Appendix E

Applicant's Environmental Report

Operating License Renewal Stage

Waterford Steam Electric Station, Unit 3

March 2016

INTRODUCTION

Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as Entergy), both subsidiaries of Entergy Corporation, submit this environmental report (ER) in conjunction with the application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Waterford Steam Electric Station Unit 3 (hereafter referred to as WF3) 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 WF3 operating license (OL). This ER is designed to assist the NRC staff with the preparation of the WF3-specific supplemental environmental impact statement required for license renewal.

The WF3 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 10 CFR Part 51, Subpart A. 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 the implementation of the proposed action.

Entergy used NRC Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for License Renewal Applications*, as guidance on the format and content of this ER. In addition, Entergy used the *Generic Environmental Impact Statement (GEIS) for License Renewal for Nuclear Plants* (NUREG-1437, Revision 1) and 10 CFR Part 51, Subpart A, Appendix B 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, Entergy concludes that the environmental impacts associated with renewal of the WF3 OL would result in no significant adverse effects. No plant refurbishment or other license-renewal-related construction activities have been identified as necessary to support the continued operation of WF3 beyond the end of the existing OL term. 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.

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ACRONYMS, ABBREVIATIONS AND SYMBOLS

§	section
°F	degrees Fahrenheit
AC	alternating current
ACCWS	auxiliary component cooling water system
AD	anno Domini—with respect to time period
AFW	auxiliary feedwater
AHP	above Head of Passes
ALARA	as low as reasonably achievable
amsl	above mean sea level
APE	area of potential effect
AQCR	air quality control region
BC	before Christ—with respect to time period
bgs	below ground surface
BMP	best management practice
BMS	boron management system
BTA	best technology available
Btu/hr	British thermal units per hour
Btu/lb	British thermal units per pound
CAA	Clean Air Act
CAFTA	Computer Aided Fault Tree Analysis
CARS	containment atmosphere release system
CCR	coal combustion residue
CCS	carbon capture and storage
CCW	component cooling water
CCWS	component cooling water system
CDF	core damage frequency

CEDM	control element drive mechanism
CEI	Coastal Environments, Inc.
CET	Containment Event Tree
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
cm^3	cubic centimeter
cm/sec	centimeters per second
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CSP	concentrating solar power
CVCS	chemical and volume control system
CWIS	circulating water intake structure
dBA	A-weighted decibel
DC	direct current
DDT	dichlorodiphenyltrichloroethane
DECON	dismantling and decontamination, one of three NRC decommissioning strategies
DOE	U.S. Department of Energy
DSM	demand-side management
EAB	exclusion area boundary
EDG	emergency diesel generator
EEC	Energy Education Center
EF	enhanced Fujita (tornado scale ranging from 0 to 5)
EFH	essential fish habitat
EFW	emergency feedwater
ENE	east-northeast

ENTOMB	permanent entombment on site, one of three NRC decommissioning strategies
EPA	U.S. Environmental Protection Agency
ER	environmental report
ERFBS	Electric Raceway Fire Barrier System
ESA	Endangered Species Act
ESE	east-southeast
FAA	Federal Aviation Administration
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FES	final environmental statement
FIVE	Fire Induced Vulnerability Evaluation
FPPA	Farmland Protection Policy Act
fps	feet per second
ft^3	cubic foot
GEIS	NUREG 1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
GHG	greenhouse gas
gpd/ft	gallons per day per foot
gpd/ft^2	gallons per day per square foot
GPI	Groundwater Protection Initiative
gpm	gallons per minute
gpy	gallons per year
GWh/yr	gigawatt hour per year
HAP	hazardous air pollutant
Hds	delta plain of the St. Bernard delta lobe, Mississippi River (Holocene age)
HEAF	High Energy Arcing Fault
HEPA	high-efficiency particulate absorption

HIC	high integrity container
Hml_1	natural levee complex of Mississippi River meander belt 1 (Holocene age)
Hmm_1	Mississippi River meander belt 1 (Holocene age)
hp	horsepower
HVAC	heating, ventilation, and air conditioning
I-10	Interstate 10
I-310	Interstate 310
IGCC	integrated gasification combined cycle
ILRT	Integrated Leak Rate Test
IMR	impingement rate
IPA	integrated plant assessment
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
IRP	integrated resource plan
ISFSI	independent spent fuel storage installation
kV	kilovolt
kW	kilowatt
$kWh/m^2/day$	kilowatt hour of solar insolation per square meter per day
LA-18	Louisiana Highway 18
LA-628	Louisiana Highway 628
LA-3127	Louisiana Highway 3127
LaDOTD	Louisiana Department of Transportation & Development
LAR	license amendment request
LDEQ	Louisiana Department of Environmental Quality
LDWF	Louisiana Department of Wildlife and Fisheries
LLMW	low-level mixed waste
LLRW	low-level radwaste

LMR	Lower Mississippi River
LOCA	loss of coolant accident
LOS	level of service
LP&L	Louisiana Power & Light Company
LPDES	Louisiana Pollutant Discharge Elimination System
LRA	license renewal application
m^2	square meter
mA	milliamperes
MACT	maximum achievable control technology
Mb	body-wave magnitude (earthquakes)
mg/l	milligram per liter
MGD	million gallons per day
MISO	Midcontinent Independent Operator System, Inc.
MM	Modified Mercalli (seismic intensity scale)
MMBtu/hr	million British thermal units per hour
MP&L	Mississippi Power & Light
mph	miles per hour
mrad	milliradiation absorbed dose
mrem	millirem
MRLC	Multi-Resolution Land Characteristic consortium
MSA	metropolitan statistical area
msl	mean sea level
MSLB	main steam line break
mSv	millisievert
MSW	municipal solid waste
MWd/MTU	megawatt-days per metric tonne uranium
MWe	megawatts electric

MWh	megawatt hour
MWt	megawatts thermal
N	north
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NE	northeast
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NGCC	natural gas combined-cycle
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNE	north-northeast
NNW	north-northwest
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPIS	nuclear plant island structure
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NW	northwest
NWI	National Wetland Inventory

OL	operating license
OSGSF	original steam generator storage facility
OSHA	Occupational Safety and Health Administration
Pb	lead
PCB	polychlorinated biphenyl
PILOT	payment in lieu of taxes
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PM_{10}	particulate matter less than 10 micrometers in diameter
POTW	publicly owned treatment works
ppm	parts per million
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
PV	photovoltaic
PWR	pressurized water reactor
RAB	reactor auxiliary building
RCP	reactor coolant pump
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
ROW	right-of-way
RVCH	reactor vessel closure head
S	south
SAFSTOR	safe storage, one of three NRC decommissioning strategies

SAMA	severe accident mitigation alternatives
SB	solidification building
SBO	station blackout
SCPC	supercritical pulverized coal
SCR	selective catalytic reduction
SCV	steel containment vessel
SE	southeast
SERC	Southeast Electric Reliability Corporation
SHPO	State Historic Preservation Office (or Officer)
SMITTR	surveillance, online monitoring, inspections, testing, trending, and recordkeeping
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPCC	spill prevention, control, and countermeasures
SSA	sole source aquifer
SSE	south-southeast
SSW	south-southwest
SU	standard units
SW	southwest
SWMS	solid waste management system
SWPPP	stormwater pollution prevention plan
TEDE	total effective dose equivalent
US-90	U.S. Highway 90
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
VOC	volatile organic compound
W	west
WF3	Waterford Steam Electric Station Unit 3
WG	water gauge
WinMACCS	Windows Melcor Accident Consequences Code System
WMA	wildlife management area
WMS	waste management system
WNW	west-northwest
WQC	water quality certification
WSW	west-southwest

1.0 PURPOSE OF AND NEED FOR ACTION

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. Nuclear power plants are initially licensed by the NRC to operate up to 40 years, and the licenses may be subsequently renewed for periods up to 20 years. Waterford Steam Electric Station Unit 3's (WF3's) operating license (OL) NPF-38 expires on midnight, December 18, 2024.

Entergy has prepared this environmental report (ER) in conjunction with its application to renew the WF3 OL, as provided by the following NRC regulations:

- Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application—Environmental Information [10 CFR 54.23] and

- Title 10, Energy, CFR, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Section 51.53, Postconstruction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)].

For license renewal, the NRC has adopted the following definition of purpose and need, stated in 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 baseload 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.

The proposed action is to renew the WF3 OL, which would preserve the option for Entergy to continue to operate WF3 to provide reliable base-load power throughout the 20-year license renewal period. For WF3 (Facility OL NPF-38), the requested renewal would extend the existing license expiration date from midnight, December 18, 2024, to midnight December 18, 2044.

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 WF3 license renewal application (LRA) fulfills that requirement. In determining what information to include in the WF3 license renewal applicant's ER, Entergy has relied on NRC regulations and the following supporting documents that provide additional insight into the regulatory requirements:

- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, Revision 1 (NRC 2013b), and referenced information specific to transportation (64 FR 48496)
- GEIS, Addendum 1, Section 6.3 Transportation (NRC 1999)
- NRC supplemental information in the *Federal Register* (77 FR 37282)
- Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications* (NRC 2013a)

Entergy 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 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

Entergy Louisiana, LLC, a subsidiary of Entergy Corporation, is the owner of WF3, located in St. Charles Parish, Louisiana. Entergy Operations, Inc., also a subsidiary of Entergy Corporation, is the licensed operator of WF3. Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") are the holders of the WF3 OL NPF-38 and, for purposes of this ER, are considered the applicant.

Based on 10 CFR Part 51, Subpart A, 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 distribution system and transmission lines that supply power to the nuclear plant from the grid. The transmission lines subject to this evaluation, which are located within the Entergy Louisiana, LLC property, are listed below.

- Two 230-kilovolt (kV) transmission lines (three phase), as shown in Figure 2.2-7, extending from the WF3 switching station to the Waterford 230-kV switchyard (approximately 0.6 miles) that transmit power to the regional transmission grid and provide offsite power to the plant during outages.

Entergy Louisiana, LLC owns and operates the in-scope transmission lines that are subject to this environmental evaluation.

1.3 Entergy Louisiana, LLC Property

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC owned property (WF3 2014a, Section 2.1.1.2). Waterford 1, 2, and 4, which are fossil fuel-fired electricity generating units, are also located on this same property but are not covered by this licensing action.

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)	9.0
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)	9.0
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)	9.7

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

Description	Requirement	ER Section(s)
Information submitted pursuant to 10 CFR 51.45(b) through (d) and not confined to information supporting the proposed action but also 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, 2.4, and 3.0
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)	2.3 and 4.0
Surface 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)	4.5.1.1
Groundwater Resources		
Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	10 CFR 51.53(c)(3)(ii)(C)	4.5.2.1
Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.5.2.2
Groundwater quality degradation (plants with cooling ponds at inland sites)	10 CFR 51.53(c)(3)(ii)(D)	4.5.2.3
Radionuclides released to groundwater	10 CFR 51.53(c)(3)(ii)(P)	4.5.2.4

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

Description	Requirement	ER Section(s)
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.1.1
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.1.2
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)	4.6.1.3
Terrestrial Resources		
Effects on terrestrial resources (non-cooling system impacts)	10 CFR 51.53(c)(3)(ii)(E)	4.6.2.1
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)	4.6.2.2
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	10 CFR 51.53(c)(3)(ii)(E)	4.6.3
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)	3.10 and 4.10
Cumulative Impacts		
Cumulative impacts	10 CFR 51.53(c)(3)(ii)(O)	4.12

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

Description	Requirement	ER Section(s)
Postulated Accidents		
Severe accidents	10 CFR 51.53(c)(3)(ii)(L)	4.15.1
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 Proposed Action

In accordance with 10 CFR 51.53(c)(2), the ER must contain a description of the proposed action. The proposed action is to renew the OL for WF3, which would preserve the option for Entergy to continue to operate WF3 to provide reliable base-load power throughout the 20-year license renewal period to meet future power generating needs. For WF3 (Facility OL NPF-38), the requested renewal would extend the license expiration date from midnight December 18, 2024, to midnight December 18, 2044.

In addition to continuing operation and maintenance activities associated with license renewal, activities to allow for extended plant operation may include refurbishment. Refurbishment is not anticipated for WF3. The relationship of refurbishment to license renewal is described in Section 2.3.

During the license renewal term, changes to surveillance, as well as online monitoring, inspections, testing, trending, and recordkeeping (SMITTR) could be undertaken as a result of the 10 CFR Part 54 aging management review. Potential SMITTR activities are described in Section 2.4.

No other plant upgrades to support extended operations that could directly affect the environment or plant effluents are planned.

2.2 General Plant Information

The environmental report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures. This report must describe in detail the affected environment around the plant and the modifications directly affecting the environment or any plant effluents. [10 CFR 51.53(c)(2)]

The principal structure at the site is the nuclear plant island structure (NPIS), a reinforced concrete box structure with solid exterior walls that houses all safety-related components (WF3 2014a, Section 3.8). The NPIS, which is flood protected up to elevation +29.27 feet mean sea level (msl) (WF3 2014a, Section 2.4.1.1), provides a common structure for the reactor building; reactor auxiliary building (RAB), which includes the control room; fuel handling building; and component cooling water system (CCWS) structures (cooling tower areas), as well as a common foundation mat for support of these structures (WF3 2014a, Section 3.8).

Main structures outside the NPIS are the turbine generator building, water treatment building, condensate polisher building, fire pump house, chiller building, service building, independent spent fuel storage installation (ISFSI), radioactive material storage building, solidification facility, meteorological tower, and the intake and discharge structures. No residences are permitted within the WF3 exclusion area boundary (EAB).

2.2.1 Reactor and Containment Systems

2.2.1.1 Reactor System

WF3 is a pressurized water reactor (PWR) plant of the Combustion Engineering design. Since March 1985, WF3 has had two increases in reactor core power level, which has resulted in an increase in design net electrical output from 1,104 megawatts electric (MWe) to 1,188 MWe. The first reactor core power level increase from 3,390 megawatts thermal (MWt) to 3,441 MWt occurred in March 2002 and resulted in an increase in design net electrical output of approximately 16 MWe. The second reactor core power level increase from 3,441 MWt to 3,716 MWt, starting with Operating Cycle 14, resulted in another increase in design net electrical output of approximately 68 MWe. (WF3 2014a, Section 1.1) The reactor coolant is heated as it passes through the reactor vessel by the energy produced by the fuel undergoing fission in the core. Pressurized water in the primary coolant loop carries the heat to the steam generators. Inside the steam generators, heat from the primary coolant loop vaporizes the water in a secondary loop, producing steam. The steam line directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity. (NRC 2015a)

Fuel for WF3 is low-enriched uranium dioxide (less than 5 percent by weight) in the form of ceramic pellets that are encapsulated in pre-pressurized Zircaloy™, ZIRLO™, or Optimized ZIRLO™ tubes that form a hermetic enclosure (WF3 2014a, Section 4.1). The limit for peak rod burnup at WF3 is 60,000 megawatt-days per metric tonne uranium (MWd/MTU) (WF3 2014a, Section 4.3A.3.1.3). A three-batch fuel management scheme is employed at WF3, where 40–50 percent of the core assemblies are replaced at each refueling. The batch average burnup will be about 45,000 MWd/MTU over the three-cycle life of the fuel. (WF3 2014a, Section 4.1) As discussed in Section 2.5, reactor refueling occurs on an 18-month cycle.

2.2.1.2 Containment System

The containment structure (or reactor building) consists of a free-standing steel containment vessel (SCV), a containment internal structure and a reinforced concrete shield building. As discussed in Section 2.2, the containment structure is founded on the NPIS. (WF3 2014a, Section 3.8)

The SCV houses the reactor pressure vessel, the reactor coolant piping, the pressurizer, the quench tank, the reactor coolant pumps, the steam generators, and the safety injection tanks. It is completely enclosed by the reinforced concrete shield building. The SCV, including all its penetrations, is a low-leakage steel shell, which is designed to withstand the postulated loss of coolant accident (LOCA) and to confine the postulated release of radioactive material. (WF3 2014a, Section 3.8.2.1)

The shield building is a reinforced concrete structure constructed as a right cylinder with a shallow dome roof. The shield building is designed to serve the following functions (WF3 2014a, Section 3.8.4.1.1):

- Biological shield during normal operation and after any accident within the SCV up to and including the postulated LOCA.
- Low-leakage structure following any accident within the SCV up to and including postulated LOCA.
- Shield for the SCV for adverse external environmental conditions due to low temperatures, winds, tornadoes, and external missiles.

2.2.2 Cooling and Auxiliary Water Systems

A schematic of water flow as it relates to WF3's operational use of the Mississippi River and the St. Charles Parish water system is presented in Figure 2.2-1.

Waterford 1, 2, and 4, which are fossil fuel-fired electricity generating units, are located adjacent to WF3 on the same Entergy Louisiana, LLC owned property as WF3. However, these units do not share a common intake or discharge structure with WF3.

2.2.2.1 Circulating Water System

At the time of the WF3 LRA submittal, the traveling screens associated with the intake structure are being replaced with MultiDisc screens in an effort to minimize condenser biofouling. Three of the four sets of screens have been replaced with the remaining set planned for installation in 2016. Therefore, the description of the traveling screens in this section is based on the MultiDisc screens (WF3 2014b). A description of the traveling screens being replaced is discussed in the WF3 *Updated Final Safety Analysis Report* (WF3 2014a, Section 10.4.5).

WF3's once-through cooling circulating water intake structure (CWIS) is located approximately 162 feet off the western shore of the Mississippi River (Figure 2.2-2) (Entergy 2005, Section 2.2). Cooling water brought into the intake structure is withdrawn from the Mississippi River through a series of intake pipes at a design flow rate of 1,555.2 million gallons per day (MGD), or 2,406 cubic feet per second (cfs). The average flow in the Mississippi River in the vicinity of the WF3 plant (River Mile 129.6) is estimated to be approximately 500,000 cfs. Based on this information, it is determined that WF3 withdraws a maximum of approximately 0.48 percent of the flow in the Mississippi River and, in actuality, this percentage is probably much less because of the additional, unaccounted for, streamflow contributions entering the Mississippi River downstream of the Vicksburg station and upstream of the WF3 plant. (Entergy 2005, Section 2.1) Because the average flow in the Mississippi River in the vicinity of the WF3 plant is estimated to be approximately 500,000 cfs, there is no significant deposition of sediment at the intake structure. As a result, no dredging activities at the intake structure to remove sediment deposition have been necessary.

The CWIS is designed to provide 1,080,000 gallons per minute (gpm) of circulating cooling water to the station using water withdrawn from the Mississippi River. The CWIS was designed for normal operation within river high-water and low-water elevations of +23.6 feet msl and +0.8 feet msl, respectively. The CWIS consists of an intake canal, intake structure, eight trash racks, eight once-through flow traveling water screens, and three screen wash pumps. (Entergy 2005, Section 3.1.1) Figure 2.2-3 provides a cross-sectional illustration of these CWIS components.

The intake canal is formed by steel sheet piling driven into the river bottom and extending approximately 162 feet out from the face of the intake structure (Figure 2.2-4). The canal has a skimmer wall across its entrance which inhibits floating debris from entering the canal. The elevation at the top of the sheet piles is +15.0 feet msl. The elevation at the bottom of the skimmer wall is -1 foot msl. The dimensions of the opening to the river are 36.9 feet in length by 34 feet in depth. The water velocity through the intake opening at the river boundary during maximum pump operation is approximately 1.9 feet per second (fps). (Entergy 2005, Section 3.1.1)

At the end of the intake canal (at the shoreline), the CWIS comprises eight intake bays (Figure 2.2-5) that are defined by concrete wingwalls. Each intake bay is approximately 11 feet wide and has a curtain wall (extending vertically from +15.0 feet to -4.0 feet msl and across the width of each bay), trash rack, and traveling water screen. Flow velocity at the intake bay screens is approximately 1.0 fps in each bay. The four circulating water pumps (one per every two intake bays) are vertical mixed-flow pumps. Each pump is capable of pumping 250,000 gpm of water. Three service water pumps are located 12.5 feet upstream of the circulating pumps. Each service water pump is capable of providing 3,000 gpm of service water. Cooling water is discharged to the Mississippi River at a location 600 feet downstream of the CWIS. (Entergy 2005, Section 3.1.1)

The trash rack in each CWIS bay is designed to remove large debris. Each trash rack consists of a series of 0.5-inch by 3.5-inch bars spaced on 3-inch centers and oriented at an angle of approximately 10 degrees from vertical. Plant personnel clean the trash racks with a mechanical trash rack cleaner. (Entergy 2005, Section 3.1.1) Debris and any associated fish contained in the debris are cleaned from the trash racks and placed in a dumpster for offsite disposal.

The traveling water screens are located approximately 30 feet upstream of the circulating water pumps and approximately 19 feet downstream from the trash racks (Entergy 2005, Section 3.1.1) and are composed of polyethylene perforated panels with 0.37-inch diameter screen mesh openings. The traveling screens are once-through flow MultiDisc screens, oriented perpendicular to the walls of the intake bays, in which sickle-shaped discs capture debris on the front face of the screen. These sickle-shaped discs rotate about an axis that is perpendicular to the flow of river water through the screen. (WF3 2014b)

The traveling water screens are cleaned by spray-wash nozzles that spray both the ascending and descending sides of the traveling screen panels. The spray-wash nozzles are designed for 115 gpm at 80 pounds per square inch (psi). (WF3 2014b) Although automatic capability exists for the spray-wash system, they are currently being run manually.

A sparger, which is located below the bottommost traveling screen pane of each screen, is used to avoid the settling of silt and grit or other debris in the spaces between the rotating screen wash panels and the bottom portions of the traveling water screens. Each traveling water screen includes a local pressure indicator, a pressure switch that triggers an alarm due to low screen wash pressure (< 70 psi). The traveling water screens are designed to maintain the differential pressure across the screens below 18 inches. At 6 inches of differential water pressure, the screen wash system is activated, and the screen is put in slow-speed operation. The screens will remain in slow-speed operation until a decreasing differential pressure of 3 inches is reached. At 10 inches of differential water pressure, the screens are placed in fast-speed operation until a decreasing differential pressure of 3 inches is reached, based on the seal in path. The screens have a slow-forward and fast-forward speed operation of 11.4 and 48.0 feet per minute, respectively. (WF3 2014b) Debris and occasional impinged fish are cleaned from the screens and returned to the Mississippi River away from the influence of the intake canal and cooling water discharge zone via a combined concrete trough system. (Entergy 2005, page ES-1)

Upon entering the plant, the Mississippi River water is circulated through the condenser tubes to remove process heat. Once warm water leaves the condenser, it is then discharged with other water from auxiliary systems via four 108-inch-diameter steel pipes that pass over the levee, and continue to the discharge structure. (WF3 2014a, Section 10.4.5.2)

The discharge structure, illustrated in Figure 2.2-6, consists of a concrete seal well with outer dimensions approximately 52 feet by 45 feet. Cooling water enters the seal well from four 108-inch-diameter steel pipes. It leaves the seal well by overflowing about 95 feet of weirs, which run around three of the four sides of the discharge structure. The height of water above the weirs at full design flow is about 3.4 feet msl. Elevation of the weir crests (highest point) is adjustable between elevations 6.0 feet and 11.0 feet msl. The elevation selected at a given time depends on the Mississippi River water level. (LP&L 1978, Section 3.4.2.5)

A sheet-pile-formed discharge canal, shown in Figure 2.2-6, carries the water from the discharge structure to the river. The bottom is constructed at elevation of approximately -5.0 feet msl. At the shore end, the discharge canal is 81 feet wide. The width is constant over the first 81 feet of canal length. From this point, the width contracts symmetrically over a distance of about 95 feet, to a width of 50 feet at the river end. The discharge canal is concrete lined to prevent erosion. The design criteria are for a discharge velocity into the river of about 7 fps at average low-water level during four pump operation. The purpose of this high discharge velocity is to promote rapid mixing with the ambient water. The top of the sheet pile is at elevation 15.0 feet msl where the canal is 81 feet wide and at elevation 10.0 feet msl where the canal is contracting. (LP&L 1978, Section 3.4.2.5)

WF3 is approved to treat raw cooling water from the Mississippi River when needed to control macro and microbiological fouling using sodium hypochlorite and sodium bromide. For silt dispersion, a polyacrylate and a polymeric dispersant are approved for use when the unit is operating. (Entergy 2009a, Section 1.0)

2.2.2.2 Thermal Discharge

When operating at the design flow rate (1,080,000 gpm of circulating cooling water), the waste heat from the condenser would be transferred to the circulating cooling water, which will raise the water temperature approximately 16.4 degrees Fahrenheit (°F) above the intake water temperature. Once this water combines with other plant process wastewaters, the resultant temperature increase at the point of discharge into the Mississippi River is approximately 16.1°F. (NRC 1981, Section 4.2.2.2)

However, based on current plant operating conditions, only approximately 888,000 gpm of water passes through the main condenser. Because the amount of water passing through the main condenser is less than the design flow rate, temperature rise will be approximately 18.9°F. After combining with other plant process wastewaters, the circulating water discharged to the river will be approximately 18.6°F above the intake temperature. (Entergy 2003, Section 5.2.3.1)

As discussed in Section 2.2.2.1 above, the design of the WF3 discharge structure promotes rapid mixing with the ambient water. The Louisiana Department of Environmental Quality (LDEQ) determined that approximately 81 percent of the river flow is unaffected by the thermal discharge, even under extreme low-flow conditions as discussed in Section 3.6.6.2.3. Therefore, due to the smaller size of the thermal plume, fewer organisms in the river are exposed to the plume; also, those organisms that are exposed to the plume remain in it for a shorter time (NRC 1981, Section 5.11).

The temperature of the heated water is continuously monitored by a plant monitoring computer and an alarm is annunciated in the main control room when the heated water approaches its thermal limit. (WF3 2014a, Section 10.4.5.2) The thermal discharge limitations specified in WF3's Louisiana Pollutant Discharge Elimination System (LPDES) Permit No. LA0007374 are a daily maximum heat input of 9.5×10^3 million British thermal units per hour (Btu/hour) and an instantaneous daily maximum temperature of 118ºF (Attachment A).

2.2.2.3 Component Cooling Water

The CCWS is the ultimate heat sink for the plant. It is designed to remove heat from the reactor coolant and the auxiliary systems during normal operation, shutdown, or emergency shutdown following a LOCA. (WF3 2014a, Section 1.2.2.7.2)

The CCWS is a closed-loop cooling water system that uses demineralized water buffered with a corrosion inhibitor and includes two component cooling water (CCW) heat exchangers (tube side), three 100-percent capacity pumps, two dry cooling towers, one surge tank (baffled), and one chemical addition tank (WF3 2014a, Section 9.2.2.2.1). The cooling water is pumped by the CCW pumps, through the dry cooling towers and the tube side of the CCW heat exchangers, through the components being cooled and back to the pumps (WF3 2014a, Section 3.1.40).

The CCWS is treated with biocides, corrosion inhibitors, a surfactant, and a dispersant as needed.

2.2.2.4 Auxiliary Component Cooling Water

The auxiliary component cooling water system (ACCWS) removes heat, if required, from the CCWS via the CCW heat exchangers and dissipates it to the atmosphere. The ACCWS consists of two independent loops which include two CCWS heat exchangers (shell side); two full-capacity pumps; two wet type, mechanical draft cooling towers; and two cooling tower basins, each of which stores sufficient water to complete a safe shutdown based upon the occurrence of a LOCA and minimum safeguards operation. (WF3 2014a, Section 3.1.40)

The ACCWS is treated with biocides, caustic soda, a surfactant, and a dispersant as needed.

2.2.2.5 Demineralized Water Makeup System

Demineralized water is produced by processing potable water from the St. Charles Parish water system. The potable water is initially stored in the primary water treatment plant clearwell tank. The water is then transferred from the clearwell tank, via the clearwell transfer pumps, to the demineralized water system where it is demineralized, de-aerated, and stored. (WF3 2014a, Section 9.2.3)

2.2.2.6 Potable Water System

The St. Charles Parish water system furnishes a metered supply of potable water to the site through municipal water mains. A valve connection supplies the majority of the water via a backflow prevention and metering station located at the southeast corner of the plant site. The potable water distribution system then supplies water to various buildings throughout the site. (WF3 2014a, Section 9.2.4.2)

A branch from this system supplies the majority of the various demands inside the protected area (Figure 3.0-1), including the fixtures and equipment in the administration building, chiller building, fuel handling building, polisher building, RAB, service building, and turbine building. The distribution system also supplies makeup water to the fire-protection water storage tanks and to the primary water treatment plant clearwell tank located inside the protected area. (WF3 2014a, Section 9.2.4.2)

2.2.2.7 Fire Protection Water System

As discussed in Section 2.2.2.6, makeup water to the fire protection water storage tanks is provided by the St. Charles Parish water system. The fire protection water distribution system consists of underground yard piping serving all plant yard fire hydrants, sprinkler systems, water spray systems, and interior standpipe systems. The underground piping forms a complete fire loop around the plant. Post indicator type sectionalizing control valves are installed in the main fire loop to facilitate system maintenance and repair without placing the entire loop out of service. Branch connections from the fire main to all systems are provided with isolation valves to minimize the need for closing sectionalizing valves on the main fire loop. (WF3 2014a, Section 9.5.1.2.2)

2.2.3 Radioactive Waste Management

2.2.3.1 Liquid Radwaste System

Radioactive liquid wastes, which are discharged from the plant, are first processed by the waste management system (WMS) or the boron management system (BMS). The chemical and volume control system (CVCS), fuel pool system, and steam generator blowdown system all process potentially radioactive liquids in the confines of the plant in preparation for reuse. The contents of turbine building sumps and detergent wastes are routinely discharged unprocessed due to their very small potential for radioactive contamination. (WF3 2014a, Section 11.2.1)

2.2.3.1.1 Waste Management System

Miscellaneous non-detergent waste is collected in one of two waste tanks. Additional storage capacity is provided in the waste storage tank. As wastes are collected, they are processed on a batch basis through the portable demineralization system which consists of vessel(s) typically containing various filtration media and/or ion exchange media. The demineralization system removes suspended solids, dissolved solids, and radioactivity. An ion exchanger is provided in the path from the portable demineralizer should further treatment be desired. The effluent is collected in one of two waste condensate tanks for sampling and analysis prior to release to the circulating water discharge. (WF3 2014a, Section 11.2.2.2.1)

Because of the redundancy of equipment, it is not expected that equipment will need to be bypassed very frequently. If process equipment is bypassed for any reason, and sampling of the waste condensate tank shows that further processing is necessary, the contents of one tank can be recycled back through a filter, or ion exchanger as desired, including the portable demineralizer system, and collected in the second tank. (WF3 2014a, Section 11.2.2.2.1)

Liquid detergent waste from the laundry, laundry sump, contaminated showers, and contaminated sinks are collected in two laundry tanks. The wastewater may be sampled to assure low activity and then be pumped through a filter directly to the circulating water discharge. The wastewater may be processed through the liquid waste management system portable demineralization skid and handled as miscellaneous waste. (WF3 2014a, Section 11.2.2.2.2)

2.2.3.1.2 Boron Management System

The BMS is designed to accept, collect, and process radioactive waste from various plant systems for recycle or disposal. The major influent to the BMS is from the letdown line in the CVCS, and is the result of feed and bleed operations during plant shutdowns, startups, and dilution due to fuel burnup over core life. Other sources into the BMS consist of valve and equipment leak-offs, miscellaneous drains, and relief-valve discharges. The reactor drain tank collects these discharges within the containment, while the equipment drain tank and equipment drain sump accumulates those from outside the containment. Both the reactor drain tank and equipment drain tank are maintained with a nitrogen blanket to prevent the buildup of hydrogen in each tank. (WF3 2014a, Section 11.2.2.1)

All processing components in the BMS from the discharge of the collection tanks and CVCS, except the holdup tanks and the boric acid condensate tanks, can be bypassed individually or collectively. Chemistry and radiological concerns determine which processing components are lined up in the processing flow path. Also, water from any point in the processing flow path can be recirculated back to any point in the processing flow path. (WF3 2014a, Section 11.2.2.1)

From the discharge of the collection tanks and CVCS, water is sent to the online holdup tanks. Although the flash tank is no longer used, temporary equipment could be utilized, if required, due to significant increases in noble gas activity. The holdup tanks provide sufficient storage capacity to accumulate discharges until a sufficient volume is available for further processing on a batch basis. The radioactivity of the liquid is significantly reduced during storage by natural decay of the short half-life radionuclides. During this period, any degasification and radioactive decay can be monitored by liquid sample analysis. The gas analyzer can be used to monitor the holdup tanks for hydrogen and oxygen content. The holdup tanks also have a continuous nitrogen blanket to eliminate the possibility of a buildup of hydrogen. The holdup tanks can be vented to the plant stack. The holdup tanks have high and low tank-level and tank-pressure alarms, which annunciate in the control room. (WF3 2014a, Section 11.2.2.1)

The contents of the holdup tanks are normally sent to the boric acid condensate tanks through some or all of the following process equipment: the preconcentrator filters, the preconcentrator ion exchangers, and the boric acid condensate ion exchangers. Prior to recycle or controlled discharge of the treated liquid waste, the fluid is analyzed for acceptability of both chemistry and activity. Recycle capability is provided for water conservation. Controlled discharge is accomplished through an effluent radiation monitor that records the release activity level and automatically terminates discharge on high radiation. (WF3 2014a, Section 11.2.2.1)

2.2.3.1.3 Steam Generator Blowdown System

The waste removed by the blowdown filters and the waste produced by regeneration of the blowdown demineralizers is collected in the filter flush tank and the regenerative waste tank (WF3 2014a, Section 11.2.2.3). The waste collected in the regenerative waste tank and the filter flush tank will normally be pumped to an aboveground concrete holding basin where they are then transferred to Waterford 1, 2, and 4, and processed and discharged in accordance with the terms of Waterford 1, 2, and 4 LPDES Permit No. LA0007439. In case of radioactivity in the blowdown, blowdown demineralizer waste and the filter-flushing water can be transferred to a radwaste processing system (WF3 2014a, Section 11.2.2.3), prior to discharging to the Mississippi River via WF3's LPDES Outfall 001.

