildlife habitat. (Bowman 1981, page 2)

There are many miles of frontage on Lake Erie in Monroe County. The lake is important for commercial navigation and for recreation. (Bowman 1981, page 2) In addition, the cooling water source for Fermi 2 plant operations is Lake Erie, and water from the plant is discharged back into Lake Erie. Swan Creek and Stony Creek are streams in the vicinity of the Fermi site (Figure 3.0-3). Detailed discussions of these waters may be found in Section 3.6.7.

Regional Ecosystems

Historically, three main ecosystems have occupied the region surrounding the Fermi plant. These include fire-dependent savanna and forest systems, tall grass prairie, and wetlands. (MDNR 2012a) Provided below is a description of each regional ecosystem.

<u>Fire-Dependent Savanna and Forest Systems</u>

Circa 1800, fire-dependent savanna and forest systems dominated this region. Oak savanna was probably the most prevalent cover type, followed by oak-hickory forest. Beech-sugar maple forest was also important on areas of lakeplain and fine-textured moraines. Species diversity and structural complexity of the beech-sugar maple forests were maintained by gap phase dynamics resulting from small-scale windthrow and ice-storm events. (MDNR 2012a)

<u>Tall Grass Prairie</u>

The region surrounding the Fermi site is the only region of Michigan that originally supported large areas of tall grass prairie, which was concentrated in the sandy interlobate area in the southwestern part of the region. Prairie and savanna ecosystems were maintained by frequent fires which were ignited by lightning strike and also started by Native Americans. (MDNR 2012a)

Trautman (1981), using diaries of soldiers traveling through the region before 1815, reports a prairie which was 90 miles long and from 2 to 10 miles wide, extending from the mouth of the Portage River in Ottawa County, Ohio, around the western end of Lake Erie "to Brownstown" south of Detroit, Michigan. The prairie was estimated to contain not less than 200,000 acres.

Wetlands

Large areas of Wet Prairie and Great Lakes Marsh occurred on the lake plains of Lake Erie, Lake St. Clair, and Lake Huron. Wetlands included extensive marshes, fens, bogs, and swamp forests. Numerous broad floodplain forests occurred along the rivers of this region. Great Lakes marsh areas were restricted to the shoreline of the Great Lakes. (MDNR 2012a)

The existing major plant communities revealed by a 2009 study include grassland (restored prairie), thicket (shrub-dominated areas intermediate between wetland and upland), emergent wetland, and two dominant forest types (lowland hardwood and mesic hardwood). The forest habitat is further divided between coastal and inland areas. Emergent wetland is densely populated by just a few invasive emergent plant species, and overall diversity is low. Thicket is maintained by a fluctuating, seasonally high water table that, along with dense shade, excludes most trees. The understory vegetation is mostly composed of shade-tolerant herbaceous species. (Black and Veatch 2009a)

Regional Animal Communities

Historical changes in the vegetation have impacted the contemporary animal communities present in the region. Animals that occur in the region also are typically found on the Fermi site if appropriate habitats are available. A list of animals that may be found in the vicinity and on the site are presented in Table 3.6-1 and described in Section 3.6.8.

3.6.2 Site and Vicinity

Early accounts of the Fermi site indicate that as recently as 1961 most of the site was in cultivation or had been otherwise disturbed. A 1974 study described nearly all of the habitats on site as being in relatively early stages of succession. While the tree flora is mostly representative of other areas of southern Michigan, the ground cover remains diminished, presumably due to the lack of an adequate seed bank for ground-cover species and probably alterations to soil conditions (fill material, mixing due to scraping, shading, etc.). The communities are categorized according to the 2006 Michigan Department of Natural Resources Terrestrial Systems for the Lower Peninsula with minor modifications. (DECo 2011, page 2-323)

As shown in Figure 3.4-3, several soil types occur on the Fermi site, with the majority classified as Lenawee. These soils are nearly level, very poorly drained, silty soils, on lake plains along Lake Erie and adjacent to large rivers and streams. Typically, the surface layer is a very dark grayish-brown silty clay loam about 10 inches thick. The subsoil is mottled and about 23 inches thick. The substratum to a depth of 60 inches is multicolored silt loam. The soils of minor extent in this association are sand deposits in areas of beach. These soils are in higher areas that pond less frequently. (Bowman 1981, page 3)

On the Fermi site, coastal lowland forest is present along the Lake Erie shoreline and is dominated by cottonwoods (*Populus deltoides*) and willows (*Salix spp.*). The inland forested habitat is dominated by a few hardwoods, mainly ash (*Fraxinus spp.*) trees and concentrations of oaks (*Quercus spp.*) or maples (*Acer spp.*), with openings that include transitions to other habitat types, such as emergent wetland or scrub-shrub habitat. Silver maple (*Acer saccharinum*), a wet-tolerant species, tends to be more dominant in lowland forest while oaks, hickories, and ashes tend to be dominant in mesic forest areas. (Black and Veatch 2009a)

The restored prairie habitat on site is dominated by grass species, primarily big bluestem (*Andropogon gerardii*). Disturbance-tolerant species are common in parts of the area, with few conservative species present. This area was previously dominated by shrubs that were cleared for safety reasons. The prairie is now maintained by mowing as needed. At the fringes of the prairie area, woody shrubs, especially dogwoods (*Cornus spp.*) and saplings blend with grasses. (Black and Veatch 2009a)

3.6.3 Potentially Affected Water Bodies

The Fermi site is located within a coastal wetland ecosystem and consists of 1,260 acres of developed and undeveloped land on the shoreline of the western basin of Lake Erie, between Swan Creek and Stony Creek (Figure 3.0-3). Coastal wetlands are common to areas surrounding the Great Lakes. Great Lakes coastal wetland systems contain morphological components of both riverine and lacustrine systems, and can be described as "freshwater estuaries." Such freshwater estuaries are formed at river mouths drowned by the postglacial rise in lake level, and are influenced by both the lake level and riverine inflows. (DECo 2011, page 2-342 to 2-343)

Water bodies on site and in the vicinity of the Fermi site include the following and are described in detail in Section 3.6.7:

- Circulating water reservoir, canals, quarry lakes, and drainage ditches
- Other waters and wetlands within the DRIWR
- Lake Erie and its associated bays
- Swan Creek
- Stony Creek

Surface water drainage at the Fermi site is influenced by Swan Creek, Lake Erie, and the waters associated with the surrounding DRIWR, including the coastal wetlands and lowlands. (DECo 2011, page 2-343)

DRIWR

The DRIWR is a conservation area along the western basin of Lake Erie and along the Detroit River. The boundaries of the refuge are segmented into eleven units, which include coastal wetlands, marshes, islands, shoals, and waterfront lands along approximately 48 miles of the western Lake Erie shoreline. (DECo 2011, page 2-345) Approximately 650 acres of the Fermi site is designated as a portion of the DRIWR (Figure 3.6-1) (DTE 2013o). Habitat associated with the refuge includes wetlands, coastal uplands and lowlands, and woodland forests (DECo 2011, page 2-357). The DRIWR is discussed in detail in Section 3.6.6.2.

3.6.4 Transmission Lines and ROWs

The in-scope transmission lines that connect Fermi 2 to the transmission grid for purposes of power transmission are located in the developed area of Fermi 2, within the property boundary. These lines are above ground and are limited to the developed portion of the site.

3.6.5 Ecological Resources History

The ecological environment at the Fermi site and in the vicinity has changed significantly. Prior to 1600, the Ottawa and Pottawatomie Indians occupied villages in what is now Monroe County. They lived nomadic lives and made many paths and trails throughout the county. About 1783, the French established a settlement along the River Raisin. Monroe County was established in July 1817. Settlements in Monroe County and elsewhere in southeastern Michigan grew in size after the Erie Canal opened in 1825. The city of Monroe is the only Michigan port city on Lake Erie. (Bowman 1981, page 2)

From the 1800s to 1978, the land cover in Monroe County changed from shrub swamp/emergent marsh and nearby wet prairie to urbanized or agricultural land, a mix of which continues to surround the present-day Fermi site. (MNFI 2013a) Generally, the land cover at the Fermi site has been transformed from swamp/marsh land to agricultural land and now industrial. Catastrophic natural environmental stresses can affect the regional ecology. These can include massive infestations, epidemics, drought, or significant weather storms and/or climatic changes. Other natural stresses include the presence of invasive species including zebra mussels and common reed (*Phragmites australis*). However, there have been no recorded environmental catastrophes on or near the Fermi site. (DECo 2011, page 2-358) Portions of the site, however, remain undeveloped and provide habitat to wildlife (Figure 3.1-1).

3.6.6 Places and Entities of Special Ecological Interest

On and within the vicinity of the Fermi site are places and entities of special interest. These include wetlands, the Lagoona Beach Unit of the DRIWR, and the transmission line corridor prairie, as described below.

3.6.6.1 Wetlands

In 1984, Michigan received authorization from the federal government to administer Section 404 of the federal CWA in most areas of the state. A state-administered 404 program must be consistent with the requirements of the federal CWA and associated regulations set forth in the Section 404(b)(1) guidelines. Unlike other states where applicants must submit wetland permit applications to both USACE and a state agency, applicants in Michigan generally submit only one wetland permit application to the MDEQ to obtain the necessary authorizations from both the MDEQ and USACE. (DECo 2011, page 2-335)

In 1979, the Michigan legislature passed the Geomare-Anderson Wetlands Protection Act, 1979 PA 203, which is now Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The MDEQ has adopted administrative rules which provide clarification and guidance on interpreting Part 303. Some wetlands in coastal areas are given further protection under Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This includes the Fermi site because the lagoons are connected to Lake Erie, one of the Great Lakes. (DECo 2011, page 2-335)

Wetlands in the vicinity of the Fermi site are common and varied in their nature and structure. Figure 3.6-2 shows all of the wetlands listed on the National Wetlands Inventory (NWI) within a 6-mile radius of the plant. Based on the NWI data (USFWS 2012b), there are 31 different types of wetlands totaling approximately 2,532 acres within this area. The five most abundant wetland types within a 6-mile radius of the site total approximately 1,508 acres and represent almost 60 percent of all of the wetlands. These wetland types include the following:

- Palustrine, Emergent, Persistent, Seasonally Flooded (PEM1C), which covers approximately 431 acres (17 percent).
- Palustrine, Emergent, Seasonally Flooded (PEMC), which covers approximately 358 acres (14 percent).
- Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded (PEMFh), which covers approximately 252 acres (10 percent).
- Palustrine, Forested, Broad-leaved Deciduous, Seasonally Flooded (PFO1C), which covers approximately 247 acres (10 percent).
- Palustrine, Forested, Broad-leaved Deciduous, Temporarily Flooded (PFO1A, which covers approximately 220 acres (9 percent).

Thirteen functions and values typically considered by regulatory and conservation agencies when evaluating wetlands are used as part of the New England Method. These include groundwater recharge/discharge; floodflow alteration; fish habitat; sediment/toxicant retention; nutrient removal; production export; sediment/shoreline stabilization; wildlife habitat; recreation;

educational/scientific value; uniqueness/heritage; visual quality/aesthetics; and endangered species habitat. (Ducks Unlimited 2011)

A field delineation and assessment of wetlands on the Fermi property was completed in June 2008 (DECo 2011, page 2-335) and was updated in 2011 (Ducks Unlimited 2011). Forty wetland units covering 509 acres of wetlands and 45 acres of open water were delineated on the Fermi property (Figure 3.6-3). Open water is characterized by inundation to a depth greater than 4 feet with no emergent vegetation present. Areas within the delineation boundary did not include open water areas in Lake Erie. (DECo 2011, page 2-336)

The primary wetland types on the Fermi property are as follows (DECo 2011, page 2-336):

- Palustrine Emergent Marsh (PEM) comprising 324 acres.
- Palustrine Forested (PFO) comprising 169 acres.
- Palustrine Scrub-Shrub (PSS) comprising 16 acres.

With the exception of a few wetlands isolated by berms or roads, the majority of wetland communities at the Fermi property are hydrologically connected and thus are considered one wetland system. The wetland system is large relative to the watershed, relatively flat with storage potential, and contains hydric soils and dense vegetation suitable to absorb and slow water flow. The principal functions of the wetland system include flood flow alteration, sediment/toxicant retention, nutrient removal, and fish and wildlife habitat. (DECo 2011, page 2-337) These functions are described below.

Additional functions and values this wetland system is suitable to provide, though not considered principal functions, are production export, sediment/shoreline stabilization, uniqueness/heritage, and endangered species habitat. The wetland system is highly suitable to reduce flood damage by retaining and gradually releasing floodwater following precipitation events. Fermi 2, including cooling towers and control centers, is located downstream and in the floodplain of the wetland system. In the event of a large storm that results in flood flow from the watershed and excess water backing in from Lake Erie, the wetland system could slow and detain floodwaters for gradual release. There are potential sources of excess sediment, toxins, and nutrients upstream in the agriculturally dominated watershed. The wetland system is also highly suitable for trapping sediments, toxicants, and pathogens, as well as nutrient retention. There is opportunity for sediment trapping and nutrient uptake in diffuse, slow-moving, and deepwater areas of the Fermi property wetlands that are edged or interspersed with dense, herbaceous, and woody vegetation. (DECo 2011, page 2-337 to 2-338)

The deepwater PEM of the Fermi wetland system is suitable to support fish habitat. There is an abundance of cover objects, the wetland is large and part of a larger, persistent, contiguous watercourse with slow velocity. The wetlands have sufficient size and depth to retain open water areas during the winter. Direct observation of fish species were observed in the wetland. The diverse wetland communities present across the entire wetland system provide suitable habitat for a significant number of wildlife species. While there has been notable direct and indirect disturbance in all wetlands observed, there remains significant abundance and diversity in habitat cover to support wildlife. With the exception of the buildings and roadways associated with the nuclear plant, the landscape is largely undeveloped with relatively large parcels of vegetated wetlands and uplands. The majority of the wetlands evaluated are connected hydrologically in spite of fragmentation by multiple roadways. The wetland system presents an interspersion of open water areas with dense emergent vegetation grading into shrub-dominated and tree-dominated communities.

The wetland system at the Fermi site is not considered well suited for groundwater recharge/ discharge; recreation; educational/scientific value; or visual quality/aesthetics (Ducks Unlimited 2011).

3.6.6.2 Lagoona Beach Unit of the DRIWR

The DRIWR consists of 11 unit types. Lands on the Fermi property constitute the DRIWR Lagoona Beach Unit, which surrounds the Fermi site on the northern, western, and southern borders (DECo 2011, pages 2-345 and 2-346; EPA 2013a). The Lagoona Beach Unit includes approximately 650 acres of land and is primarily divided into four sections, DRIWR-1 through DRIWR-4 as shown in Figure 3.6-1 (DTE 2013o). The four sections are described as follows (DECo 2011, page 2-345):

- DRIWR-1 is located in the north-northeast portion of the Fermi site. DRIWR-1 consists primarily of coastal wetlands and palustrine systems, including freshwater emergent wetlands and lake areas that are semi-permanently flooded.
- DRIWR-2 is located in the northwest portion of the Fermi site and includes coastal wetlands, upland forests, wet meadows, and coastal prairies, with palustrine scrub-shrub systems consisting of broad-leaved deciduous vegetation. The area is seasonally inundated.
- DRIWR-3 is located in the southwest portion of the Fermi site and encompasses upland forest and palustrine forested land with broad-leaved deciduous vegetation. The area is seasonally inundated and/or partially drained at various times during the year.
- DRIWR-4 is located in the south-southeast portion of the Fermi site. This section includes coastal wetland and upland forest composed of palustrine forested seasonally inundated areas, as well as seasonally flooded palustrine emergent areas.

The general public does not have access to the DRIWR (DECo 2011, page 2-338).

3.6.6.3 Transmission Line Corridor Prairie

The USFWS, ITC *Transmission,* and DTE cooperatively funded the restoration and planting of a 29-acre prairie area in the onsite transmission corridor along the north side of the existing facility approach road. The restoration began in 2005 and was completed in 2006. Surveys of the restoration area were conducted in 2005, 2007, and 2011 to determine the plant species present. The vegetative communities associated with this prairie area might best be described as a wet prairie ecosystem. (DECo 2011, page 2-338) Typically, the area supports stands of big bluestem and Indian grass (DECo 2011, page 2-323).

3.6.7 Aquatic Communities

Several types of aquatic communities are located within or adjacent to the Fermi site including Lake Erie, quarry lakes, circulating water reservoir (heat dissipation system), Stony Creek, Swan Creek, and waters of the DRIWR. The aquatic communities on site and in the vicinity of the Fermi site have been subject to a variety of historical and current environmental stresses, both man induced and natural. Man-induced stresses can include many aspects of habitat conversion, consumptive biological resource use, pollution, and modification of natural processes, including increased sediment deposits caused by deforestation and dredging of streambeds and drainages. Natural stresses include biological interactions and additional natural processes, including drying out and inundation of onsite areas and scouring of the shoreline.