2.2.3.1.4 Radioactive Releases

During liquid processing by the BMS and WMS, radioactivity is removed so that the bulk of the liquid is restored to clean water, which is either recycled in the plant or discharged to the environment. The radioactivity removed from the liquids is concentrated in filters and ion exchange resin. These concentrated wastes are sent to the solid waste management system (SWMS) for packaging and eventual shipment to an approved offsite disposal location. If the water is to be recycled back to the reactor coolant system, it must meet the purity requirements for reactor coolant. If the liquid is to be discharged, the activity level must be consistent with the discharge criteria of 10 CFR Part 20 and Appendix I to 10 CFR Part 50. The BMS and WMS are capable of monitoring radioactive liquid discharge from the systems to ensure that activity concentrations do not exceed predetermined limits. If a limit is exceeded, discharge will be automatically terminated. (WF3 2014a, Section 11.2.3)

2.2.3.2 Gaseous Radwaste System

Radioactive gases are collected and processed through the following systems depending upon their origin (WF3 2014a, Section 11.3):

- Gaseous Waste Management System
- Vent Gas Collection Header
- Main Condenser Evacuation System
- Turbine Gland Sealing System
- Building Ventilation Systems
- Atmospheric Dump Valves

2.2.3.2.1 Gaseous Waste Management System

Waste gases which are routed to the gas surge header are mainly hydrogenated, radioactive, or potentially radioactive gases from various sources throughout the plant. Gaseous wastes are generated from reactor coolant degassing operations, processing of radioactive liquid wastes, and tank purgings. Waste gases enter the gaseous waste management system by way of three headers: the vent gas collection header, the containment vent header, and the gas surge header. (WF3 2014a, Section 11.3.2)

Vent Gas Collection Header

The vent gas collection header collects gas primarily from aerated vents of process equipment in the WMS, BMS, CVCS, and the fuel pool system. Because of the large volume of gas and the low activity level from the sources, the gases are routed directly to the plant stack. The radioactive releases from the vent gas collection header will be negligible compared with other sources. As a further check to prevent unexpected activity release from this source, the radioactive release via plant stack is continuously monitored and the plant stack alarms on abnormal activity release. (WF3 2014a, Section 11.3.2.1)

Containment Vent Header and Gas Surge Header

Gases from the gas surge header, including the contribution of the containment vent header, flow into the gas surge tank where they are collected. The gases remain in the gas surge tank until the pressure builds to a point that actuates a single waste gas compressor. The waste gas compressor feeds a preselected gas decay tank until the pressure in the gas surge tank drops to a point where the waste gas compressor stops. A second waste gas compressor will start if the pressure in the gas surge tank builds due to a surge of the inputs. This automatic operation of the waste gas compressors will continue until a gas decay tank is observed to approach its upper operating pressure. At this point, another gas decay tank will be manually lined up by means of a remote-operated valve on the WMS control panel to receive the waste gas compressor's discharge. The just-filled tank is analyzed by the gas analyzer for hydrogen and oxygen content. Grab samples can also be taken for radioactivity analysis. The just-filled tank is then isolated for decay and released via a batch release permit, as specified in plant procedure. (WF3 2014a, Section 11.3.2.2)

The only process flow bypass line that exists in the gaseous waste management system leads from the gas surge tank directly to the gas discharge header and bypasses the waste gas compressor and gas decay tanks. This flow path is used mainly to purge air from components after maintenance operations, at which time the vented gas contains essentially no radioactivity. The valve on this bypass line is locked closed to facilitate administrative control. Moreover, the bypass flow passes through the radiation monitor in the gas discharge header. Liquid seals are not used in this system. (WF3 2014a, Section 11.3.2.2)

2.2.3.2.2 Main Condenser Evacuation System

The main condenser evacuation system consists of three 100-percent capacity condenser vacuum pump assemblies. Each assembly consists of one motor driven, rotary water seal type two-stage vacuum pump and seal water system. Each seal water system includes one centrifugal circulating pump; one heat exchanger; one separator; and all necessary piping, valves, instruments, and electric devices for automatic operation of the system. Energizing the condenser vacuum pump starter automatically starts the seal water system associated with the condenser vacuum pump assembly. (WF3 2014a, Section 10.4.2.2)

The noncondensible gases and water vapor mixture are drawn directly from each shell of the condenser. The mixture flows through the condenser vacuum pump(s), then to the separator where most of the water vapor is condensed, and the noncondensible gases are released to the atmosphere via a discharge silencer. The condensed water normally is returned to the condenser; however, a safety overflow drain line is routed to the industrial waste sump. Upon receipt of a high-radiation signal by the radiation monitor on the industrial waste discharge header, discharging from the industrial waste sump will be stopped. Once it is analyzed, it will be directed to the proper location. Depending on main condenser vacuum level, one or two of the three condenser vacuum pumps are in standby and are properly controlled to start up on failure of the running pump. (WF3 2014a, Section 10.4.2.2)

2.2.3.2.3 Turbine Gland Sealing System

The turbine gland sealing system controls the steam pressure to the turbine glands to maintain adequate sealing under all conditions of turbine operation. The system consists of individually controlled diaphragm-operated valves, relief valves, and a gland steam condenser. (WF3 2014a, Section 10.4.3.2)

At startup, the sealing steam source may be either main steam or auxiliary steam. When sufficient pressure has been established in the steam generator, the auxiliary steam source valve is closed, and main steam provides sealing. As the turbine load is increased, the steam pressure inside the high-pressure turbine increases and the steam leakage path is outward toward the rotor ends, thus eliminating the need to supply sealing steam to these glands. The leak-off steam and air mixture then flows to the gland steam condenser which is maintained at a pressure slightly below atmospheric, so as to prevent escape of steam from the ends of glands. The gland steam condenser returns seal leakage to the main condenser as condensate. (WF3 2014a, Section 10.4.3.2)

Noncondensible gases from the gland steam condenser are monitored for radioactivity. If radioactivity is detected, these gases are routed to the plant vent instead of being directly discharged to atmosphere. (WF3 2014a, Section 10.4.3.2)

2.2.3.2.4 Building Ventilation Systems

2.2.3.2.4.1 Reactor Building

<u>Containment Cooling System</u>

The containment cooling system consists of four containment fan coolers and a ducted air distribution system with associated instrumentation and controls. Each fan cooler consists of two banks of cooling coils, casing, vane axial two-speed fan and motor. Each containment cooling system loop consists of two fan coolers, both of which discharge into a common duct. The duct from each loop is interconnected into a common ring header and ductwork system, which distributes the discharge of the fan coolers to different areas of the containment. The cooling units are located on two levels in the containment outside of the secondary shield wall. (WF3 2014a, Section 6.2.2.2.1)

Each fan cooler has a back draft damper at the fan discharge which prevents backflow through the fan cooler if it is not operating. During normal operation, three of the four fan coolers are manually started from the main control room and operate at the higher of two speeds. (WF3 2014a, Section 6.2.2.2.1)

<u>Airborne Radioactivity Removal System</u>

The system consists of two airborne radioactivity removal units, each consisting of a medium efficiency filter, high-efficiency particulate absorption (HEPA) prefilter, charcoal adsorber, and centrifugal fan. The airborne radioactivity removal units are operated when required to limit the buildup of airborne radioactivity leaking from the reactor coolant system during normal operation. The frequency of operation will depend on the concentration of particulate and gaseous activities present in the closed containment atmosphere as measured by radiation monitors. Airborne radioactivity removal units are manually started and stopped from the main control room. The airborne radioactivity removal system is shut down automatically when the reactor coolant pump deluge system is actuated. Filter differential pressure and charcoal adsorber temperature are monitored. (WF3 2014a, Section 9.4.5.2.2)

Containment Atmosphere Purge System

The containment atmosphere purge system consists of a containment purge air makeup unit and a containment purge exhaust, which is connected to the exhaust portion of the RAB normal ventilation system. Makeup air enters through a louvered damper and passes through a medium efficiency filter and an electric heating coil—all located in a casing installed at the RAB. The makeup air flows in series through pneumatic operator-actuated butterfly valves to enter the containment. (WF3 2014a, Section 9.4.5.3.2)

Area radiation monitors and airborne radiation monitors located inside the containment and at the plant stack will generate a containment purge isolation signal upon detection of radioactivity above their setpoint. This action will prevent release of containment air that contains an unacceptable level of radioactivity. The purge isolation valves are permitted to open when the radioactivity being monitored falls to an acceptable level. This acceptable level is achieved by manually starting the airborne radioactivity removal system to provide air cleaning for reduction of airborne radioactivity. The isolation valves will also close upon receipt of a containment isolation actuation signal. (WF3 2014a, Section 9.4.5.3.2)

The exhaust portion of the RAB normal ventilation system operates in the refueling ventilation mode during refueling operations to ventilate the refueling pool inside the containment and to simultaneously provide some purging of the containment atmosphere (WF3 2014a, Section 9.4.5.3.2)

Containment Atmosphere Release System

The containment atmosphere release system (CARS) consists of two 100-percent capacity redundant exhaust fans and associated ductwork and two 100-percent capacity redundant supply fans. When post LOCA containment pressure has reduced sufficiently, CARS transfers combustible gases from inside containment to the reactor building annulus. The gases are filtered to remove radioactive particulates and iodines by the operating shield building ventilation system, prior to being released. A centrifugal exhaust fan draws air from the containment and discharges into the recirculation duct of the shield building ventilation system. The CARS supply ductwork extends from the controlled ventilation area into the containment and includes a check valve in the discharge piping to prevent backflow from the containment. (WF3 2014a, Section 6.2.5.2.3)

Containment Vacuum Relief System

Automatic vacuum relief devices are used to prevent the containment vessel from exceeding the external design pressure in accordance with the requirements of Article 16, Section III of the ASME Boiler and Pressure Vessel Code. The automatic vacuum relief system consists of two redundant 24-inch penetrations connecting the annulus to the containment. Each system includes one 24-inch butterfly valve with pneumatic operator and one 24-inch check valve located on the containment side of the penetration in series. Each butterfly valve is actuated by a separate pressure controller which senses the differential pressure between the containment and the annulus. Each butterfly valve is provided with an air accumulator of minimum capacity to allow the valve to open at least two times after failure of instrument air. The check valve is set to open when the pressure of the upstream (annulus) side of the valve is 1.1 inch water gauge (WG) above the pressure of the downstream (containment) side of the valve. (WF3 2014a, Section 3.8.2.3)

The butterfly valve will actuate automatically. It is set to open before containment pressure decreases 10 inches WG below annulus pressure. The valve can only be manually closed after containment pressure increases above the butterfly valve actuation setpoint. The combined pressure drop at rated flow through the two valves in either line will not exceed the design external pressure differential of 0.65 pounds per square inch gauge (psig) with any prevailing atmospheric pressure. (WF3 2014a, Section 3.8.2.3)

Reactor Cavity Cooling System

The reactor cavity cooling system consists of two 100-percent capacity axial supply fans arranged in parallel and connected to a common supply duct. Each fan is provided with a supply discharge gravity damper to prevent recirculation through the standby fan. Each axial supply fan draws cooled air from the containment cooling system ring header. The fans supply air to ventilate the annular space between the reactor vessel and primary shield wall. The cooling provided by the reactor cavity cooling system minimizes the possibility of concrete dehydration and subsequent faulting. The system limits thermal growth of the reactor vessel supporting steelwork. (WF3 2014a, Section 9.4.5.6.2)

System redundancy is provided to assure continuity and reliability of operation. Each fan is powered from separate safety buses. If there is a loss of offsite power, the fans are tripped and can be loaded manually onto the safety buses. (WF3 2014a, Section 9.4.5.6.2)

Control Element Drive Mechanism Cooling System

The control element drive mechanism (CEDM) cooling system consists of four 50-percent capacity exhaust fans and cooling coils. Two of the four fans operate to maintain a negative pressure inside the CEDM cooling shroud. The other two fans are standby units. Isolation dampers are provided to prevent flow through the standby fans. Containment air is drawn through the cooling shroud for the magnetic jack coil elements to the CEDM cooling system. The heated air is cooled by water cooling coils, supplied from the CCWS, and is discharged back to the containment through the system fans, thereby rejecting the CEDM-generated heat to a sink outside the containment. (WF3 2014a, Section 9.4.5.7.2)

Each fan is started manually from a control switch in the main control room. Indicating lights in the main control room indicate operating status. Control room indication exists for air temperature entering the cooling coil, and high exit temperature is annunciated. The shroud temperature and the temperature of component cooling water leaving the cooling coil are indicated in the main control room. A low temperature lockout, sensing containment temperature, prevents fans from starting. (WF3 2014a, Section 9.4.5.7.2)

2.2.3.2.4.2 Reactor Auxiliary Building

The RAB ventilation supply system includes an outside air louver, medium efficiency bag type filter, electric heating coil, two 100-percent capacity centrifugal fans, gravity discharge dampers and chilled water cooling coil located in the common discharge duct of fans. Supply air is discharged through a sheet metal duct distribution system throughout the RAB. The flow of air throughout the building is from areas of low potential radioactivity to areas of progressively higher potential radioactivity. (WF3 2014a, Section 9.4.3.1.2)

Air is exhausted from the RAB spaces through a ventilation exhaust system. The ventilation exhaust system includes a medium efficiency prefilter, HEPA filter, charcoal adsorber, fan inlet vane dampers, two 100-percent capacity centrifugal fans, and discharge dampers to prevent air recirculation through the standby fan. The ventilation exhaust system discharges to the plant stack. The exhaust fan inlet vane dampers automatically adjust air flow from the minimum flow rate during the RAB "ventilation only" mode to the maximum flow rate for the RAB ventilation and the reactor building "purge combined" mode. The maximum flow occurs only during containment purge. (WF3 2014a, Section 9.4.3.1.2)

Air-flow monitors in the discharge duct of exhaust fans maintain the design air-flow rate through the nonsafety-related filtration unit. Low air flow and failure of the supply fan are alarmed in the main control room. The operating supply fan is automatically stopped if the exhaust fan fails, but the operating exhaust fan continues to operate if the supply fan fails. Individual filter pressure drops are alarmed in the main control room through the plant monitoring computer. (WF3 2014a, Section 9.4.3.1.2)

2.2.3.2.4.3 Fuel Handling Building

During normal operation, air is distributed throughout the fuel handling building by an air handling unit and exhausted from the building by normal exhaust fans. When the air handling unit is started, one of the two redundant 100-percent capacity exhaust fans also start. The exhaust fans are interlocked with the air handling unit, so that they cannot function unless the air handling unit is operating. A gravity damper prevents air recirculation through the respective non-operating fan. The air handling unit includes a bank of medium efficiency filters, electric heating coil, and centrifugal fan. The electric heating coil will not operate unless airflow is established in the discharge duct of the air handling unit. A low-limit freeze protection thermocouple, located downstream of the electric heating coil, will stop the air handling unit fan when the air temperature falls below its setpoint. The output of the electric heating coil will be controlled by means of controls sensing temperature downstream of the supply fan. The ductwork is designed to assure that airflow is directed from areas of low potential radioactivity to areas of progressively higher potential radioactivity. (WF3 2014a, Section 9.4.2.2.1)

The emergency filtration exhaust units are redundant, and each is sized at 100-percent exhaust air capacity. Each unit includes an electric heating coil, a bank of medium efficiency filters, a bank of HEPA prefilters, a charcoal adsorber, a bank of HEPA after-filters, and a centrifugal exhaust fan. Both exhaust fans will start, and their associated intake dampers will open upon receipt of a fuel handling accident signal. The electric heating coil is provided to assure that the air entering the adsorber has a relative humidity not exceeding 70 percent in order to assure maximum adsorption efficiency of the charcoal. When the emergency filtration units are started, their respective makeup air dampers operate in response to differential pressure controls, whose function is to maintain the spent fuel handling area at a negative pressure relative to the outdoors. (WF3 2014a, Section 9.4.2.2.2)

2.2.3.2.4.4 Turbine Building

The turbine building ventilation system, except for the switchgear room described below, is a single-pass type and consists of ventilation air intake louvers and dampers, supply fans, exhaust fans, and exhaust louvers and dampers distributed about the periphery of the building on both the ground floor and the mezzanine floor (WF3 2014a, Section 9.4.4.2).

The turbine building switchgear room is separately ventilated by two 50-percent capacity air handling units, which cool the space with outside air. Each air handling unit contains a medium efficiency filter and centrifugal fan. Outside air intake for the switchgear area is automatically varied from zero air flow to the maximum system air flow by temperature control of system dampers. As the outside air intake is increased, the return air is decreased proportionately. All filters are provided with local indication of pressure drop. (WF3 2014a, Section 9.4.4.2)

Electric unit heaters are provided on the ground floor and the mezzanine floor, distributed to cover all areas, so that a minimum temperature of 50°F can be maintained. Fans are manually controlled by local switches mounted on a central heating, ventilation, and air conditioning control panel in the turbine building. (WF3 2014a, Section 9.4.4.2)

2.2.3.2.5 Atmospheric Dump Valves

Steam release from valve operation is considered less than 1 percent of release from the turbine building due to steam leakage. This source is considered negligible and, as a result, there is no dedicated radiation monitor for this pathway. (WF3 2014a, Section 11.3.2.6)

2.2.3.3 Solid Radwaste System

Low-level solid radioactive wastes are processed, packaged, and stored for subsequent shipment and offsite burial by the SWMS. Wastes include spent ion exchange resin, used filter cartridges, and miscellaneous refuse. (WF3 2014a, Section 11.4)

The SWMS is composed of the portable solidification system and/or dewatering system, the spent resin handling system, filter handling, and the dry active waste handling system (WF3 2014a, Section 11.4.2).

2.2.3.3.1 Portable Solidification and Dewatering Systems

WF3 utilizes a portable solidification or dewatering system to provide for plant solidification or dewatering requirements. This solidification or dewatering system is housed in a weatherproof structure with curbing and a sump which may be pumped to the liquid waste management system. The portable systems are operated as specified to comply with the respective process control programs. (WF3 2014a, Section 11.4.4)

Major components include solidification media storage, fill-head assembly, pump and valve skid(s), control panel, and liner shielding. Connections between the in-plant system and portable system equipment are by reinforced flexible hoses. The waste concentrates storage and handling portion of the in-plant SWMS and the spent resin handling system is utilized to supply waste feed to the portable system. These parts of the in-plant SWMS are situated with appropriate shielding, remote sampling, separation of components, and accessibility to reduce leakage and facilitate maintenance and operation. (WF3 2014a, Section 11.4.4.1)

A predetermined amount of spent resin is pumped into the container through the fill-head assembly if required. If dewatering is required, it can be done at the same time as the container is being filled. Solidification media, if needed, are added to the container after waste fill is completed. The container can then be put into interim storage or shipped offsite for processing or to a burial ground, as desired. (WF3 2014a, Section 11.4.4.2)

2.2.3.3.2 Spent Resin Handling System

The purpose of the spent resin transfer system is to collect and store spent radioactive ion exchanger resin from the various process demineralizers, and to transfer resins to the portable solidification and/or dewatering system. (WF3 2014a, Section 11.4.5)

The components of the spent resin transfer system consist of one spent resin tank; one spent resin transfer pump; one spent resin dewatering pump; two spent resin strainers; and associated valves, piping, and controls. (WF3 2014a, Section 11.4.5)

Spent ion exchanger resin from the waste condensate ion exchanger, boric acid condensate ion exchangers, pre-concentration ion exchangers, fuel pool demineralizers, and purification ion exchangers may be sluiced to the spent resin tank. The blowdown demineralizers may be sluiced to the spent resin tank. When resin transfer is completed, the system may be flushed to remove residual resin from the piping system. (WF3 2014a, Section 11.4.5)

2.2.3.3.3 Radioactive Filter Handling

One or more filters may be replaced using a bottom-loading filter transfer shield when radiation levels dictate remote handling. After remotely removing bolts on the head of the filter, the filter is lifted into the filter transfer shield, and the shield is closed. At the solidification area, the bottom of the shield is removed. An overhead crane is used to lift the transfer shield containing the filter into position over a container, and the filter is lowered into the container. The container, after closure, is appropriately stored or buried at an offsite licensed burial site. (WF3 2014a, Section 11.4.6)

2.2.3.3.4 Dry Active Waste Handling

The bulk dry waste material is collected in containers as it is generated in the radiation controlled area. The waste is surveyed for radiation prior to transportation to a licensed volume reduction facility. Plant procedures provide guidelines for monitoring the dry waste for materials that could cause chemical reactions or spontaneous combustion. (WF3 2014a, Section 11.4.7)

An onsite box compactor utilizing hydraulic pressure or an offsite licensed volume reduction facility may be used to volume reduce radioactive waste such as contaminated clothing, rags, paper, low activity filters, activated charcoal and HEPA filters from plant ventilation systems, and miscellaneous contaminated material generated by maintenance and operations of the facility (WF3 2014a, Section 11.4.7).

2.2.3.3.5 Solidification Building

The function of the solidification building (SB) is to provide shelter for the portable equipment and to supply the necessary service requirements and waste delivery for this equipment. In addition to service provided to this facility (air, water, electric power), a 10-ton overhead crane is provided to handle the portable equipment and containers. (WF3 2014a, Section 11.4.8)

The waste solidification (and/or resin dewatering) operation has provisions for the use of shielded containers. Waste is supplied to the container by flexible hoses connected to waste transfer lines routed from inside the RAB out to the SB. Support equipment for the portable system is mounted on skids. The SB supplies space for equipment required for solidification and dewatering. To manage radwaste spills, a sump is provided in the SB. If desired, liquids may be transferred to the plant radwaste systems. (WF3 2014a, Section 11.4.8)

2.2.3.3.6 Low-Level Radwaste Storage Facility

The low-level radwaste (LLRW) storage facility is located outside the protected area west of the fire protection water storage tanks. The facility is an 80-foot wide by 140-foot long by 50-foot tall steel frame building with metal siding and is designed to support a 20-ton traveling crane. The

LLRW storage facility has the capacity to store sixty 8-foot x 20-foot x 8-foot high sea/land containers and 32 high integrity containers (HICs). The facility contains four concrete cubicles to store HICs. Each cubicle has the capacity to hold eight HICs (i.e., four stacked two high). (WF3 2014a, Section 11.4.10.5)

2.2.3.3.7 Original Steam Generator Storage Facility

As part of the change out of the steam generators and reactor vessel closure head (RVCH) performed during Refueling Outage 18, the original steam generators and original RVCH, including original CEDMs, were placed in an onsite-constructed original steam generator storage facility (OSGSF). The OSGSF meets the requirements for temporary storage of the original steam generators and original RVCH until site decommissioning consistent with 10 CFR 20.1301 and 40 CFR Part 190. The OSGSF is designed to be used as a non-occupied facility for the temporary storage of these large components, and no radwaste storage other than the original steam generators and original RVCH is permitted within the facility. (WF3 2014a, Section 11.4.10.6)

2.2.3.4 Radwaste Storage—License Renewal Term

WF3 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 onsite storage facilities to accommodate generated radwaste.

LLRW 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 and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated hardware. The majority of LLRW generated at WF3 would be Class A waste and can be shipped to licensed processors, such as the EnergySolutions facility in Oak Ridge, Tennessee, for reduction and repackaging, and then shipped to a Class A disposal facility such as the EnergySolutions facility in Clive, Utah. Classes B and C wastes constitute a low percentage by volume of the total LLRW generated, and they are currently stored in the LLRW storage facility at WF3. Classes B and C wastes can be shipped to the EnergySolutions facility in Oak Ridge, Tennessee, where they can then be shipped to the Waste Control Specialist facility in Texas, which is licensed for disposal of Classes A, B, and C wastes. Disposal of waste greater than Class C is the responsibility of the federal government.

2.2.3.5 Low-Level Mixed Wastes

Although low-level mixed wastes (LLMW) would be managed and transported to an offsite facility licensed to accept and manage the wastes in accordance with appropriate site and company procedures if generated (Entergy 2015a), there has been no mixed waste generated or stored at WF3 for more than 10 years. In addition, there has been no need to claim the Low-Level Mixed

Waste Storage and Treatment Conditional Exemption in 40 CFR Part 266, Subpart N, for storage of LLMW at WF3.

2.2.3.6 Spent Fuel Storage

The WF3 ISFSI is located south of the four large water storage tanks that are situated at the south end of the WF3 plant area, just west of the switchyard, within the protected area (Figure 3.0-1). The ISFSI pad is sized to store 72 HI-STORM storage casks, with each cask capable of storing 32 spent fuel assemblies, which is adequate to meet the projected WF3 spent fuel storage needs during the initial 40-year license period. The WF3 ISFSI operates under the conditions of the general license in accordance with 10 CFR Part 72 regulations. (Entergy 2011a, Section 2.0)

NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*, generically determines the environmental impacts of continued storage, including those impacts identified in the remand by the Court of Appeals in the *New York v. NRC* decision, and provides a regulatory basis for a revision to 10 CFR 51.23 that addresses the environmental impacts of continued storage for use in future NRC environmental reviews. In this context, "the environmental impacts of continued storage" means those impacts that could occur as a result of the storage of spent nuclear fuel at reactor and away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available. NUREG-2157 evaluates potential environmental impacts to a broad range of resources. Cumulative impacts are also analyzed. (NRC 2014a, page iii)

2.2.3.7 Transportation of Radioactive Materials

WF3 radioactive waste shipments are packaged in accordance with NRC [10 CFR Part 71] and U.S. Department of Transportation [49 CFR Parts 173 and 178] requirements. The type and quantities of solid radioactive waste generated at and shipped from WF3 vary from year to year, depending on plant activities. WF3 currently transports radioactive waste to a licensed processing facility in Tennessee such as EnergySolutions in Oak Ridge, or the Studsvik Processing Facility LLC in Erwin or Memphis, where it is further processed prior to being sent to a facility such as EnergySolutions in Clive, Utah. WF3 may also receive WF3-generated material from an offsite processing facility back to the plant site for reuse or storage.

2.2.4 Nonradioactive Waste Management

The Resource Conservation and Recovery Act (RCRA) governs the disposal of solid waste. The LDEQ has received U.S. Environmental Protection Agency (EPA) authorization to administer and enforce the hazardous waste management program in Louisiana. As a generator of hazardous wastes, WF3 is required to maintain a hazardous waste generator identification number (Table 9.1-1). There are no nonradioactive hazardous waste storage or treatment permits related to WF3's operations.

WF3 generates nonradioactive waste as a result of plant maintenance, cleaning, and operational processes that occur at the site. Because WF3 is classified as a small quantity generator, hazardous wastes routinely make up only a small percentage of the total wastes generated, consisting of paint wastes, spent and off-specification (e.g., shelf-life expired) chemicals, and occasional project-specific wastes. Universal wastes generated typically consist of fluorescent lamps, batteries, mercury devices, electronics (state-specific) and antifreeze (state-specific). Recycled wastes typically consist of scrap metal, batteries, and waste oil.

Nonradioactive wastes are collected in central collection areas and managed in accordance with appropriate regulatory requirements and Entergy's waste management procedure (Entergy 2015a). 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 quantities generated at the facility are shown in Table 2.2-1.

Entergy Corporation maintains a list of waste vendors that are approved for use across the entire company. Based on 2010–2014 waste shipments from WF3, the following Entergy approved waste vendors were utilized to manage hazardous and nonhazardous wastes, and recyclable wastes generated at the site:

- BFI Colonial Landfill in Sorrento, Louisiana, for landfill burial of empty containers and plant trash.
- Clean Harbors Deer Park, LLC in La Porte, Texas, for treatment and disposition of hazardous and nonhazardous wastes.
- FCC Environmental, LLC in New Orleans, Louisiana, for recycling used oil, filters, and oily absorbents.
- Lamp Environmental Industries in Hammond, Louisiana, for treatment and disposition of polychlorinated biphenyl (PCB) ballasts.
- Lamp Environmental Industries in Independence, Louisiana, for recycling fluorescent lamps and non-PCB ballasts.
- Lard Oil Company in Denham Springs, Louisiana, for recycling empty drums.
- Louisiana Scrap Metal in Port Allen, Louisiana, for recycling lead and lead-acid batteries.
- Sanders Lead Company in Troy, Alabama, for recycling lead-acid batteries.

Although waste quantities generated each year may vary due to outages or specific project activities, WF3 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 (Entergy 2015b). Entergy's fleet waste management and chemical control programs also work in conjunction with site waste minimization efforts to minimize waste generation to the maximum extent practicable (Entergy 2015a; Entergy 2015c).

2.2.5 Power Transmission Systems

2.2.5.1 In-Scope Transmission Lines

Based on 10 CFR Part 51, Subpart A, 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 distribution system, and transmission lines that supply power to the nuclear plant from the grid. The following transmission lines associated with WF3, designated as in-scope transmission lines for the environmental review, are subject to evaluation (Figure 2.2-7):

- Two 230-kV transmission lines (three phase) extending from the WF3 switching station to the Waterford 230-kV switchyard (approximately 0.6 miles) that transmit power to the regional transmission grid and provide offsite power to the plant during outages.

All in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned property.

Although not within the scope of this environmental review, the Waterford 230-kV switchyard also has several other 230-kV transmission lines connected to it. Transmission lines connect Waterford Units 1, 2, and 4 to the 230-kV switchyard. Transmission lines cross the river on river-crossing towers to tie into the Little Gypsy 230-kV switchyard. There is also a 230-kV tie to the adjacent 500-kV switchyard. (WF3 2014a, Section 8.2.1.1)

2.2.5.2 Vegetation Management Practices

There is a limited amount of right-of-way (ROW) associated with the two in-scope transmission lines, because the lines cross the WF3 industrial area, where vegetation is sparse. For the approximately 8 acres where a transmission line ROW exists, Entergy Louisiana, LLC maintains the ROW by applying spot herbicide treatments to treat undesirable brush and woody vegetation on a 2-year cycle (Entergy 2011b; Entergy 2012a). Herbicide application volumes typically range from 10 to 25 gallons per brush acre (Entergy 2012a). Typical herbicides applied in the ROW away from areas near aquatic sites include Milestone®, while Rodeo® and Garlon® 3A are utilized in areas near aquatic sites. All chemical herbicide mixtures/formulations are applied according to label directions and/or manufacturer recommendations by licensed companies with qualified applicators (Entergy 2012a), which ensures that proper protocols are followed when applying herbicides near streams or wetlands.

As discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within Entergy Louisiana, LLC owned property. Although no cultural resources were identified in a previous survey of the transmission corridor that consisted of a walkover and 30-centimeter (cm) augering tests along transect lines (NRC 1981, Section 4.3.6), any land disturbance activities in the transmission line corridor would be subject to review in accordance with Entergy's fleet administrative procedural controls discussed in Sections 9.5.20 and 9.6. These procedural controls would ensure that environmentally sensitive areas at WF3 such as cultural resources, if present, are adequately protected.

2.2.5.3 Avian Protection

Based on a review of site condition reporting records over the previous 5 years (2010–2014), which typically document observed bird deaths, no transmission line-related bird deaths have been recorded. In addition, there is no threat of electrocution to birds with a large wingspread, because the distance between the closest energized conductor and the grounded steel tower is 8 feet (NRC 1981, Section 5.5.2). Therefore, there has not been the need to implement avian protection measures associated with the in-scope transmission lines.

2.2.5.4 Induced Shock Hazards

2.2.5.4.1 Public

As stated in Section 2.2.5.1, all in-scope transmission lines are located completely within Entergy Louisiana, LLC owned property. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

2.2.5.4.2 Plant Workers

Based on NRC's 2005 WF3 Final Environmental Assessment and Finding of No Significant Impact related to the proposed license amendment to increase the licensed power level (Technical Assignment Control No. 1355), it was determined that Entergy's analysis showed that the transmission lines would continue to meet the applicable shock prevention provisions of the National Electrical Safety Code (NESC) even with an electrical current increase (NRC 2005, page 5). Entergy's analysis determined that the calculated induced short-circuit current for a 65-foot-long semi-trailer truck (18-wheeler) was approximately 3.9 milliamperes (mA), which is within the NESC 5-mA standard (Entergy 2004).

In addition, the Occupational Safety and Health Administration (OSHA) governs the occupational safety and health of the WF3 operations staff. It was determined in NUREG-1437 (GEIS) 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 OSHA are incorporated into WF3's occupational health and safety program. Specifically, as it relates to transmission lines and acute shock hazards, WF3 has implemented the following practices which limit the potential for workers to receive an "induced" current from an object becoming capacitively charged:

- When a truck, mobile crane, or other equipment is flagged and considered energized, employees standing on the ground must avoid contacting the truck, crane, or equipment unless suitable protective clothing is used. In addition, an insulated access must be used for persons getting on and off the truck, crane, or equipment. (Entergy 2015d, Section 5.3)

- Mobile cranes or other lifting equipment are grounded where the possibility of static buildup is present. (Entergy 2015d, Section 5.3)

- Briefings are conducted and a safety checklist completed on approach distances for vehicles, cranes, and personnel when working near energized conductors. (Entergy 2015e, Section 5.10)

- Personnel are required to wear appropriate protective equipment. (Entergy 2015e, Section 5.10)

In addition, overhead hazards located over a roadway are identified by one or all of the following methods: (1) orange aviation balls or flags on power lines $\leq$ 100 feet from the ground, (2) roadway signs indicating "Overhead Hazard", and (3) painted warnings no closer than 30 feet from the approach points to the overhead hazard on paved/finished roadways. (Entergy 2015d, Section 5.3)

Table 2.2-1
WF3 Hazardous Waste Generation, 2010–2014

Year	Pounds
2010	1,285
2011	805
2012	800
2013	600
2014	765

(Entergy 2016a)

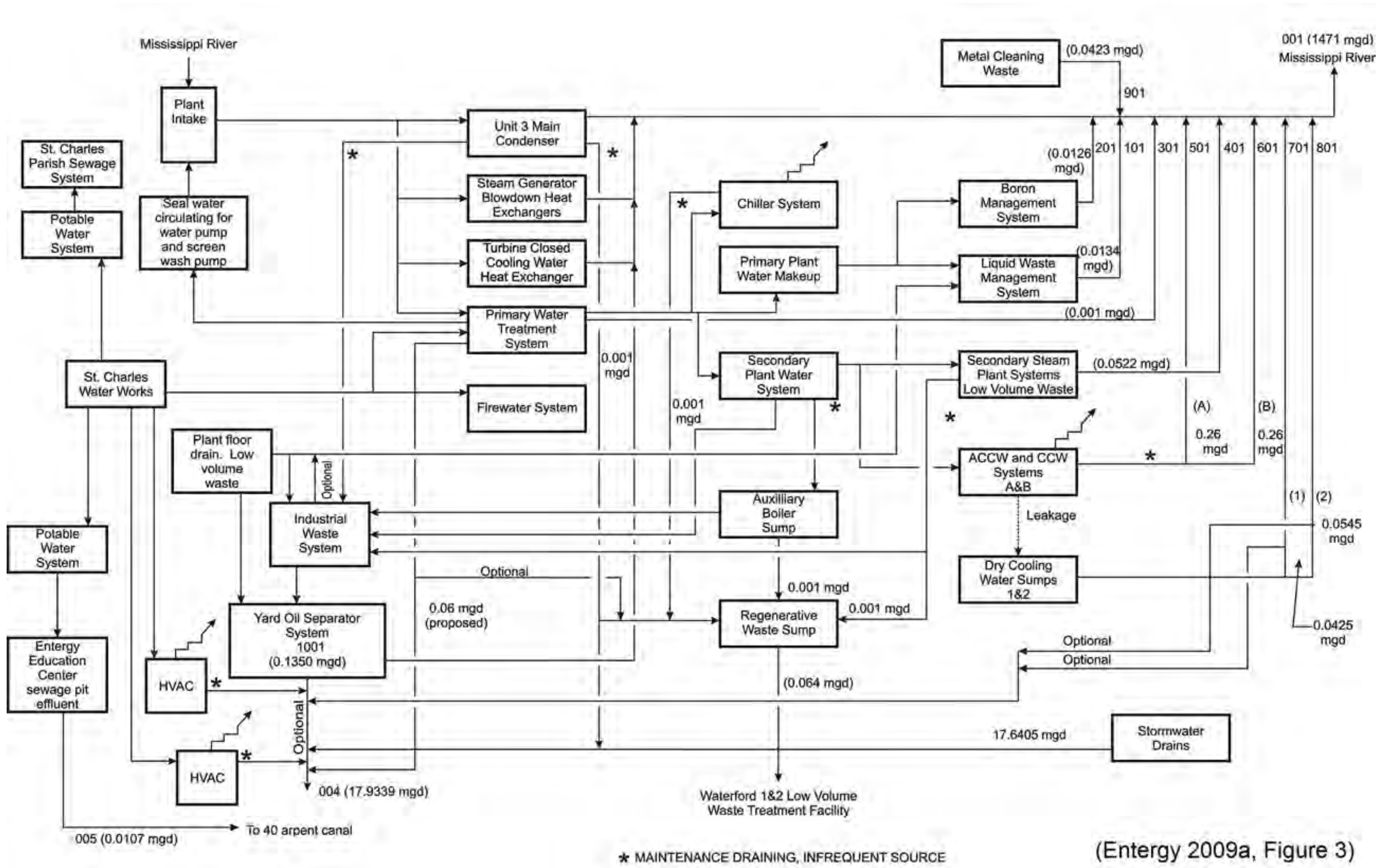
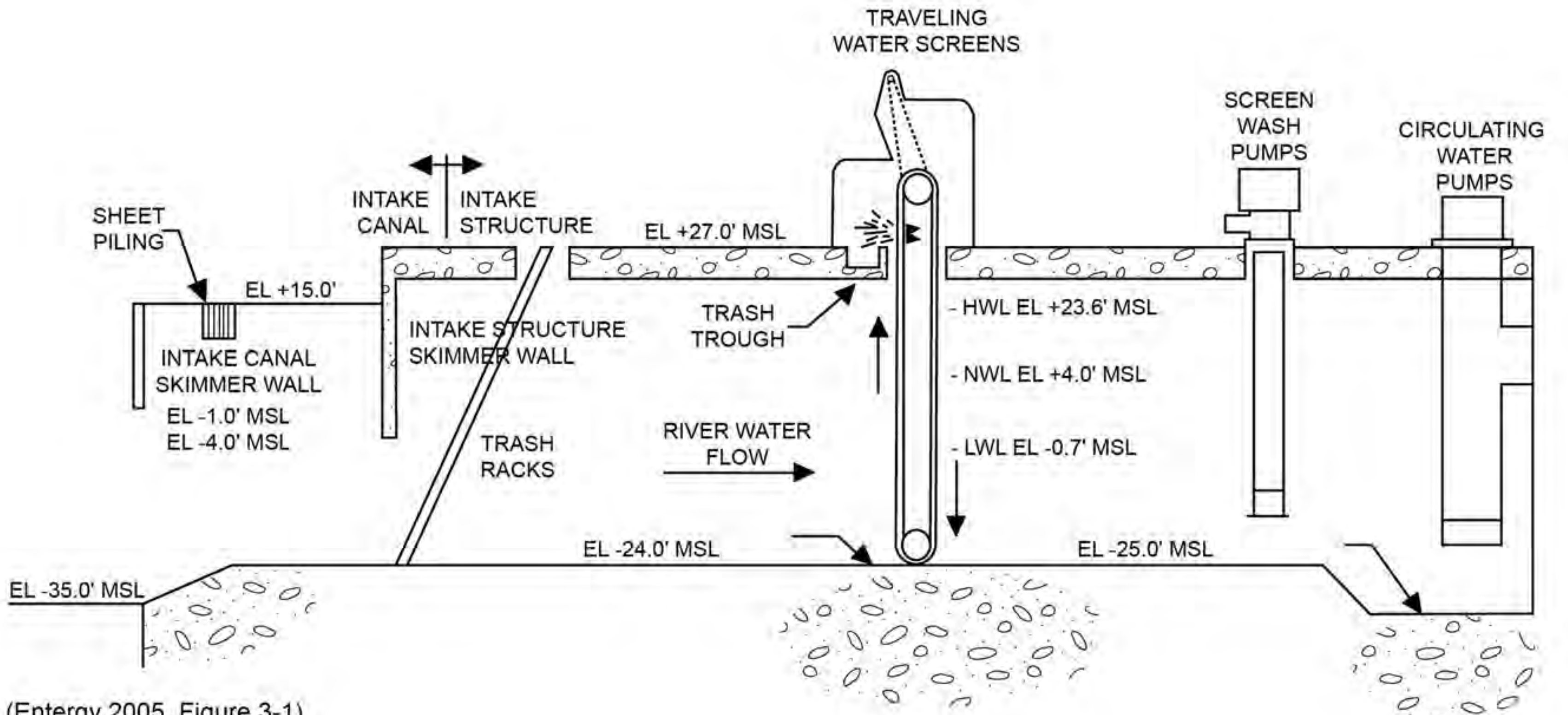


Figure 2.2-1
WF3 LPDES Permit Schematic Flow Diagram

(Entergy 1983; Entergy 2013a; ESRI 2014; WF3 2009)

Figure 2.2-2
WF3 Cooling Water Intake Structure Location



(Entergy 2005, Figure 3-1)

Figure 2.2-3
WF3 Cooling Water Intake Structure

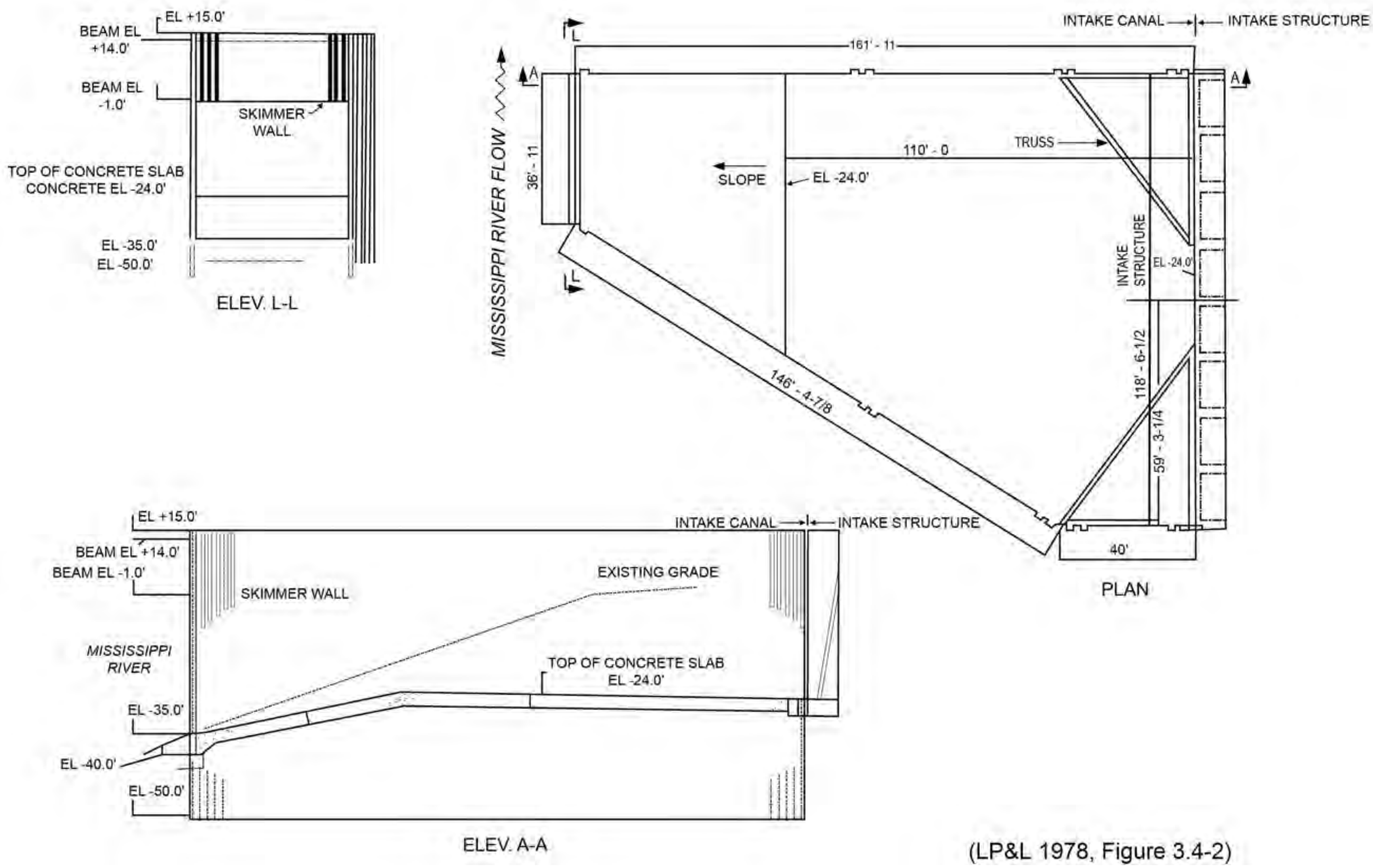


Figure 2.2-4
WF3 Cooling Water Intake Canal

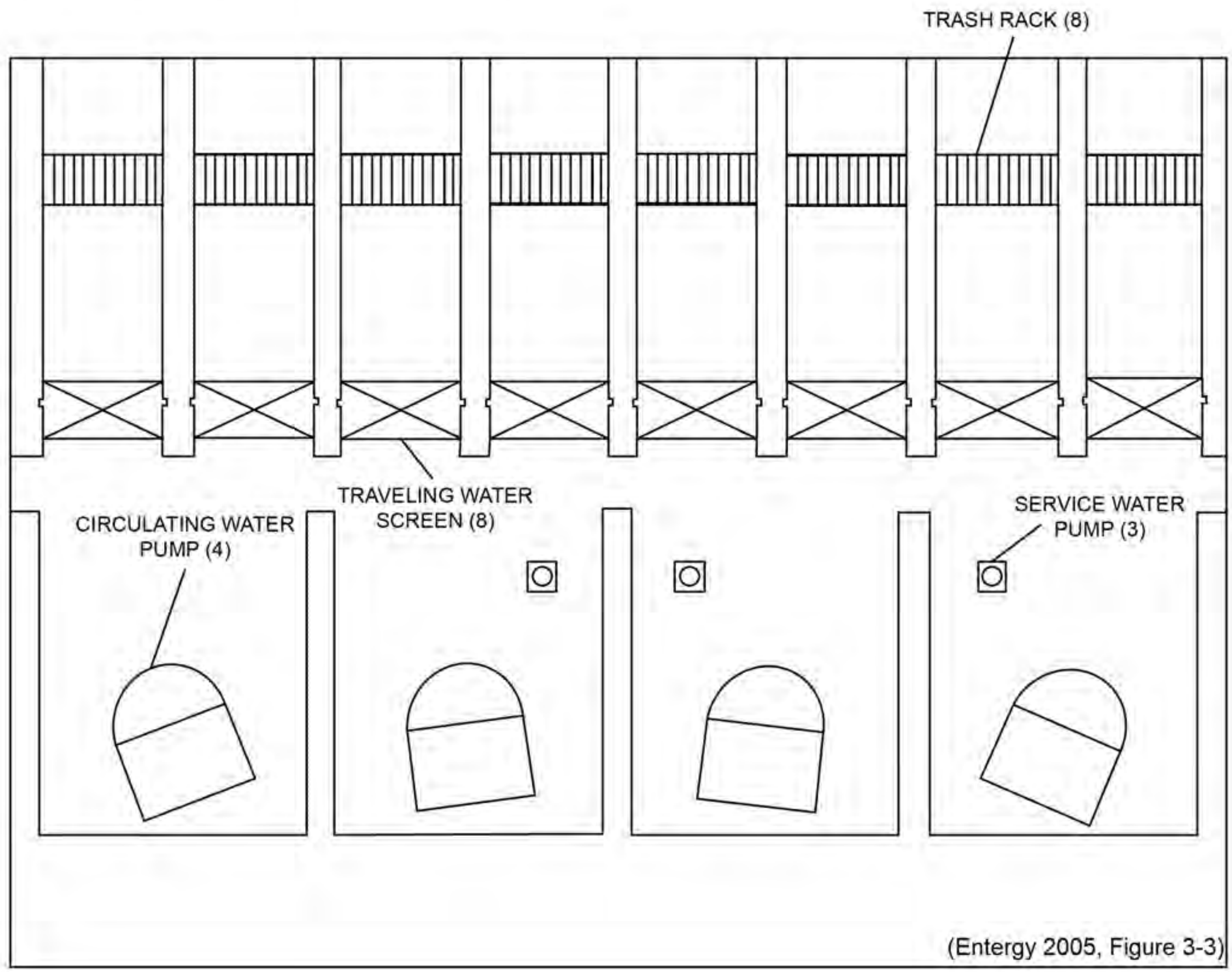
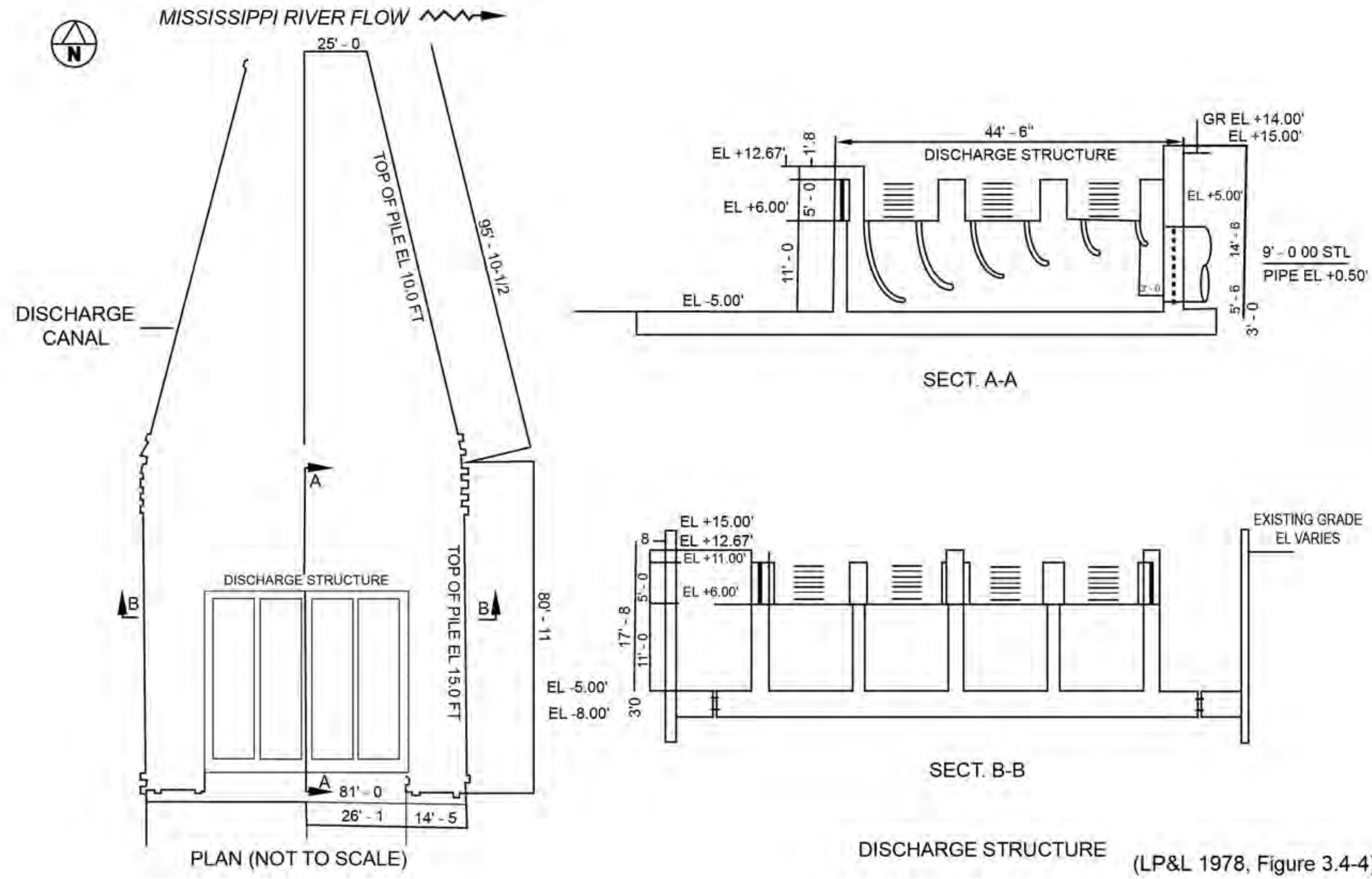


Figure 2.2-5
WF3 Intake Bays and Traveling Screens



(Note: Elevations are at msl.)

Figure 2.2-6
WF3 Discharge Structure and Canal

Figure 2.2-7
WF3 In-Scope Transmission Lines

2.3 Refurbishment Activities

In accordance with 10 CFR 51.53(c)(2), the environmental report must contain a description of the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21. This report must describe in detail any planned refurbishment activities. The environmental report must also contain analyses of the impacts of refurbishment activities, if any, associated with license renewal. [10 CFR 51.53 (c)(3)(ii)]

The incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories. One of those categories involves refurbishment actions, which usually occur infrequently and possibly only once in the life of the plant for any given item. (NRC 2013b, Section 2.1.1)

NRC requirements for the renewal of operating licenses for nuclear power plants include preparation of an integrated plant assessment (IPA) [10 CFR 54.21]. The IPA must identify systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, reactor vessel head and steam generator replacement.

The WF3 IPA that Entergy conducted under 10 CFR Part 54, which is described in the body of the WF3 LRA, has identified no refurbishment or replacement actions needed to maintain the functionality of important systems, structures, and components during the period of extended operation. 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.

2.4 Programs and Activities for Managing the Effects of Aging

In accordance with 10 CFR 51.53(c)(2), the environmental report must contain a description of the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21. This report must describe in detail the modifications directly affecting the environment or any plant effluents.

The incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories: (1) surveillance, monitoring, inspection, testing, trending, and recordkeeping actions, most of which are repeated at regular intervals . . . . (NRC 2013b, Section 2.1.1)

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 WF3 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. Other than implementation of the programs and activities identified in the IPA, there are no planned modifications of WF3's administrative control procedures associated with license renewal.

2.5 Employment

The non-outage work force at the site consists of approximately 641 full-time workers (Table 2.5-1). There are no plans to add workers to support plant operations during the 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 25–30 days, there are typically an additional 700–900 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
Employee Residence Information, January 2016

State, Parish/County, and City/Town	Permanent Full-Time Employees
LOUISIANA	
Ascension	**65**
Darrow	1
Donaldsonville	1
Geismar	7
Gonzales	25
Prairieville	26
Sorrento	2
St. Amant	3
Assumption	**2**
Napoleonville	1
Paincourtville	1
Beauregard	**1**
Dry Creek	1
East Baton Rouge	**17**
Baker	1
Baton Rouge	12
Zachary	4
Iberia	**1**
New Iberia	1
Jefferson	**98**
Avondale	1
Bridge City	1
Gretna	4
Harahan	2
Harvey	7

Table 2.5-1 (Continued)
Employee Residence Information, January 2016

State, Parish/County, and City/Town	Permanent Full-Time Employees
Jefferson	3
Kenner	30
Marrero	6
Metairie	26
River Ridge	11
Terrytown	2
Waggaman	2
Westwego	3
Lafourche	**45**
Gheens	1
Lockport	3
Raceland	5
Thibodaux	36
Livingston	**14**
Albany	1
Denham Springs	4
French Settlement	1
Holden	1
Livingston	1
Maurepas	2
Springfield	2
Walker	2
Orleans	**35**
New Orleans	35
Plaquemines	**1**
Belle Chasse	1

Table 2.5-1 (Continued)
Employee Residence Information, January 2016

State, Parish/County, and City/Town	Permanent Full-Time Employees
Rapides	**1**
Woodworth	1
St. Bernard	**2**
Meraux	1
Violet	1
St. Charles	**187**
Ama	4
Boutte	7
Des Allemands	11
Destrehan	26
Hahnville	23
Killona	9
Luling	94
Montz	5
Norco	3
Paradis	3
St. Rose	2
St. James	**30**
Convent	1
Gramercy	3
Lutcher	3
Paulina	5
St. James	1
Vacherie	17

Table 2.5-1 (Continued)
Employee Residence Information, January 2016

State, Parish/County, and City/Town	Permanent Full-Time Employees
St. John the Baptist	**46**
Edgard	4
Garyville	3
LaPlace	35
Reserve	3
Wallace	1
St. Mary	**1**
Morgan City	1
St. Tammany	**30**
Bush	1
Covington	7
Madisonville	5
Mandeville	5
Pearl River	2
Slidell	10
Tangipahoa	**34**
Amite	1
Hammond	12
Independence	3
Loranger	3
Pontchatoula	14
Robert	1
Terrebonne	**21**
Bourg	1
Gray	2
Houma	18

Table 2.5-1 (Continued)
Employee Residence Information, January 2016

State, Parish/County, and City/Town	Permanent Full-Time Employees
Vernon	**1**
Pitkin	1
West Feliciana	**1**
St. Francisville	1
GEORGIA	
Cobb	**1**
Mableton	1
MISSISSIPPI	
Adams	**1**
Natchez	1
Jackson	**3**
Moss Point	3
Lincoln	**1**
Brookhaven	1
VERMONT	
Windham	**1**
Brattleboro	1
VIRGINIA	
Amherst	**1**
Amherst	1
Total	**641**

(Entergy 2016b)

2.6 Alternatives to the Proposed Action

Section 2.1 describes the proposed action, which is for NRC to renew the operating license for WF3 for an additional 20 years beyond the current expiration date. Because the decision before the NRC is to renew or not renew the license, there is only one fundamental alternative to the proposed action: the no-action alternative. However, the no-action alternative would presumably result in a need for new electrical generating capacity in the region served by WF3.

The no-action alternative refers to a scenario in which the NRC does not renew the WF3 operating license. Unlike the proposed action of renewing the license, denying license renewal does not provide a means of meeting future electric system needs. Therefore, unless replacement generating capacity is provided as part of the no-action alternative, a large amount of base-load generation would no longer be available, and the alternative would not satisfy the purpose and need for the proposed action (Section 1.1). For this reason, the no-action alternative has two components: replacing the generating capacity of WF3 and decommissioning the WF3 facility.

2.6.1 Alternatives Evaluation Process

The "no-action alternative" to the proposed action is to not renew the WF3 OL. In this alternative, it is expected that WF3 would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin (Section 7.3.3). Because WF3 constitutes reliable long-term base-load capacity, it is reasonable to assume that a decision to not renew the WF3 OL would necessitate the replacement of its approximately 1,188-MWe capacity with another generation source capable of providing equivalent base-load power. The environmental impacts of the no-action alternative would be from decommissioning WF3 and providing a replacement power source or sources as discussed in Chapter 7.

In reviewing alternative energy sources, Entergy utilized the following criteria to determine a reasonable set of alternatives for purposes of evaluating the no-action alternative under National Environmental Policy Act (NEPA) requirements and NRC environmental regulations.

- The purpose of the proposed action (license renewal) is the continued production of approximately 1,188 net MWe of reliable base-load generation.
- The time frame for the needed generation is 2024–2044.
- Alternatives considered must be available (constructed, permitted, and connected to the grid) by the time the current WF3 OL expires in 2024.
- Alternatives must be electricity generating sources that are technically feasible and commercially viable.

- The annual capacity factor of WF3, based on a 3-year average for the years 2012–2014, is 85.8 percent (Entergy 2013b; Entergy 2014a; Entergy 2015f). 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 on a timetable supporting new generation in 2024.

2.6.2 Alternatives Considered

Chapter 7 presents, in some detail, the methodology of identifying actions that could be taken to replace the base-load generation capacity of WF3 in the region. Alternative generating technologies were evaluated to identify candidate technologies that would be capable of replacing the WF3 generating capacity by the end of the licensed unit's term in 2024.

Entergy's 2015 Integrated Resource Plan (IRP) is the long-range strategy for meeting customers' power needs (Entergy 2015g). The IRP is intended to provide guidelines for resource planning and decisions, and includes a 5-year action plan that allows Entergy to provide safe, reliable, and economic services to all customers, existing and new.

Entergy's IRP determined that the following alternatives were found appropriate for further analysis (Entergy 2015g):

- Pulverized coal—supercritical pulverized coal with carbon capture.

- Natural gas-fired alternatives (simple-cycle combustion turbines, combined-cycle gas turbines, small-scale aeroderivatives, and large-scale aeroderivatives).

- Nuclear—Generation III technology.

- Renewables (biomass, onshore wind power, and solar photovoltaic).