Quarry lakes, ponds, and streams account for 44 acres or 3.5 percent of the site. These aquatic communities contribute to a healthy ecosystem (DECo 2011, page 2-344).

Significant aquatic plant communities on site include the state-listed threatened American lotus (*Nelumbo lutea*) and the invasive species common reed. The American Lotus, a marsh dwelling emergent plant of the Great Lakes can be found in both small and extensive aquatic beds throughout various portions of the Fermi property. These aquatic beds of American lotus represent a significant aquatic community. This species is further discussed in Section 3.6.12.2. In addition, the common reed is a dominant species found in several of the habitat areas on the property. In some of these areas, this invasive plant species is the most dominant species, composing nearly 95 percent of the area and covering areas in excess of a few acres. (Kogge and Heslinga 2013)

3.6.7.1 Lake Erie

Lake Erie is the fourth largest of the Great Lakes and ranks as the 13th largest lake in the world. Measuring 241 miles long and 57 miles from north to south, Lake Erie's open water surface area is 9,910 square miles, with 871 miles of shoreline, and a volume of 116 cubic miles. Lake Erie has a mean depth of 62 feet and a maximum depth of 210 feet. The hydraulic retention time of the lake is 2.6 years. (NOAA 2012b)

Lake Erie is divided into three basins: the eastern basin, the central basin, and the western basin. Because the Fermi site is located on the western shore of the western basin, this portion of Lake Erie is of the greatest interest. Depth generally increases from west to east in Lake Erie. The western basin is the shallowest basin in the lake, averaging approximately 24 feet in depth (Figure 3.6-4). The western basin receives 95 percent of the drainage water entering Lake Erie, including five major river drainages (Maumee River, River Raisin, Rouge River, Huron River, and Detroit River), as well as numerous streams that discharge directly into the western basin. While thermal stratification in the central basin is a frequent and persistent condition during summer months for the central basin, stratification events are relatively rare and brief in the western basin. 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. (NRC 2013c, page 2-71)

Water levels in Lake Erie fluctuate in response to seasonal precipitation variations. The most significant lake-level variations are observed at the western and eastern basins of the lake. During prolonged high southwesterly winds, Lake Erie is subject to surges when water from the western basin is pushed to the eastern basin resulting in surges greater than 7 feet. Lake Erie also experiences seiches in response to such surges. (DECo 2011, page 2-348) Seiches produce a standing wave that rocks back and forth across the lake with gradually decreasing motion (Horne and Goldman 1994). Major shifts in winds, a significant front, or high- or low-pressure weather systems can initiate a seiche event. Seiche events can cause flooding in low-lying areas of the eastern basin and cause already shallow bay areas of the western basin to become emergent sand flats. (DECo 2011, page 2-348)

Lake Erie has undergone a series of man-induced changes that have defined and redefined the local aquatic ecology. Lake Erie accounts for approximately 171 acres or 13.6 percent of the Fermi site. The main body of Lake Erie lies north and east of the Fermi site. (DECo 2011, page 2-327) Cooling water for the site comes from Lake Erie, and the lake also receives discharges from plant operations.

Lake Erie Fish Populations

The improving overall health of Lake Erie has been contributing to a healthy fish population. There are a variety of fish species in the vicinity of the Fermi site in both lotic (flowing water) and lentic (relatively still water) environments (Table 3.6-2). Lake Erie supports good populations of commercial and recreational fish, including the presence of important sport and commercial fish species such as walleye (*Sander vitreus*) and yellow perch (*Perca flavescens*), and an increased abundance of common species such as bluegill (*Lepomis macrochirus*) and white perch (*Morone americana*) (Table 3.6-3). Important game fish species have shown population increases that have been attributed to improving water quality in the western basin.

Lake Erie supports one of the largest freshwater commercial fisheries in the world. Commercial harvest of fish in the Michigan waters of Lake Erie in 2010 totaled 752,956 pounds with an estimated value of $288,563. The fish were primarily used for human consumption. The top three species—carp (*Cyprinus carpio*), freshwater drum (*Aplodinotus grunniens*), and quillback (*Carpiodes cyprinus*)—represented 57.0 percent of the total harvest and 34.6 percent of the total value of the commercial fishery in 2010. (USGS 2010)

Important recreational species include both yellow perch and walleye. Both have been the highest valued sport and commercial species in Lake Erie over the last 50 years. In Michigan waters of Lake Erie, yellow perch and walleye routinely account for more than 80 percent of the total number of fish harvested by the sport fishery. (Thomas and Haas 2005) Not only are these species important recreationally, but they also serve as indicators of the general health of the lake (EPA 2012a; EPA 2013b).

The western basin of Lake Erie is known as the "Walleye Capital of the World." From 1999 to 2002, the walleye population abundance was estimated to be less than 25 million fish, which is less than half of the walleye abundance in 1989 (Thomas and Haas 2005). From 2000 to 2005, walleye populations exhibited an increasing trend, with the population rated as "high quality" in 2005. Annually, approximately three million walleye are harvested in the western and central basins of Lake Erie. (EPA 2013b)

Yellow perch is one of the most popular sport and commercial fish in Lake Erie. From the late 1980s through the 1990s, after a 40-year absence due to pollution and eutrophication, large benthic invertebrates including mayfly larvae, caddisfly larvae, and amphipods recolonized the basin. When burrowing mayflies (*Hexagenia spp.*) recolonized western Lake Erie in the mid-1990s as water quality improved, the yellow perch population increased. Yellow perch are valuable economically, and the species is an indicator of the ecological condition of Lake Erie. Yellow perch are also beneficial because they feed on the nonnative, invasive round goby (*Neogobius melanstomus*). (EPA 2012a) In the case of yellow perch, it has been suggested oligotrophication and trophic shifts due to zebra mussel filtering and round goby predation on zebra mussels have played a role in changing yellow perch abundance in western Lake Erie (Thomas and Haas 2005).

Recently, lake sturgeon (*Acipenser fulvescens*) and spawning lake whitefish (*Coregonus clupeaformis*) have been documented in the Detroit River approximately 10 miles northeast of the Fermi site (DECo 2011, page 2-349). Lake sturgeon were reported to have spawned in the 1800s to 1900s off Stony Point about 1 mile south of the plant site (Goodyear et al. 1982).

Lake Erie Invertebrate Populations

Plankton are small plants or animals without strong locomotive ability, that are suspended in the water column of a body of water. Plankton are carried by currents and wave action and may make daily or seasonal movements in the water column. (Armantrout 1998) Studies of zooplankton and phytoplankton communities (the animal and plant components of plankton, respectively) of the western basin of Lake Erie extend back to the late 19th and early 20th centuries. (DECo 2011, page 2-350)

Phytoplankton studies conducted in the 1980s and 1990s in near-shore waters of the western basin near the Davis-Besse Power Station (located 25 miles south of the Fermi site) demonstrated that plankton biomass fluctuates seasonally, with highest overall general phytoplankton densities occurring in the spring. A total of 54 taxa have been identified (Table 3.6-4). However, the species of greatest abundance, diatoms (*Bacillariophyceae spp.*) and green algae (*Chlorophyceae spp.*), both exhibited peak abundance in the summer and fall months. Phytoplankton density varies spatially throughout the western basin, with increased phytoplankton abundance along the entire southern shore and decreased abundance off shore and throughout deeper waters. Phytoplankton tend to favor shallower water conditions due to increased light available in the shallow water column. (DECo 2011, page 2-350)

Harmful algal blooms (HABS) have occurred in western Lake Erie. HABS are episodes during which large quantities of six to seven harmful forms of algae appear in parts of the lake. These six to seven algae species are of a group called cyanobacteria, commonly called blue-green algae. Although small numbers may be present at all times, cyanobacteria normally require warmer water temperatures (> 60°F or 15°C; maximum growth rates occur in the 25°C–30°C range) and high levels of nutrients to germinate from propagules resting on the lake or river bottom and form blooms. Therefore, blooms of HABs are most likely to occur during the summer to early-fall months. Some are capable of producing a number of toxins. The most common toxin is "microcystin," which has been implicated in human illnesses and deaths. The World Health Organization (WHO) recommends that the concentration of microcystin not exceed 1.0 parts per billion (ppb) for drinking water and 20.0 ppb at swimming beaches. The highest levels reported for Lake Erie are about 60 ppb. In July 2010, Grand Lake St. Marys State Park, a park located on a large shallow inland lake located 23 miles southwest of Lima, Ohio, was closed and people advised to stay away from the water because the concentration had reached more than 2,000 ppb. In addition to their toxin-producing capability, these blue-green algal species tend to create aesthetic problems when they form floating blooms and produce taste and odor problems in drinking water systems. They are not eaten by any organisms that support fish production. (Reutter et al. 2011)

In recent years, *Lyngbya wollei*, an invasive filamentous cyanobacterial (blue-green algae) species, has become a nuisance 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 miles 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 feet 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 miles 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 miles southwest of the Fermi site) in 2008. *Lyngbya* has not been documented at the Fermi site.

In September 2011, benthic algae were collected at two sites: the proposed Fermi 3 discharge and the existing Fermi 2 discharge point. Ten replicate samples were collected at each site and analyzed microscopically at the Algal Ecology Laboratory at Bowling Green State University. The sediment surface had a distinct golden-brown hue characteristic of a healthy diatom-dominated algal community, and microscopic analyses of the algal communities confirmed that they were heavily dominated by diatoms. The results indicate the presence of a typical and healthy assemblage of a benthic algal community. There was no evidence of the presence or proliferation of large benthic microalgae such as *Lyngbya* or *Cladophora* at either location. (NRC 2012a)

Seasonal zooplankton sampling has been conducted near the Davis-Besse Power Station. Oblique tows identified 45 different species of zooplankton, with rotifers being the dominant species (Table 3.6-5). Vertical tow data collected in the mid- to late-1980s identified 118 zooplankton species and 53 genera, with rotifers dominating the biomass. Two species of zooplankton, the spiny water flea (*Bythotrephes spp.*) and the fishhook water flea (*Cercopagis pengoi*), are considered invasive species throughout Lake Erie. (DECo 2011, page 2-350) These same zooplankton species might be expected to be present in Lake Erie near the Fermi site.

Lake Erie Benthic Invertebrates

Benthic organisms inhabit the bottom of aquatic environments. Benthic organisms serve as valuable indicators of the relative health of the surrounding ecosystem. Benthic species may include epifauna, which live on the surface of the substrate, and infauna, which burrow into sediment. (Armantrout 1998; DECo 2011, page 2-351)

Many studies in Lake Erie have been conducted focusing on benthic organisms and communities. Benthic communities are important to the lake's ecosystem for several reasons. They serve as food sources for many aquatic species, are significant indicators of water quality, aid in protection of the shoreline, and provide spawning and nursery grounds for many aquatic species. (DECo 2011, page 2-351)

Populations of benthic invertebrates south of the mouth of the Detroit River are lowest in near-shore areas, likely due to lack of appropriate habitat. Benthic data collected in studies conducted in the late 1970s in the western basin of Lake Erie identified 25 taxa, with annelids dominating the samples. Benthic trawl data collected in 2006, taken near the southern shore of the western basin, identified 11 taxa, with mussels (*Dreissena spp.*) accounting for the largest portion of the sample. (DECo 2011, page 2-351)

Lake Erie was one of the first water bodies to be colonized by invasive zebra mussels and quagga mussels (*Dreissena rostriformis bugensis*) in the late 1980s. The zebra mussels have caused extensive economic and environmental impact to Lake Erie, as well as many other freshwater systems in the United States. Many power plants, including Fermi 2, have implemented control programs specifically to address the zebra mussel. Native mussel species also have been affected by the decrease of natural habitat and food sources due to the introduction of the zebra mussel. (DECo 2011, page 2-351)

Lake Erie Insects

Mayfly nymphs (*Hexagenia spp.*) returned to sediments of western Lake Erie in the early 1990s after an absence of 40 years. Their recovery was aided by pollution-abatement programs, combined with the invasion of exotic zebra mussels in 1986 that changed the trophic status of near-shore waters of the Great Lakes. Populations of nymphs in the 1990s were similar to historical abundances before extirpation in the mid-1950s. (EPA 2012b)

Mayflies are considered an ecological keystone species and their presence is believed to be an important environmental indicator of mesotrophic (i.e., moderately productive) conditions. Mayflies are ecologically important as a trophic indicator, linking detrital (bottom litter) energy resources directly to the many fish species that feed on *Hexagenia*. Mayfly nymphs prefer to burrow in soft sediment, which often carries high concentrations of pollutants in contaminated areas. Nymphs are intolerant of polluted sediment associated with eutrophication and a lack of oxygen in the lowest layer of the water column. Extended lack of oxygen eliminates the nymphs. (EPA 2012b)

3.6.7.2 Swan Creek

Swan Creek is located approximately 0.5 miles north of the Fermi site, originating approximately 12 miles northwest. Land use adjacent to the Swan Creek drainage includes small residential communities and agricultural development. (DECo 2011, page 2-349)

Swan Creek is a shallow waterway (averaging 3 feet in depth) that is mainly used for recreation (DECo 2011, page 2-349). There are no recognized commercial fishery operations in Swan Creek (DECo 2011, page 2-355). A fisheries survey of the Swan Creek estuary was conducted in September 2005 as a joint venture by the MDNR and USFWS. A total of 38 species of fish from 13 families was collected at these sampling sites. Species most well represented in the catch included gizzard shad (*Dorosoma cepedianum*), bluntnose minnow (*Pimephales notatus*), mimic shiner (*Notropis volucellus*), bluegill, pumpkinseed (*Lepomis gibbosus*), goldfish (*Carassius auratus*), and largemouth bass (*Micropterus salmoides*). Recreational fisheries in Swan Creek include the northern pike (*Esox lucius*), largemouth bass, and bluegill. (DECo 2011, page 2-352 to 2-353) A list of fish collected in the vicinity of Fermi 2 may be found in Table 3.6-2.

The benthic habitat associated with Swan Creek consists of sandy sediment interspersed with small pockets of gravel and flat stone. The shoreline of Swan Creek, near the Fermi site, is heavily vegetated with aquatic plants such as cattails (*Typha latifolia*) and common reed. (DECo 2011, page 2-349) Extensive benthic research has not been conducted on Swan Creek; however, some general species surveys have been conducted to determine general fish species abundance. The most common species collected included sunfishes (*Lepomis spp.*), carp, and minnows (*Cyprinidae*). (DECo 2011, page 2-352)

3.6.7.3 Stony Creek

Stony Creek is located approximately 2.6 miles southwest of the Fermi site, and it drains directly into the western basin of Lake Erie. Stony Creek is approximately 35 miles long. The creek bed is mostly composed of rock, and the banks are heavily forested or adjacent to agricultural and residential development. Stony Creek is supported by many more miles of smaller tributaries which compose the Stony Creek Watershed and the larger Ottawa-Stony Creek Watershed. The upper portion of the watershed is well developed and utilized by residential, commercial, and industrial sectors. The lower portion of the watershed has been developed mainly for agricultural use, although some residential areas have been developed as well. (DECo 2011, page 2-349 to 2-350)

There are no recognized commercial or recreational fisheries within the boundaries of Stony Creek, the DRIWR, or other water bodies located at the Fermi site (DECo 2011, page 2-355).

3.6.7.4 Onsite Manmade Aquatic Communities

Two quarry lakes are located in the southwestern portion of the Fermi site. The two lakes each are approximately 50 feet deep. The lakes were created when water filled the abandoned rock quarries, which were used for site development and construction of Fermi 2. Although the lakes are currently not utilized for recreational or commercial purposes, they have been used in the past for scuba diving and recreational fishing by plant personnel. (DECo 2011, page 2-345)

The quarry lakes support a small variety of aquatic species common to the Great Lakes coastal marsh. Historical recreational fishing catch was not recorded, but carp and sunfish are known to occur within the lakes. (DECo 2011, page 2-347) In addition to fish, common reeds and panic grasses (*Panicum* spp.) were among the species of aquatic vegetation observed along the banks during a Fermi site walkdown in late May 2012 (Heitman 2012). Both migratory and non-migratory birds are also known to utilize the quarry lakes habitat as well (DECo 2011, page 2-347).

The aquatic species that occur in the circulating water reservoir, overflow and discharge canals, and drainage ditches on the Fermi site are expected to be representative of typical Great Lakes coastal ecosystems and species (DECo 2011, page 2-346).