Based on the IRP analysis, gas-fired combustion turbines and combined-cycle gas turbines were selected as the preferred technologies for new build resources. The remaining alternatives, new nuclear, new coal, solar photovoltaic, and biomass, were not selected in any of the scenarios. Wind had a significant role in only one of the scenarios that involves high gas and carbon prices. (Entergy 2015g)

Entergy determined that the most likely alternative that would replace WF3 due to economic reasons, and relatively short development and construction time (approximately 3 years) would be a natural gas combined-cycle (NGCC) plant at the Entergy Louisiana, LLC property. However, for the sole purpose of this NEPA analysis and to assist the NRC staff with the preparation of the WF3-specific supplemental environmental impact statement, the hypothetical alternatives considered reasonable and discussed in greater detail in Chapter 7 are as follows:

- NGCC plant at the Entergy Louisiana, LLC property, 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 net 1,188 MWe generated by WF3.

- Supercritical pulverized coal (SCPC) plant at an alternate site consisting of multiple boiler/steam turbine generator units with net electricity generation approximately equivalent to the net 1,188 MWe generated by WF3.

- New nuclear plant at the Entergy Louisiana, LLC property where WF3 is located with net electricity generation approximately equivalent to the net 1,188 MWe generated by WF3.

- Combination of hypothetical alternatives consisting of an NGCC plant and biomass plants at the Entergy Louisiana, LLC property where WF3 is located, and demand-side management (DSM).

Entergy determined that the following alternatives were not considered as a reasonable replacement in comparison to renewal of the WF3 OL. The bases for these determinations are discussed in Section 7.1.2.

- Purchased power
- Plant reactivation or extended service life
- Conservation or DSM
- Wind
- Solar technologies: photovoltaic cells and solar thermal power
- Hydropower
- Geothermal
- Wood waste
- Municipal solid waste
- Other biomass-derived fuels
- Fuel cells
- Oil
- Ocean wave and current energy
- Coal-fired integrated gasification combined cycle (IGCC)

3.0 AFFECTED ENVIRONMENT

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC owned land. As previously discussed in Section 1.3, Waterford 1, 2, and 4 are also located on this same property. Waterford 1 and 2 are 411-MWe oil/gas-fired generating plants, and Waterford 4 is a 33-MWe oil-fired peaking generating plant.

3.0.1 Location and Features

WF3 is located on the west (right descending) bank of the Mississippi River between Baton Rouge, Louisiana, and New Orleans, Louisiana. The site is in the northwestern section of St. Charles Parish, Louisiana, and is near the communities of Killona and Taft. (WF3 2014a, Section 2.1.1.1) As shown in Table 3.10-1, the city of New Orleans, Louisiana, is the largest population center in the region, and is approximately 25 miles east of the site. The second largest population center in the region is Baton Rouge, Louisiana, approximately 50 miles northwest of the site. Figure 3.0-1 shows the property boundary, facility structures, and the EAB. WF3 falls within the Public Land Survey System and is located in Section 26, Township 12S, Range 20E (Entergy 2014b), as shown in Figure 3.0-2.

3.0.2 Vicinity and Region

The vicinity of WF3 is defined as the area within a 6-mile radius from the center of the WF3 containment structure and includes segments of St. Charles and St. John the Baptist parishes (Figure 3.0-3). As described in Section 3.1, land within the vicinity of the site is primarily developed for industrial and residential uses, with agricultural fields, wetlands, and open water. WF3 is located adjacent to the Mississippi River, at River Mile 129.6. The Mississippi River itself is the most prominent natural feature of the region. Other important natural features include Lac des Allemands, about 5.5 miles southwest of the site, and Lake Pontchartrain, about 7 miles northeast of the site. The land slopes gently from its high points near the river (+10 to 15 feet msl) to extensive wetlands located about 1.5 to 2.5 miles inland from the river. (WF3 2014a, Section 2.1.1.1)

The region of WF3 is defined as the area within a 50-mile radius (Figure 3.0-4) centered on the WF3 containment structure. The region includes portions of the following 21 parishes in the state of Louisiana: Ascension, Assumption, East Baton Rouge, Iberia, Iberville, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. Helena, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and West Baton Rouge.

As shown in Table 3.10-2, St. Charles Parish, where WF3 is located, had a 2010 population of 52,780, up from 48,072 in 2000. St. Charles Parish and both neighboring Jefferson and St. John the Baptist parishes are designated as part of the New Orleans-Metairie-Kenner Metropolitan Statistical Area (MSA) (RPC 2014). Jefferson Parish had a 2010 population of 432,552, down from 455,466 in 2000. St. John the Baptist Parish had a 2010 population of 45,924, up from 43,044 in 2000. (USCB 2014a)

Table 3.10-1 provides 2010 U.S. Census data for communities that are located totally or partially within a 50-mile radius of WF3. Important urban centers in the region of the site include New Orleans, which had a 2010 population of 343,829, down from a population of 484,674 in 2000; and Baton Rouge, which had a 2010 population of 229,493, up from a population of 227,818 in 2000. Communities near the site include Killona (1 mile west-northwest) with a 2010 population of 793, down from a population of 797 in 2000; Taft (1 mile east-southeast) with a 2010 population of 63, and no reported population in 2000; Montz (2 miles north-northeast) with a 2010 population of 1,918, up from a population of 1,120 in 2000; Norco (4 miles east) with a 2010 population of 3,074, down from a population of 3,579 in 2000; Hahnville (4 miles east-southeast) with a 2010 population of 3,344, up from a population of 2,792 in 2000; and Laplace (5 miles north) with a 2010 population of 29,872, up from a population of 27,684 in 2000. All the communities near the site except Laplace are located in St. Charles Parish. Laplace is located in neighboring St. John the Baptist Parish. Within a 50-mile radius of the site, there are 10 communities with a 2010 population greater than 25,000, and three of these have a 2010 population greater than 100,000. (USCB 2014b)

The region has a highly developed roadway network and rail system (Figures 3.0-3 and 3.0-4). Interstate Highway 10 (I-10) parallels the Mississippi River from Baton Rouge to New Orleans. Interstate Highway 12 runs east-west and is located north of Lake Pontchartrain. North-south Interstate Highway 55 and Interstate Highway 59 both feed traffic into New Orleans. The Union Pacific Railroad has an east-west line that runs through the Entergy Louisiana, LLC property.

Large industries are located along the Mississippi River both north and south of the site as far as Baton Rouge and New Orleans. These industries are predominantly refineries, petrochemicals manufacturers, sugar manufacturers, and grain elevators. (WF3 2014a, Section 2.1.1.1)

The reactor building is approximately 1,000 feet from the shoreline of the Mississippi River, which is one of the major inland waterway shipping routes in the United States. (WF3 2014a, Section 2.2.2.4) There are approximately 50 major pipelines operated by 12 different companies within 2 miles of WF3. Products carried in these pipelines include natural gas, hydrogen, ammonia, liquefied petroleum gas, ethane, gasoline, propane, and raw materials. The pipelines closest to the site are (1) Bridgeline Holdings's 16-inch natural gas line (0.3 miles to the west) and (2) Evangeline Gas Pipeline Co's two 20-inch natural gas lines (one to Waterford 1, 2, and 4, approximately 0.4 miles to the west; the other to Little Gypsy, approximately 0.4 miles to the east). There are four producing gas and oil fields within a 5-mile radius of WF3. (WF3 2014a, Section 2.2.2.3)

Within 10 miles of WF3, there are three private heliports, one private airfield, and one general aviation airport open to the public. As illustrated in Figure 3.0-3, two private heliports and one private air field (WF3, River Parish Hospital, and Triche Field) are located within 6 miles of the site. The Louis Armstrong New Orleans International Airport is a full-service commercial airport located approximately 13 miles from the plant, as shown in Figure 3.0-4. (AirNav 2014)

3.0.3 Station Features

The principal structures at WF3 are identified in Section 2.2. In addition to the principal structures, the WF3 plant area is defined as including the fenced area immediately adjacent to WF3 (WF3 2014a, Section 2.1.1.2). The WF3 protected area is completely enclosed by security fencing, with access to the area controlled through a security access portal system. A plant security system monitors the protected area, as well as the buildings within the station. The site area is shown, along with principal station structures and nearby features in Figure 3.0-1. The nearest residences to WF3 are located approximately 0.9 miles to the northeast, east-northeast, west-northwest and northwest of the reactor. (Entergy 2015h, Table 2.1)

Entergy has full control of all activities conducted within the EAB (Figure 3.0-1) of WF3. All of the property within the designated exclusion area is owned by the licensee with the exception of the bottom lands below the mean low water of the Mississippi River. (WF3 2014a, Section 2.1.2.1)

Transportation facilities near WF3 include the following (WF3 2014a, Section 2.1.1.1):

- Mississippi River (0.2 miles from the site);
- Louisiana Highway 18 (LA-18) (0.1 miles north-northeast);
- Louisiana Highway 628 (LA-628) (0.7 miles north-northeast across the Mississippi River);
- Louisiana Highway 3127 (LA-3127) (1.1 miles south-southwest); and
- Union Pacific Railroad (0.5 miles south-southwest), and as shown in Figure 3.0-1, a rail spur from the main line extends into the WF3 industrial area.

In the northern portion of the Entergy Louisiana, LLC property outside the industrial areas, the primary land use is cultivated crops. The southern portion of the property is dominated by wetlands, as described in Section 3.1. The drainage from the plant site runoff flows southwest to Lac Des Allemands (WF3 2014a, Section 2.4.1.2).

3.0.4 Federal, Native American, State, and Local Lands

A number of public lands are located within the vicinity of WF3, as listed in Table 3.0-1 and illustrated in Figure 3.0-5. The federal parcel nearest to the site is the Bonnet Carre Spillway. The Bonnet Carre Spillway is located on the east bank of the Mississippi River, approximately 1 mile east-northeast of the plant, and is a major flood control public works structure near WF3 in the Lower Mississippi Valley. Approximately 25 miles upstream of the city of New Orleans, Louisiana, the spillway and structure were constructed to divert approximately 250,000 cfs of floodwaters from the Mississippi River to Lake Pontchartrain to prevent overtopping of levees at and below New Orleans, assuring the safety of New Orleans and the downtown delta area during major floods on the lower Mississippi. (WF3 2014a, Section 2.4.1.2)

The area within a 6-mile radius of WF3 contains no state parks. A portion of the Maurepas Swamp Wildlife Management Area (WMA) lies within the vicinity, and public access and camping are permitted within the swamp. Numerous outdoor recreational activities (fishing, hunting, trapping, boating, and bird watching) are available for the public to pursue. (LDWF 2014a)

Various local parks lie within the vicinity (Table 3.0-1), located in both St. Charles and St. John the Baptist parishes. Closest to the site are two organized park areas: Killona and Montz parks. Killona Park, located approximately 1 mile northwest of the site, is a 12.5-acre park containing basketball courts and baseball fields. Montz Park is located approximately 1 mile east-northeast of the site and contains a baseball field. (WF3 2014a, Section 2.1.3.4.3)

There are a variety of national and state parks and WMAs located throughout the region, as shown in Figure 3.0-6. There are no Indian reservations or Native American owned lands within the 50-mile region. As illustrated in Figure 3.0-6, there is one military installation: Naval Air Station Joint Reserve Base New Orleans located approximately 30 miles east-southeast of WF3.

3.0.5 Known or Reasonably Foreseeable Projects in Site Vicinity

As previously discussed in Section 3.0, there are three other Entergy Louisiana, LLC owned fossil fuel-fired electricity generating facilities located on the same property on which WF3 is located: Waterford 1, 2, and 4.

WF3 has an ISFSI used to safely store spent fuel in licensed and approved dry cask storage containers on site. This ISFSI is licensed separately from the WF3 operating unit and would remain in place until the U.S. Department of Energy (DOE) takes possession of the spent fuel and removes it from the site for permanent disposal or processing. Expansion of the onsite spent fuel storage capacity may be required in the future if the DOE does not take responsibility for the permanent storage and disposal of the onsite spent fuel. The impacts associated with this expansion would be assessed under a separate NRC licensing and review process.

Along the west shore of Lake Pontchartrain, the U.S. Army Corp of Engineers (USACE) is investigating the potential to provide hurricane and storm-surge risk reduction on the east bank of the Mississippi River in St. Charles, St. John the Baptist, and St. James parishes. The study area is located west of the Bonnet Carre Spillway. (USACE 2014a) The federal project under discussion includes construction of an $881 million dollar levee project in St John the Baptist Parish by the USACE to protect east bank communities from hurricane storm surge. (The Times-Picayune 2014)

Based on public information, foreseeable manufacturing projects within a 50-mile radius of WF3 include the following (The Advocate 2015):

- A.M. Agrigen's fertilizer plant in the Killona area of St. Charles Parish.
- Castleton Commodities International LLC's methanol manufacturing plant in the Braithwaite area of Plaquemines Parish.

- Yuhuang Chemical Inc.'s methanol complex in St. James Parish on River Road on the west bank of the Mississippi River.

- Williams Partners LP's potential addition of an ethane cracker to the company's Geismar complex located in Ascension Parish. The company is exploring this idea.

Table 3.0-1
Federal, State, and Local Lands, 6-Mile Radius of WF3

Name[(a)]	Management	Distance[(b)]	Direction	Nearest Place	Parish
LOUISIANA					
Montz Park	Local	1	ENE	Montz	St. Charles
Killona Park	Local	1	NW	Killona	St. Charles
Bonnet Carre Spillway[(c)]	Federal	1	ENE	Montz	St. Charles
Bethune Park	Local	3	ENE	Norco	St. Charles
Laplace Weigh Station—Airline Highway	State	4	NNE	Laplace	St. John the Baptist
Cambridge Park	Local	5	N	Laplace	St. John the Baptist
Emily C. Watkins Park	Local	5	NNW	Laplace	St. John the Baptist
Highway 51 Park	Local	5	N	Laplace	St. John the Baptist
Larayo Park	Local	5	NNW	Laplace	St. John the Baptist
Wisner Donation Charity Hospital—New Orleans	State	5	W	Edgard	St. John the Baptist
Division of State Lands—Patent	State	6	SSE	Boutte	St. Charles
Division of State Lands—Patent	State	6	ENE	Norco	St. Charles
Maurepas Swamp Wildlife Management Area	State	6	NNE	Laplace	St. John the Baptist
Greenwood Park	Local	6	NNW	Laplace	St. John the Baptist
River Parishes Mental Health Center	State	6	NNW	Laplace	St. John the Baptist

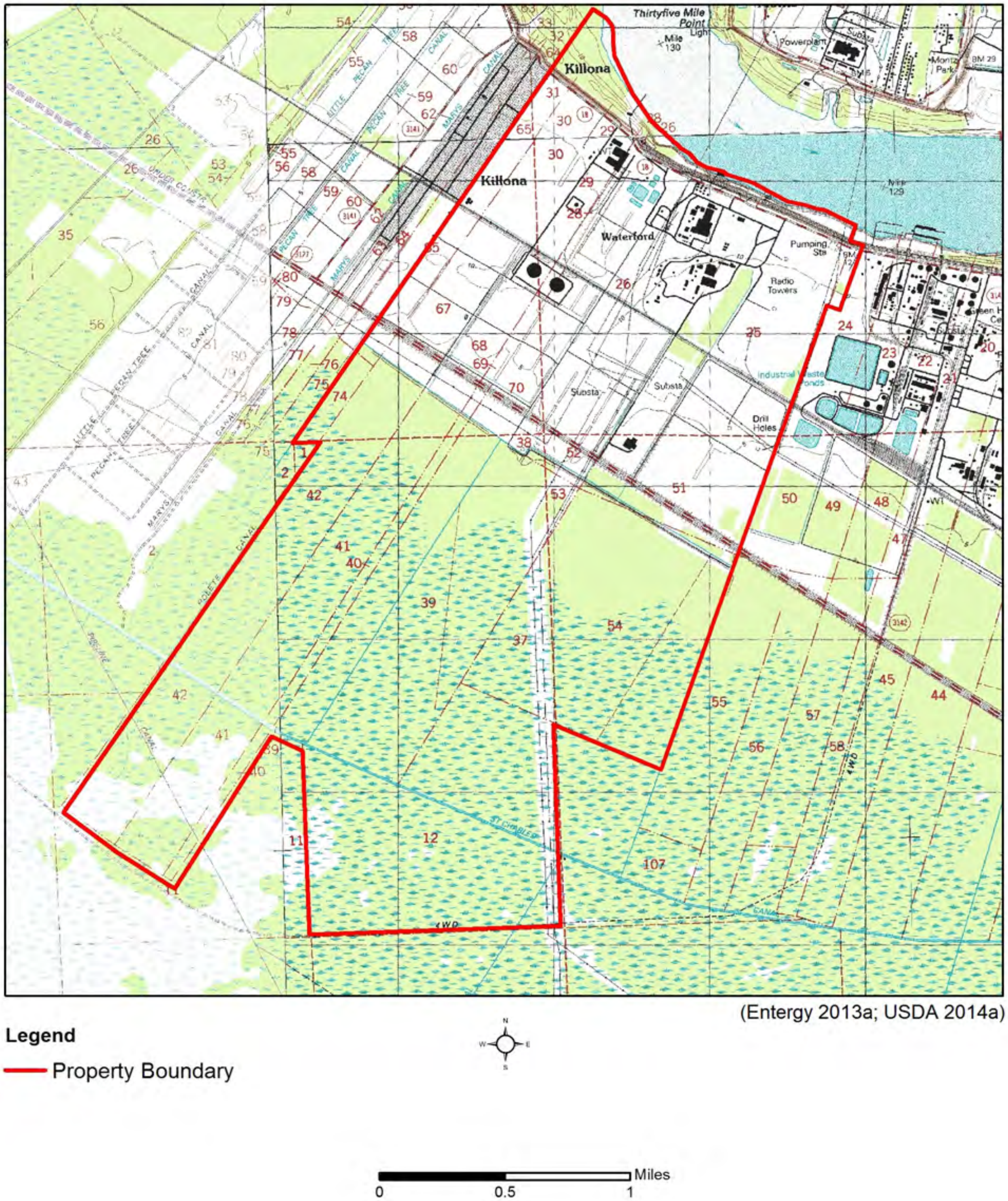
(LDOA 2014; SCP 2011; SJBP 2014a; USDA 2014a; WF3 2014a)

a. List is based on best available public information and includes lands that are totally or partially located within a 6-mile radius of WF3.
*A complete list of St. Charles Parish parks and recreation sites is available in the St. Charles Parish 2030 Comprehensive Plan (SCP 2011).
*A complete list of parks and recreation sites for St. John the Baptist Parish is available at the parish website (SJBP 2014a).

b. Distances are approximate miles (rounded to the nearest whole number and calculated based on WF3 location and land centroid data).

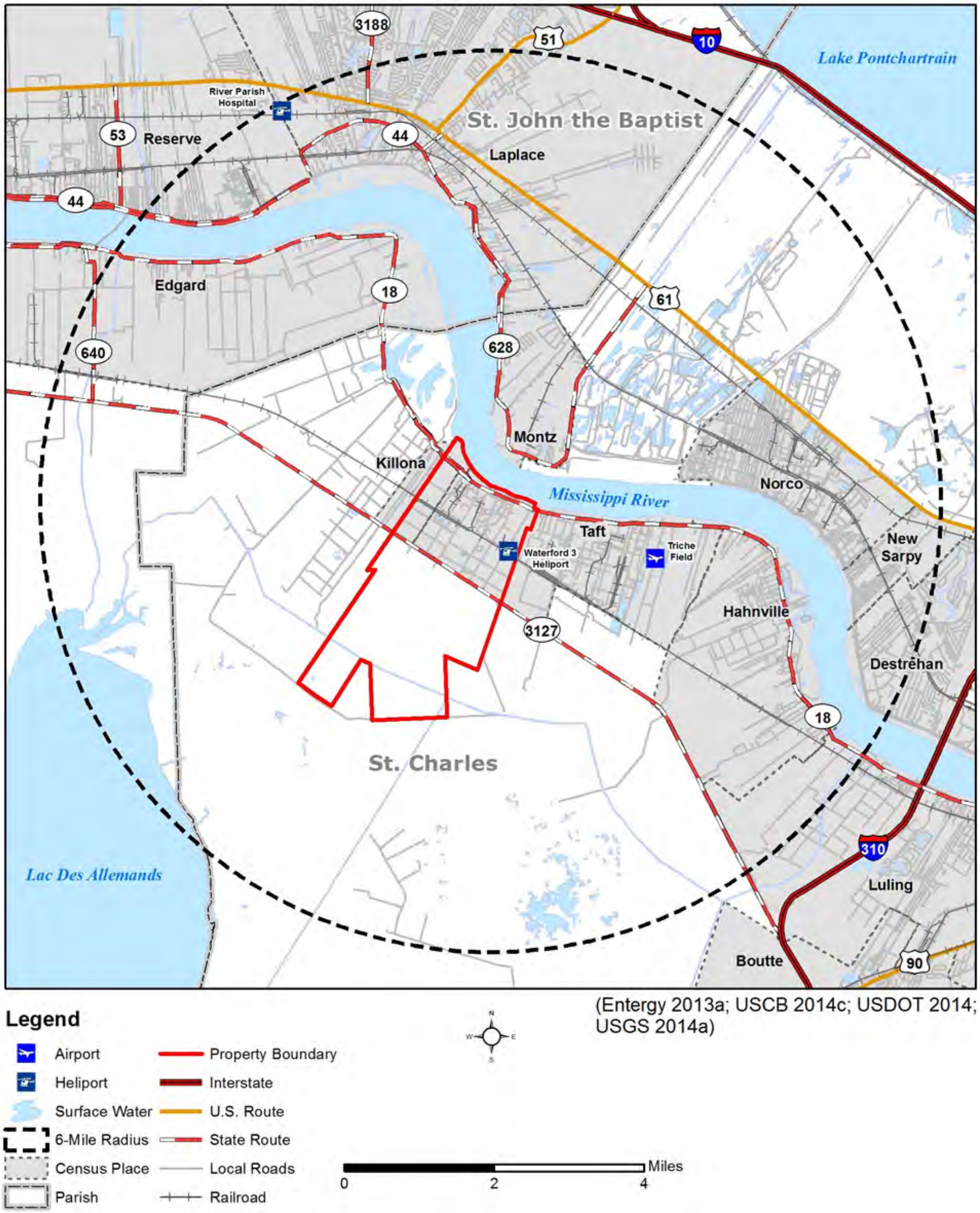
c. The distance reported for the Bonnet Carre Spillway is rounded and based on the point of the property boundary closest to WF3 (WF3 2014a, Section 2.1.1.1).

Figure 3.0-1
WF3 Plant Layout



(Entergy 2013a; USDA 2014a)

Figure 3.0-2
Entergy Louisiana, LLC Property and Area Topography



(Entergy 2013a; USCB 2014c; USDOT 2014; USGS 2014a)

Figure 3.0-3
6-Mile Radius of WF3

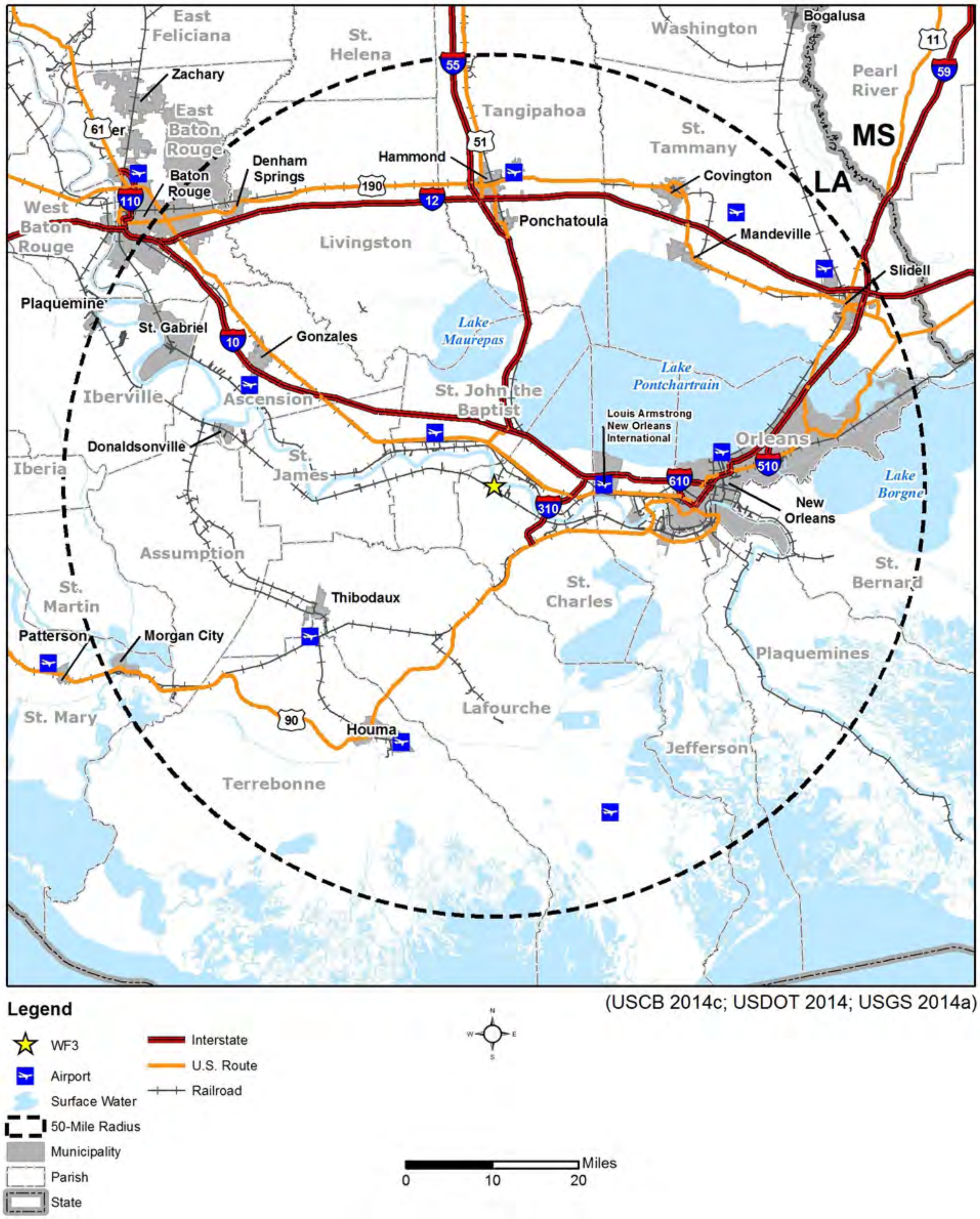
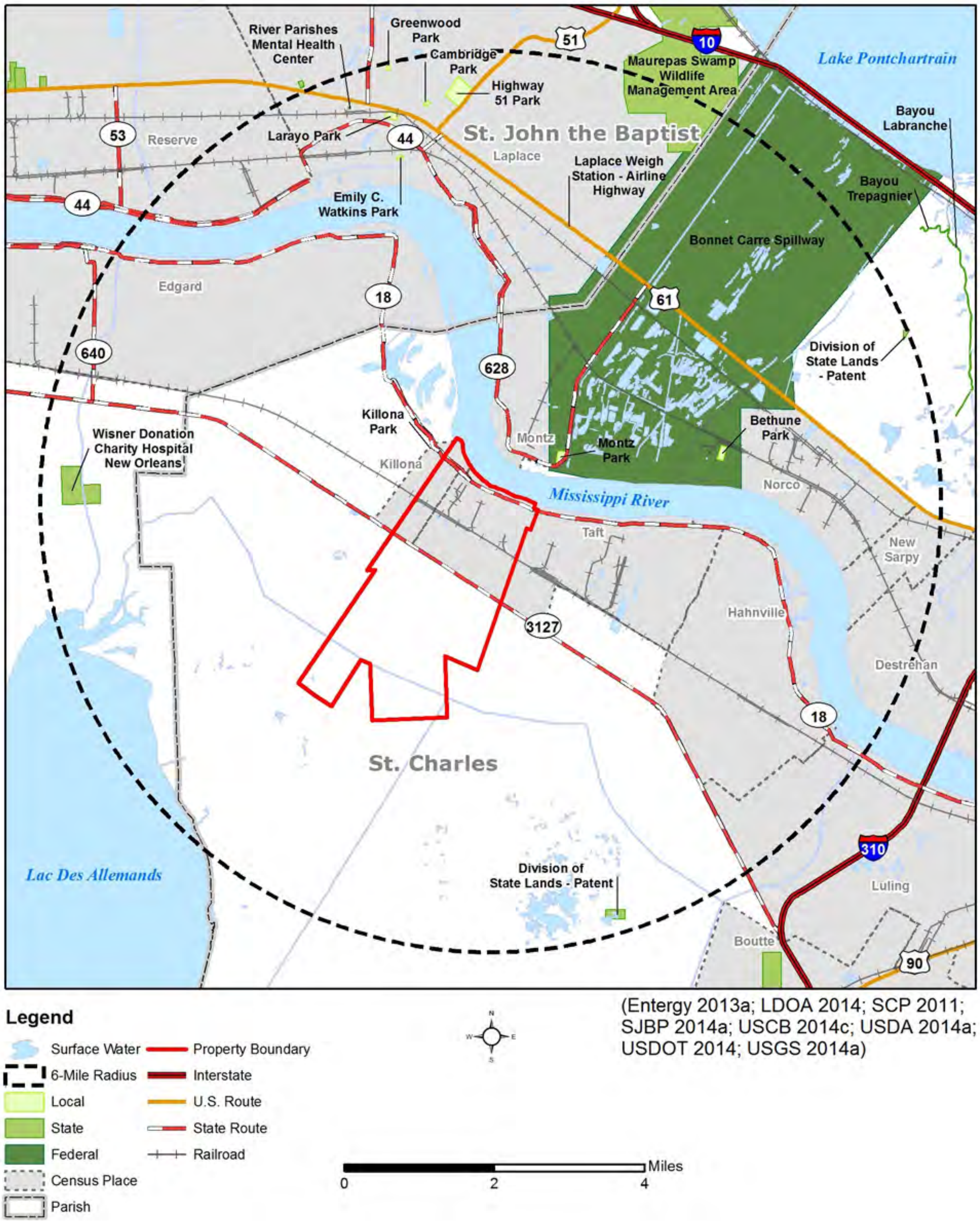
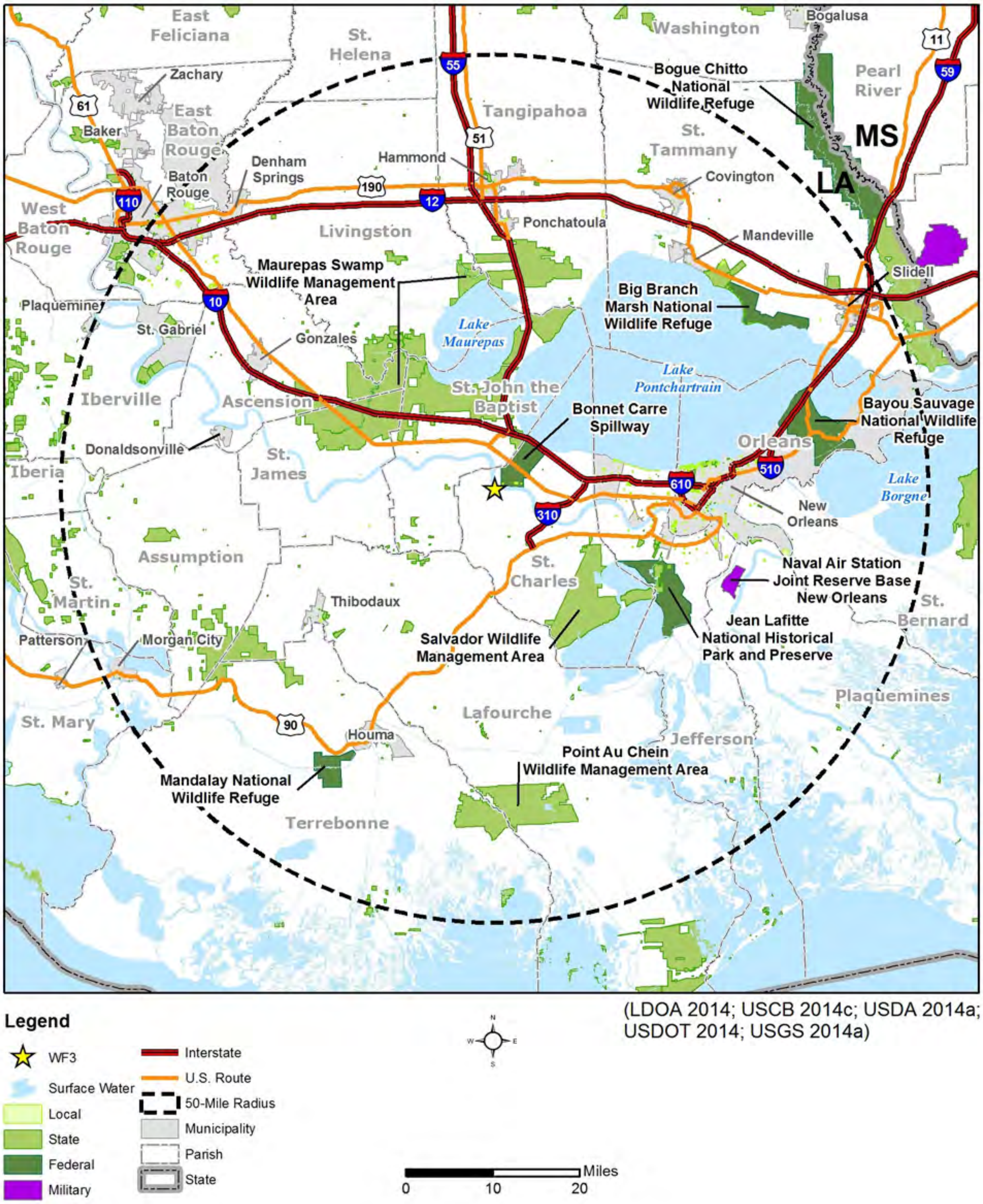


Figure 3.0-4
50-Mile Radius of WF3



(Entergy 2013a; LDOA 2014; SCP 2011; SJBP 2014a; USCB 2014c; USDA 2014a; USDOT 2014; USGS 2014a)

Figure 3.0-5
Federal, State, and Local Lands, 6-Mile Radius of WF3



(LDOA 2014; USCB 2014c; USDA 2014a; USDOT 2014; USGS 2014a)

Figure 3.0-6
Federal, State, and Local Lands, 50-Mile Radius of WF3

3.1 Land Use and Visual Resources

Land use descriptions are focused on St. Charles and Jefferson parishes in Louisiana because WF3 is located in St. Charles Parish, approximately 44 percent of WF3 employees are located in these two parishes, and because WF3 is one of Entergy Louisiana, LLC's assets on which property taxes are paid to St. Charles Parish. The remaining WF3 employees reside in 19 different parishes and four different states.

3.1.1 Onsite Land Use

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC owned land. The WF3 plant area itself covers 40.1 acres. (WF3 2014a, Section 2.1.1.2) The plant is located in the northwestern section of St. Charles Parish, Louisiana, near the towns of Killona and Taft (Figure 3.0-3) (WF3 2014a, Section 2.1.1.1). The largest cities near the site are New Orleans and Baton Rouge, Louisiana, located approximately 25 miles east and 50 miles northwest, respectively (Figure 3.0-4). The site is located adjacent to the Mississippi River, with the majority of manmade features located on the narrow strip of dry land between the Mississippi River and the wetlands (WF3 2014a, Section 2.1.1.1), as shown in Figure 3.0-1.

As shown in Table 3.1-1 and illustrated in Figure 3.1-1, wetlands are the largest land cover category, covering approximately 63 percent of the Entergy Louisiana, LLC property. These wetlands are classified primarily as woody wetlands (58.5 percent) and emergent herbaceous wetlands (4.1 percent). The next largest category is agriculture, with approximately 23 percent of the property classified as cultivated crops. (USDA 2014a) Regarding agricultural land use, approximately 660 acres of the property is currently leased to Raceland Raw Sugar LLC for growing sugar cane, milo, or soybeans as stipulated in the lease agreement. The term of the lease is limited to three crop years, as that term is generally used in the agricultural community. The current lease will expire November 1, 2017 (Entergy 2014c) but can be extended for an additional three crop years.

Land on the Entergy Louisiana, LLC property is zoned as an industrial area by St. Charles Parish. Future land use maps from the St. Charles Parish 2030 Comprehensive Plan indicate that these uses are anticipated to continue on the Entergy Louisiana, LLC property. (SCP 2011)

Entergy Louisiana, LLC owns, in title, all surface rights within the EAB. There is no anticipated future exploration for subsurface minerals within the exclusion zone. Entergy Louisiana, LLC is the full or partial owner of mineral rights on lands adjoining the exclusion zone. Entergy Louisiana, LLC has no intention of executing mineral leases for drilling on this property; however, if this were contemplated, a condition of the lease agreement would be a restriction prohibiting directional drilling into the subsurface below the exclusion zone. (WF3 2014a, Section 2.1.2.1)

3.1.2 Offsite Land Use

As shown in Table 3.10-2, St. Charles Parish has seen an increase in total population since 2000 and is projected to continue this trend through 2045. In contrast, Jefferson Parish saw a decrease in total population between 2000 and 2010; however, total population is projected to increase through 2045.

St. Charles Parish is located in southeast Louisiana and is bordered on the north by Lake Pontchartrain, on the west by St. John the Baptist Parish, on the south and southwest by Lafourche Parish, and on the east by Jefferson Parish (Figure 3.0-4). The Mississippi River bisects the parish in a general east-west direction and there is heavy industrial development along the banks of the river. Approximately 31 percent of the total parish area is open water, while another approximately 61 percent of the total parish area is wetlands, scrub, and marsh. Only about 11 percent of land area (approximately 20,000 acres) is potentially developable land, of which approximately 12,300 acres are already developed. Agriculture is the most prevalent land use, with more than 7,000 acres (3.89 percent of land area) cultivated for crops, and pasture and grassland for livestock. Single-family residential, at 3 percent of land area (approximately 5,400 acres), and industrial, at 2.67 percent of land area (approximately 4,800 acres), are the next two largest land use categories. (SCP 2011)

The vicinity (6-mile radius) surrounding WF3 lies primarily within St. Charles Parish; however, a small portion to the north and east includes land area in St. John the Baptist Parish (Figure 3.0-3). The land use and land cover categories located within a 6-mile radius of WF3 are illustrated in Figure 3.1-2. Wetlands are the largest land cover category, covering approximately 55 percent. These wetlands are primarily classified as woody wetlands (approximately 39.2 percent) and emergent herbaceous wetlands (approximately 15.9 percent). The next largest category is agriculture, with approximately 13.6 percent of the vicinity classified as cultivated crops, followed by open water at approximately 10.5 percent (approximately 7,632 acres). Developed land, which includes open space, low intensity, medium intensity, and high intensity, totals approximately 13,409 acres (18.5 percent). These four categories compose the majority (approximately 97.7 percent) of the land use/land cover types that occur within the vicinity, which are presented in greater detail in Table 3.1-2. (USDA 2014a)

St. Charles Parish occupies approximately 177,830 acres of land, of which 16,216 acres are proportioned to farmland. The 2012 Census of Agriculture reports that the parish had a total of 70 farms, with an average farm size of 232 acres. Approximately 31 farms produced crops, with primary crops reported as forage (1,598 acres) and vegetables harvested for sale (20 acres). Approximately 48 farms produced livestock, with the primary commodity being reported as beef cows. (USDA 2012)

Jefferson Parish occupies approximately 189,203 acres of land, of which 7,748 acres are proportioned to farmland. In 2012, it was reported that the parish had a total of 57 farms, with an average farm size of 136 acres. Approximately 22 farms produced crops, with primary crops reported as forage (454 acres) and orchards (2 acres). Livestock is also an important agricultural product in the parish, with livestock commodities such as cattle and calves (13 farms), layers (2 farms), and beef cows (8 farms) being reported. Other agricultural uses of farmland within the parish included woodlands (645 acres; 14 farms), permanent pasture and rangeland (2,782 acres; 29 farms), and aquaculture (11 farms). (USDA 2012)

The Louisiana Revised Statutes Title 33, Municipalities and Parishes, Part IV, Physical Development of Parishes and Municipalities, grants the power (to every parish and municipality) to create a planning commission and an official master plan. The legislation defines master plan as a statement of public policy for the physical development of a parish or municipality adopted by a parish or municipal planning commission. Further, it states that a parish or municipal planning commission shall make and adopt a master plan for the physical development of the unincorporated parish territories and municipality. The plan should include the following (LA 2014):

- Location, character, and extent of transportation routes, public park spaces, aviation fields, and other public ways, grounds, and open spaces;
- General location of public buildings, schools, and other public property;
- General character, extent and layout of public housing and the replanning of blighted districts and slum areas;
- General location and extent of public utilities and terminals for water, light, sanitation, communication, power, transportation, and other purposes;
- The removal, relocation, widening, narrowing, vacating, abandonment, change of use, or extension of any of the foregoing ways, grounds, open spaces, buildings, property, utilities, or terminals.

St. Charles Parish, Jefferson Parish, and nearby New Orleans Metropolitan Region all have master plans with active zoning regulations.

St. Charles Parish has a history that includes a proactive approach to zoning, resulting in 51 percent of the land set aside for specific types of land use. In the Parish's 2030 Plan, this approach has continued with planned land use categories identified on their future land use map. The map includes five major categories: residential, employment, commercial, activity centers, and resources (e.g., recreation, wetlands, existing and planned roadways, and wetland mitigation banks). For each of these categories, there is significant potential for development capacity. For example, the vacant, potentially developable land set aside for residential zoning districts adds up to nearly 10,000 acres, which could accommodate almost 10 times the number of homes anticipated to be needed in 2030. St. Charles Parish objectives for future land use, housing, and community character include the following (SCP 2011):

- Provide for an orderly and cost-effective redevelopment and growth pattern;
- Minimize incompatibilities between different types of uses;
- Enhance community livability, historical value, appearance, and visual character;
- Protect and maintain rural character;

- Preserve productive farmland and promote economically viable and compatible agricultural uses in the parish; and

- Reduce development vulnerability to storms and other disasters.

Jefferson Parish's Envision 2020 Plan characterizes land within the hurricane protection levee system as the de facto urban growth area for the parish. The urban growth area contains nearly 65,500 acres of land outside of the incorporated cities and is approximately 67 percent developed. The majority of this land area is located along the west bank of the Mississippi River. Within the urban growth area, the primary land use category is residential (17,697.6 acres; 40.4 percent), followed by public or private ROWs for transportation and drainage canals (11,381.2 acres; 25.9 percent). (UWDUPD 2006)

The parish's goals for future land use include the following (UWDUPD 2006):

- Provide for a sustainable urban environment that will support and enhance neighborhoods and businesses and accommodate their growth;

- Provide suitable and adequate opportunities for commercial and industrial development that is convenient, visually pleasing, and environmentally sound;

- Accommodate a diverse range of housing types and densities in a manner well suited to surrounding uses;

- Preserve existing residential neighborhoods;

- Protect and enhance the major economic activity centers; and

- Ensure that dependable and adequate public infrastructure supports the existing and future development needs of the parish.

3.1.3 Visual Resources

As discussed in Section 3.0.1, WF3 is located on the west bank (right descending) of the Mississippi River. Figure 3.0-1 shows the building site layout and the property boundary in association with the Mississippi River. As discussed in Section 3.1.1, the largest land use categories on the Entergy Louisiana, LLC property are wetlands at approximately 63 percent and agriculture at approximately 23 percent.

The profile of WF3 is dominated by the 249.5-foot high, domed-roof reactor shield building. The base of the reactor containment and the reactor auxiliary building is situated 50 feet below ground, which reduces the height of the plant's skyline profile. All auxiliary structures, ducts, pipes, and tanks are painted a blue-gray color that blends with the natural-finish concrete of the principal structures. WF3 is seen by viewers in conjunction with Entergy Louisiana, LLC's three existing fossil-fueled units and is visibly compatible with the industrialized character of adjacent properties. (LP&L 1978, Section 3.1)

Within the vicinity, there is heavy industrial and commercial development along the Mississippi River. Near WF3, there are several large industrial facilities, including Waterford 1, 2, and 4 (0.4 miles west-northwest of WF3); Little Gypsy Steam Electric Station Units 1, 2, and 3 (0.8 miles north-northeast of the site, across the river); and Occidental Chemical Corporation (0.8 miles east-southeast). Other large industries are located along the Mississippi River both north and south of the site as far as Baton Rouge and New Orleans. These industries are predominantly refineries, petrochemicals manufacturers, sugar manufacturers, and grain elevators. (WF3 2014a, Section 2.1.1.1) Additional industrial facilities located on LA-3142 near WF3 include Air Liquide America; Galata Chemicals; Occidental Chemical Corp.; Praxair Distribution, Inc.; and Union Carbide (wholly-owned subsidiary of The Dow Chemical Company). (Dow 2015; SCP 2015a).

Visual impacts from the site are limited to adjacent properties and traffic, associated with the Mississippi River (0.2 miles from the site), LA-18 (0.1 miles north-northeast), LA-628 (0.7 miles north-northeast, across the river), and LA-3127 (1.1 miles south-southwest). (WF3 2014a, Section 2.1.1.1) As discussed in Section 3.0.3, the nearest residences to WF3 are located approximately 0.9 miles to the northeast, east-northeast, northwest, and west-northwest of the reactor. As discussed in Section 3.0.4, the nearest organized park areas closest to WF3 are Killona and Montz parks. Killona Park is located approximately 1 mile northwest of the site, while Montz Park is located approximately 1 mile east-northeast of the site. As shown in Table 3.7-2, the nearest aboveground historic property is 2 miles from WF3. Therefore, WF3 is visibly compatible with the industrialized character of adjacent properties and does not visually impact aboveground historic properties or areas that have a high degree of recreational use.

Table 3.1-1
Land Use/Land Cover, Entergy Louisiana, LLC Property

Category	Acres	Percent
Open water	46.93	1.3
Developed	467.70	12.9
Open space	69.16	1.9
Low intensity	309.80	8.5
Medium intensity	35.81	1.0
High intensity	52.93	1.5
Barren land (rock/sand/clay)	12.45	0.3
Shrub/scrub	1.56	0.0
Grassland/herbaceous	7.78	0.2
Pasture/hay	2.89	0.1
Cultivated crops	820.19	22.6
Woody wetlands	2,128.32	58.5
Emergent herbaceous wetlands	148.11	4.1
Total	**3,635.93**[a]	**100.0**

(USDA 2014a)

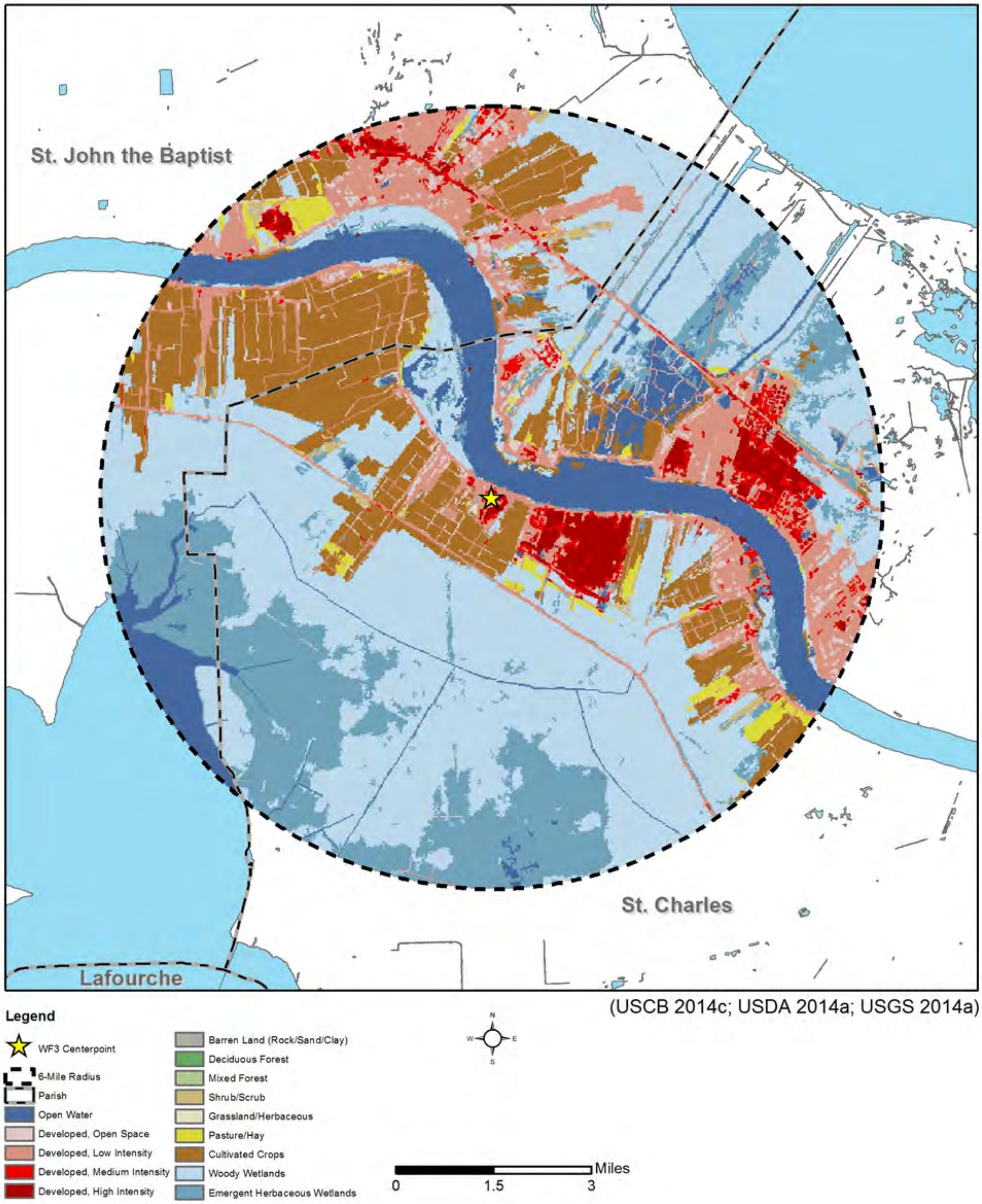
a. The acreages presented in this table are based on the MRLC land use/land cover data. These data are presented in a raster (pixel-based) format, and because of their square geography they do not exactly match the Entergy Louisiana, LLC property boundary. This geography variation creates a small difference between the total acreage reported in Table 3.1-1 compared to the Entergy Louisiana, LLC property acreage stated throughout the ER.

Table 3.1-2
Land Use/Land Cover, 6-Mile Radius of WF3

Category	Acres	Percent
Open water	7,632.14	10.54
Developed	13,408.84	18.52
Open space	1,877.01	2.59
Low intensity	8,625.58	11.92
Medium intensity	1,240.29	1.71
High intensity	1,665.96	2.30
Barren land (rock/sand/clay)	35.36	0.05
Deciduous forest	8.67	0.01
Mixed forest	3.78	0.01
Shrub/scrub	465.03	0.64
Grassland/herbaceous	45.37	0.06
Pasture/hay	1,008.34	1.39
Cultivated crops	9,860.76	13.62
Woody wetlands	28,381.12	39.21
Emergent herbaceous wetlands	11,534.28	15.93
Total	**72,383.69**	**100.00**

(USDA 2014a)

Figure 3.1-1
Land Use/Land Cover, Entergy Louisiana, LLC Property



(USCB 2014c; USDA 2014a; USGS 2014a)

Figure 3.1-2
Land Use/Land Cover, 6-Mile Radius of WF3

3.2 Meteorology and Air Quality

3.2.1 General Climate

The climate of southeastern Louisiana is classified as humid subtropical. It is influenced to a large degree by the many water surfaces provided by lakes and streams and by proximity to the Gulf of Mexico. During mid-June to mid-September, the prevailing southeast to southwest winds carry inland warm, moist tropical air favorable for sporadic, often quite localized development of thunderstorms. Occasionally the pressure distribution of the atmosphere changes to bring in a flow of hotter and drier air. (WF3 2014a, Section 2.3.1.1)

The prevailing southeast to southwest winds in the summer months are usually associated with the "Bermuda High" that often remains stationary in the Atlantic Ocean off the southeast coast of the United States; on some days, however, such winds merely reflect a localized sea breeze. The hotter drier conditions on the other hand are usually caused by the formation of a high pressure system over the western Gulf of Mexico. Cool continental air rarely reaches the site region in summer. If a cold front does occur, the cold air behind the front has usually been greatly moderated by solar heating over the plains states to the north or northwest. (WF3 2014a, Section 2.3.1.1)

From late fall until early spring, bursts of cold air do reach southeastern Louisiana, but the cool temperatures which result seldom last more than a few days. Even during these seasons, the weather is still usually dominated by maritime tropical air from the Gulf of Mexico. The interaction between this moist air and the much colder, drier air to the north often generates or intensifies winter storms which then usually pass to the north of the site. Throughout the year, the many water surfaces in the site area modify the relative humidity and temperature by decreasing the range between extremes. During periods of southerly wind flow, these effects are increased, imparting the characteristics of a marine climate. Relative humidity of less than 50 percent occurs in each month of the year; however, it is less frequent in the summer than during the other seasons. Freezing temperatures are not common and are generally restricted to the period mid-December to mid-March. Some years have no temperatures below freezing. (WF3 2014a, Section 2.3.1.1)

3.2.2 Meteorology

3.2.2.1 Wind Direction and Speed

Surface wind data for New Orleans (Moisant International Airport) for the 30-year period 1981–2010 were used to define long-term wind conditions for the New Orleans area. The data show a south wind to be the predominant direction. The average wind speed over this same 30-year period was 8 miles per hours (mph). (NCDC 2015)

Tabulated wind rose data and actual wind roses for the WF3 onsite meteorological station (30 foot level) for the periods July 1973 through June 1975 and February 1977 to February 1978 indicated the site experiences fewer calms and more frequent southeasterly winds than does the airport. The decrease in calm conditions recorded at the site as opposed to the airport may be due to the low wind speed threshold for the anemometer and a longer averaging period of the observation (60-minute) at the site. The directional differences are most likely due to the effects of Lake Pontchartrain and the location of the lake with respect to the airport and WF3. (WF3 2014a, Section 2.3.2.1.1)

Based on a 5-year average (2010–2014) of meteorological measurements at WF3, the hourly average wind speed on an annual period was 6.6 mph, with a maximum hourly averaged wind speed of 43.1 mph recorded in 2012, as a result of Hurricane Isaac. In addition, consistent with the July 1973 through June 1975 and the February 1977 to February 1978 measurements discussed above, the site experienced few calms during this 5-year period. (WF3 2011a; WF3 2012; WF3 2013; WF3 2014c; WF3 2015a) Annual wind rose data for the period 2010–2014 (Figures 3.2-1, 3.2-2, 3.2-3, 3.2-4, and 3.2-5) indicate that the predominant directions originate from the south, south-southeast, and northeast sectors.

3.2.2.2 Temperature

In the New Orleans area, on average, there are only about 7 days per year when the temperature rises to 95°F or higher (WF3 2014a, Section 2.3.2.1.2), and 102°F is the highest temperature of record, occurring most recently in August, 1980, in Orleans Parish (NCDC 2014a). During the 30-year period 1981–2010, the greatest number of days in New Orleans with temperatures of 90°F or higher was 74 days in 1974 (NCDC 2014a).

From about mid-November to mid-March, the area is subjected alternately to tropical air and cold continental air in periods of varying length. About 80 percent of the December–February hourly temperatures range from 41°F to 69°F. The mean date of the first occurrence of 32°F or lower is about December 12, while the mean date of the last occurrence is about February 13. Between these dates, temperatures are above freezing more than 6 days out of seven entirely with some afternoons having temperatures in the 70s and 80s. The mean length of the freeze-free period is about 302 days. The latest freeze date in spring was March 27, 1955, with 30°F reported. The earliest freeze date in the fall was November 11, 1894, when a reading of 32°F was recorded. (WF3 2014a, Section 2.3.2.1.2)

The usual track of winter storms is to the north of New Orleans, but occasionally one moves into the area, bringing large and rather sudden drops in temperature. However, the cold spells seldom last more than 3 or 4 days. In about two-thirds of the years, the annual lowest temperature is 24°F or warmer, with some years entirely above freezing. The all-time record low temperature recorded in New Orleans was 7°F on February 13, 1899. The coldest winter on record was 1885–1886, when the temperature for December, January, and February averaged 50.9°F. (WF3 2014a, Section 2.3.2.1.2)

The long-term temperature records of the area show the typical annual cycle. The monthly average temperature varies from a minimum of 53.2°F in January to a maximum of 82.5°F in July at Moisant International Airport (NCDC 2014a). Temperature records for New Orleans (Audubon Park) and Reserve show similar annual cycles (WF3 2014a, Section 2.3.2.1.2). Extremes in temperature range from 7°F recorded in February, 1899 (WF3 2014a, Section 2.3.2.1.2) to 102°F in August 1980 (NCDC 2014a). Although the diurnal temperature range is several degrees lower at WF3, the annual mean temperature for New Orleans and WF3 are within 0.7°F (WF3 2014a, Section 2.3.2.1.2).

The monthly average temperature values (°F) for data collected at the New Orleans International Airport for a 75-year period of record (1939 through 2013) are shown below (NCDC 2014a).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53.2	55.4	62.0	68.5	75.7	80.6	82.5	82.4	78.6	70.3	60.8	55.2

The highest daily maximum temperatures (°F) recorded for each month at the New Orleans International Airport for a 67-year period of record (1947 through 2013) are shown below (NCDC 2014a).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
83	85	89	92	96	101	101	102	101	94	87	84

3.2.2.3 Precipitation

Rather frequent and sometimes very heavy rains are typical for this area. There are an average of 120 days of measurable rain per year and an annual average accumulation of more than 60 inches. (NCDC 2014a) The greatest 24-hour amount of precipitation since 1871 was 14.01 inches which fell on April 15–16, 1927, while 13.68 inches fell on October 1–2, 1937. The heaviest recorded rate of rainfall in the New Orleans area was 1 inch in 5 minutes, measured during a thunderstorm on February 5, 1955; however, such a rate is never long sustained. In contrast, one can expect a period of 3 consecutive weeks without measurable rainfall about once in 10 years. The longest period was 53 days from September 29 to November 20, 1924. (WF3 2014a, Section 2.3.2.1.4)

The monthly average precipitation values (in inches) for data collected at the New Orleans International Airport for the years 1981 through 2010 are shown below (NCDC 2014a).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.15	5.30	4.55	4.61	4.63	8.06	5.93	5.98	4.97	3.54	4.49	5.24

3.2.2.4 Snow and Glaze

Snowfall amounts are generally light, with the snow usually melting as it lands (WF3 2014a, Section 2.3.2.1.4). Snowfall amounts of 2 inches or more have only been recorded five times in the 100 years of data available prior to 1975 (5 inches in January 1881, 8.2 inches in February 1895, 3 inches in February 1899, 2 inches in February 1958 [NCDC 2014a], and 2.7 inches in December 1963). Similarly, only one glaze storm was reported in the region by the U.S. Weather Bureau in the 28-year period of record (1925–1953). However, the Weather Bureau data contain only limited information on glaze occurrences in the New Orleans area. (WF3 2014a, Section 2.3.1.2.6)

3.2.2.5 Relative Humidity and Fog

From December to May, the waters of the Mississippi River are usually colder than the air temperature, favoring the formation of river fog, particularly with light southerly winds. Nearby lakes also serve to modify the extremes of temperature and to increase the incidence of fog over narrow strips along the shores. (WF3 2014a, Section 2.3.2.1.3)

January is the month with the greatest frequency of fog occurrences. In about half of the winter hours, however, the relative humidity is less than 80 percent, and values less than 50 percent are about twice as frequent in winter as in the summer. (WF3 2014a, Section 2.3.2.1.3)

3.2.2.6 Severe Weather

3.2.2.6.1 Hurricanes

The state of Louisiana is occasionally in the path of tropical storms or hurricanes. Tropical systems have the potential to harm life and property in Louisiana, especially along the coast. The state experiences, on average, one tropical system per year. While not all of the tropical systems are hurricanes, they can still pack a punch regardless of intensity. September is the most active month for tropical weather in Louisiana. (NCDC 2014b)

From 1871 to 2013, the area within 60 miles of New Orleans has been hit by tropical storms 63 times. Thirty-seven storms were classified as tropical storms and 26 as hurricanes. (Hurricane City 2014) Since 2000, there have been three hurricanes that have made landfall within 60 miles of New Orleans, as discussed below:

- In August 2005, Hurricane Katrina hit just east of New Orleans with 125 mph winds while moving north. Final wind reports showed Category 1 and Category 2 winds were most common in the city. Ninety-seven mph winds were measured by NASA that same day. Katrina was officially a Category 3 while hitting southeast Louisiana and the Mississippi coast. The large size of Katrina, as well as being a Category 5 before hitting land, caused a near 27-foot storm surge on the Mississippi coast, resulting in a high surge into Lake Pontchartrain. Eighty percent of New Orleans flooded after passage of Hurricane Katrina. (Hurricane City 2014)

- In September 2008, Hurricane Gustav made landfall as a Category 2 hurricane near Cocodrie, Louisiana, passing approximately 80 miles to the southwest while moving northwest with 110 mph winds and a high storm surge, but the flood control levees held. Gustav continued to move northwest across south Louisiana and weakened to a Category 1 storm over south-central Louisiana later that day. The storm diminished to a tropical depression over northwestern Louisiana. (NASA 2014)

- The New Orleans area was last affected in August 2012 by Hurricane Isaac, which passed 45 miles to the southwest with 80 mph winds while moving slowly north-northwest causing surge flooding in surrounding areas. The New Orleans Airport reported gusts up to 83 mph. (Hurricane City 2014)

3.2.2.6.2 Thunderstorms

In summer, the prevailing southerly winds provide moist, semitropical weather often favorable for afternoon thunderstorms. With westerly to northerly winds, periods of hotter and drier weather interrupt the prevailing moist condition. The heaviest rains of short duration are associated with thunderstorms, although tropical systems or their remnants sometimes cause prolonged heavy rains. Showers and thunderstorms occur quite often in all parts of the state, during the summer. Most of these storms are convective in nature and occur at the peak of daytime heating. (NCDC 2014b)

Based on 21 years of U.S. Weather Bureau records at Moisant International Airport (1949–1969), the mean number of days with thunderstorms is as follows (WF3 2014a, Section 2.3.1.2.3):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2	2	3	5	6	9	16	13	7	2	1	2	68

3.2.2.6.3 Tornadoes

Tornadoes are generated in Louisiana either due to severe thunderstorms or hurricanes that occur in the area. Based on National Climatic Data Center data for the period 1991–2010, the average annual number of tornadoes that occurred in Louisiana was 37; the average annual number of enhanced Fujita (EF) 0–EF5 tornadoes per 10,000 square miles was 8.5; the average annual number of EF3–EF5 tornadoes was 0.9; and the average annual number of EF3–EF5 per 10,000 square miles was 0.2 (NCDC 2014c). From 1950 to 2013, a total of 15 tornadoes were reported in St. Charles Parish, mostly occurring in non-summer months with a peak of four tornadoes in November. Since 2006, no tornado reported in St. Charles Parish was greater than an EF0. (NCDC 2014d) In neighboring Orleans Parish, there were 17 tornadoes reported during the period 1950–2013 with a peak of four tornadoes occurring in July. Since 2006, the strongest tornado in Orleans Parish was an EF2, two of which occurred on February 13, 2007 (NCDC 2014e).