One clay-lined canal, approximately 5 to 10 feet deep by 70 feet wide, originates in the central portion of the Fermi site and extends north where it confluences with Swan Creek. This canal is termed the overflow canal. The overflow canal was previously utilized as a cooling water discharge/overflow canal for operation of Fermi 1. Currently, the Fermi site utilizes the canal for discharges from several NPDES and stormwater outfalls. A second canal (discharge canal), approximately 5 to 10 feet deep by 70 feet wide, originates in the central portion of the Fermi site and extends south where it confluences with the South Lagoon. This canal serves as a drain path for the western wetlands area. A stagnant waterbody lies between the two canals. (DECo 2011, page 2-345)

If aquatic species do not already exist in the overflow and discharge canals, the potential exists for aquatic species present in Swan Creek and the South Lagoon to eventually inhabit the canals due to the hydrological connectivity of the water bodies. The onsite drainage ditches are not expected to serve as suitable habitat for aquatic species as they only carry stormwater runoff and are routinely maintained. (DECo 2011, page 2-346)

3.6.7.5 DRIWR

Areas within the DRIWR have been designated as important aquatic habitats.

An important aquatic habitat is defined in NUREG-1555 as wildlife sanctuaries, refuges, or preserves; habitats identified by state and federal agencies as unique, rare, or of priority for protection if they may be adversely affected by plant or transmission line construction or operation; wetlands, floodplain, or other resources specifically protected by federal regulations or executive order, or by state regulations; and land areas identified as "critical habitat" for species listed as threatened and endangered by the USFWS. The only important aquatic habitat identified on the Fermi site is the DRIWR. (DECo 2011, page 2-344 to 2-345)

A fisheries survey of coastal marshes within the DRIWR was conducted in September of 2005 as a joint venture by the MDNR and USFWS to document fish communities associated with Michigan waters of Lake Erie and to inventory the fisheries resources of the DRIWR. As previously mentioned, a total of 38 species of fish from 13 families was collected from Swan Creek, which is located in the DRIWR. Species most well represented in the catch included gizzard shad, bluntnose minnow, mimic shiner, bluegill, pumpkinseed, goldfish, and largemouth bass. (DECo 2011, page 2-347)

Wetland areas within the DRIWR provide spawning and feeding grounds, as well as the ideal habitat they provide for hydrophytic vegetation. Aquatic plant species observed in September 2007 include American lotus, floating duckweed (*Lemna spp.*), and the common reed. These species provide a significant amount of spatial coverage for most of the DRIWR within the Fermi site. (DECo 2011, page 2-346 to 2-347)

The Lake Erie western basin, Swan Creek, Stony Creek, the circulating water reservoir, overflow and discharge canals, and drainage ditches are aquatic habitats not characterized as important aquatic habitats, per the criteria of NUREG-1555. (DECo 2011, page 2-344 to 2-345)

3.6.7.6 Impingement and Entrainment

Because Fermi 2 is a closed-loop cooling water system and no average velocity at the intake forebay and traveling screens exceeded 0.5 fps (LMSE 1993), the impacts to fish and other aquatic life are greatly reduced. Particularly as compared with once-through systems, the rates of fish impingement and entrainment are low. A detailed description of the Fermi 2 intake structure may be found in Section 2.2.2.1. There is, however, a history of impingement and entrainment sampling at the Fermi 2 plant. These studies are summarized below.

Impingement

Impingement data collected at the Fermi site during the period 1991–1992 found that the annual estimated impingement was 13,699 fish with an estimated biomass of 727 pounds. The dominant species impinged was gizzard shad, which represented 71.5 percent of the estimated annual total abundance of the impinged fish. White perch was the second most abundant species impinged at 6.8 percent of the annual total. Third, fourth, and fifth species ranked by abundance included the rock bass (*Ambloplites rupestris*), freshwater drum, and emerald shiner (*Notropis atherinoides*). (LMSE 1993)

More recently, between 2008 and 2009, 11 impingement samples were collected resulting in a total of 101 fish. A December 2008 sample yielded the greatest number of fish (34), while the June 2009 and July 2009 samples yielded the fewest fish. Fish composition was dominated by gizzard shad (39 percent), emerald shiner (29 percent), white perch (10 percent), and bluegill (7 percent). Impingement rates (number of fish per cubic meter [fish/m^3]) ranged from 1.9E-4 fish/m^3 in December 2008 to 4.3E-6 fish/m^3 in June 2009. (Pittman 2009, page ES-2)

It was estimated that 3,102 fish were impinged annually at Fermi 2 with intake pumps at operational capacity (actual intake volumes used to determine monthly operational intake). Of those, gizzard shad (1,204) and emerald shiner (889) were the most commonly impinged fish totaling 2,093. December (1,054) and March (806) had the highest estimated impingement numbers with Fermi 2 intake pumps at operational capacity. (Pittman 2009, page ES-2)

No threatened or endangered species were identified during the above-described impingement studies conducted at Fermi 2.

Entrainment

Based on sampling conducted during the period 1991–1992, the annual ichthyoplankton entrainment was estimated to be 2,955,693 (2,883,326 larvae and 72,367 eggs). Clupeids (gizzard shad and alewife [*Alosa pseudoharengus*]) represented 28.8 percent (813,303 eggs and larvae). Moronids (white perch and white bass) represented 26.3 percent, and Cyprinids were the third most abundant taxa sampled at 23.0 percent of the total number of fish and eggs sampled. (LMSE 1993)

Entrainment samples were collected during 10 months from July 2008 through July 2009. A total of 1,286 organisms were entrained, which included 12 identified taxa, 74 unknown eggs, and 2 unknown centrarchid larvae. The May sample yielded the greatest number of fish eggs and larvae (533), while both November and March yielded the lowest number (0). Sample composition was dominated by gizzard shad, emerald shiner, bluntnose minnow, yellow perch, and brook silverside (*Labidesthes sicculus*). Entrainment rates (fish eggs + larvae/m^3) ranged from 4.82/m^3 in July 2009 to 0.00/m^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. Of the 12 taxa identified in entrainment samples, the gizzard shad reflected the highest entrainment rate at 0.36/m^3, while the white perch and the brook silverside represented the lowest entrainment rates at 0.0015/m^3. (Pittman 2009, page ES-3)

It is estimated that 62,566,648 fish (3,940,823 eggs and 58,625,825 larvae) were entrained annually at Fermi 2 with intake pumps at operational capacity. The difference in entrainment estimates between the two studies may be due to natural variations in fish population abundances during the two study years. Of those, 33,852,880 were entrained in July with gizzard shad (30,238,133) being the most commonly entrained fish each year with Fermi 2 intake pumps functioning at operational capacity. (Pittman 2009, page ES-3) As a matter of perspective, gizzard shad are prolific spawners. It has been reported that in Lake Erie, 2-year-old female fish produced on average 378,990 eggs per fish (Wallus 1990) and, in Ohio, gizzard shad may produce up to 500,000 eggs per female (ODNR 2013). Thus, the estimated entrainment of gizzard shad represents the average egg production of about 120 fish.

No threatened or endangered species larvae or eggs were identified during the above-described entrainment studies conducted at Fermi 2.

3.6.7.7 Public Health Issues

Commercial and recreational fisheries in Lake Erie have been directly impacted by pollution from human activities. The source and impact of some of these perturbations are previously discussed. While fishing is popular, the Michigan Department of Community Health has recommended that the general population not eat carp, catfish (*Ictalurus spp.*), or large whitefish (> 22 inches), and that consumption of smaller whitefish be limited to one meal per week. Portions for pregnant women and children are more restrictive. (MDCH 2012)

3.6.8 Terrestrial Communities

Habitat diversity in an area generally contributes directly to the diversity of wildlife present in the same area. The more diverse the habitat, the greater the number of wildlife species that can be supported. The Fermi site and vicinity provide primarily a rural agricultural setting with small parcels of disturbed grassland, forest, and wetland habitats scattered throughout the area. (DECo 2011, page 2-327) The majority of the Fermi site proper is occupied by disturbed forest, lagoons, thickets, and developed areas that are fragmented by roads and other development (e.g., the shooting range). In addition, portions of the site were once cleared and/or covered by fill materials. Some of the forested areas, such as those along the southern edge of the property, have experienced logging in the past. Historical research suggests that prior to the construction of Fermi 1, the south lagoon was disturbed by dredging activities to create fish ponds. (Demeter et al. 2012) These activities have degraded the habitat value of essentially all the plant communities on the property. While there are no adequate quantitative data available with which to compare today's conditions, this disturbance suggests a diminished habitat for wildlife. (DECo 2011, page 2-339)

The dominance of marsh areas by common reed also prevents or limits use by many species, such as rails, bitterns, turtles, frogs, and some snakes because the stem density obstructs movement to a considerable degree. Common reed also limits the presence of desirable emergent vegetation that could be used as food or cover by rails and bitterns. (Black and Veatch 2009b)

The quarry lakes area should represent a significant wildlife feature, attracting and supporting a diverse variety of wildlife dependent on water or using it for short periods. However, the reported low abundance of prey species inhabiting the surface waters and a general lack of safe access (e.g., shallow areas for wading birds or puddle ducks) makes it largely unusable for many wildlife species, reflected in the predominance of edge tolerant and nonaquatic species. Many of the bird species observed in the quarry lakes area flew over the area and did not use the aquatic habitat, including many gulls. (Black and Veatch 2009b)

The 1973–1974 study by NUS Corporation listed 17 species of mammals directly or indirectly observed. The 2000 Wildlife Management Plan listed three newly observed species of mammals. (DECo 2011, page 2-327) A general habitat survey conducted by the Wildlife Habitat Council (WHC) in July 2000 identified 21 species of wildlife and 28 species of plants in the vicinity. Species common to the area have been identified on site. The second growth forests have been determined to not provide habitat quality sufficient to attract unusual species. (DECo 2011, page 2-347) In 2002, the Wildlife Habitat Program Re-Certification document listed one additional newly observed mammal, bringing the total number of mammals observed on the property to 21. (DECo 2011, page 2-327)

Mammals

The area surrounding the site is a mosaic of developed land, mowed grass, woodlots, and second generation forest that do not appear to provide significant wildlife travel corridors as might be found along watercourses or entry/exit locations for desirable foraging or resting habitats. The Fermi property is surrounded by high chain-link fence in terrestrial areas, which would be expected to inhibit larger mammals from accessing the site. Because the property is fenced, wildlife corridors in the truest sense are not present on the property. However, the Lake Erie waterfront and north lagoon areas may provide access via the shoreline. Animals can also gain access through entrance roadways. White-tailed deer (*Odocoileus virginianus*), for instance, are frequently seen on site. The varied habitats around the site, however, are well suited to small mammals such as the coyote (*Canis latrans*), raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), and eastern fox squirrel (*Sciurus niger*), although the diminished quality of most of the communities discussed provides less than ideal foraging opportunities. None of the mammal species observed or reported at the site is unusual for the region. (DECo 2011, page 2-328)

Birds

Birds in the Fermi region include year-round residents, seasonal residents, and transients (birds stopping briefly during migration). A large percentage of the species occurring in Michigan are migratory, and because Fermi is situated on the western shore of Lake Erie, it lies within the Central and Atlantic flyways, which are two of several major migratory flyways in North America. Although the 2000 Wildlife Management Plan provided a list of 287 species potentially occurring in the Fermi vicinity, only 150 were noted as observed on the Fermi property. In 2002, the Wildlife Habitat Program re-certification added six new species. According to the Michigan Natural Features Inventory (MNFI), the potential number of resident and transient birds in the region is much higher depending on the reporting resource group. In 2002, an April bird survey by the DTE Wildlife Habitat Team at Fermi counted 293 individuals and 31 species. Five species accounted for 50 percent of the birds counted: common grackle (*Quiscalas quiscala*), red-winged blackbird (*Agelaius phoeniceus*), herring gull (*Larus argentatus*), brown-headed cowbird (*Molothrus ater*), and northern pintail (*Anas acuta*). (DECo 2011, page 2-328)

Woodlots provide forested resting areas. For water birds, the lagoons, wetlands, and lakes provide resting and foraging areas. (DECo 2011, page 2-339) A 2008–2009 survey (Black and

Veatch 2009b) confirmed that the birdlife at Fermi is diverse, but that a few common bird species make up the largest proportion of individuals. The five most abundant species observed (i.e., recorded in the highest number across all survey sessions) were European starling (*Sturnus vulgaris*), Canada goose (*Branta canadensis*), two gull species (herring gull and ring-billed gull [*Larus delawarensis*]) and red-winged blackbirds (*Agelaius phoeniccus*). Seasonal variation in both the number of species and the numbers of individuals within a species was observed, most notably during the spring and fall migration when larger assemblages of some species were observed. However, use of the site by bird species appears to be lower than would be expected given the variety of habitats present.

Fragmentation of forested habitat (e.g., by roads) may limit the use by species requiring large unbroken forested tracts. However, the absence of interior forest species even during migration, when such species usually are more readily observed in smaller forests, suggests that the Fermi site does not experience even transitory use by these species. Many wading birds are limited on the Fermi site because the shallow marshy habitat preferred by these birds can be submerged during high water periods. (Black and Veatch 2009b)

Noise can be a deterrent to wildlife when it is abrupt and irregular. However, most wildlife tend to adapt to constant noise and this appears to be the case at Fermi. For example, song birds, wading birds, and waterfowl may be regularly observed in the north lagoon immediately west of the cooling towers, an area which has one of the highest outdoor noise levels on the site. In addition, it is not unusual to observe groups of turkey vultures (*Cathartes aura*) soaring above the cooling towers. (DECo 2011, page 2-340) As discussed below, eagles have adapted to nesting adjacent to the firing range.

Additional avian studies were conducted between late-2006 and mid-2008 as part of the Fermi 3 licensing activity. Point surveys were conducted early and late in the day in different areas across the Fermi property that were representative of the variety of habitats present. The sampling periods included seasonal variation, such as spring and fall migration periods. These surveys confirm that the avian fauna at Fermi, especially songbirds and certain water birds, remains diverse, but that a small number of common species make up a large percentage of individuals present. The most common species observed were the European starling, Canada goose, gulls, and red-winged blackbirds. (DECo 2011, page 2-328)

Annual Christmas season bird counts were also typically conducted on site. Some of the most common birds identified were canvasback ducks (*Aythya valisineria*), mallards (*Anas platyrhynchos)*, tundra swan (*Cygnus columbianus*), herring gulls, and European starling (DTE 2013u).

Birds of prey have not been frequently observed on the Fermi site. The most common sightings were those of turkey vultures and red-tailed hawks (*Buteo jamaicensis*). In 1973, a single peregrine falcon (*Falco peregrinus*) and a single osprey (*Pandion haliaetrus*) were observed over the lagoon. No peregrine falcons were observed in recent studies, but several ospreys have been observed at the site. There is no evidence of nesting for these species on the property. (DECo 2011, page 2-329)

The bald eagle (*Haliaeetus leucocephalus*) occurs in the area. In the fourth quarter of 2007, three nests were observed on the property; two were north and one was south of the Fermi 2 plant in the large trees of the coastal shoreline forest adjacent to Lake Erie. Eagles may be more common during the winter months around the plant where the warmer cooling water keeps some areas ice free. By May 2008, only the two nests north of Fermi 2 remained, as the southernmost nest had been destroyed by winter storms. Only one of the remaining nests was occupied. (DECo 2011, page 2-329) During a Fermi site walk down in late May 2012, it was observed that an eagle nest adjacent to the firing range had produced chicks (Heitman 2012). In early spring of 2013 before leaf out, a new active nest was observed near the dredge basin on the Lake Erie shoreline (DTE 2013v).

Bird Strikes

Deceased birds are occasionally found around the towers. Typically only a few birds are observed at any one time, but on one occasion in September 1973, 15 dead birds were found at the Fermi 2 south cooling tower. In October 2007, 45 dead birds were found at the Fermi 2 south cooling tower during a 1-week period. (DTE 2012d) In both cases, the towers were not in operation. Since then, occasional individuals or small numbers of birds have been found (DTE 2012d).