3.2.2.7 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme (ranging from A for extremely unstable to G for extremely stable) based on temperature differences is set forth in the NRC's Regulatory Guide 1.23, Revision 1 (NRC 2007, pages 7 and 8). When the temperature decreases rapidly with height (typically during the day when the sun is heating the ground), the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height (typically during the night as a result of the radiative cooling of the ground), the atmosphere is stable and dispersion is more limited. The stability category between unstable and stable conditions is D (neutral), which would occur typically with higher wind speeds and/or higher cloud cover, irrespective of day or night. (NRC 2013c, Section 2.9.1.4)

Based on a 5-year average (2010–2014), onsite temperature difference data recorded at WF3 indicate that stable atmospheric conditions (E to G) occurred about 52.9 percent of the time and unstable conditions (A to C) occurred about 15.4 percent of the time. The remaining observations (about 31.6 percent) fell into the neutral (D) category. Stability class distributions at WF3 covering the period 2010–2014 are presented in Table 3.2-1.

3.2.3 Onsite Meteorological System

The meteorological monitoring system is composed of two tower facilities. The facilities are 1,200 feet apart and located east of the plant. One of these facilities is designated as the primary meteorological monitoring system, while the other is designated as the backup system. These digital systems sample each sensor every half second (1,800 scans per 15-minute period). Both meteorological tower systems are linked to the plant monitoring computer and provide meteorological data transfer every 10 seconds. The primary tower system also provides data remotely via a modem accessible from an external phone line for use by the National Weather Service. (Entergy 1999)

One-minute, 15-minute, and hourly calculations are performed locally at the towers. The results are recorded in storage modules mounted locally at the tower and recorded by the plant monitoring computer with the METDATA program. Redundant sensors and data acquisition systems are used to ensure greater than 90 percent data recovery for atmospheric stability, wind speed, and wind direction. Failure of the primary meteorological system is compensated for by data from the backup meteorological system to ensure continuous data availability. (Entergy 1999)

Both towers are 200 feet tall with a boom arm located at the 33-foot and 199-foot elevations. The booms are 8 feet in length and point in the eastward direction. The sensing elements are mounted on these boom arms. The towers are open lattice-type structures and are guyed to three anchors. Each tower is equipped with a winch and pulley system to raise and lower the instruments for inspection and maintenance. Both towers have two red lights at the 199-foot elevation (for alerting airplanes), and they are automatically turned on and off by a photoelectric cell. The primary and backup meteorological towers also have lightning protection systems and surge suppression circuits to prevent instrument and equipment damage from lightning strikes. (Entergy 1999)

There have been no changes in land use around the tower sites that have occurred since installation that would affect the performance of any of the meteorological sensors.

3.2.3.1 Primary System

The primary meteorological tower facility consists of a 200-foot tower, rain gauge, equipment shelter, tower instrumentation, independent power supply, and electronic signal conditioning and communication cables. The tower is equipped with two wind sensors and three temperature sensors that are mounted on two booms located at the 33-foot and 199-foot elevations. The booms are pointed on the east side of the tower which precludes tower structure interference with the sensors. The meteorological parameters monitored by the primary system sensors are simultaneously recorded by a data logger and storage module located in the equipment shelter, and by the plant monitoring computer. (Entergy 1999)

The primary tower monitors the following meteorological parameters at the specified elevations:

Parameter	Level (feet)
Wind speed	33
Wind speed	199
Wind direction	33
Wind direction	199
Sigma theta	33
Sigma theta	199
Delta temperature "A"	33/199
Delta temperature "B"	33/199
Ambient temperature	33
Relative humidity	33
Barometric pressure	ground
Wet bulb temperature	33/ground
Precipitation	ground

(Entergy 1999)

The primary meteorological tower measures the standard deviation of horizontal wind direction (sigma theta) and wind speed to estimate wind dispersion. The temperature difference with height is used to estimate vertical dispersion. In the event of a radiological release, these parameters are used to determine the dispersion of the radioactive material in the environment. (Entergy 1999)

3.2.3.2 Back-Up System

The backup system is similar to the primary system and consists of a 200-foot tower, equipment shelter, lightning protection system, signal conditioning and communication cables, tower instrumentation, and an independent power supply. This facility is located 1,200 feet north of the primary tower and east of the plant. The tower is equipped with one wind sensor and one temperature sensor mounted on a boom arm located at the 33-foot elevation. Another temperature sensor mounted on a boom arm is located at the 199-foot elevation. The parameters monitored by the backup system are simultaneously recorded by a data logger and storage module located in the equipment shelter and by the plant monitoring computer. (Entergy 1999)

The backup system monitors the following parameters at the specified elevations:

Parameter	Level (feet)
Wind speed	33
Wind direction	33
Sigma theta	33
Delta temperature	33/199

(Entergy 1999)

3.2.3.3 Basic System Flow Path

Each tower facility is equipped with sensors to measure meteorological parameters, a Climatronics data logger to process the sensor inputs, and modems to transmit data to the plant computer. Each tower is also equipped with a handheld keypad and a personal computer for local accessing, trending, and programming. Individual meteorological points can be addressed via the keypad, or all tower points can be viewed via the local computer. Points being displayed will continuously update on either display. A listing of the meteorological points being monitored and the units of measurement are located at each tower site. (Entergy 1999)

As noted above, the plant monitoring computer is equipped with a data processing program known as METDATA. The program stores 15-minute and 60-minute meteorological data in a file for future analysis. The METDATA program stores the same calculated values as the local storage module. The data stream to the plant monitoring computer contains the same calculated values (15- and 60-minute averages) as the storage module. At the first scan cycle after the hour and after each 15-minute period, the METDATA program stores these calculated values. (Entergy 1999)

3.2.3.4 Data Verification

Hourly averaged data are checked to verify the quality of the meteorological data. The data are noted as suspect, if a value is outside the limits contained in the program. Checks performed on meteorological data include data invariant, excessive variation, above or below sensor limits, stability class versus day or night, redundant sensor checks, and upper-to-lower parameter checks. Data quality checks follow guidelines as set forth in NUREG-0917. After data review and verification, a joint frequency distribution of meteorological data is compiled using the annual data. The joint frequency summary and receptor locations, provided by results from the radiological environmental monitoring program (REMP) land use census, are used for data input into the program XOQDOQ, which determines relative dispersion and deposition values for WF3. (WF3 2015a)

3.2.3.5 Calibration and Maintenance

Semiannual calibrations are performed at the primary and backup meteorological towers to ensure high recovery rates of accurate data (WF3 2007a; WF3 2014d; WF3 2014e). Daily and monthly checks are also performed in the time period between calibrations to determine that the instrumentation is functioning satisfactorily and that data recovery is maintained at a high rate (WF3 2007a; WF3 2011b).

3.2.3.6 Data Recovery

Based on the previous 5 years (2010–2014), the meteorological data recovery rate at WF3 has been > 90 percent (WF3 2011a; WF3 2012; WF3 2013; WF3 2014c; WF3 2015a).

3.2.4 Air Quality

The Clean Air Act (CAA) was established in 1970 [42 U.S.C. § 7401 et seq.] to reduce air pollution nationwide. The EPA has developed primary and secondary National Ambient Air Quality Standards (NAAQS) under the provisions of the CAA. The EPA classifies the air quality within an air quality control region (AQCR) according to whether the region meets or exceeds federal primary and secondary NAAQS. An AQCR or a portion of an AQCR may be classified as being in attainment or nonattainment, or it may be unclassified for each of the six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$, fine particulates, and PM_{10}, coarse particulates), ozone, and sulfur dioxide (SO_2).

WF3 is located in St. Charles Parish, Louisiana, which along with 34 other parishes in Louisiana and 15 counties in Texas, is part of the Southern Louisiana-Southeast Texas Interstate AQCR. Surrounding AQCRs include the Shreveport-Texarkana-Tyler Interstate AQCR to the north, the Mobile (Alabama)-Pensacola-Panama City (Florida)-Southern Mississippi Interstate AQCR to the north and east, and the Austin-Waco Intrastate AQCR and Metropolitan Houston-Galveston Intrastate AQCR to the west. (EPA 2014a)

Five parishes (Ascension, Livingston, Iberville, East Baton Rouge, and West Baton Rouge) make up the nonattainment areas and maintenance area for the 8-hour ozone standard. As indicated in Figure 3.2-6, all of the parishes surrounding WF3 outside a 50-mile radius of the site are in attainment for the 1997 annual and 2006 24-hour NAAQS for $PM_{2.5}$. In addition, all of the parishes within a 50-mile radius of WF3 are in attainment for the 1971 NAAQS for CO and NO_2, the 2008 NAAQS for Pb, and the 1987 NAAQS for PM_{10}. (EPA 2014b)

The EPA has designated part of St. Bernard Parish as a nonattainment area for the 2010 SO_2 NAAQS with the boundaries recommended by the state of Louisiana. The area is bounded on the east by the Gulf of Mexico; on the south by Plaquemines Parish; on the west and north by Orleans Parish and Lake Borgne. (EPA 2014b) The SO_2 nonattainment area is shown in Figure 3.2-6.

Figure 3.2-6 illustrates nonattainment and maintenance areas defined under the CAA, as amended, within a 50-mile radius of WF3. There are no mandatory Class I federal areas on the mainland of Louisiana. The nearest Class I area is the Breton Wilderness Area (EPA 2015a), located on Breton Island and part of the Breton National Wildlife Refuge that includes Breton Island and all of Chandeleur Islands in St. Bernard Parish, Louisiana. (USGS 2014b) The Breton Wilderness Area is located approximately 99 miles southeast of WF3. This distance is outside the 62-mile requirement to contact federal land managers for the operation of any new major stationary source or major modification.

3.2.5 Air Emissions

WF3 is classified as a minor air emission source. Although WF3 may periodically utilize a portable auxiliary boiler or generator(s) during outages, nonradioactive gaseous effluents result primarily from testing of emergency generators and diesel pumps. Because WF3 utilizes a once-through cooling system for condenser cooling purposes, there are no cooling towers or associated particulate emissions.

To protect Louisiana's ambient air quality standards and ensure that impacts from facilities that generate air emissions are maintained at acceptable levels, the LDEQ governs the discharge of regulated pollutants by establishing specific conditions in the air permit. Permitted emission sources and conditions established in WF3 Air Permit 2520-00091-00 are shown in Table 3.2-2. Annual emissions for the previous 5 years (2010–2014) are shown in Table 3.2-3.

As discussed in Section 2.1, no refurbishment or other license-renewal-related construction activities have been identified. In addition, Entergy's review did not identify any future upgrade or replacement activities necessary for plant operations (e.g., diesel generators, diesel pumps) that would affect WF3's current air emissions program. Therefore, no increase or decrease of air emissions is expected over the license renewal period.

Studies have shown that the amount of ozone generated by even the largest lines in operation (765 kV) would be insignificant (NRC 2013b, Section 4.3.1.1). As discussed in Section 2.2.5.1, WF3's in-scope transmission lines are 230 kV. Therefore, the amount of ozone generated from the in-scope transmission lines is anticipated to be minimal.

Because WF3 is not required to inventory and report greenhouse gases (GHGs), data do not exist for mobile sources such as visitors and delivery vehicles. Therefore, Entergy calculated GHG gas emissions on those direct (stationary and portable combustion sources in Table 3.2-2) and indirect (workforce commuting) plant activities where information was readily available. GHG emissions generated at WF3 are presented in Table 3.2-4.

Although WF3 has four transformers that contain perfluorocarbons, there have been no additions to this electrical equipment over the previous 5 years (2010–2014). In addition, ozone depleting substances such as chlorofluorocarbons and hydrochlorofluorocarbons are present at WF3 and can potentially be emitted; however, estimating GHG emissions from these substances is complicated due their ability to deplete ozone, which is also a GHG, making their global warming potentials difficult to quantify. These ozone depleting substances are regulated by the CAA under Title VI. As discussed in Section 9.5.3.3, Entergy maintains a program to manage stationary refrigeration appliances at WF3 to recycle, recapture, and reduce emissions of ozone depleting substances and is in compliance with Section 608 of the CAA. Therefore, Entergy did not include potential emissions as result of leakage, servicing, repair, and disposal of refrigerant equipment at WF3.

Table 3.2-1
WF3 Stability Class Distributions

Percent Frequency of Occurrence by Stability Class Pasquill Stability Class[(a)]							
Year	**A**	**B**	**C**	**D**	**E**	**F**	**G**
2010	4.2	3.9	6.4	31.6	30.8	14.8	8.3
2011	6.4	4.6	6.3	30.8	28.7	13.4	9.7
2012	3.8	4.2	6.5	29.9	32.6	15.1	7.8
2013	2.8	4.5	6.4	34.5	32.5	12.9	6.5
2014	4.9	4.9	7.4	31.0	29.1	13.7	8.9
Average	**4.4**	**4.4**	**6.6**	**31.6**	**30.7**	**14.0**	**8.2**

(WF3 2015a)

a. Classes are as follows:
Class A: Extremely unstable
Class B: Moderately unstable
Class C: Slightly unstable
Class D: Neutral
Class E: Slightly stable
Class F: Moderately stable
Class G: Extremely stable

Table 3.2-2
Permitted Air Emission Points

Emission Point[a]	Description	Capacity Rating	Permit Condition
3-79	Emergency Diesel Generator A	4,400 kW	• Opacity (≤ 20%) • Fuel sulfur limit (≤ 0.5% by weight) • PM_{10}, SO_2, NO_x, CO, and VOC emission limitations
4-79	Emergency Diesel Generator B	4,400 kW	
5-79	Fire Water Diesel Pump A	170 hp	
6-79	Fire Water Diesel Pump B	170 hp	
7-79	Security Emergency Diesel Generator	286 hp	
8-83	Emergency Operations Facility Emergency Diesel Generator	355 hp	
9-99	Dry Cooling Tower Diesel Pump A	20 hp	
10-99	Dry Cooling Tower Diesel Pump B	20 hp	
11-00	IT Emergency Diesel Generator	125 kW	
19-79	Portable Diesel Generator	45 kW	
20-00	ACCW Wet Cooling Tower A	6,500 gpm	• PM_{10} emission limitations
21-00	ACCW Wet Cooling Tower B	6,500 gpm	
12-79	Diesel Fuel Oil Storage Tank (100,000 gallons)	198,288 gpy	• VOC emission limitations
13-79	Emergency Diesel Fuel Oil Storage Tank A (42,500 gallons)	41,310 gpy	
14-79	Emergency Diesel Fuel Oil Storage Tank B (42,500 gallons)	41,310 gpy	
15-79	Clean Lube Oil Batch Tank A (21,210 gallons)	21,150 gpy	
16-79	Dirty Lube Oil Batch Tank B (21,210 gallons)	21,150 gpy	
17-79	Main Turbine Lube Oil Reservoir (20,900 gallons)	20,900 gpy	
18-79	Gasoline Fuel Storage Tank (900 gallons)	10,800 gpy	

Table 3.2-2 (Continued)
Permitted Air Emission Points

Emission Point[a]	Description	Capacity Rating	Permit Condition
22-02	Portable Outage/Maintenance Diesel Engines	200,640 gpy	• Opacity (≤ 20%) • Fuel sulfur limit (≤ 0.5% by weight) • Fuel usage • PM_{10}, SO_2, NO_x, CO, and VOC emission limitations
23-02	Portable Gasoline Outage/Maintenance Engines	9,600 gpy	
24-03	Portable Auxiliary Boiler	46.2 MMBtu/hr	

(WF3 2004a)

a. Stationary combustion sources also subject to 40 CFR Part 63, Subpart ZZZZ—National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

Table 3.2-3
Annual Air Emissions Inventory Summary, 2010–2014

Year	Annual Emissions (tons/year)[(a)]					
	SO_x	NO_x	CO	PM_{10}	VOCs	HAPs
2010	0.4	15.0	3.9	0.7	1.0	0.01
2011	0.5	20.5	5.3	1.0	1.2	0.02
2012	1.8	38.5	9.1	2.2	2.7	0.04
2013	0.6	18.1	4.7	0.8	1.0	0.03
2014	0.6	22.2	5.5	1.2	1.5	0.02

(Entergy 2015i)

a. Emissions are based on calculated gallons of fuel usage shown below.

Equipment	2010	2011	2012	2013	2014
Stationary diesels (> 600 hp)	52,986	68,648	61,562	62,139	56,477
Stationary diesels (≤ 600 hp)	2,605	2,605	3,185	2,624	7,270
Portable diesels (≤ 600 hp)	7,468	11,974	74,529	4,500	20,902
Portable boiler (< 100 MMBtu)	0	64,467	65,280	200,980	79,815
Portable gasoline	110	110	0	0	0

Table 3.2-4
Annual Greenhouse Gas Emissions Inventory Summary, 2010–2014

Carbon Dioxide Equivalent (CO_2e) Emissions, Metric Tons[a]					
Emission Source	**2010**	**2011**	**2012**	**2013**	**2014**
Combustion sources (Table 3.2-2)	647	1,513	2,094	2,767	1,684
Workforce commuting	2,722	2,722	2,722	2,722	2,722
Total	**3,369**	**4,235**	**4,816**	**5,489**	**4,406**

(Entergy 2015i)

a. GHG calculated emissions are based on the following:

- Fuel usage for combustion sources shown in "footnote a" to Table 3.2-3.
- Workforce commuting:
  1. Statistical information from U.S. Census Bureau indicates that 10.5 percent of U.S. residents carpool to work (USCB 2015). Number of WF3 employees as of January 2016 was 641. Utilizing the 10.5 percent USCB carpool statistic, a value of "574" passenger vehicles per day was utilized.
  2. The EPA's Greenhouse Gas Equivalencies Calculator shows that the CO_2e/vehicle/year was estimated to be 4.75 metric tons (EPA 2015b).
  3. Carbon dioxide has a global warming potential (100-year time horizon) of "1" based on Table A-1 to Subpart A of 40 CFR Part 98.
  4. 573 vehicles × 4.75 metric tons CO_2e/vehicle/year × 1 (global warming potential).

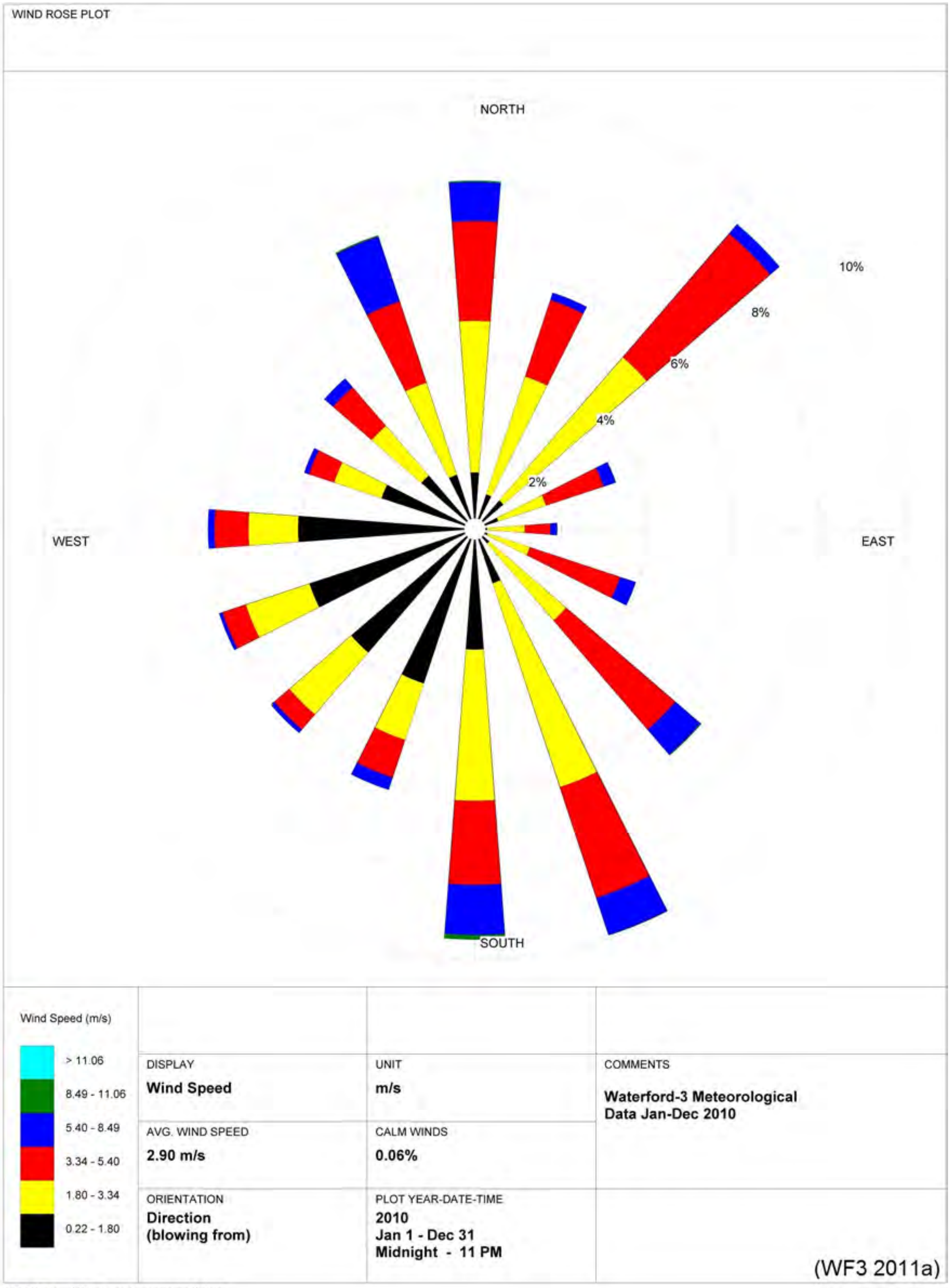


Figure 3.2-1
WF3 2010 Wind Rose

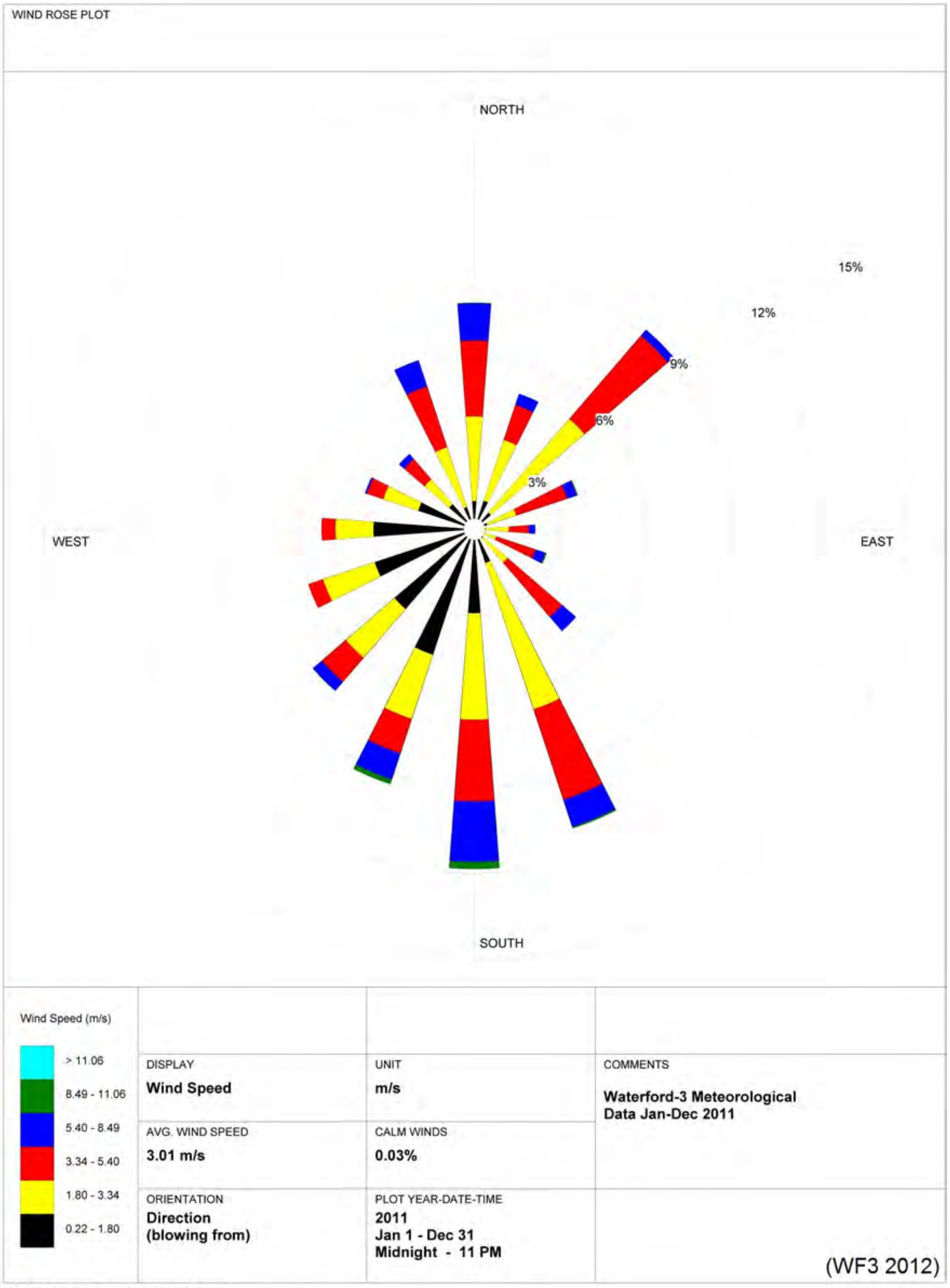
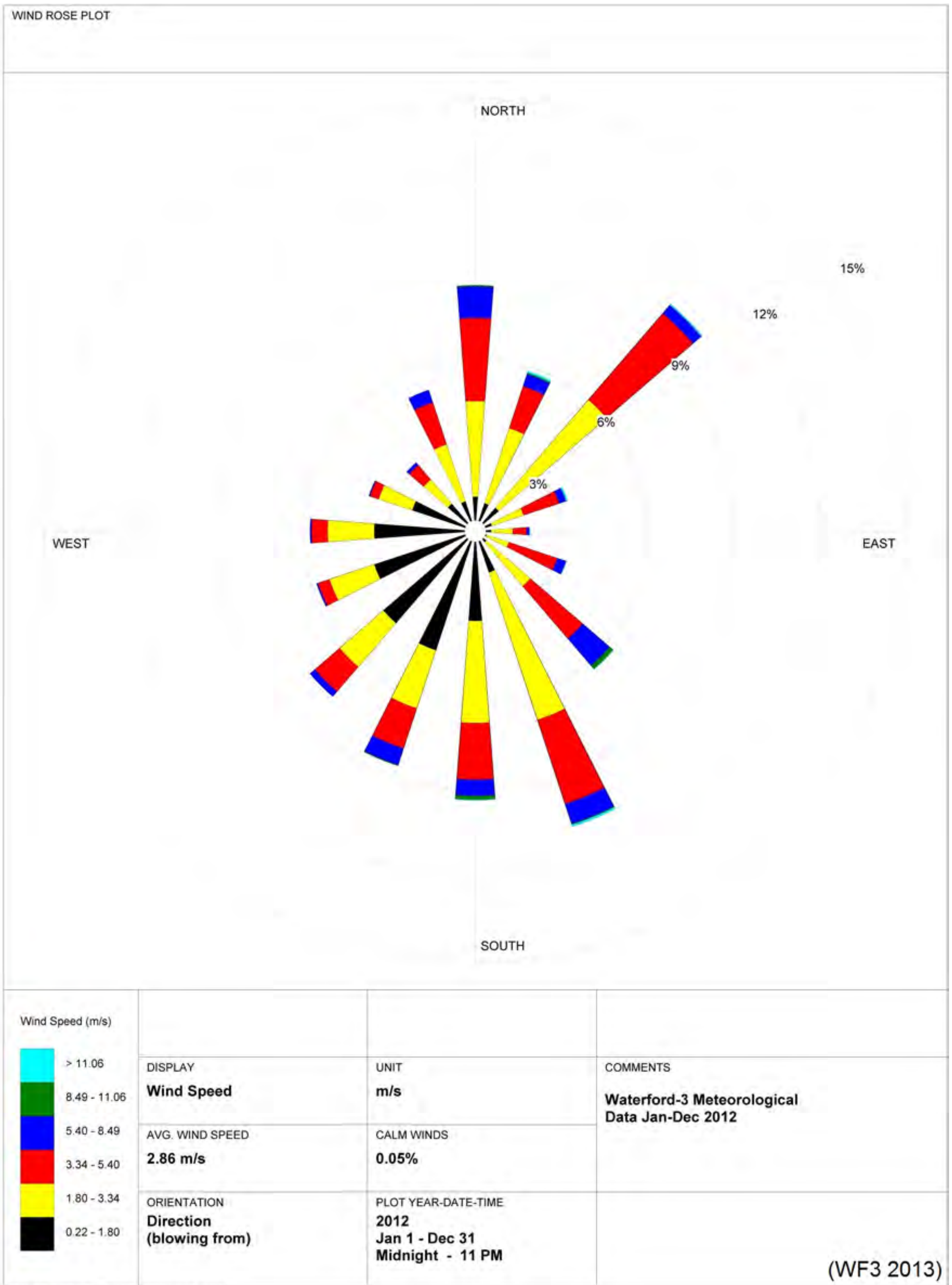