On October 21, 2011, a badly decomposed bald eagle carcass was found near the east fence of the 120-kV mat fence. The bones and feathers were collected by the USFWS and a necropsy was performed. It was determined that the eagle died due to an electric current that affected the foot, causing coagulation of the skin and likely conduction in the heart. (DTE 2012d)

Amphibians and Reptiles

The lagoons, other wetlands areas, and adjacent habitats provide a significant amount of potential habitat for amphibians and reptiles on the Fermi property. Direct and indirect observations of a diversity of these species, however, have been infrequent both in recent and past studies. The 2000 Wildlife Management Plan listed 18 species of amphibians whose geographical ranges include the Fermi site, but only three species were observed. The same report did not list any reptiles. The 2002 wildlife habitat re-certification document listed three additional amphibians and three reptiles. (DECo 2011, page 2-330) A 2009 survey observed five reptile species on site, including the eastern fox snake (*Elaphe gloydi*), the Blanding's turtle (*Emydoidea blandingii*), eastern garter snake (*Thamnophis sirtalis sirtalis*), midland painted turtle (*Chrysemys picta marginata*), and queen snake (*Regina septemvittata*). Six amphibian or frog species were observed including the American toad (*Bufo americanus*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), northern leopard frog (*Rana pipiens*), pickerel frog (*Rana palustris*), and the western chorus frog (*Pseudacris triseriata triseriata*). No salamanders were found during the study. (Black and Veatch 2009b)

A 2013 survey observed two reptile species on site, including the eastern fox snake and the eastern box turtle (*Terrapene carolina carolina*). The survey also observed three species of amphibians, including the bullfrog, chorus frog (*Pseudacris sp.*) and the green frog. (Kogge and Heslinga 2013)

Plant Communities

A Black and Veatch study (2009a) confirmed the results of previous studies in that many of the plant species observed on the Fermi site are considered relatively common, many of which are introduced or otherwise weedy species. The vegetation survey further confirmed that the plant communities at the Fermi site have good species richness, but that a few common species make up the largest proportion of individuals. The five most abundant species were jumpseed (*Polygonum virginianum*), moneywort (*Lysimachia nummularia*), white avens (*Geum canadense*), poison ivy (*Toxicodendron radicans*), and garlic mustard (*Alliaria petiolata*). These represent common species associated with early successional and disturbed habitats, such as the Fermi site. In 2013, Cardno JFNew observed that the common reed, an invasive species, is a dominant plant species found in several of the habitat areas on the Fermi property. (Kogge and Heslinga 2013)

3.6.9 Invasive Species

The Fermi site is situated on the western bank of Lake Erie and, as the result of this location, there are several invasive species that may be found on and/or adjacent to the site. Many of these invasive species, as identified below, have been introduced recently by way of ships in Lake Erie or the other Great Lakes. These invasive species have affected both aquatic and terrestrial ecosystems.

3.6.9.1 Invasive Aquatic Species

Aquatic nuisance species have the capability to cause large-scale ecological and economic problems when they have been introduced into a system that does not have the proper natural controls to keep them in check, such as pathogens, predators, and parasites. The lack of natural controls may cause the nuisance populations to grow at or near maximum exponential rates. If a nuisance species becomes established, it may disrupt the existing ecosystem balance. As a nuisance species proliferates, it may prey upon, out-compete, or cause disease in the existing inhabitants. The common aquatic nuisance species near the Fermi site are discussed below. (DECo 2011, page 2-356)

Quagga Mussel

The quagga mussel is a nuisance species native to the Ukraine, and is believed to have been introduced to the United States through the ballast water discharge of transatlantic shipping vessels. It is well established in Lake Erie. It has been reported in the Lake Erie mouths of Swan and Stony creeks (near the Fermi site), and it is most likely present in parts of the Detroit River. Very similar to the zebra mussel, the quagga mussel inhabits all types of living and non-living things including intake pipes and structures, causing problems for operation and maintenance of these structures. Another threat posed by the quagga mussel lies in its filtration of the water. By filtering phytoplankton and suspended matter from the water column, the quagga mussel eliminates the biggest zooplankton food source, thus impacting 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. (DECo 2011, page 2-357)

Round Goby

The round goby is a small, bottom-dwelling fish that was first found in the Great Lakes region in 1990. Originally from the Black and Caspian seas of Eastern Europe, it is believed this exotic species arrived in the ballast water of vessels coming into the Great Lakes. Since the first sighting in the St. Clair River, round gobies have spread to all of the Great Lakes and are working their way inland through the rivers and canal systems. (USGS 2012b)

Sea Lamprey

Historically, sea lampreys were prevented from entering Lake Erie because of their inability to surmount Niagara Falls. In 1829, the completion of the Welland Canal made it possible for the sea lamprey to migrate from Lake Ontario to Lake Erie. Sea lampreys are uncommon in Lake Erie due to lack of sufficient spawning and nursery areas in streams adjacent to the lake. (Trautman 1981) The biggest threat of the sea lamprey includes disruption of the food chain and aquatic ecosystem.

Spiny Water Flea and Fish Hook Flea

Far from fleas, these are microscopic predatory zooplankton that feed on smaller, native zooplankton, an important part of the Great Lakes food web. Native to the Caspian Sea areas of northern Europe, they arrived via the ballast water of an international ship in 1997 and spread to all the lakes except Lake Superior. In the years since their introduction, the Great Lakes have seen a decline in native zooplankton, which are a vital food for young fish. They are also known to clog the lines and gear of fisherman. (USGS 2012c)

Zebra Mussel

Zebra mussels are considered a nuisance species throughout all of the Great Lakes Region and are known to inhabit the western basin of Lake Erie, near the Fermi site. Originally found primarily in Russia, the mussel was transported to the Great Lakes Region by transatlantic freighter in 1988. Since that time, the mussel has spread to more than 100 lakes and several major river systems including the Mississippi River. Zebra mussels have been reported in Swan Creek, Stony Creek, and the Detroit River as well. (DECo 2011, page 2-357)

3.6.9.2 Invasive Terrestrial Species

Common Reed

Common reed is a wetland plant species found in every U.S. state. It can grow to nearly 20 feet tall in dense stands and is long-lived. The common reed is capable of reproduction by seeds, but primarily employs asexual reproduction by means of rhizomes. It is invasive, particularly in the eastern states along the Atlantic Coast and increasingly across much of the Midwest and in parts of the Pacific Northwest. It is also widely distributed throughout the world, ranging over Europe, Asia, Africa, South America, and Australia; however, the origin of the species is unclear. Until recently, the status of the plant as native to North America or introduced has been in dispute, but new work has demonstrated the existence of native and introduced genotypes of common reed. The common reed is a clonal grass species with woody hollow culms. Leaves are lanceolate, often 8–16 inches long and 0.4–1.5 inches wide. Flowers develop by mid-summer and are arranged in tawny spikelets with many tufts of silky hair. Common reed is wind-pollinated but self-incompatible. Seed set is highly variable and occurs through fall and winter and may be important in colonization of new areas. Germination occurs in spring on exposed moist soils. Vegetative spread by below-ground rhizomes can result in dense clones with up to 200 stems/m^2. (EMIPP 2013)

Cutleaf Watermilfoil

Cutleaf watermilfoil (*Myriophyllum pinnatum*) is an aquatic, either submersed or semiterrestrial perennial, with stems rooting in mud, freely branched or becoming much elongated when growing in water. Its leaves are in whorls of three to five or subverticillate or commonly scattered, to about 1 inch long. The submersed leaves have approximately five or more short or somewhat elongate remote capillary divisions. The emersed leaves are linear to oblanceolate, comb-like or sharply toothed, to 0.08 inches long and winter buds are absent. The flowers are perfect or unisexual in the axils of the emersed leaves. The bracteoles are bluntly triangular, about 0.04 inches long. The petals are purplish, approximately 0.06 to 0.08 inches long, rounded above, with a short claw. There are four stamens and the anthers are about 0.04 inches long. (E-FLORA BC 2013)

While cutleaf *M. pinnatum* is present in the Ohio portion of Lake Erie, it is not listed as being present in Michigan (USDA 2013b). This species of watermilfoil is not listed as an invasive species in Michigan (MNFI 2013b).

Emerald Ash Borer

The emerald ash borer (*Agrilus planipennis*) is an exotic beetle discovered in southeastern Michigan near Detroit in the summer of 2002. It probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. Because ash trees in North America have no immunity to the insect, the emerald ash borer has the potential to wipe out more than 700 million ash trees in Michigan. Since 2002, it has killed more than 30 million ash trees in southeastern Michigan alone. State and federal agencies in Michigan and researchers in Michigan universities are working to stop the emerald ash borer from spreading. This includes the initiation of quarantines to stop the movement of infested ash wood and wood products, research to understand the pest's life cycle and what methods and strategies can control or eradicate it, and development of educational and informational materials to help communities detect and deal with emerald ash borer infestations. (Michigan Information 2012)

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*), originally found in Eurasia, was introduced to the northeastern United States and Canada in the 1800s for ornamental and medicinal uses. It is still widely sold as an ornamental, except in states such as Minnesota, Wisconsin, and Illinois, where regulations now prohibit its sale, purchase, and distribution. Purple loosestrife adapts readily to natural and disturbed wetlands. (NPS 2013b)

A perennial that stands erect on a square, woody stem, purple loosestrife grows from a large taproot with rhizomes forming a dense mat. Each rootstock can have up to 50 stems emerging from it. Stems can reach a maximum height of 10 feet. Green leaves are whorled or opposite on the stem. They are lance-shaped with smooth edges and are covered in a downy pubescence. This plant puts up many flower spikes and each spike is covered with many individual flowers. Each flower has five to six pink-to-purple petals with yellow centers. This plant is a prolific seed producer; annually each plant can produce up to 2.7 million seeds. Each seed is the size of a grain of sand and is stored in a seed capsule that replaces the flower when it falls off. Many other plants may be confused with purple loosestrife—fireweed, swamp loosestrife, winged loosestrife, and blue vervain are but a few such plants. (INDNR 2013a)

Purple loosestrife will grow on the edges of rivers, lakes, sloughs, dams, bogs, swamps, irrigation ditches, streams, and other wet areas. It can tolerate wet soil conditions as well as drier conditions. Seeds usually germinate in late spring or early summer. Of the millions of seeds produced annually per plant, approximately 60 to 70 percent are viable. Seeds can remain dormant for many years. The seeds have many modes of dispersal. Water, animals, humans, and boats are all vectors for long-distance dispersal. All of this aids purple loosestrife in its rapid invasion of new sites. It has the ability to adapt to a variety of environmental conditions, which gives it another competitive advantage over other plants. The plant's large woody rootstock enables it to re-grow if its stem is cut or damaged. Purple loosestrife will flower from June until September, and insects are its main source of pollination. The stems die in the fall, but new shoots emerge from buds at the top of the root crown in the spring. (INDNR 2013a)

Reed Canary Grass

Reed canary grass (*Phalaris arundinacea*) is native to Europe, but also has been speculated as indigenous to Asia and parts of North America. In the United States, it is now present in 43 states. This cool-season grass is large and coarse with erect, hairless stems reaching up to 9 feet in height. Reed canary grass has gradually tapering leaves that are 3.5 to 10.0 inches long. The upper and lower surfaces of the leaves have a rough texture. This perennial species can range from a light green to a straw color. A wetland plant, reed canary grass frequents saturated soils, but cannot survive extended periods of standing water. Ideally, it does best in ditches, levees, shallow marshes, and meadows. A perennial grass, reed canary grass reproduces by seed or spreads by creeping rhizomes (underground rootstalks). Growth begins in early spring, when it grows vertically for 5–7 weeks before expanding horizontally. Flowering occurs in early summer. (INDNR 2013b)

Unusual Terrestrial Pest Species

No unusual terrestrial pest species or disease vectors have been identified in recent studies, and none have been identified by federal or state agencies. Common pest species and disease vectors include mosquitoes and ticks, which can be carriers of West Nile disease and Lyme disease, respectively. (DECo 2011, page 2-339)

3.6.10 Procedures and Protocols

DTE relies on administrative controls and other regulatory programs to ensure that habitats, including the onsite portions of the DRIWR, and wildlife are protected as a result of a change in plant operations (i.e., water withdrawal increase, new NPDES discharge point, wastewater discharge increase, air emissions increase), or prior to ground-disturbing activities. The administrative controls, as discussed in Section 9.1.4, involve reviewing the change, identifying effects, if any, on the environmental resource area (i.e., habitat and wildlife), establishing BMPs, modifying existing permits, or acquiring new permits as needed to minimize impacts. Existing regulatory programs that the site is subject to, as discussed in Chapter 9, also ensure that habitats and wildlife are protected. These are related to programs such as the following: stormwater management for controlling the runoff of pollution sources such as sediment, metals, or chemicals; spill prevention to ensure that BMPs and structural controls are in place to minimize the potential for a chemical release to the environment; MDEQ and USACE permitting programs to minimize dredging impacts; and management of herbicide applications (i.e., Pramitol® 25E, Hyvar® XL, Reward® Landscape and Aquatic Herbicide, Aquathol® K, and Cutrine®–Plus Algeacide/Herbicide) to ensure that the intended use will not adversely affect the environment.

3.6.11 Studies and Monitoring

Terrestrial site reconnaissance was conducted for the Fermi 3 license application in 2007 and 2008, and additional terrestrial surveys were conducted in 2008 and 2009 (Section 3.6.8) (DECo 2011, page 2-340). Another recent study is that of the DTE/North American Wetlands Conservation Act transmission ROW prairie planting that was surveyed for plant species occurrences in 2005 and 2007 (DECo 2011, page 2-340), and again in 2011 (Fermi 2011c). Most recently, in July and August of 2013, a terrestrial study was performed by Cardno JFNew to update previous studies (Kogge and Heslinga 2013). Ongoing terrestrial monitoring includes annual Christmas season bird counts (Section 3.6.8), wildlife habitat annual monitoring, and Fermi 2's REMP.

3.6.12 Threatened, Endangered, and Protected Species, and Essential Fish Habitat

The definition of "Important Species" in NUREG-1555, Supplement 1, Rev. 0 is (1) species listed or proposed for listing as threatened, endangered, candidate, or species of special concern in 50 CFR 17.11 and 50 CFR 17.12, by the USFWS, or the state in which the project is located; (2) commercially or recreationally valuable species; (3) species essential to the maintenance and survival of rare or commercially or recreationally valuable species; (4) species critical to the structure and function of local terrestrial ecosystems; or (5) species that could serve as biological indicators of effects on local terrestrial ecosystems. Based on the above definition, only element (1) is applicable to the species found on the Fermi site and vicinity.

An important aquatic habitat is defined in NUREG-1555 as wildlife sanctuaries, refuges, or preserves if they may be adversely affected by plant or transmission line construction or operation; habitats identified by state or federal agencies as unique, rare, or of priority for protection if they may be adversely affected by plant or transmission line operation and maintenance; wetlands, floodplain, or other resources specifically protected by federal regulations or executive order, or by state regulations; and land areas identified as "critical habitat" for species listed as threatened or endangered by the USFWS. The only important aquatic habitat identified is the DRIWR.

3.6.12.1 Federally Listed Species

Some species of plants and animals that may occur on or within the vicinity of the Fermi site have been deemed to require specific protection under federal laws. These plants and animals have been identified (USFWS 2012c), and a summary of related information is presented for each species below. Table 3.6-6 provides a listing of federally and state-listed important species within Monroe and/or Wayne County. The only federally listed species seen on site was the piping plover. This migratory bird was seen on the sandy beach south of the Fermi 2 intake in July of 2008 and was believed to be transient (Black and Veatch 2009b). Based on 2013 surveys, no piping plovers were observed and no suitable habitat for nesting was identified on site (Kogge and Heslinga 2013).

Mollusks

Northern Riffleshell

The northern riffleshell (*Epioblasma torulosa rangina*) is a medium-sized (to 2 inches) mussel with a shell that is ovate to quadrate in shape becoming thicker anteriorly. There is considerable sexual dimorphism in riffleshell. Male shells have a sulcus or ridge running posterioventrally from just below the beak, whereas the female shells have a low bulge along the posterio-ventral edge of the shell that accommodates the enlarged marsupium containing eggs. The hinge teeth are medium-sized and well developed. The shell is light green-yellow to olive green, with dark, narrow, closely-spaced rays. Northern riffleshell occur in fine to coarse gravel areas of swift current riffle and runs. (MNFI 2012a)

The northern riffleshell is listed as endangered by both the USFWS and the state of Michigan. It has been found in Monroe County twice, the most recent occurrence in 1977. (MNFI 2012a)

Rayed Bean

The rayed bean (*Villosa fabalis*), a small freshwater mussel that only grows to about 1.5 inches in length, can no longer be found in much of its historic range in the Midwest and eastern United States. The rayed bean has been extirpated from Illinois, Kentucky, and Virginia but is still found in Indiana, Michigan, New York, Ohio, Pennsylvania, Tennessee, West Virginia and Ontario, Canada. Generally, it lives in smaller, headwater creeks, but is sometimes found in large rivers and wave-washed areas of glacial lakes. The rayed bean prefers gravel or sand substrates, and is often found in and around roots of aquatic vegetation. (USFWS 2013)

The rayed bean is listed as endangered by both the USFWS and the state of Michigan. It has been observed in Monroe County five times, the most recent occurrence in 1984. (MNFI 2013c)

Snuffbox Mussel

The snuffbox (*Epioblasma triquetra*) is a medium-sized (to 2 inches) mussel that is triangular in shape. Its shell is thick and yellowish on the outside with numerous, broken, dark green rays. Beak sculpture is double looped and the hinge teeth are elevated and compressed. The snuffbox inhabits sand, gravel, or cobble substrates in swift, small and medium-sized rivers. Individuals are often buried deep in the sediment. The snuffbox mussel is sensitive to river impoundment, siltation, and disturbance due to its requirement for clean, swift current and relative immobility as an adult. As with all mussels, protection of their host habitat is also crucial. Because the life cycle of the snuffbox is inherently linked with that of the logperch (*Percina caprodes*) in Michigan, conservation and management of this mussel species is needed to insure conservation of the snuffbox. (MNFI 2012b)

The snuffbox mussel is listed as endangered by both the USFWS and the state of Michigan. It has been found twice in Monroe County with the last occurrence in 1933. (MNFI 2012b)

Reptiles

Eastern Massasauga Rattlesnake

The eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is a small snake with thick body, heart-shaped head, and vertical pupils. The average length of an adult is about 2 feet. Adult massasaugas are gray or light brown with large, light-edged, chocolate brown blotches on the back and smaller blotches on the sides. The snake's belly is marbled dark gray or black and there is a narrow, white stripe on its head. Its tail has several dark brown rings and is tipped by gray-yellow horny rattles. Young snakes have the same markings, but are more vividly colored. (USFWS 1999)

Massasaugas live in wet areas including wet prairies, marshes, and low areas along rivers and lakes. In many areas, massasaugas also use adjacent uplands during part of the year. Massasaugas hibernate alone, often in crayfish burrows, but they may also be found under logs and tree roots or in small mammal burrows. (USFWS 1999)

Like all rattlesnakes, massasaugas bear live young. The young actually hatch from eggs while still in the female's body. Depending on the health of the individual, adult females may bear young every year or every other year. Litter size varies from 5 to 19 young. (USFWS 1999)

Massasaugas eat small rodents like mice and voles, but they will sometimes eat frogs and other snakes. They hunt by sitting and waiting. Heat-sensitive pits near the snakes' eyes alert the snake to the presence of prey. They can find their prey by sight, by feeling vibrations, by sensing heat given off by their prey, and/or by detecting odors given off by the animal. (USFWS 1999)

The massasauga is a federal candidate species and a state species of special concern. While massasaugas are found throughout much of the lower peninsula of Michigan, there are no reported occurrences in Monroe County, and the last reported occurrence of this snake in Wayne County was in 1858. (MNFI 2013d)

Birds

Piping Plover

The piping plover (*Charadrius melodus*) is a small compact robin-sized shorebird, roughly 7.25 inches in length and a wingspan of roughly 15 inches. It has a very short and stout bill, and very pale, sandy colored underparts used for camouflage. The piping plover is identified by distinctive markings on its upper chest, forehead, legs, and bill.

Habitat for the piping plover consists of wide, flat, open, sandy beaches with sparse vegetation and scattered cobble. Nesting territories often include a variety of micro-habitats such as seeps, interdunal wetlands, and small creeks. This species is both federally and state listed as endangered. (MNFI 2013e)

While several individuals of this species were identified by Black and Veatch, on one occasion, in their July 2008 survey, these birds were likely transient (migratory). No individuals have been observed since. The small beach at the Fermi site is narrower than preferred by this species and was likely used as a stopover during migration. (Black and Veatch 2009b) The optimal habitat necessary for nesting of this species is not found on the Fermi site. (Kogge and Heslinga 2013)

Mammals

Indiana Bat

The USFWS indicated the Fermi site lies within the range for Indiana bat (*Myotis sodalis*) (USFWS 2012c), and although it has not been reported from Monroe County, MNFI records indicate that the Indiana bat has been observed in counties to the north and west of Monroe County (MNFI 2013f). The bat is distributed from the Ozarks of Oklahoma east to Tennessee and northern Florida, and north to Vermont, northern Indiana, and southern Michigan. The Indiana bat spends the winter hibernating in limestone caves (hibernacula) south of Michigan. From late spring to early fall, bats returning to Michigan typically roost in forested areas under the loose bark of large trees or in hollow snags. They leave their roosts to forage for insects from a half hour to one hour before dark in or near forested areas (DECo 2011, page 2-332). There have been no reported sightings of the Indiana bat on the Fermi site. In fact, regarding the Indiana bat, only one Michigan hibernaculum is known and is located in Manistee County more than 200 miles northwest of the Fermi site. (Black and Veatch 2011)

The Indiana bat is both a federally and state-listed endangered species (MNFI 2013f).

Insects

Karner Blue Butterfly

The Karner blue butterfly (*Lycaeides melissa samuellis*) is a small silvery butterfly with a 0.9- to 1.3-inch wingspan. The dorsal (top) surface is silvery blue in males with a narrow, dark border and white fringe. Females range from dull violet to bright purplish blue near the body and central portions of the wings; the remainder of the wing can range from light to dark gray-brown. The hindwing of the female also has a row of dark spots with orange crescents along the outer edge. The ventral (bottom) surface of both sexes is grayish fawn to pearly gray with several rows of small black spots on the inner portions of both wings and a row of metallic blue-green, orange, and black spots just inside the outer margin of both wings, becoming less pronounced in the forewing. (MNFI 2013g)

The Karner blue butterfly usually is associated with landscapes composed of sandy soils, which supported oak or oak-pine savanna or barrens prior to European settlement. Because their historical habitat suffers from fire suppression efforts, the butterfly often occurs in forest openings, old fields, and ROWs surrounded by close-canopied oak forest. Karner blue larvae feed exclusively on wild lupine (*Lupinus perennis*). Adults visit a wide variety of flowering plants for nectar. The Karner blue butterfly has a specific need for habitats that include openings with lupine in dry southern forests. (MNFI 2013g)

The Karner blue butterfly is federally listed as endangered by the USFWS and state listed as threatened. It has been found in Monroe County twice, most recently in 2008. (MNFI 2013g)

Plants

Eastern Prairie Fringed Orchid

The eastern prairie fringed orchid (*Plantathera leucophaea*) is a stout orchid (up to 3 feet) of wet prairies and bogs; stem leafy, with larger lanceolate leaves at base; flowers creamy-white and three-parted with a prominently fringed lower lip, clustered on a terminal stalk. (MNFI 2013h)

Eastern prairie fringed orchid is found in moist alkaline and lacustrine soils. It is primarily found in moist prairie remnants, particularly those associated with lake plains, but it can also occur in open or semi-open bogs and peaty lakes shores. Though rare, this orchid can readily colonize highly disturbed sites like ditches, unmowed old fields, and even the edges of golf courses, as long as competition is not overly intense and proper soil fungi are present. (MNFI 2013h)

The eastern prairie fringed orchid is federally listed as threatened and state listed as endangered. It has been observed twice in Monroe County as recently as 2006. (MNFI 2013h)

3.6.12.2 State-Listed Species

MNFI records (MNFI 2013i; MNFI 2013j; MNFI 2013k) were reviewed regarding the presence of known or potential occurrences of state-listed animals and plants in and around the Fermi site. Terrestrial and aquatic species listed by MDNR to occur in Monroe or Wayne counties are shown in Table 3.6-6. All species previously discussed in Section 3.6.12.1 are also state listed and are not repeated in this section discussion. Because the species listing in Table 3.6-6 is voluminous, DTE is limiting the discussion of state-listed species to those that are either discussed in the MNFI consultation response letter (see Attachment B) or were identified as being present on the Fermi site in a previous study. It should be noted that in some cases the species discussed below have been reported on the Fermi site but not listed by MNFI as being present in Monroe or

Wayne counties. In 2013, an updated terrestrial survey for threatened and endangered species was conducted on site (Kogge and Heslinga 2013). A number of plants previously reported as being on site were not observed and are believed not to be present based on, for example, the absence of suitable habitat or location outside the geographic range of the species. These plants are only identified in Table 3.6-6. Birds that were identified in previous surveys as being on site, but where no suitable nesting habitat is available and are believed to be migrant, are also only listed in Table 3.6-6. A discussion of species of special concern can be found in Section 3.6.12.6.

Fish

Although there are state-listed fish species in Monroe and Wayne counties as shown in Table 3.6-6, DTE has elected not to include a discussion of these species, because no fish species were listed in the MNFI consultation response letter (see Attachment B). Also, Section 2.4.2.3 of the Fermi 3 FEIS provides a discussion of some selected state-listed species.

Mollusks

Black Sandshell

The black sandshell (*Ligumia recta*) is up to 10 inches long and is elongate and quadrate in shape. The shell is usually fairly thick, heavy, somewhat inflated and cylindrical. The anterior end is rounded or saber-shaped depending on gender. Beaks are situated nearer to the anterior margin than the posterior margin. The beak sculpture has two to three indistinct, double-looped bars. (ADW 2013a)

The black sandshell is found in rivers, lakes, and large streams, usually in riffles or raceways with good current. (ADW 2013a) The black sandshell is listed in Michigan as endangered (MNFI 2013l) and was last observed in the area in 1980 (Attachment B). Suitable habitat for this species is not present at the Fermi site (Kogge and Heslinga 2013).

Eastern Pondmussel

The eastern pondmussel (*Ligumia nasuta*) is up to 4 inches long and is elongate in shape. The outer shell layer is smooth, except for growth lines and tan to dark green, sometimes with fine green rays. The beak cavity is shallow to moderately deep. Although the nacre is white, occasionally it has a pink or salmon tint and is iridescent at the posterior end. (ADW 2013b)

The eastern pondmussel is found in the lower peninsula of Michigan in drainages on the eastern side of the state, generally in lakes, ponds, and quiet streams of water. (ADW 2013b) The eastern pondmussel is listed in Michigan as endangered. (MNFI 2013l) Suitable habitat for this species is not present at the Fermi site. (Kogge and Heslinga 2013)

Purple Wartyback

The purple wartyback (*Cyclonaias tuberculata*) has a roughly circular shell (to 5 inches) with numerous bumps covering about three-quarters of the exterior. The beak sculpture consists of numerous wavy ridges and the cavity is very deep. They have very heavy, well developed cardinal teeth and lateral teeth along the hinge. The thick and heavy shell is yellowish brown or green brown, becoming dark brown in older individuals. Nacre color ranges from white with a hint of purple to deep purple. (MNFI 2013m)

The purple wartyback is found in medium to large rivers with gravel or mixed sand and gravel substrates. The purple wartyback is listed in Michigan as threatened and was last reported in Monroe County in 2000 and in Wayne County in 2006. (MNFI 2013m) Suitable habitat for this species is not present at the Fermi site (Kogge and Heslinga 2013).

Round Hickorynut

The round hickorynut (*Obovaria subrotunda*) is a small (average size is 1.75 inches) mussel that has a nearly perfect circular shell that is moderately thick and inflated. The shell is brown, smooth, and lacks rays. The beak is centrally located, and the beak sculpture has slight, indistinct circular ridges, which are especially apparent on young individuals. The round hickorynut is typically found in medium to large rivers and along the shores of Lake Erie and Lake St. Clair, near river mouths. The round hickorynut generally is found in sand and gravel substrates in areas with moderate flow. (MNFI 2012c)

The round hickorynut mussel is listed in Michigan as endangered and has been found in Monroe County as recently as 1977 (MNFI 2012c). Suitable habitat for this species is not present at the Fermi site. (Kogge and Heslinga 2013)

Amphibians

Blanchard's Cricket Frog

The Blanchard's cricket frog (*Acris crepitans blanchardi*) is a small, warty-skinned frog that grows to between 0.6 and 1.5 inches as an adult. It is usually tan, brown, gray, or olive green, sometimes with scattered green, reddish, or black blotches and a broad light stripe down the back. A dark triangular mark is usually visible between the eyes on top of the head. (MNFI 2013n)

The Blanchard's cricket frog inhabits a large variety of habits including permanent ponds, lakes, floodings, bogs, seeps, and slow-moving streams and rivers. It prefers open or partially vegetated mud flats, muddy or sandy shorelines, and mats of emergent aquatic vegetation in shallow water. It has natural community types of coastal plain marsh, rich tamarack swamp, emergent marsh, inundated shrub swamp, wet prairie, southern shrub-carr, bog, prairie fen, and southern wet meadow. (MNFI 2013n)

The Blanchard's cricket frog is listed as threatened in Michigan. It has been seen once in Monroe County, in 1913 (MNFI 2013n). It has been reported at the Fermi site in a previous site survey, 1973–74 (Fermi 1978, Appendix 2B, page 140). Night-time surveys were conducted in July 2013 (species mating season) to specifically listen for the Blanchard's cricket frog. The species was not heard. (Kogge and Heslinga 2013)

Reptiles

Eastern Fox Snake

The eastern fox snake is large (adult length 3 to 5.5 feet), boldly patterned snake with large dark brown or black blotches down the middle of the back and smaller, alternating blotches along the sides of a yellowish to light-brown body. The underside is yellowish checkered with dark squarish spots. The head can be yellow, light brown to reddish-brown and is generally unmarked except for a dark band between the eyes on the top of the head and a few dark bands extending from the eye down to the mouth. Juvenile eastern fox snakes are paler in color than the adults and have gray or brown blotches bordered in black on the back and more distinctive head markings. (MNFI 2013o)

The eastern fox snake inhabits emergent wetlands along Great Lakes shorelines and associated large rivers and impoundments. They prefer habitats with herbaceous vegetation such as cattails. Although primarily an open wetland species, eastern fox snakes also occupy drier habitats such as vegetated dunes and beaches, old fields, and open woodlands. They also are able to utilize disturbed areas such as farm fields, pastures, woodlots, vacant urban lots, rock riprap, ditches, dikes, and residential properties. Eastern fox snakes are usually found near water, and are capable of swimming long distances over open offshore waters and between islands. This species deposits its eggs in or under the soil, woody debris, sawdust piles, decaying vegetation, and mammal burrows, and it hibernates in abandoned mammal burrows, muskrat lodges, or other suitable shelters. (MNFI 2013o)

The eastern fox snake is listed as threatened in Michigan. There have been nine occurrences of the eastern fox snake reported by the state in Monroe County, with the most recent being in 2007. (MNFI 2013o) This species of snake was sighted twice on the Fermi property in June 2008 (DECo 2011, page 2-334). In 2013, this species was sighted once on the Fermi property on a sand/gravel beach on the northern edge of the site (Kogge and Heslinga 2013).

Birds

Barn Owl

The barn owl (*Tyto alba*) is a medium-sized owl (16 inches in length), with pale tawny upperparts and white under parts. The heart-shaped white facial disk and dark eyes are distinctive. (MNFI 2013p) The barn owl is a distinctive species that uses a wide array of natural community types, including agricultural lands and buildings. These resident birds may be found year-round if prey species are abundant. Although reported in the region in the early 1980s, there appear to be no recent reports of occurrence and no observations were made during project-related studies. (DECo 2011, page 2-333)

The barn owl is listed as endangered in Michigan and has been observed four times in Monroe County, most recently in 1982 (MNFI 2013p).

Caspian Tern

The caspian tern (*Sterna caspia*) is the largest of the terns, with a wingspan averaging 31 inches. Its larger size, stout red bill, and a lack of a deeply forked tail distinguish it from other white terns found in the state. It has a black cap, large red bill, and a tern-like habit of flying slowly with its bill pointed downward. (MNFI 2013q)

Caspian terns nest on islands to avoid many terrestrial predators. They have a natural community type of sand and gravel beaches. (MNFI 2013q) The caspian tern is listed as threatened in Michigan. Twelve caspian terns were seen feeding in the water off the far northern portion of the Fermi site during the updated 2013 site terrestrial surveys (Kogge and Heslinga 2013). MNFI does not list this species as occurring in either Monroe or Wayne counties (MNFI 2013q). No indications of nesting were observed in the updated July and August 2013 terrestrial surveys, and the known nesting range of Caspian terns in Michigan is restricted to certain central and northern Michigan counties. Utilization of the site is likely temporary or sporadic. (Kogge and Heslinga 2013)

Common Moorhen

The common moorhen (*Gallinula chlorpus*) is a duck-like bird with a dark body, white undertail, and white flank stripes. Its most conspicuous characteristic is the red-orange bill and forehead shield with a yellow-tip. (MNFI 2013r)

The common moorhen uses a variety of emergent marsh types but also lakes and ponds with emergent and grassy vegetation along the border. It has a natural community type of great lakes marsh, coastal plain marsh, and emergent marsh. The common moorhen is listed as threatened in Michigan. MNFI indicates that this species has been observed in Monroe County only once, in 1986. (MNFI 2013r) The common moorhen was not seen on site during the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013). It was last documented on site during the 1973–74 survey (NUS Corporation 1974).

Common Tern

The common tern (*Sterna hirundo*) has a slender body, long pointed wings (31-inch average wingspan), and deeply forked tail, and its typical call is a drawled "kee-arr" (MNFI 2013s).