Figure 3.2-2
WF3 2011 Wind Rose



WRPLOT View 3.05 by Lakes Environmental Software

Figure 3.2-3
WF3 2012 Wind Rose

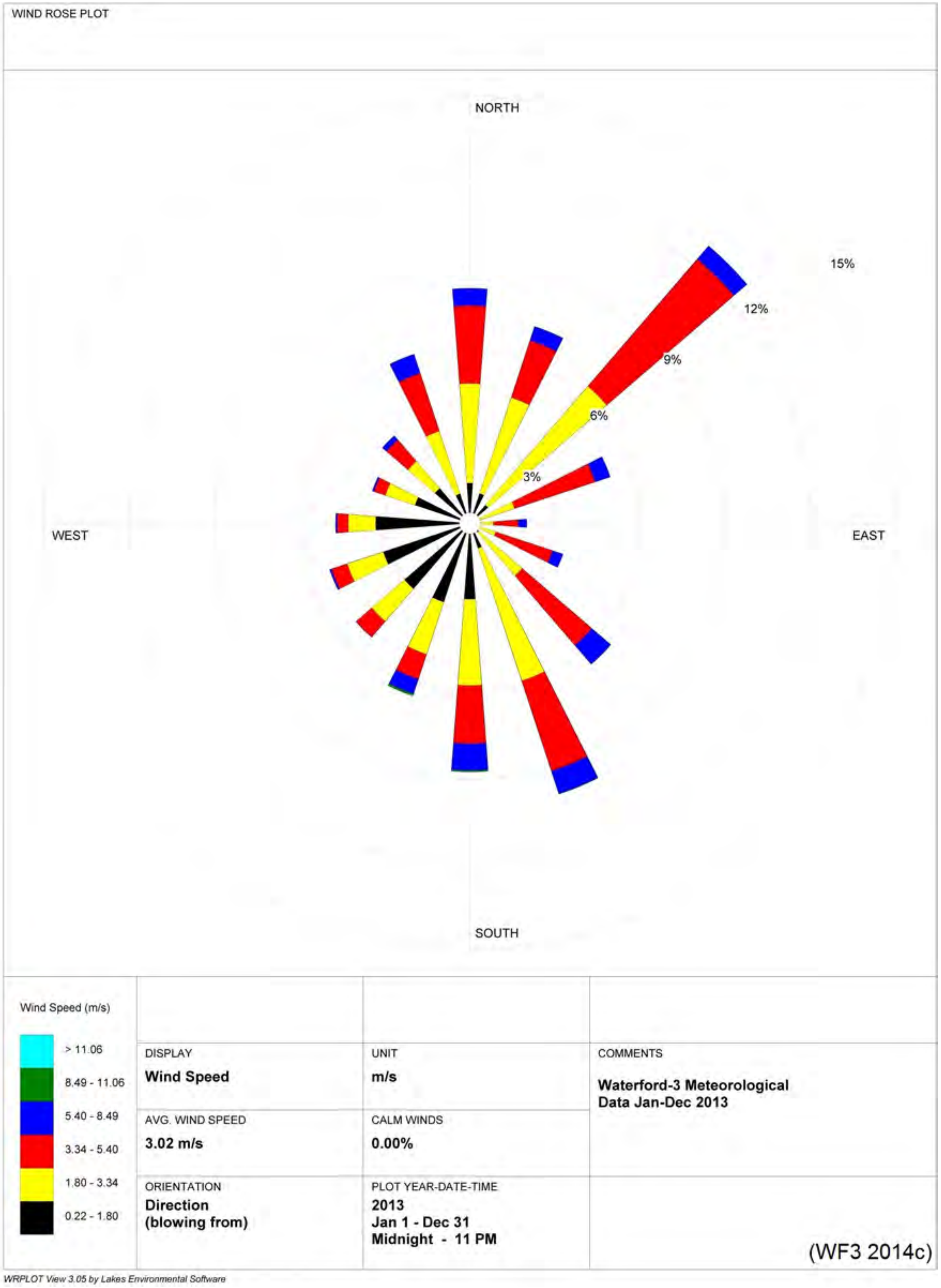


Figure 3.2-4
WF3 2013 Wind Rose

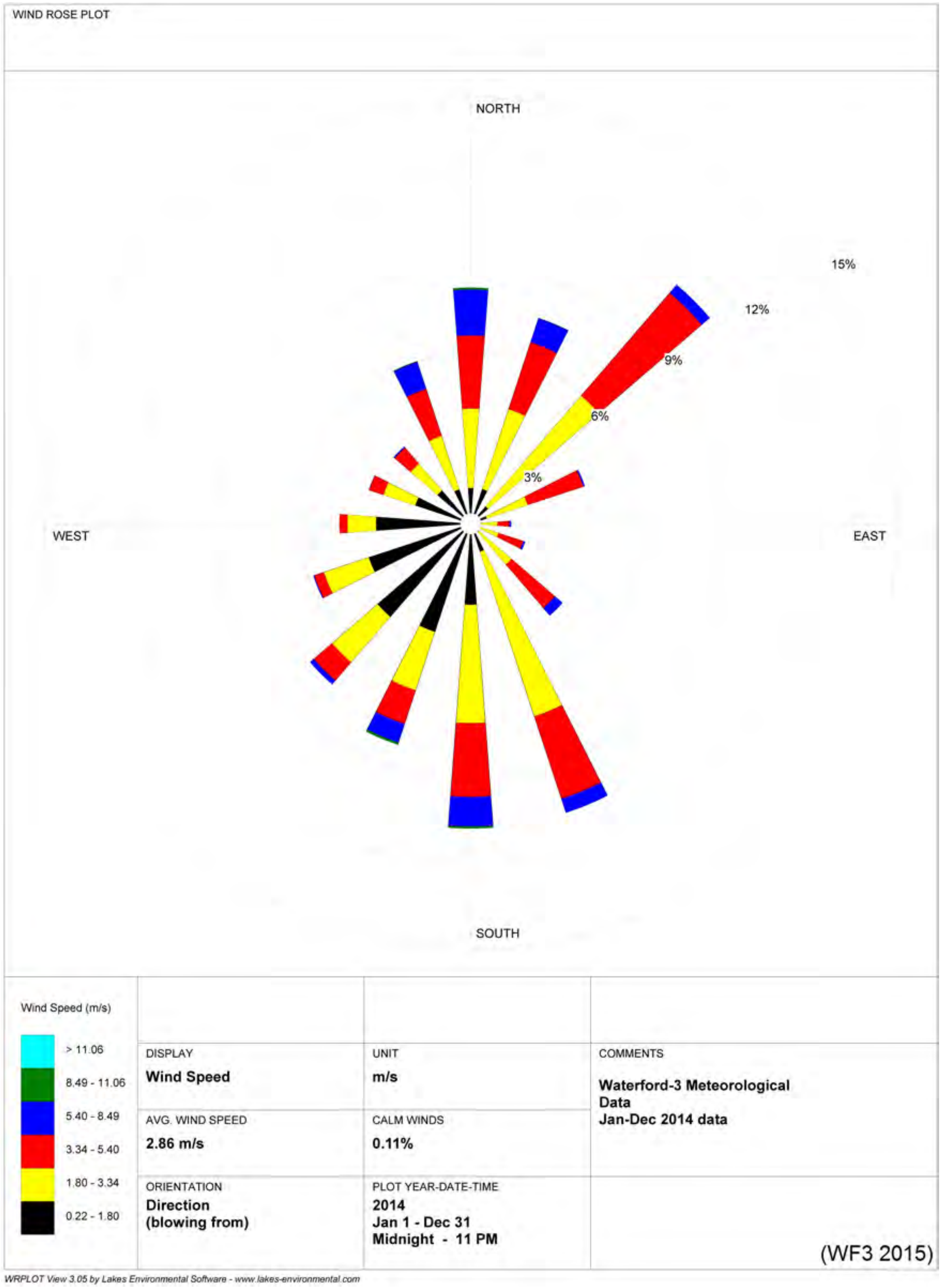


Figure 3.2-5
WF3 2014 Wind Rose

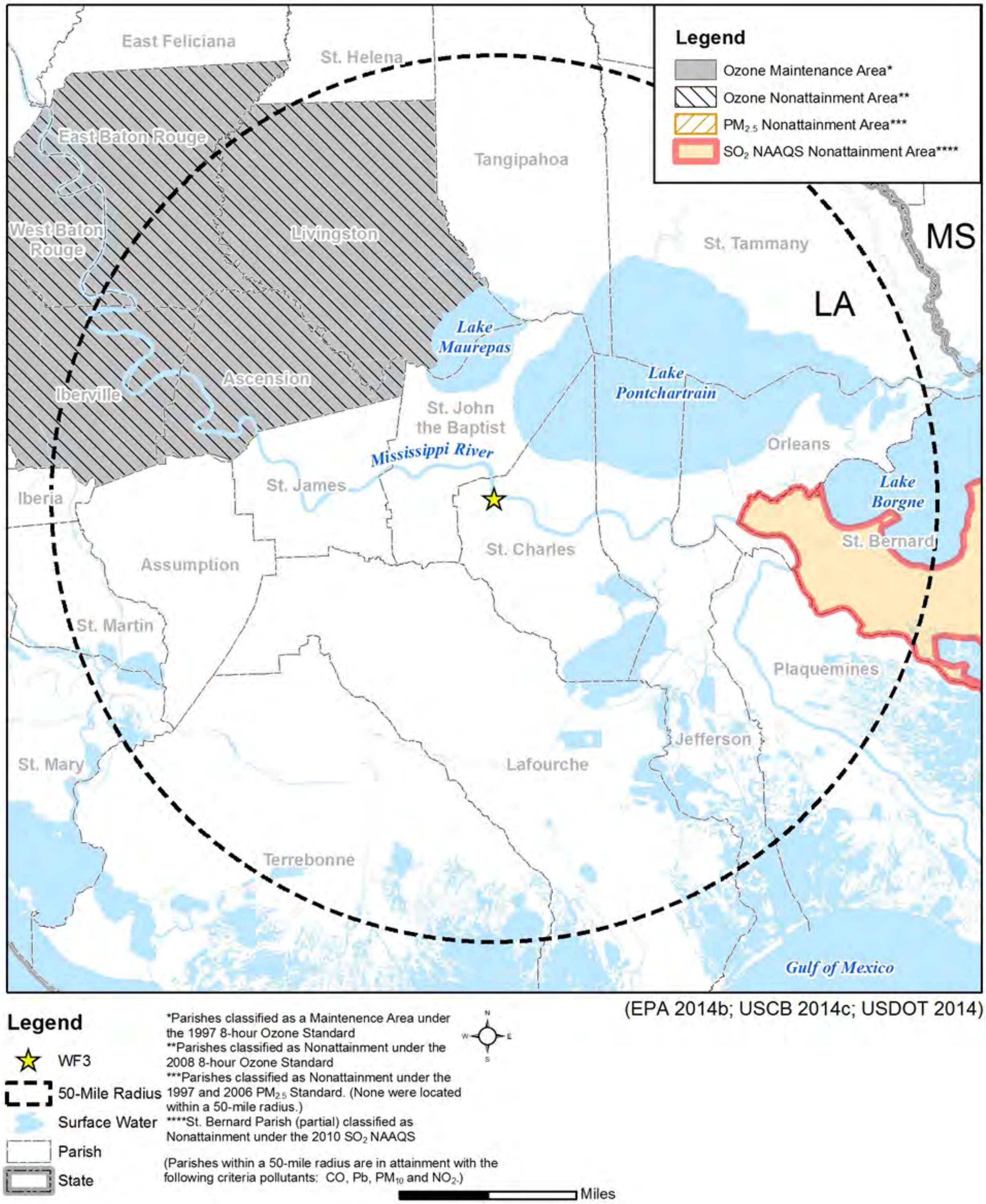


Figure 3.2-6
Nonattainment and Maintenance Areas, 50-Mile Radius of WF3

3.3 Noise

Local noise regulations applicable to WF3 are included in the St. Charles Parish Code of Ordinances where maximum permissible sound limits have been established for receiving land use categories, including residential, commercial, and industrial. For residential land use, established sound level limits range from a daytime 60 A-weighted decibels (dBA) to a nighttime level of 55 dBA. For multi-family dwelling land use, established sound level limits range from a daytime 50 dBA to a nighttime level of 45 dBA. Commercial land use has been set at 65 dBA for daytime hours and 60 dBA for nighttime. There are no receiving sound limits designated for the industrial land use category. (SCP 2014a)

The WF3 plant has been granted an industrial area land use designation by St. Charles Parish and is regulated for an M-2 Heavy Manufacturing Zoning District, applicable to energy generating facilities. M-2 special provisions assert that buffer zones are necessary to insure the protection and well-being of neighboring areas and that major operations must be located 2,000 feet from the nearest residential and commercial district, or located a lesser distance if clearly dictated safe by industry standards and approved by the local Board of Adjustments. (SCP 2014a)

During initial licensing of WF3, noise level measurements were taken within the Entergy Louisiana, LLC property boundary, outside the property boundary, and in the surrounding communities within a 5-mile radius of the plant during the period February 8–10, 1977. Meteorological conditions were taken into consideration during the measurement period and are included with the original OL application. The noise survey indicated that the major ambient noise sources at WF3 and in the surrounding communities were manmade in origin, and consisted primarily of transportation and industrial noises. (LP&L 1978, Section 2.7.2.1) The estimated levels for WF3 operation were about 55 dBA at the edge of the exclusion area and about 45 dBA at the near edge of the wetlands (Figure 3.0-1). At the time, it was determined that these outdoor noise levels would not interfere with normal conversation and impose no known mental or physiological stress upon humans and vertebrate biota. (NRC 1981, Section 5.5.1) A facility records search was conducted to locate any more recent noise surveys that may have occurred since 1977, but none were found.

The loudest noise-generating WF3 facility on site is the turbine generator, located approximately 1,400 feet from the nearest property boundary on the Mississippi River shoreline. Periodic use of the gun range is another onsite activity that creates occasional noise. The gun range is located approximately 2,250 feet from the property boundary along the Mississippi River. (WF3 2009) As discussed in Section 3.0.3, the nearest residences from WF3 are approximately 0.9 miles in distance and, as discussed in Section 3.0.4, the nearest parks are located approximately 1 mile from WF3. Therefore, the residences and parks nearest to WF3 exceed the buffer distance established by St. Charles Parish for M-2 Zoning Districts.

Because WF3 is located in a heavily industrialized area, it is very unlikely that noise levels from the facility would affect offsite residences. This is further substantiated by the fact that over the previous 5 years (2010–2014), there have been no noise complaints received by Entergy as it relates to WF3 plant operational and outage activities.

3.4 Geologic Environment

3.4.1 Geology

3.4.1.1 Regional Geology

WF3 is situated along the west (right descending) bank of the Mississippi River, approximately 25 miles west of New Orleans, Louisiana. It is located in the southern portion of the Gulf Coastal Plain geologic province. The southern portion of the Gulf Coastal Plain is the Mississippi River deltaic plain physiographic province. The Mississippi River has dominated the development of geologic and physiographic features in the deltaic plain since the beginning of Neogene. The deltaic plain is characterized by low marshy terrain, much of which is covered by water. The higher natural ground within the deltaic plain generally occurs along the natural levees of existing and abandoned stream courses. (WF3 2014a, Section 2.5)

3.4.1.1.1 Physiography

WF3 is located at River Mile 129.6 above Head of Passes (AHP). The site region is located within the Gulf Coastal Plain physiographic province (Figure 3.4-1). The Gulf Coastal Plain extends about 600 miles inland from the coast along the site longitude, 90° west, approximately 200 miles inland along longitude 88° west and approximately 300 miles inland along longitude 94° west. (WF3 2014a, Section 2.5.1.1.1)

The Gulf Coastal Plain province is divided into subprovinces including the Mississippi Alluvial Valley, Chenier/Delta Plain, Loess Hills, Prairie Coastwise Terraces, Southern Hills, Eastern Hills, and Western Hills (Figure 3.4-1).

Loess Hills

The Loess Hills subprovince extends along the eastern bank of the Mississippi River from Kentucky to southwestern Mississippi. The Loess Hills consists of an eastward thinning loess (silt) deposit that is 0 to 100 feet thick and extends 10 to 30 miles east of the Mississippi River. (SERI 2005, Section 2.5.1.1.1.1)

The topography of the Loess Hills is characterized by flat-topped ridgelines and fluvial terraces that are separated by deeply incised dendritic drainage systems, and varies in elevation from 100 to 300 feet above mean sea level (amsl). Erosion along the eastern edge of the Mississippi River floodplain has formed a steep escarpment along the western edge of the Loess Hills. (SERI 2005, Section 2.5.1.1.1.1)

The Loess Hills were formed through deposition of successive sheets of silt during late Quaternary time. Up to five distinct periods of loess deposition are documented. Each of these deposits is separated by leached buried soils that represent significant periods of landscape stability. (SERI 2005, Section 2.5.1.1.1.1)

Mississippi Alluvial Valley

The Mississippi River and its tributaries follow a broad, north-south trending lowland that begins at the head of the Mississippi embayment, near the junction with the Ohio River, and extends southwest about 600 miles to the Gulf. This lowland is composed of an alluvial plain that extends from the Ohio confluence to near the Atchafalaya River in Louisiana and a deltaic plain that continues to the Gulf of Mexico. (WF3 2014a, Section 2.5.1.1.1)

In the site region, the Mississippi Alluvial Valley subprovince also includes a number of interdistributary lowlands, basins, and ridges. Elevations generally range from 50 to 250 feet. Higher elevations occur in tributary valleys with highs of 300 feet in the Ouachita River valley and 500 feet in the upper Red River valley near the Ouachita Mountains. The topographic highs along the Mississippi River are remnants of older alluvial deposits that mostly were eroded and removed from the valley. The valley topography is relatively flat with a gentle southward gradient and is characterized by fluvial geomorphic features typical of a braided stream and meandering river system (e.g., valley train, oxbow lakes, meander belts, and floodplains). (SERI 2005, Section 2.5.1.1.1.2)

Deposits in the Mississippi Alluvial Valley consist primarily of Pleistocene to Holocene sediments derived from the Mississippi River and its tributaries. (SERI 2005, Section 2.5.1.1.1.2)

Eastern Hills

The Eastern Hills subprovince lies north of the Southern Hills and east of the Loess Hills. The subprovince covers the area from central Mississippi and central Alabama to western Tennessee, and extends to the eastern margin of the Gulf Coastal Plain. The topography is characterized by gently rolling hills that range in elevation from 100 to 600 feet amsl and gradually decrease in elevation southward. The Eastern Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by tributaries of the Mississippi River. (SERI 2005, Section 2.5.1.1.1.3)

Western Hills

The Western Hills subprovince lies north of the Southern Hills and west of the Mississippi Alluvial Valley. The subprovince covers the area from central Louisiana to central Arkansas, and extends westward into eastern Texas. The topography is characterized by gently rolling hills that range in elevation from 200 to 700 feet amsl and gradually decrease in elevation southward. The Western Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by the Arkansas River and Red River, two major tributaries of the Mississippi River. (SERI 2005, Section 2.5.1.1.1.4)

Southern Hills

The Southern Hills subprovince occupies the area between the Prairie Coastwise Terrace (described below) and the Eastern Hills and Western Hills subprovinces. The Southern Hills cover portions of southern Mississippi, southern Louisiana, and southeastern Texas. The topography of this subprovince is characterized by gently rolling hills and flat-topped ridges that range in elevation from 50 to 500 feet amsl, and generally decrease toward the Gulf Coast. The Southern Hills are underlain by the Miocene Catahoula Formation, and the Pliocene and Pleistocene Upland Complex. (SERI 2005, Section 2.5.1.1.1.5)

Prairie Coastwise Terrace

The Prairie Coastwise Terrace subprovince occupies the area south of the Southern Hills and north of the Chenier and Delta Plain subprovinces (described below) along the Gulf Coast. The subprovince extends across southern Mississippi, southern Louisiana, and southeastern Texas. The topography of the Prairie Coastwise Terrace is characterized by gently rolling hills and remnants of dissected terrace surfaces that range in elevation from 25 to 150 feet amsl and gradually decrease in elevation coastward. This subprovince is underlain by terrace deposits of the late Pleistocene Prairie Complex. (SERI 2005, Section 2.5.1.1.1.6)

Chenier Plain

The Chenier Plain subprovince occupies the area between the Prairie Coastwise Terrace and the Gulf of Mexico. The subprovince extends along the Louisiana and eastern Texas coastline. "Cheniers" are abandoned beaches of the Gulf of Mexico, with large expanses of Holocene marshes that developed on prograding mudflats. A typical chenier ridge is less than 10 feet high, but may extend for miles or tens of miles. The topography of the Chenier Plain is characterized by low-lying coastal ridges and marshes. The most prominent features are abandoned beach ridges at elevations of between sea level and 25 feet amsl. Subtle variations in elevations, on the order of inches, have a pronounced effect on vegetation and habitat in the Chenier Plain. The only preserved pre-Holocene features are remnants of the Prairie Coastwise Terrace and emergent landforms developed above salt dome piercement structures. (SERI 2005, Section 2.5.1.1.1.7)

Delta Plain

The Delta Plain subprovince occurs in southeastern Louisiana where the Mississippi River meets the Gulf of Mexico. The topography of the Delta Plain is characterized by abandoned distributary channels, distributary levee ridges, and coalescing delta complexes near the mouth of the Mississippi River. The distributary levee ridges form the most prominent topographic features, but do not exceed 10 feet in elevation. Distributary channels radiate in a fan shape and form apices of delta complexes. The morphologic expression of the channel and distributary features become markedly less pronounced with increasing age, and eventually become buried due to coastal subsidence. (SERI 2005, Section 2.5.1.1.1.8)

3.4.1.1.2 Stratigraphy

Soil Units

The soil units in the region include Holocene-aged deposits consisting of sand, sandy silt, silt, clayey silt, silty clay, and clay deposited by the Mississippi River. Figure 3.4-2 shows the distribution of surface Holocene deposits surrounding the site. (LGS 2003; LGS 2011)

The developed portion of the Entergy Louisiana, LLC property is located on the natural levee complex of Mississippi River meander belt 1 (Hml_1). These deposits consist of the natural levees flanking Mississippi River meander belt 1 and, typically, they consist of sandy silt, silt, clayey silt, silty clay, and clay. (LGS 2003; LGS 2011)

The northern corner of the Entergy Louisiana, LLC property overlies Mississippi River meander belt 1 (Hmm_1) point bar deposits buried by a thin layer of overbank sediments (LGS 2003). These point bar deposits typically are composed predominantly of silt, sandy silt, and poorly sorted silty sand. They are mapped where overlying natural levee deposits (i.e., $Hml_{1)}$ are sufficiently thin that scroll marks, however faint, are perceptible as a surface indicator of point-bar ridge-and-swale topography. (LGS 2011)

The southern portion of the Entergy Louisiana, LLC property overlies the delta plain deposits of the Mississippi River St. Bernard delta lobe (Hds). They are composed of cyclically interbedded, interdistributary peat and clay; natural levee silt and clay; distributary sand; and delta-front and prodelta mud and clay. (LGS 2011)

Rock Units

The general geologic conditions of the upper 500 feet, which is the deepest penetration of the site borings, are depicted as geologic cross sections in Figure 3.4-3. (Saucier 1994; WF3 2014a, Figures 2.5-30a through 2.5-30e) The elevations of the various strata vary across WF3. Therefore, the elevations and thicknesses described below are representative of the NPIS, unless otherwise noted.

The upper 50 feet of materials are recent alluvial deposits described as soft clays and silty clays with occasional sand lenses or pockets. At approximately 50 feet of depth, or elevation -40 feet msl, and extending to great depths, there is a marked change in soil strata indicating the top of the Pleistocene soils. (WF3 2014a, Section 2.5.1.2.4)

The upper parts of these soils are stiff, gray and tan clays with occasional silt lenses. These clays extend to about elevation -320 feet msl and contain only two significant and continuous silty sand strata. One is from about elevation -77 feet msl to elevation -92 feet msl. These silty sands are dense to very dense as indicated by high standard penetration test results. The stratum below the stiff clays from elevation -320 feet msl to at least elevation -500 feet msl (the deepest elevation penetrated), is a very dense, gray silty sand. (WF3 2014a, Section 2.5.1.2.4)

3.4.2 Site Geology

WF3 is located in the southern portion of the Gulf Coastal Plain of the Mississippi River deltaic plain physiographic province. The deltaic plain developed over the northern flank of the Gulf geosyncline since the Tertiary Period (Cenzoic era). The geologic structures were developed in thick sedimentary sequences consisting of nontectonic structures associated with salt and clay mobilization and growth faults associated with sediment instability at the shelf edge. (GZA 2007, Section 4.1.1)

WF3 is located along the eastward extension of the Grand Chenier fault system. This system is related to thickening of upper Miocene strata in the downthrown block. Growth faulting that is simultaneous with sediment deposition ceased prior to the deposition of the upper 1,000 feet of Miocene sediments. Contours of individual strata down to about 5,000 feet show no indication of faulting. Based on a review of data, the WF3 *Updated Final Safety Analysis Report* concluded there is no relationship between the tonal anomalies noted in aerial photographs and geologic structure located 5,000 feet or deeper. (GZA 2007, Section 4.1.1)

The northern Gulf has been in an interglacial period, with sea level at approximately its present level during the last 5,000 years. Sedimentation has exceeded subsidence in the Mississippi delta, and the shoreline has been extended southward to the very edge of the continental shelf by means of a sequential series of seven delta systems. The deltaic sediments consist of irregularly distributed organic clays, silt, and fine sands, which vary in thickness from a few feet in the northern delta to more than 700 feet at the Mississippi River mouth. (GZA 2007, Section 4.1.1)

The Louann salt formation (Louann) occurs at a depth of at least 40,000 feet beneath the site area. Continuous marine shales overlie the Louann extending upward to a depth of about 10,500 feet below ground surface (bgs). Petroleum test wells completed in the nearby area have encountered shale alternating with thin sandstone layers between 10,500 feet bgs and 7,500 feet bgs, overlain by massive sandstone interbedded with scales which extend upward to about 4,900 feet bgs. The overlying Pliocene sediments are about 3,000 feet thick and consist mainly of clays and relatively thin sand layers. Sediments from about 1,900 feet bgs to 1,100 feet bgs are classified as Plio-Pleistocene deposits, consisting of interbedded sands and clay, probably representing near-shore marine and marine depositional environments. Pleistocene sands and clays continue to a depth of about 50 feet bgs, and include the Gramercy, Norco, and Gonzales-New Orleans aquifers, which occur at 210 feet bgs, 335 feet bgs, and 610 feet bgs, respectively. (GZA 2007, Section 4.1.1)

3.4.3 Soils

3.4.3.1 Onsite Soils and Geology

WF3 is located almost entirely upon the natural levee of the Mississippi River (Figure 3.4-2). The southernmost portion of the Entergy Louisiana, LLC property, about 2 miles southwest of the plant site, is freshwater swamp adjacent to the natural levee. The surface elevations of the natural levee on the property range between near sea level in the southwestern portion to about 14 feet amsl near the river, at the base of the manmade, flood-control levee. The crest of the Mississippi River flood-control levee, which is the highest point on the Entergy Louisiana, LLC property, is about 30 feet amsl. The lowest elevations on the Entergy Louisiana, LLC property occur in the swamp, at the southwestern end of the property. In this area, elevations are 1 to 2 feet amsl. (WF3 2014a, Section 2.5.1.2.1) Figure 3.0-2 shows the topography of the Entergy Louisiana, LLC property.

Detailed soil units on the Entergy Louisiana LLC property are shown in Figure 3.4-4 and include the Allemands-Larose association, Barbary muck, Cancienne silt loam and silty clay loam, Cancienne and Carville soils, Fausse clay, Kenner muck, Levees-Borrow pits complex, Maurepas muck, Schriever clay and silty clay loam, Thibaut clay, and Urban land. These soil units, associations, and descriptions are presented in Table 3.4-1. (USDA 2014b)

Backfill material around the WF3 power block area consists of Class A material, which was placed immediately around seismic Category I structures from grade (17 feet amsl) to -40 feet msl, and Class B material to backfill the remainder of the excavation up to natural grade. Class A material is basically clean, pumped Mississippi River sand with no more than 12 percent fines content. Class B material is non-seismic Category I material consisting of sand or a combination of sand and clam shell filter material capable of practical compaction. The filter blanket placed immediately beneath the common mat consists of a 1-foot thick compacted layer of clam shells dredged from Lake Pontchartrain. (WF3 2014a, Section 2.5.4.5.3.1)

3.4.3.2 Erosion Potential

Because WF3 has been operational since the mid-1980s, stabilization measures are already in place to prevent erosion and sedimentation impacts to the site and vicinity. Based on information from the U.S. Department of Agriculture (USDA), all soil units listed in Table 3.4-1 have a slight erosion potential with the exception of Levees-Borrow pits complex and Urban land which were not rated as to erosion potential (USDA 2014b). However, WF3 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 best management practices (BMPs) that will be used to prevent or reduce the pollutants in stormwater discharges (WF3 2007b).

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 ground disturbance of one or more acres requires a construction stormwater permit to be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, therefore minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Although currently, no license-renewal-related construction activities are planned, these activities would continue to be managed in adherence to the WF3 SWPPP.

3.4.3.3 Prime Farmland Soils

USDA Natural Resources Conservation Service maps show areas of prime farmland surrounding the developed portion of the Entergy Louisiana, LLC property. The northern portion of the approximately 3,560-acre parcel of land owned by Entergy Louisiana, LLC is designated as prime farmland and is currently used as farmland with the exception of residential areas, so these areas would most likely still be considered prime farmland even though it is part of the property owned by Entergy Louisiana, LLC. (USDA 2014b) However, even if areas of the property are designated prime farmland, WF3 would not be subject to the Farmland Protection Policy Act (FPPA), because the Act does not include federal permitting or licensing for activities on private or non-federal lands (USDA 2015). The southern portion of the Entergy Louisiana, LLC property is undeveloped and is not designated as prime farmland. Soil units designated as prime farmland are included in Table 3.4-1. (USDA 2014b)

3.4.4 Seismic History

The regional geologic structures in the deltaic plain consist of salt structures, their overlying attendant faults, and growth faults. The growth faults represent previously unstable areas which were at the leading slope of sediment accumulation. The subsurface data demonstrate that such regional structures cannot affect WF3. (WF3 2014a, Section 2.5)

Epicentral locations for all recorded earthquakes from 1811 to 2015 in the central Gulf Coastal Plain (including the Mississippi embayment) with a recorded magnitude of 3.0 or greater are plotted in Figure 3.4-5. Historic earthquake data for the areas between latitude 27.5° to 37.3° north and longitude 86° to 96° west were assembled. (ANSS 2016; EOI 2008a, App 2.5.2AA; USGS 2014c; USGS 2015a; WF3 2014a, Section 2.5.2.1)

New Orleans, Louisiana, was settled in 1718 by the French. During the greater than 295-year period since New Orleans was settled, only three shocks of the 1811–1812 New Madrid series, and the 1930 Donaldsonville earthquake have probably been felt at the site and surrounding area. The New Madrid series of earthquakes had three events rated XII Modified Mercalli (MM) epicentral intensity. At New Orleans, these series were assigned an intensity of III MM (December 1811), IV–V MM (January 1812), and V MM (February 1812). For the October 1930 Donaldsonville earthquake, the site experienced intensities between IV and V Rossi-Forel scale (IV MM). (WF3 2014a, Section 2.5.2.1.3)

Within the state of Louisiana from 1811 to 2015, there have been only 20 small earthquakes as shown in Figure 3.4-6 and listed in Table 3.4-2. Within a 50-mile radius of WF3, there have been only five epicenters recorded in the last 213 years (Figure 3.4-6). The maximum earthquake was the 1930 event in Donaldsonville, Louisiana, (approximately 31.7 miles west of the site) with an epicenter intensity of nearly VI MM. The WF3 plant has been designed for a maximum horizontal ground surface acceleration of 0.1g, about two times greater than the maximum acceleration appropriate for the Donaldsonville earthquake (WF3 2014a, Section 2.5).

The site lies within a region of infrequent and minor seismic activity, and there are no major seismic zones within the state of Louisiana. Based on NUREG-1407, seismic hazards at WF3 are low (NRC 1991 Section 3.2.3). In addition, the U.S. Geological Survey (USGS) national seismic hazard map shows that WF3 is in a region that has a 2 percent in 50 years (once in 25,000 years) probability of exceeding a peak ground acceleration between 0.04 and 0.05g (USGS 2008, Figure 30).