The common tern is one of the most widespread terns, but was nearly wiped out in the late 19th century by hunters seeking its feathers. The 1918 Migratory Bird Treaty Act (MBTA) helped protect it, and its numbers increased, but populations have declined again in recent decades due to human disturbance, habitat loss, and pollution. Common terns nest in a shallow scrape on bare sand, often gravel or similar surface. They use dry vegetation and debris during incubation. They usually have one brood of two to three eggs in May through August. They mainly eat fish that they catch by plunging into the water. (Vuilleumier 2009)

The common tern is listed as threatened in Michigan, and was seen on site in 2009. (Black and Veatch 2009b) This species was not observed in the updated July and August 2013 terrestrial surveys. Optimal habitat for nesting was not found on the Fermi property as this species prefers to nest on islands, away from human disturbances and land-based predators. (Kogge and Heslinga 2013)

<u>Peregrine Falcon</u>

The peregrine falcon (*Falco peregrinus*) is relatively large for a falcon, with a wingspan of 41 inches. Its body is stocky, with pointed wings and a short tail. The adult falcon has a slate gray back, white breast, finely barred underparts, a black cap, white cheek patch and distinctive dark, heavy "sideburns." (MNFI 2013t)

Peregrine falcons historically nested on cliff faces, but they have been introduced in several Michigan cities and are faring quite well by nesting on many types of manmade structures and feeding on the abundance of small city birds like rock pigeons. The peregrine falcon is listed in Michigan as endangered and was reported in both Monroe and Wayne counties in 2012 (MNFI 2013t), though not specifically identified in the MNFI consultation response letter (Attachment B). This species was observed on site in April 2009 (Black and Veatch 2009b), but was not observed on site in the updated July and August 2013 terrestrial surveys and is not believed to be nesting on site (Kogge and Heslinga 2013).

Plants

<u>American Lotus</u>

The American lotus (*Nelumbo lutea*) is a large perennial plant that grows from thick tubers and flowers in mid-summer. Healthy populations of American lotus are found in scattered areas of southern Michigan. The species is distributed from New England to Florida and west to Michigan and Texas. It occurs in shallow water, usually in marshes, quiet backwaters, and near-shore areas of large rivers and lakes. (DECo 2011, page 2-334)

American lotus is listed in Michigan as threatened (MNFI 2013u). This species is abundant in the south and north lagoons on the Fermi site (DECo 2011, page 2-334). The total area of American lotus on the site is approximately 65 acres, which represents a regionally significant population of American lotus (Kogge and Heslinga 2013).

<u>Arrowhead</u>

The arrowhead (*Sagittaria montevidensis*) is a stout aquatic-emergent of marshes: leaves broadly arrow-shaped, much broader than long; flowers white, with sepals closely cupped around the flower and fruit (MNFI 2013v). Broad-leaved arrowhead is found in wet to shallowly inundated mud flats and banks, lagoons, and estuaries (DECo 2011, page 2-334).

The arrowhead is listed in Michigan as threatened and has been observed in Monroe County as recently as 2001 (MNFI 2013v). This species was a part of an updated terrestrial survey in July and August of 2013 and was not seen on site (Kogge and Heslinga 2013).

Bugleweed (Virginia Water-Horehound)

The bugleweed (*Lycopus virginicus*) is a small forb found in floodplain forests. It has a stem without a tuberous base, and its leaves are elliptic and coarsely serrated. Its flowers are tiny and white, and it fruits are a set of four tiny nutlets with tiny triangular calyx lobes not longer than the nutlets. (MNFI 2013w)

The bugleweed is found in first and second bottoms of floodplain forests and has a natural community type of floodplain forest. The bugleweed is listed as threatened in Michigan. (MNFI 2013w) It has been reported on the Fermi site in the restored prairie and the western edge of the mixed hardwood forest adjacent to Bullit Road, as recently as 2009. (Black and Veatch 2009a) In July and August 2013, an updated terrestrial site survey was conducted and specifically looked for this species, but did not identify any on site, despite the presence of potential habitat (Kogge and Heslinga 2013).

Purple Coneflower

The purple coneflower (*Echinacea purpurea*) is a stout perennial forb (approximately 3 feet or more) found in mesic prairies. It has leaves that are broadly lanceolate, toothed and hairy. Its flowers are large with a dark central disk and numerous purple drooping petals. (MNFI 2013x)

The purple coneflower is primarily found in prairie remnants. The purple coneflower was seen on the Fermi site in the prairie during the updated 2013 terrestrial surveys (Kogge and Heslinga 2013), as well as in the prairie during the 2009 site survey (Black and Veatch 2009a). However, this species was part of a prairie seed mix that was previously planted in this area in 2005. This population does not represent a natural, remnant population that is tracked by the State or required to be protected. The purple coneflower is listed as extirpated (legally 'threatened' if rediscovered) in Michigan. (MNFI 2013x)

Red Mulberry

The red mulberry (*Morus rubra*) is a medium-sized tree of forested floodplains. Most of its leaves are broadly ovate, heart-shaped at base (superficially similar to basswood [*Tilia americana*] but not offset at the base), and roughly pubescent on the surface. Some leaves may be irregularly lobed. This tree recently was listed in Michigan as threatened. It was last found in Monroe County in 1949 and in Wayne County in 2006. (MNFI 2013y)

This species was a part of an updated terrestrial survey in July and August of 2013 and was not seen on site (Kogge and Heslinga 2013). This species has been reported to be on site in a previous survey (Fermi 2002); however, it is easily mistaken for a white mulberry (*Morus alba*). Due to a lack of optimal habitat, this species is not believed to be on site. However, white mulberry, a very common non-native species that is commonly found in disturbed areas, was identified on site (Kogge and Heslinga 2013).

3.6.12.3 Essential Fish Habitat

Endangered Species Act

During the Fermi 3 licensing activity, NOAA was consulted regarding essential fish habitat (EFH) in the vicinity of the Fermi site. In a letter dated November 17, 2011, NOAA concluded that there was no EFH in the vicinity of the Fermi site. (NOAA 2011)

3.6.12.4 Species Protected Under Other Acts

In addition to the federal and state laws which are protective of the species discussed in Sections 3.6.12.1 and 3.6.12.2, two other federal laws, the MBTA and the Bald and Golden Eagle Protection Act, mandate the protection of certain species.

Based on previous avian surveys (Section 3.6.8), there are several bird species protected under the MBTA that have the potential to occur in the vicinity of or in transit through the Fermi site. These consist of the common grackle, red-winged blackbird, herring gull, ring-billed gull, brown-headed cowbird, northern pintail, Canada goose, turkey vulture, mallard, tufted titmouse, hairy woodpecker, and red-tailed hawk, as discussed in Section 3.6.8.

In addition, all 18 bird species shown in Table 3.6-6 are protected under the MBTA, one of which is also protected under the Bald and Golden Eagle Protection Act. While the bald eagle does occur on site as discussed in Section 3.6.8, there is a potential for ospreys, peregrine falcons, and barn owls to transit the Fermi site. A discussion the osprey is included in Section 3.6.12.6; the peregrine falcon and barn owl is included in Section 3.6.12.2; and a discussion of the bald eagle can be found below. There have been no sightings of the remaining species, although the potential exists for them to transit the Fermi site.

Bald Eagle

The bald eagle is a large bird of prey with a wingspan of up to 7.5 feet. Mature adults are readily recognized by their white head and tail and dark brown body. Their hooked beak and feet are yellow. Juvenile plumages are variable, but the head and tail have increasing amounts of white until they obtain their adult plumage at about 5 years of age. Females are larger than males. Bald eagles nest in a variety of habitats close to water. They may stay year-round as long as there is open water where they can forage. (MNFI 2013z) Bald eagles are opportunistic feeders that prefer to scavenge on carrion and steal prey from other birds (Vuilleumier 2009).

While found throughout the continent, the bald eagle is a state species of special concern (MNFI 2013z). As of August 8, 2007, the bald eagle was formally delisted from the endangered species act. However, the species continues to receive federal protection under the MBTA and the Bald and Golden Eagle Protection Act, which prohibit the take, transport, sale, barter, trade, import and export, and possession of eagles, making it illegal for anyone to collect eagles and eagle parts, nests, or eggs without a USFWS permit. (USFWS 2012d) Bald eagles were observed nesting at the Fermi site during a site walk down in May 2012. Bald eagles were observed during the updated 2013 site terrestrial surveys (Kogge and Heslinga 2013).

3.6.12.5 Federal and State Agency Consultations

In an effort to obtain an independent review, the USFWS and the MDNR were consulted for input regarding federally and state-listed threatened, endangered, and protected species, and designated critical habitat on the Fermi 2 site and vicinity (Attachment B). The response from the MDNR deferred project review requests to the MNFI, a program of the Michigan State University Extension. Responses from USFWS, MDNR, and MNFI are included in Attachment B.

3.6.12.6 Species of Special Concern

The State of Michigan has given several species of plants and animals the status of "Species of Special Concern." While these species are not afforded legal protection under Part 365 of the Michigan Natural Resources and Environmental Protection Act, many of these species are of concern because of declining or relict populations in the state. (MNFI 2013l) A summary of the species of special concern that have been noted on or in the vicinity of the Fermi property can be found in Table 3.6-6.

DTE is limiting the discussion of state-listed species of special concern to those that are either discussed in the MNFI consultation response letter (see Attachment B) or were identified as being present on the Fermi site in a previous study. It should be noted that, in some cases, the species discussed below have been reported on the Fermi site but not listed by MNFI as being present in Monroe or Wayne counties. In 2013, an updated terrestrial survey for threatened and endangered species was conducted on site. A number of plants previously reported as being on site were not observed and are believed not to be present based on, for example, the absence of suitable habitat or location outside the geographic range of the species. These plants are only identified in Table 3.6-6. Birds that were identified in previous surveys as being on site, but where no suitable nesting habitat is available and are believed to be migrant, are also only listed in Table 3.6-6.

3.6.12.6.1 MNFI Identified Species of Special Concern

The MNFI has identified the following species of special concern as being within 1.5 miles of Fermi 2 (Attachment B):

Mollusks

Of the seven threatened, endangered, or special concern freshwater mussel species identified by MNFI (Attachment B) to potentially occur on or near the subject property, only one species (paper pondshell) was determined to have the potential of being present on the site. (Kogge and Heslinga 2013)

Kidney Shell

The kidney shell (*Ptychobranchus fasciolaris*) is usually found in small to medium rivers, usually in areas with fairly good flow. It generally inhabits substrates of sand and/or gravel. (ADW 2013c) It was last observed in the area prior to 1954. (Attachment B) Suitable habitat for this species is not present at the Fermi site (Kogge and Heslinga 2013).

Paper Pondshell

The paper pondshell (*Utterbackia imbecillis*) can be found in ponds, lakes, or mud-bottomed pools of creeks and rivers (ADW 2013d). It was last observed in the area in 1935 (Attachment B). Suitable habitat for this species is present at the Fermi site (Kogge and Heslinga 2013).

Round Pigtoe

The round pigtoe (*Pleurobema sintoxia*) can be found in mud, sand, or gravel substrates of medium to large rivers. It has been identified in Monroe County several times, most recently in 2000. (MNFI 2013aa) Suitable habitat for this species is not present at the Fermi site (Kogge and Heslinga 2013).

Birds

Bald Eagle

Refer to Sections 3.6.8 and 3.6.12.4 for a thorough discussion of the bald eagle.

Plants

Trailing Wild Bean

The trailing wild bean (*Strophostyles helvula*) can be found in sandy soil, thickets on disturbed ground, roadsides, ditch banks, beaches, and dunes (MNFI 2013bb). It was last observed in the area in 1982. (Attachment B)

3.6.12.6.2 Additional Species of Special Concern

In addition to those species of special concern identified by the MNFI, several species have been seen on site recently or are known to reside on site. Typical habitats and onsite locations of these species are discussed below.

Reptiles

Blanding's Turtle

The Blanding's turtle (*Emydoidea blandingii*) inhabits clean, shallow waters with abundant aquatic vegetation and soft muddy bottoms over firm substrates. This species is found in ponds, marshes, swamps, bogs, wet prairies, river backwaters, embayments, sloughs, slow moving rivers, and lake shallows and inlets. Females nest in open uplands adjacent to wetland habitats, preferring sunny areas with moist but well-drained sandy or loamy soil. (MNFI 2013cc) This species was last seen on site in April 2009 by DTE staff (Black and Veatch 2009b). This species was not seen on site during the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013).

Eastern Box Turtle

The eastern box turtle (*Terrapene carolina carolina*) has a typical habitat occurring in forested habitats with sandy soils near a source of water such as a stream, pond, lake, marsh or swamp. They also may be found in adjacent thickets, old fields, pastures, or vegetated dunes. They will nest in unshaded sandy, open areas. (MNFI 2013dd) One eastern box turtle was identified during the updated July and August 2013 terrestrial surveys in a mowed area along a roadside south of the quarry lakes (Kogge and Heslinga 2013).

Queen Snake

The queen snake (*Regina septemvitta*) occurs in or near shallow streams, canals, or ponds and often basks in shrubs hanging over the water. They are generally found in the southern two thirds of Michigan's Lower Peninsula and are generally uncommon and local in Michigan. (MDNR 2013) The queen snake has been seen on site as recently as 2008 along the Lake Erie shoreline, south of the plant (Black and Veatch 2009b). This species was not seen on site during the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013).

Birds

Black-Crowned Night Heron

The black-crowned night heron (*Nycticorax nycticorax*) typically nests near the coast of the Great Lakes. Adults may forage inland during the nestling stage, and both adults and immature birds may show up during migration. (MNFI 2013ee) Although no nesting colonies were observed, black-crowned night herons were observed on site during the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013).

Marsh Wren

The marsh wren (*Cistothorus palustris*) has an ideal habitat in narrow-leafed cattail and cord-grass marshes. Nest placement over standing water in dense cattail is preferred. (MNFI 2013ff) This migratory bird was seen in a July 2008 survey on the outer edge of the dredge disposal facility (Black and Veatch 2009b) and again in the updated July and August 2013 terrestrial surveys on the north side of the south lagoon. Although no nests were observed, the repeated singing of males is suggestive of breeding activity (Kogge and Heslinga 2013).

Northern Harrier

The northern harrier (*Circus cyaneus*) nests and hunts in a variety of open habitats dominated by herbaceous vegetation. Large patches of suitable habitat are important to this ground-nesting raptor. (MNFI 2013gg) This migratory bird was observed on site in April 2009 (Black and Veatch 2009b) and occasionally during onsite Christmas bird surveys, but was not observed on site in the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013).

Osprey

The osprey (*Pandion haliaetus*) historically nests only in trees or snags or on cliffs, but have adapted to use some manmade structures such as utility poles and towers, chimneys, windmills, buoys, and platforms. Preferred nest sites are above or near water. This migratory bird was reported on the northern edge of the Fermi site (Black and Veatch 2009b), although MNFI (2013hh) does not list this species as occurring in either Monroe or Wayne counties. A story about banding chicks in an osprey nest north of the Fermi site in Estral Beach was reported in the *Monroe Evening News* on July 13, 2013. No ospreys, though, were observed on site during the updated July and August 2013 terrestrial surveys (Kogge and Heslinga 2013).

Plants

Purple Sand Grass

Purple sand grass (*Triplasis purpurea*) is found in sandy, open ground where there is little competition, usually within oak savanna and prairie complexes. It also occurs along dunes on the Great Lakes shoreline (MNFI 2013ii). This species was identified during the updated July and August 2013 terrestrial surveys in a 0.10-acre area on the sand-gravel beach on the northern shore (Kogge and Heslinga 2013).

Table 3.6-1
Common Animals Occurring on or in the Vicinity of the Fermi Site[(a)]

Common Name	Scientific Name
Amphibians	
American toad	*Bufo americanus*
Bullfrog	*Rana catesbiana*
Chorus frog	*Pseudacris triseriata*
Northern leopard frog	*Rana pipiens pipiens*
Birds	
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
European starling	*Sturnus vulgaris*
Hairy woodpecker	*Picoides villosus*
Herring gull	*Larus argentatus*
Mallard	*Anas platyrhynchos*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-billed gull	*Larus delawarensis*
Tufted titmouse	*Baeolophus bicolor*
Mammals	
Badger	*Taxidea taxus*
Coyote	*Canus latrans*
Eastern cottontail rabbit	*Sylvilagus floridanus*
Eastern fox squirrel	*Sciurus niger*
Feral cat	*Felis catus*
Gray squirrel	*Sciurus carolinensis*
House mouse	*Mus musculus*
Masked shrew	*Sorex cinereus*
Meadow vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethica*

Table 3.6-1 (Continued)
Common Animals Occurring on or in the Vicinity of the Fermi Site[a]

Common Name	Scientific Name
Norway rat	*Rattus norvegicus*
Opossum	*Didelphis virginiana*
Prairie deer mouse	*Peromyscus maniculatus*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes*
Red squirrel	*Tamiasciurus hudsonicus*
Short-tailed shrew	*Blarina brevicauda*
Striped skunk	*Mephitis mephitis*
White-footed mouse	*Peromyscus leucopus*
White-tailed deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
Reptiles	
Banded water snake	*Natrix sipedon fasciata*
Eastern fox snake	*Elaphe gloydi*
Eastern garter snake	*Thamnophis sirtalis sirtalis*
Eastern milk snake	*Lampropeltis doliata triangularius*
Eastern spiny softshell turtle	*Trionix spiniferus*
Map turtle	*Graptemys geographica*
Midland painted turtle	*Chrysemys picta marginata*
Northern water snake	*Natrix sipedon sipedon*
Painted turtle	*Chrysemys picta*
Snapping turtle	*Chelydra serpentine serpentina*
Speckled kingsnake	*Lampropeltis getulus holbrooki*
Three-toed box turtle	*Terrapene carolina triunquis*

(DECo 2011)

a. This is not a comprehensive list of all animals that may be found on or in the vicinity of the Fermi site.

Table 3.6-2
Fish Species Found on and in the Vicinity of the Fermi Site

Common Name	Scientific Name[a]
Alewife	*Alosa pseudoharengus*
Banded killifish	*Fundulus diaphanus*
Bigeye chub	*Hybopsis amblops*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black bullhead	*Ameiurus melas*
Blackchin shiner	*Notropis heterodon*
Blacknose shiner	*Notropis heterolepis*
Blackside darter	*Percina maculata*
Bluegill	*Lepomis macrochirus*
Bluntnose minnow	*Pimephales notatus*
Bowfin	*Amia calva*
Brindled madtom	*Noturus miurus*
Brook silverside	*Labidesthes sicculus*
Brook stickleback	*Culaea inconstans*
Brown bullhead	*Ameiurus nebulosus*
Carp	*Cyprinus carpio*
Central mudminnow	*Umbra limi*
Central stoneroller	*Campostoma anomalum*
Channel catfish	*Ictalurus punctatus*
Channel darter	*Percina copelandi*
Common shiner	*Luxilus cornutus*
Creek chub	*Semotilus atromaculatus*
Creek chubsucker	*Erimyzon oblongus*
Emerald shiner	*Notropis atherinoides*
Fantail darter	*Etheostoma flabellare*
Fathead minnow	*Pimephales promelas*
Flathead catfish	*Pylodictis olivaris*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Golden redhorse	*Moxostoma erythrurum*

Table 3.6-2 (Continued)
Fish Species Found on and in the Vicinity of the Fermi Site

Common Name	Scientific Name[a]
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Green sunfish	*Lepomis cyanellus*
Greenside darter	*Etheostoma blenniodes*
Hornyhead chub	*Nocomis biguttatus*
Iowa darter	*Etheostoma exile*
Johnny darter	*Etheostoma nigrum*
Lake chubsucker	*Erimyzon sucetta*
Largemouth bass	*Micropterus salmoides*
Least darter	*Etheostoma microperca*
Logperch	*Percina caprodes*
Longear sunfish	*Lepomis megalotis*
Longnose gar	*Lepisosteus osseus*
Mottled sculpin	*Cottus bairdi*
Northern hog sucker	*Hypentelium nigrans*
Northern pike	*Esox lucius*
Orangespotted sunfish	*Lepomis humilis*
Orangethroat darter	*Etheostoma spectabile*
Pugnose minnow	*Opsopoeodus emiliae*
Pumpkinseed	*Lepomis gibbosus*
Quillback	*Carpiodes cyprinus*
Rainbow darter	*Etheostoma caruleum*
Redfin pickerel[b]	*Esox americanus*
Redfin shiner	*Lythrurus umbratilis*
River chub	*Nocomis micropogon*
River darter	*Percina shumardi*
Rock bass	*Ambloplites rupestris*
Rosyface shiner	*Notropis rubellus*
Sand shiner	*Notropis stramineus*

Table 3.6-2 (Continued)
Fish Species Found on and in the Vicinity of the Fermi Site

Common Name	Scientific Name[a]
Sauger	*Sander canadensis*
Shorthead redhorse	*Moxostoma macrolepidotum*
Silver redhorse	*Moxostoma anisurum*
Silverjaw minnow	*Notropis buccatus*[c]
Smallmouth bass	*Micropterus dolomieu*
Spotfin shiner	*Cyprinella spiloptera*
Spottail shiner	*Notropis hudsonius*
Spotted gar	*Lepisosteus oculatus*
Spotted sucker	*Minytrema malanops*
Stonecat	*Noturus flavus*
Striped shiner	*Luxilus chrysocephalus*
Tadpole madtom	*Noturus gyrinus*
Trout	*Salmonidae*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus*
Western mosquitofish	*Gambusia affinis*
White bass	*Morone chrysops*
White perch	*Morone americana*
White sucker[b]	*Catostomus commersonii*[c]
Yellow bullhead	*Ameiurus natalis*
Yellow perch	*Perca flavescens*

(DECo 2011)

a. Scientific names from Nelson et al. 2004.
b. Common name has been corrected here.
c. Scientific name has been corrected here.

Table 3.6-3
Commercial and Recreational Fish Species in the Vicinity of the Fermi Site

Common Name	Scientific Name	Commercial Importance	Use
Alewife	*Alosa pseudoharengus*	Animal food	Baitfish
Black crappie	*Pomoxis nigromaculatus*	Food species	Sportfish
Bluegill	*Lepomis macrochirus*	Food species	Sportfish
Bluntnose minnow	*Pimephales notatus*	N/A	Baitfish
Carp	*Cyprinus carpio*	Commercial fishery	Sportfish
Channel catfish	*Ictalurus punctatus*	Commercial fishery	Sportfish
Common shiner	*Luxilus cornutus*	N/A	Baitfish
Emerald shiner	*Notropis atherinoides*	N/A	Baitfish
Freshwater drum	*Aplodinotus grunniens*	Commercial fishery	Sportfish
Gizzard shad	*Dorosoma cepedianum*	N/A	Baitfish
Largemouth bass	*Micropterus salmoides*	Food species	Sportfish
Pumpkinseed	*Lepomis gibbosus*	N/A	Sportfish
Quillback	*Carpiodes cyprinus*	Commercial fishery	Sportfish
Rainbow smelt	*Osmerus mordax*	Animal food	Sportfish
Rock bass	*Ambloplites rupestris*	Food species	Sportfish
Spottail shiner	*Notropis hudsonius*	N/A	Baitfish
Walleye	*Sander vitreus*	Food species	Sportfish
White bass	*Morone chrysops*	Food species	Sportfish
White crappie	*Pomoxis annularis*	Food species	Sportfish
White perch	*Morone americana*	N/A	Sportfish
Yellow perch	*Perca flavescens*	Food species	Sportfish

(DECo 2011, Table 2.4-14)

N/A indicates a fish which is not commercially important in the vicinity of the Fermi site.

Table 3.6-4
Individual Phytoplankton Taxa from Lake Erie Near the Davis-Besse Power Plant

Family	Scientific Name
Bacillariophyceae	*Asterionella formosa*
	Diatoma spp.
	Fragilaria crotonensis
	Gyrosigma spp.
	Melosira spp.
	Navicula spp.
	Nitzschia sigmoidea
	Nitzschia spp.
	Sceletonema subsalsa
	Stephanodiscus spp.
	Stephanodiscus binderanus
	Surirella spp.
	Synedra actinastroides
	Synedra spp.
	Tabellaria spp.
Chlorophyceae	*Actinastrum hantzchii*
	Actinastrum spp.
	Ankistrodesmus falcatus
	Binuclearia tatrana
	Botryococcus sudeticus
	Closteriopsis longissima
	Closterium acerosum
	Closterium spp.
	Coelastrum spp.
	Cosarium spp.
	Dictyospahaerium spp.

Table 3.6-4 (Continued)
Individual Phytoplankton Taxa from Lake Erie Near the Davis-Besse Power Plant

Family	Scientific Name
Chlorophyceae (continued)	*Kirchneriella spp.*
	Oocystis spp.
	Pediastrum duplex
	Pediastrum simplex
	Scenedesmus spp.
	Selenastrum spp.
	Spirogyra crassa
	Spirogyra spp.
	Staurastrum paradoxum
	Tetraspora spp.
	Trentepohlia spp.
	Unidentified
Chrysophyseae	*Dinobryon spp.*
Dinophyceae	*Ceratium hirudinella*
	Peridinium spp.
Euglenophyceae	*Euglena spp.*
Myxophyceae	*Anabaena spiroides*
	Anabaena spp.
	Aphanizomenon flos-aquae
	Chroococcus spp.
	Coelsphaerium spp.
	Merismopedia spp.
	Microcystis spp.
	Oscillatoria spp.
	Raphidiopsis spp.
	Unidentified
Protozoa	Unidentified *flagellate*
	Domatomonas spp.

(DECo 2011)

Table 3.6-5
Individual Zooplankton Taxa from Lake Erie Near the Davis-Besse Power Plant

Family	Scientific Name
Cladocera	*Bosmina longirostris*
	Chydorus sphaericus
	Diaphanosoma
	Leuchtenbergianum
	Daphnia galeata mendote
	D. retrocurva
	Eubosmina corregoni (mature)
	E. corregoni (immature)
	Leptodora kindtii
Copepoda	*Calanoid copepods*
	Diaptomus minutus
	D. sicilis
	D. siciloides
	Eurytemora affinis
	Copepodids, calanoid
	Nauplii, calanoid
	Cyclopoid copepods
	Cyclops bicuspidatus thomasi
	C. vernalis
	Mesocyclops edax
	Tropocyclops pransnex
	Copepodids, cyclopoid
	Naupleii, cyclopoid
Protozoa	*Difflugia spp.*
Rotifera	*Asplianchna priodonta*
	Brachionus angularis

Table 3.6-5 (Continued)
Individual Zooplankton Taxa from Lake Erie Near the Davis-Besse Power Plant

Family	Scientific Name
Rotifera (continued)	*B. calyciflorus*
	B. diversicornus
	H. stagnalis
	Cephadella spp.
	Chromogaster spp.
	Filinia terminalis
	Kellicottia longispina
	Keratella cochlearis
	K. quadrata
	K. vulga
	Lecane spp.
	Lepadella spp.
	Notholca spp.
	Polyarthra vulgaris
	Synchaeta spp.
	Trichocerca spp.
	T. multicrinis
	Unknown Rotifer A
	Unknown Rotifer B

(DECo 2011)

Table 3.6-6
Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
FISH[d]			
Brindled madtom	*Noturus miurus*	—	Special Concern
Channel darter	*Percina copelandi*	—	Endangered
Creek chubsucker	*Erimyzon oblongus*	—	Endangered
Eastern sand darter	*Ammocrypta pellucida*	—	Threatened
Lake sturgeon	*Acipenser fulvescens*	—	Threatened
Northern madtom	*Noturus stigmosus*	—	Endangered
Orangethroat darter	*Etheostoma spectabile*	—	Special Concern
Pugnose minnow	*Opsopoeodus emiliae*	—	Endangered
Pugnose shiner	*Notropis anogenus*	—	Endangered
Redside dace	*Clinostomus elongatus*	—	Endangered
River darter	*Percina shumardi*	—	Endangered
River redhorse	*Moxostoma carinatum*	—	Threatened
Sauger	*Sander canadensis*	—	Threatened
Silver chub	*Macrhybopsis storeriana*	—	Special Concern
Silver shiner	*Notropis photogenis*	—	Endangered
Southern redbelly dace	*Phoxinus erythrogaster*	—	Endangered

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
MOLLUSKS			
A fingernail clam	*Pisidium simplex (Neopisidium punctatum)*	—	Special Concern
Black sandshell	*Ligumia recta*	—	Endangered
Brown walker	*Pomatiopsis cincinnatiensis*	—	Special Concern
Campeloma spire snail	*Cincinnatia cincinnatiensis*	—	Special Concern
Deertoe	*Truncilla truncate*	—	Special Concern
Eastern pondmussel	*Ligumia nasuta*	—	Endangered
Elktoe	*Alasmidonta marginata*	—	Special Concern
Fawnsfoot	*Truncilla donaciformis*	—	Threatened
Gravel pyrg	*Pyrgulopsis letsoni*	—	Special Concern
Greater European pea clam	*Pisidium amnicum*	—	Special Concern
Hickorynut	*Obovaria olivaria*	—	Endangered
Kidney shell	*Ptychobranchus fasciolaris*	—	Special Concern
Lilliput	*Toxolasma parvus*	—	Endangered
Northern riffleshell	*Epioblasma torulosa rangiana*	Endangered	Endangered
Paper pondshell	*Utterbackia imbecillis*	—	Special Concern
Proud globe	*Mesodon elevatus*	—	Threatened
Proud globelet	*Mesodon pennsylvanicus*	—	Special Concern

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Purple lilliput	*Toxolasma lividus*	—	Endangered
Purple wartyback	*Cyclonaias tuberculata*	—	Threatened
Rainbow	*Villosa iris*	—	Special Concern
Rayed bean	*Villosa fabalis*	Endangered	Endangered
Round hickorynut	*Obovaria subrotunda*	—	Endangered
Round pigtoe	*Pleurobema sintoxia*	—	Special Concern
Salamander mussel	*Simpsonaias ambigua*	—	Endangered
Slippershell	*Alasmidonta viridis*	—	Threatened
Snuffbox mussel[e]	*Epioblasma triquetra*	Endangered	Endangered
Threehorn wartyback	*Obliquaria reflexa*	—	Endangered
Wavy-rayed lampmussel	*Lampsilis fasciola*	—	Threatened
White catspaw	*Epioblasma obliquata perobliqua*	—	Endangered
Yellow globelet	*Mesodon clausus*	—	Special Concern
AMPHIBIANS			
Blanchard's cricket frog[f][g]	*Acris crepitans blanchardi*	—	Threatened
Smallmouth salamander	*Ambystoma texanum*	—	Endangered

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
REPTILES			
Blanding's turtle[f]	*Emydoidea blandingii*	—	Special Concern
Eastern box turtle[h]	*Terrapene carolina carolina*	—	Special Concern
Eastern fox snake[f][h]	*Elaphe gloydi*	—	Threatened
Eastern massasauga	*Sistrurus catenatus catenatus*	Candidate	Special Concern
Queen snake[f][i]	*Regina septemvittata*	—	Special Concern
Spotted turtle	*Clemmys guttata*	—	Threatened
BIRDS			
Bald eagle[f][h]	*Haliaeetus leucocephalus*	—	Special Concern
Barn owl	*Tyto alba*	—	Endangered
Black-crowned night-heron[f][h]	*Nycticorax nycticorax*	—	Special Concern
Caspian tern[h][i][j][k]	*Hydroprogne caspia*	—	Threatened
Cerulean warbler	*Dendroica cerulea*	—	Threatened
Common moorhen[f][j]	*Gallinula chloropus*	—	Threatened
Common tern[f][j]	*Sterna hirundo*	—	Threatened
Dickcissel[f][j]	*Spiza americana*	—	Special Concern
Forster's tern	*Sterna forsteri*	—	Threatened
Grasshopper sparrow	*Ammodramus savannarum*	—	Special Concern

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Henslow's sparrow	*Ammodramus henslowii*	—	Endangered
King rail	*Rallus elegans*	—	Endangered
Least bittern	*Ixobrychus exilis*	—	Threatened
Marsh wren[f][h]	*Cistothorus palustris*	—	Special Concern
Merlin[f][i][j][k]	*Falco columbarius*	—	Threatened
Northern harrier[f][i]	*Circus cyaneus*	—	Special Concern
Osprey[f][i][j]	*Pandion haliaetus*	—	Special Concern
Peregrine falcon[f][j]	*Falco peregrinus*	—	Endangered
Piping plover[f][i][j][k]	*Charadrius melodus*	Endangered	Endangered
Prothonotary warbler	*Protonotaria citrea*	—	Special Concern
Western meadowlark	*Sturnella neglecta*	—	Special Concern
Wilson's phalarope	*Phalaropus tricolor*	—	Special Concern
Yellow-throated warbler[f][i][j][k]	*Dendroica dominica*	—	Threatened
MAMMALS			
Indiana bat	*Myotis sodalis*	Endangered	Endangered
INSECTS			
Barrens buckmoth	*Hemileuca maia*	—	Special Concern
Blazing star borer	*Papaipema beeriana*	—	Special Concern

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Culvers root borer	*Papaipema sciata*	—	Special Concern
Dukes' skipper	*Euphyes dukesi*	—	Threatened
Dusted skipper	*Atrytonopsis hianna*	—	Special Concern
Elusive snaketail	*Stylurus notatus*	—	Special Concern
Karner blue butterfly[e]	*Lycaeides melissa samuelis*	Endangered	Threatened
Laura's snaketail	*Stylurus laurae*	—	Special Concern
Maritime sunflower borer	*Papaipema maritima*	—	Special Concern
Mitchell's satyr butterfly[e][i]	*Neonympha mitchellii mitchellii*	Endangered	Endangered
Newman's brocade	*Meropleon ambifusca*	—	Special Concern
Regal fritillary	*Speyeria idalia*	—	Endangered
Robinson's underwing	*Catocala robinsoni*	—	Special Concern
Russet-tipped clubtail	*Stylurus plagiatus*	—	Special Concern
Silphium borer moth	*Papaipema silphii*	—	Threatened
Smokey rubyspot	*Hetaerina titia*	—	Special Concern
Swamp metalmark	*Calephelis mutica*	—	Special Concern
Wild indigo duskywing	*Erynnis baptisiae*	—	Special Concern

Table 3.6-6 (Continued)
Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
PLANTS			
American chestnut	*Castanea dentata*	—	Endangered
American lotus[f][h]	*Nelumbo lutea*	—	Threatened
Arrowhead[g][l]	*Sagittaria montevidensis*	—	Threatened
Beak grass	*Diarrhena obovata (Diarrhena americana)*	—	Threatened
Bedstraw[g][i][k][l]	*Galium kamtschaticum*	—	Endangered
Blue-eyed-grass	*Sisyrinchium hastile*	—	Presumed extirpated
Canadian burnet	*Sanguisorba canadensis*	—	Endangered
Chives / Wild chives[f][g][i][k]	*Allium schoenoprasum*	—	Threatened
Climbing fumitory	*Adlumia fungosa*	—	Special Concern
Clinton's bulrush	*Scirpus clintonii*	—	Special Concern
Compass plant	*Silphium laciniatum*	—	Threatened
Conobea	*Leucospora multifida*	—	Special Concern
Corn salad	*Valerianella umbilicata*	—	Threatened
Cross-leaved milkwort	*Polygala cruciata*	—	Special Concern
Cup plant	*Silphium perfoliatum*	—	Threatened
Davis's sedge	*Carex davisii*	—	Special Concern
Downy sunflower	*Helianthus mollis*	—	Threatened

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Dropseed[f][g][i][k]	*Sporobolus clandestinus*	—	Endangered
Dwarf-bulrush	*Hemicarpha micrantha*	—	Special Concern
Eastern prairie fringed orchid[m]	*Plantanthera leucophaea*	Threatened	Endangered
Engelmann's spike rush	*Eleocharis engelmannii*	—	Special Concern
False boneset[f][g][i][k]	*Kuhnia eupatorioides*	—	Special Concern
Fescue sedge	*Carex festucacea*	—	Special Concern
Few-flowered nut rush	*Scleria pauciflora*	—	Endangered
Field chickweed	*Cerastium velutinum*	—	Presumed Extirpated
Fire pink	*Silene virginica*	—	Endangered
Fleabane[g][i][k][l]	*Erigeron acris*	—	Threatened
Forked aster	*Aster furcatus*	—	Threatened
Gattinger's gerardia	*Agalinis gattingeri*	—	Endangered
Gentian-leaved St. John's-wort	*Hypericum gentianoides*	—	Special Concern
Ginseng	*Panax quinquefolius*	—	Threatened
Goldenseal	*Hydrastis canadensis*	—	Threatened
Gray birch	*Betula populifolia*	—	Special Concern
Green violet	*Hybanthus concolor*	—	Special Concern
Hairy angelica	*Angelica venenosa*	—	Special Concern

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Hairy mountain mint	*Pycnanthemum pilosum*	—	Threatened
Hairy wild petunia	*Ruellia humilis*	—	Threatened
Knotweed dodder	*Cuscuta polygonorum*	—	Special Concern
Least pinweed	*Lechea minor*	—	Presumed extirpated
Leggett's pinweed	*Lechea pulchella*	—	Threatened
Leiberg's panic grass	*Dichanthelium leibergii*	—	Threatened
Meadow beauty	*Rhexia virginica*	—	Special Concern
Missouri rock-cress	*Arabis missouriensis var. deamii*	—	Special Concern
Mullein-foxglove	*Dasistoma macrophylla*	—	Endangered
Nodding mandarin	*Prosartes maculata*	—	Presumed Extirpated
Nodding rattlesnake-root	*Prenanthes crepidinea*	—	Threatened
Northern appressed clubmoss	*Lycopodiella subappressa*	—	Special Concern
Orange- or yellow-fringed orchid	*Platanthera ciliaris*	—	Endangered
Pale avens	*Geum virginianum*	—	Special Concern
Pale beard tongue	*Penstemon pallidus*	—	Special Concern
Plains blazing star	*Liatris squarrosa*	—	Presumed Extirpated
Prairie trillium	*Trillium recurvatum*	—	Threatened
Pumpkin ash	*Fraxinus profunda*	—	Threatened

Table 3.6-6 (Continued)
Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Purple coneflower[f][h][i][k]	*Echinacea purpurea*	—	Threatened/Extirpated
Purple milkweed	*Asclepias purpurascens*	—	Threatened
Purple twayblade	*Liparis liliifolia*	—	Special Concern
Raven's-foot sedge	*Carex crus-corvi*	—	Endangered
Red mulberry[f][g]	*Morus rubra*	—	Threatened
Rosepink[f][g][i][k]	*Sabatia angularis*	—	Threatened
Round-fruited St. John's-wort	*Hypericum sphaerocarpum*	—	Endangered
Sand cinquefoil	*Potentilla paradoxa*	—	Threatened
Sand grass[h][i]	*Triplasis purpurea*	—	Special Concern
Sedge	*Carex squarrosa*	—	Special Concern
Short-fruited rush	*Juncus brachycarpus*	—	Threatened
Showy orchis	*Galearis spectabilis*	—	Threatened
Shumard's oak	*Quercus shumardii*	—	Special Concern
Side-oats grama grass[f][g][i][k]	*Bouteloua curtipendula*	—	Endangered
Small love grass	*Eragrostis pilosa*	—	Special Concern
Smooth carrion-flower	*Smilax herbacea*	—	Special Concern
Smooth rose-mallow	*Hibiscus laevis*	—	Presumed extirpated
Stiff gentian	*Gentianella quinquefolia*	—	Threatened

Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Sullivant's milkweed	*Asclepias sullivantii*	—	Threatened
Swamp candles	*Lysimachia hybrida*	—	Presumed Extirpated
Tall green milkweed	*Asclepias hirtella*	—	Threatened
Tall nut rush	*Scleria triglomerata*	—	Special Concern
Three-awned grass	*Aristida longespica*	—	Threatened
Tinted spurge	*Euphorbia commutata*	—	Threatened
Trailing wild bean	*Strophostyles helvula*	—	Special Concern
Twinleaf	*Jeffersonia diphylla*	—	Special Concern
Vasey's rush	*Juncus vaseyi*	—	Threatened
Violet wood sorrel	*Oxalis violacea*	—	Presumed Extirpated
Virginia snakeroot	*Aristolochia serpentaria*	—	Threatened
Virginia spiderwort	*Tradescantia virginiana*	—	Special Concern
Virginia water-horehound[f][g]	*Lycopus virginicus*	—	Threatened
Wahoo	*Euonymus atropurpurea*	—	Special Concern
Water willow	*Justicia americana*	—	Threatened
White or prairie false indigo	*Baptisia lactea*	—	Special Concern
Wild bean	*Phaseolus polystachios*	—	Presumed Extirpated
Wild hyacinth	*Camassia scilloides*	—	Threatened

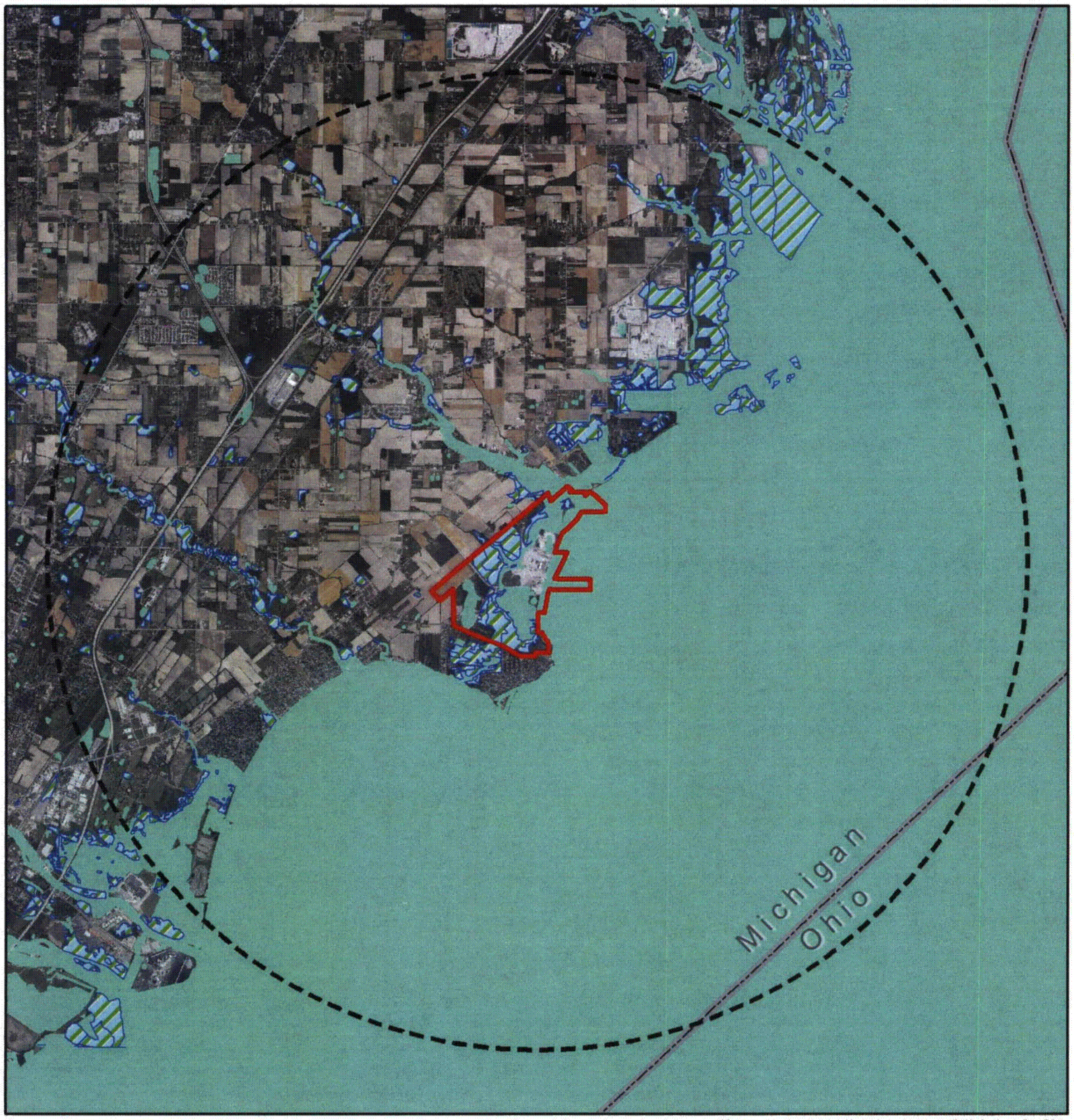
Table 3.6-6 (Continued)

Federally and State-Listed Species within Monroe and/or Wayne Counties, Michigan[a]

Common Name	Scientific Name	Federal Status[b]	State Status[c]
Wild rice	*Zizania aquatica var. aquatica*	—	Threatened
Wild sweet William[f][g][i][k]	*Phlox maculate*	—	Threatened
Willow aster	*Aster praealtus*	—	Special Concern
Winged monkey flower	*Mimulus alatus*	—	Presumed Extirpated
Wisteria	*Wisteria frutescens*	—	Threatened
Woodland lettuce	*Lactuca floridana*	—	Threatened

a. The information presented in this table represents the best available information for the species of listed plants and animals likely to be found in Monroe and Wayne counties, Michigan. In some specific instances, species not identified by MNFI as being found in Monroe or Wayne counties have been reported at the Fermi site. These species are identified below.
b. (USFWS 2012c).
c. (MNFI 2013i), (MNFI 2013j), (MNFI 2013k).
d. Common and scientific names of fish are from Nelson et al. 2004.
e. Common name used in NRC 2013c, Section 2.4.
f. Previously identified on site.
g. 2013 updated terrestrial surveys indicate species was not present.
h. Observed in July and August 2013 updated terrestrial surveys (Kogge and Heslinga 2013).
i. Not listed by MNFI as being in Monroe or Wayne counties.
j. Bird believed to be migrant observed on site; no sign of nesting observed.
k. Fermi 2 is not within the typical geographic range and/or does not contain suitable habitat for these species (Kogge and Heslinga 2013).
l. Identified in a previous study to genus name only.
m. This plant also is known by the common name prairie white-fringed orchid. Listing is based on USFWS.

Figure 3.6-1
DRIWR Boundaries at the Fermi Site



(DTE 2013j; USDA 2012a; USFWS 2012b)

Legend

- Property Boundary (Approximate)
- 6-Mile Radius
- NWI Wetlands
- NWI Ponds, Lakes and Rivers
- State

N W E S

0 2 4 Miles

Figure 3.6-2
NWI Wetlands within a 6-Mile Radius of the Fermi Site

(DTE 2011; ESRI 2012)

Legend

PEM - Palustrine Emergent Wetland

PFO - Palustrine Forested Wetland

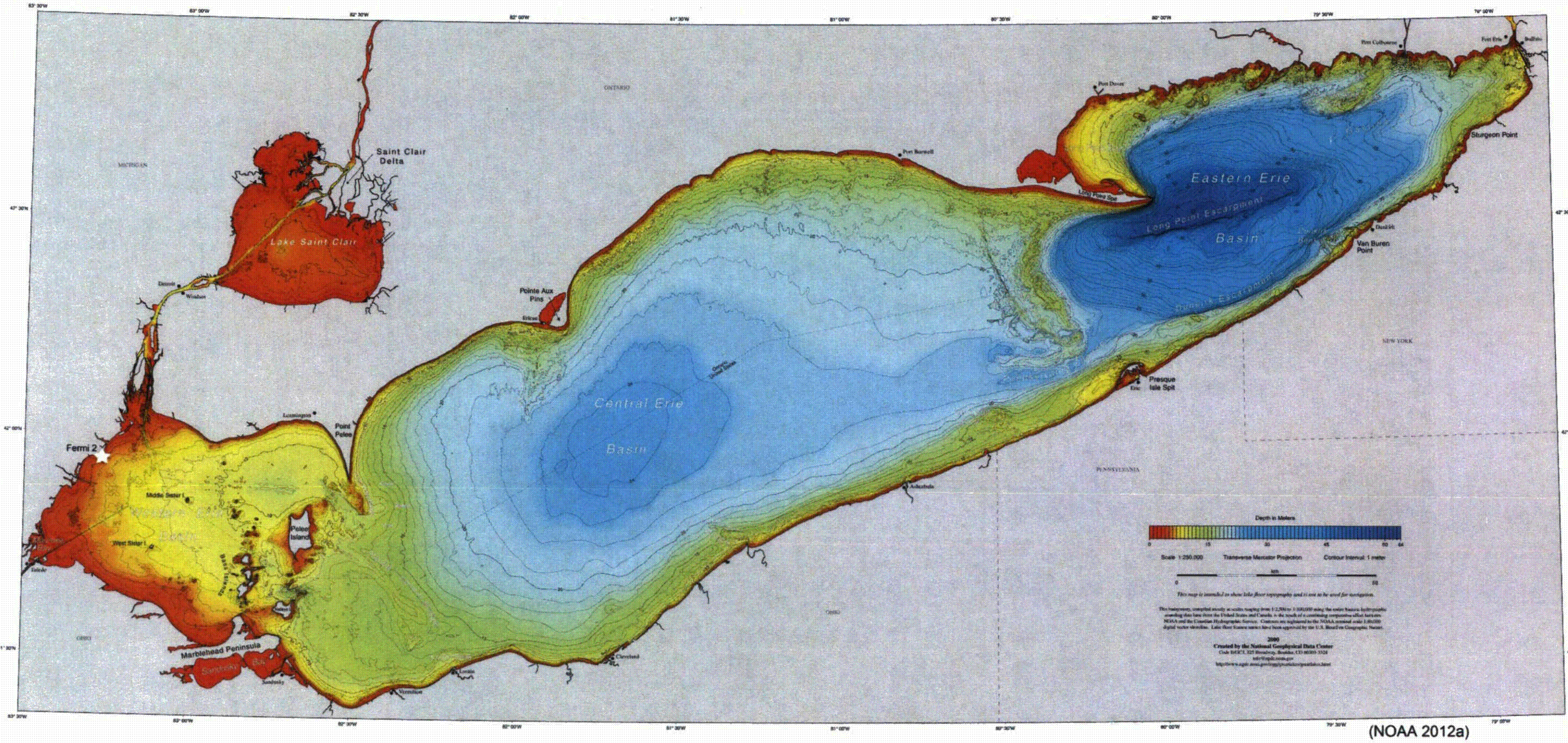
PSS - Palustrine Scrub Shrub Wetland

* The dredge basin is a water treatment pond exempt from Michigan wetland regulations per Michigan Compiled Law 324.30305(4)(b).

N W E S

0 0.25 0.5 Miles

Figure 3.6-3
Wetlands on the Fermi Site



(NOAA 2012a)

Figure 3.6-4
Bathymetry of Lake Erie