In summary, the 1811–1812 New Madrid series of earthquakes of epicentral intensity XII MM and the 1930 Donaldsonville earthquake with an epicentral intensity of V–VI are probably the only seismic events that have been felt at the site and in the surrounding area during the past 295 years. The greatest intensity experienced at the site during the historic record was V MM or less. There is no physical evidence to indicate any earthquake effects at the site. (WF3 2014a, Section 2.5.2.1.3)

Table 3.4-1
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
AR	Allemands-Larose association	The Allemands component makes up 45 percent of the map unit. Slopes are 0 to 1 percent. This component is on freshwater marshes on delta plains. The parent material consists of decomposed organic material overlying clayey backswamp deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 58 percent. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a slightly sodic horizon within 30 inches of the soil surface. The Larose component makes up 40 percent of the map unit. Slopes are 0 to 1 percent. This component is on freshwater marshes on delta plains. The parent material consists of thin herbaceous organic material over fluid clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 58 percent. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a slightly sodic horizon within 30 inches of the soil surface.	Not prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
BB	Barbary muck, 0 to 1 percent slopes, frequently flooded	The Barbary, frequently flooded component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on backswamp floodplains, delta plains. The parent material consists of fluid clayey alluvium derived from sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is very high. Shrink-swell potential is very high. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 50 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. There are no saline horizons within 30 inches of the soil surface.	Not prime farmland
Cc	Cancienne silt loam, 0 to 1 percent slopes	The Cancienne component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on lower natural levees on alluvial plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 2 percent. There are no saline horizons within 30 inches of the soil surface.	All areas are prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
Cm	Cancienne silty clay loam, 0 to 1 percent slopes	The Cancienne, silt clay loam component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on natural levees on alluvial plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 43 inches during January, February, March, April, November, and December. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 1 percent.	All areas are prime farmland
Cn	Cancienne silty clay loam, frequently flooded	The Cancienne component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on natural levees on delta plains. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria.	All areas are prime farmland

**Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions**

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
CR	Cancienne and Carville soils, frequently flooded	The Cancienne component makes up 48 percent of the map unit. Slopes are 0 to 1 percent. This component is on swale on natural levees on delta plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The Carville component makes up 33 percent of the map unit. Slopes are 0 to 3 percent. This component is on ridge on natural levees on delta plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 21 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent.	Not prime farmland
FA	Fausse clay, 0 to 1 percent slopes, frequently flooded	The Fausse, frequently flooded component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on backswamp floodplains on alluvial plains. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is high. Shrink-swell potential is very high. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, November, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 2 percent.	Not prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
KE	Kenner muck, 0 to 1 percent slopes, very frequently flooded	The Kenner, very frequently flooded component, makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on marshes on coastal plains. The parent material consists of mucky clayey herbaceous organic material over fluid clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches is very high. Shrink-swell potential is very high. This soil is very frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 40 percent. This soil meets hydric criteria. The soil has a slightly saline horizon within 30 inches of the soil surface. The soil has a slightly sodic horizon within 30 inches of the soil surface.	Not prime farmland
LV	Levees-Borrow pits complex, 0 to 25 percent slopes	The Levees-Borrow pits complex consists of generally two components. The Arents component makes up 60 percent of the map unit. Slopes are 5 to 20 percent. This component is on manmade levees on delta plains. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. This soil does not meet hydric criteria. The Aquents component makes up 40 percent of the map unit. Slopes are 0 to 1 percent. This component is on natural levees on delta plains. The parent material consists of clayey dredge spoils and/or loamy dredge spoils. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is rarely flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during January, February, March, April, May, June, November, and December. This soil meets hydric criteria.	Not prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
MA	Maurepas muck	The Maurepas component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on freshwater swamps on delta plains. The parent material consists of highly decomposed woody organic material over fluid clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 40 percent. This soil meets hydric criteria. There are no saline horizons within 30 inches of the soil surface.	Not prime farmland
Sa	Schriever silty clay loam	The Schriever component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on backswamps on Mississippi River delta plains. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is very high. This soil is rarely flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent.	All areas are prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
Se	Schriever clay, 0 to 1 percent slopes	The Schriever component makes up 95 percent of the map unit. Slopes are 0 to 1 percent. This component is on backswamps on Mississippi River delta plains. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is very high. This soil is rarely flooded. It is not ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 1 percent.	All areas are prime farmland
Sh	Schriever clay, 0 to 1 percent slopes, frequently flooded	The Schriever, frequently flooded component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on floodplains on Mississippi River alluvial plains. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is very high. This soil is frequently flooded. It is occasionally ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 2 percent. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. The soil has a slightly sodic horizon within 30 inches of the soil surface.	Not prime farmland
Tu	Thibaut clay, 0 to 1 percent slopes	The Thibaut component makes up 80 percent of the map unit. Slopes are 0 to 1 percent. This component is on intermediate position on natural levees. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria.	All areas are prime farmland

Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions

Map Symbol (Figure 3.4-4)	Soil Unit Name	Description	Prime Farmland Designation
UR	Urban land	This map unit consists of areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. Examples are business centers, parking lots, industrial sites, grain elevators, and nuclear power plants along the Mississippi River industrial corridor. The mapped areas range from 100 to 500 acres. Included with this Urban land in mapping are areas of lawns that are mostly covered with miscellaneous, artificial fill. In some areas, several feet of this fill has been placed over the original soil surface. The included areas make up about 15 percent of the map unit. Examination and identification of soils or soil material in this map unit are impractical. Careful onsite investigation is needed to determine the potential and limitations for any proposed use.	Not prime farmland

(USDA 1987; USDA 2014b)

Table 3.4-2
Louisiana Historic Earthquakes ≥ 3.0 Mb, 1811–2015

Year	Month	Day	Latitude	Longitude	Intensity	Magnitude (Mb)	Hypocenter Depth (miles)	Area (square miles)	Distance to Site (miles)	Remarks
1842	May	7	30.77	-91.92		3.9			101.6	St. Landry Parish, Louisiana
1868	November	28	31.31	-92.46		3.8			149.1	Alexandria, Louisiana
1870	January	9	31.14	-92.29		4.2			134.0	Rapides Parish, Louisiana
1905	February	3	30.50	-91.10		3.7				Merrydale, Louisiana (Baton Rouge)
1927	December	15	28.90	-89.40		3.8			99.4	2km south of Southwest Pass Entry, Louisiana
1929	July	28	28.90	-89.40		3.8			99.4	2km south of Southwest Pass Entry, Louisiana
1930	October	19	30.00	-91.00	V-VI			15,000	31.7	Donaldsonville, Louisiana
1947	September	20	31.90	-92.60		3.3			182.3	Winn Parish, Louisiana
1952	October	17	30.10	-93.70		3.1			193.2	Calcasieu Parish, Louisiana
1958	November	6	29.90	-90.10		3.1			23.2	Marrero, Louisiana (New Orleans)
1958	November	19	30.30	-91.10	V				43.3	Baton Rouge, Louisiana

Table 3.4-2 (Continued)
Louisiana Historic Earthquakes ≥ 3.0 Mb, 1811–2015

Year	Month	Day	Latitude	Longitude	Intensity	Magnitude (Mb)	Hypocenter Depth (miles)	Area (square miles)	Distance to Site (miles)	Remarks
1959	October	15	29.80	-93.10		3.7			158.0	Creole, Louisiana
1964	April	23	31.50	93.80	V	3.7			223.6	Sabine Parish, Louisiana
1964	April	24	31.60	93.80	V	3.7			226.8	Sabine Parish, Louisiana
1964	April	27	31.50	93.80	V	3.4			223.6	Sabine Parish, Louisiana
1964	April	28	31.70	93.60	V	4.4			220.1	Sabine Parish, Louisiana
1981	February	13	30.00	-91.80		3.1			79.5	Southern Louisiana
1983	October	16	30.24	93.39		3.8	3.1		175.5	Sulphur, Louisiana
2005	December	20	30.26	90.71		3.0	3.1		23.0	Livingston Parish, Louisiana
2010	August	2	30.82	90.85		3.0	0.3		61.1	East Feliciana Parish, Louisiana

(ANSS 2015; ANSS 2016; EOI 2008a, App 2.5.2AA; USGS 2014c; WF3 2014a, Table 2.5-8)

Mb: body-wave magnitude

Figure 3.4-1
Physiographic Provinces and Subprovinces Associated with WF3

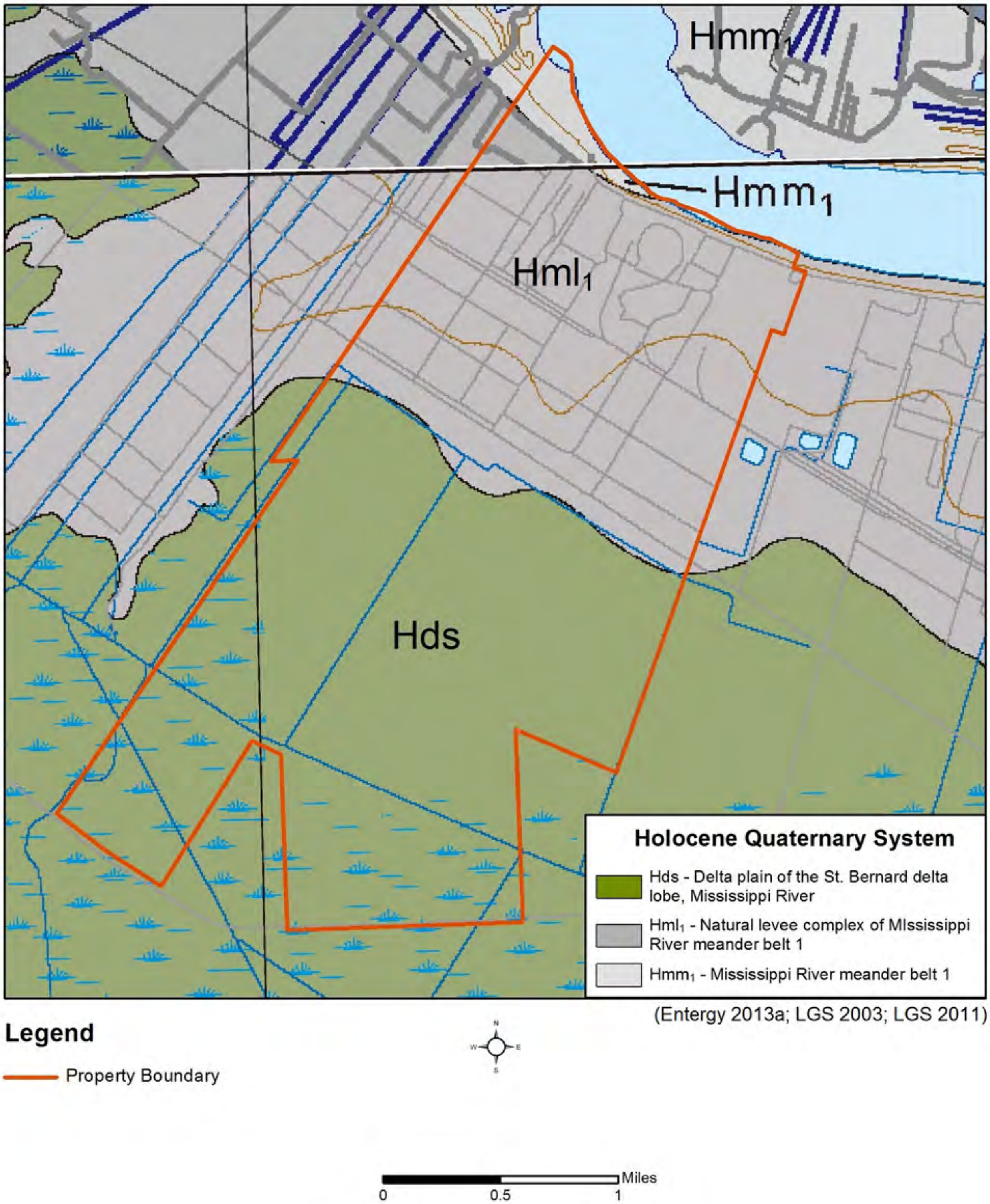


Figure 3.4-2
Surficial Geology Map, Entergy Louisiana, LLC Property

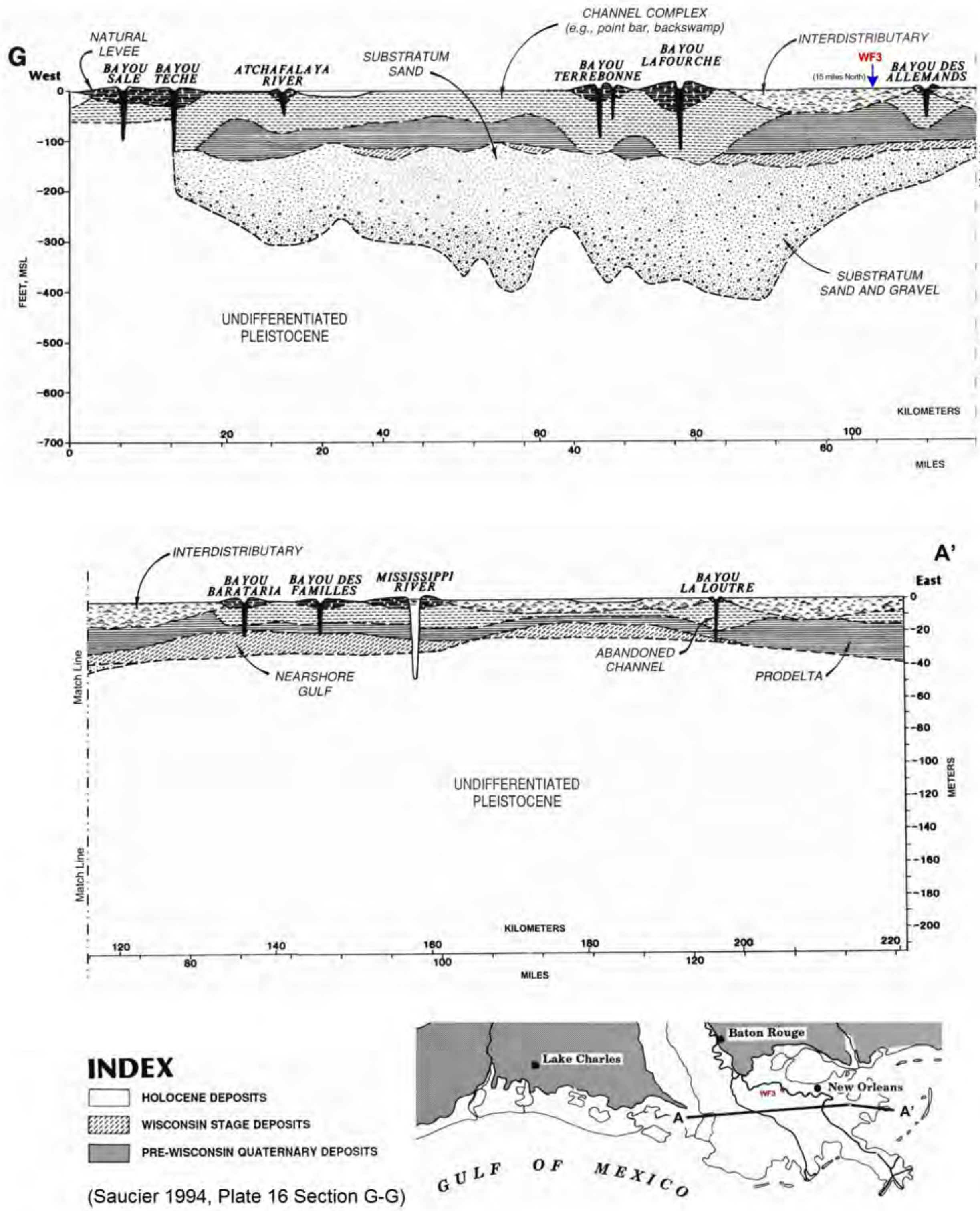
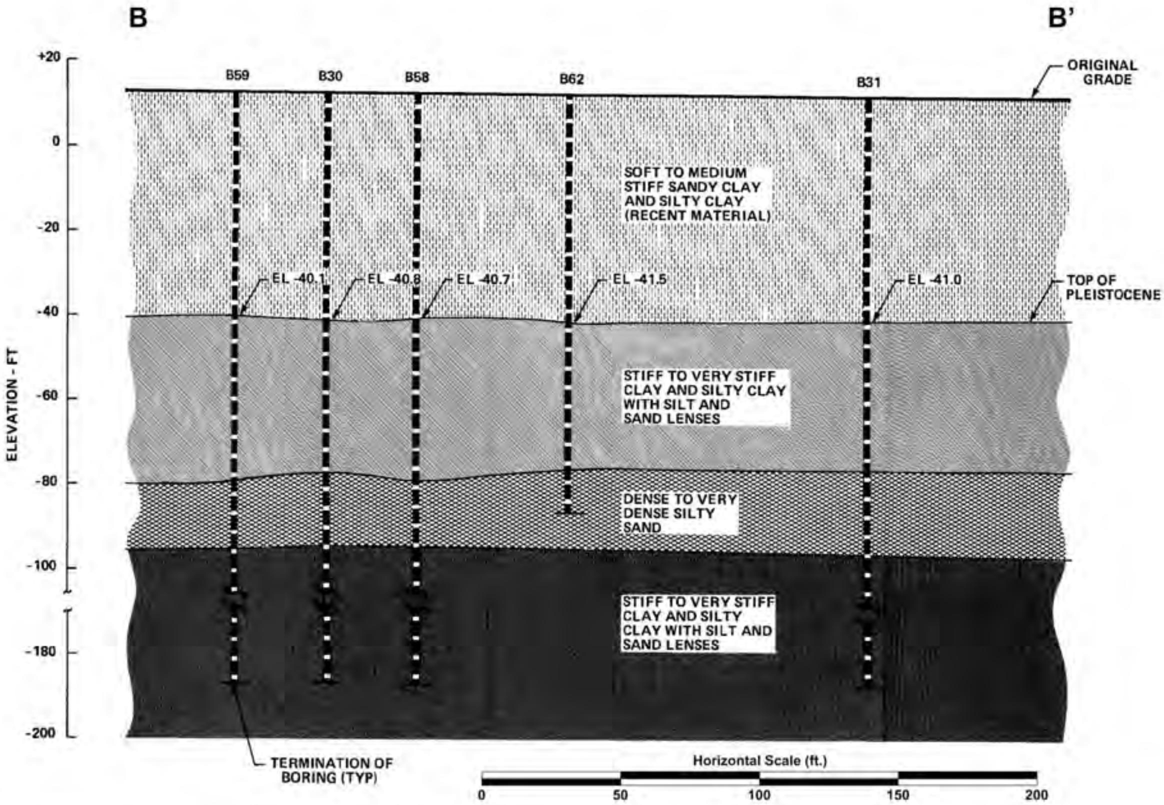


Figure 3.4-3
WF3 Geologic Cross Section (A-A')
(Sheet 1 of 5)



(WF3 2014a, Figures 2.5-30a and 2.5-30b)

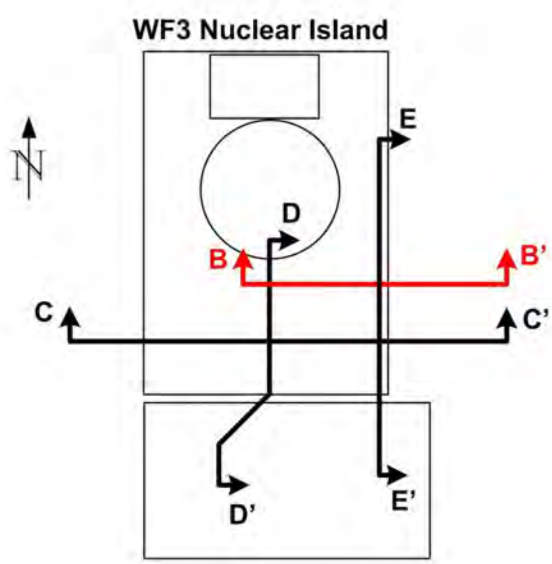
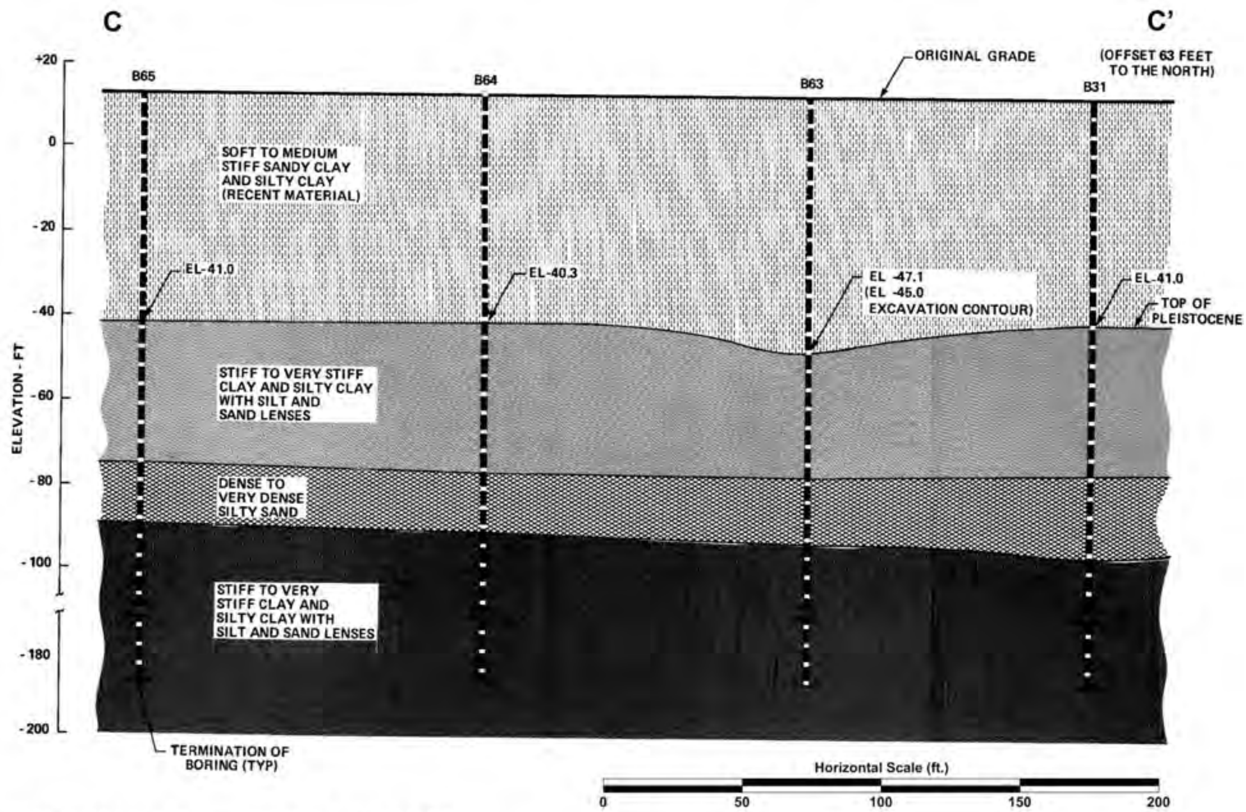


Figure 3.4-3
WF3 Geologic Cross Section (B-B')
(Sheet 2 of 5)



(WF3 2014a, Figures 2.5-30a and 2.5-30c)

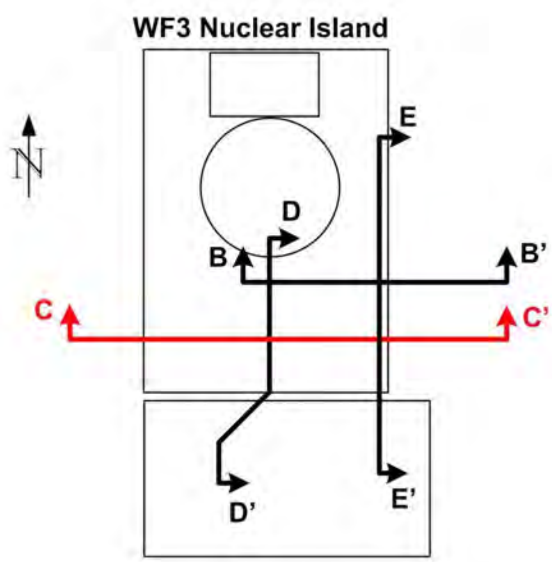
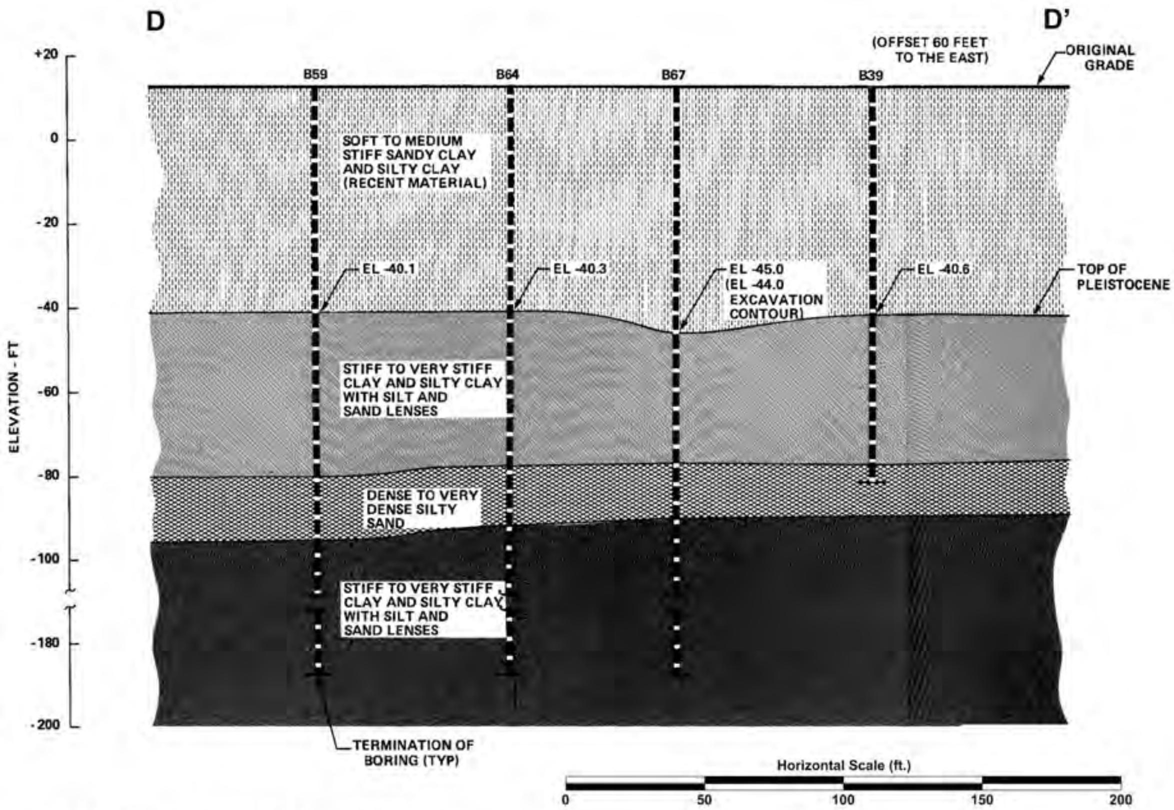


Figure 3.4-3
WF3 Geologic Cross Section (C-C')
(Sheet 3 of 5)



(WF3 2014a, Figures 2.5-30a and 2.5-30d)

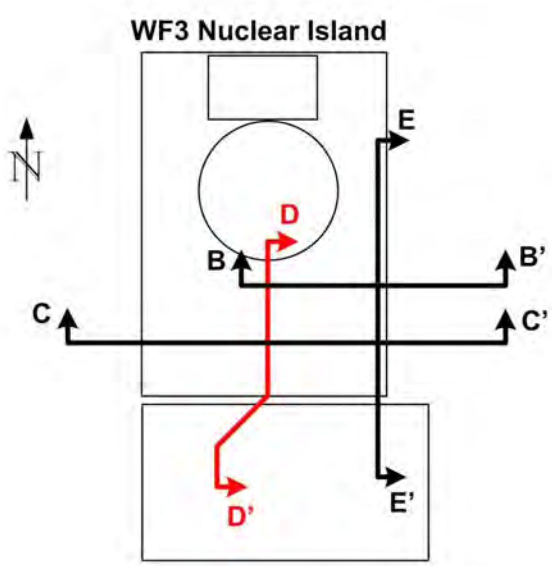
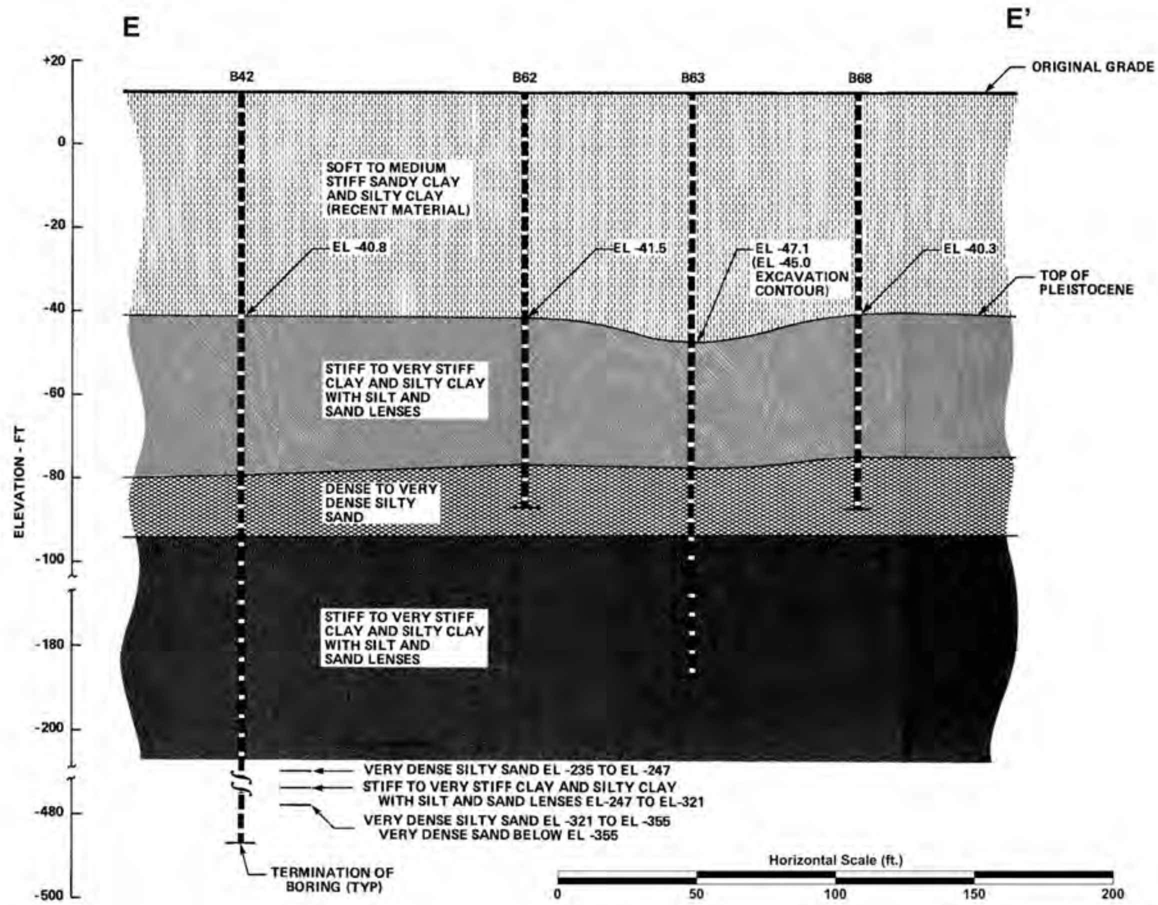


Figure 3.4-3
WF3 Geologic Cross Section (D-D')
(Sheet 4 of 5)



(WF3 2014a, Figures 2.5-30a and 2.5-30e)

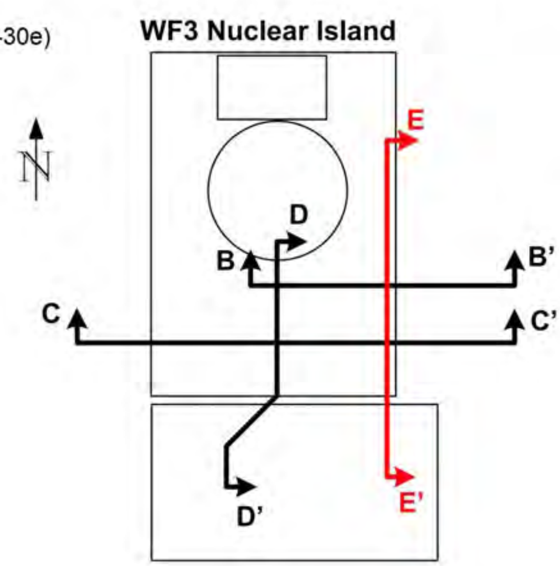


Figure 3.4-3
WF3 Geologic Cross Section (E-E')
(Sheet 5 of 5)

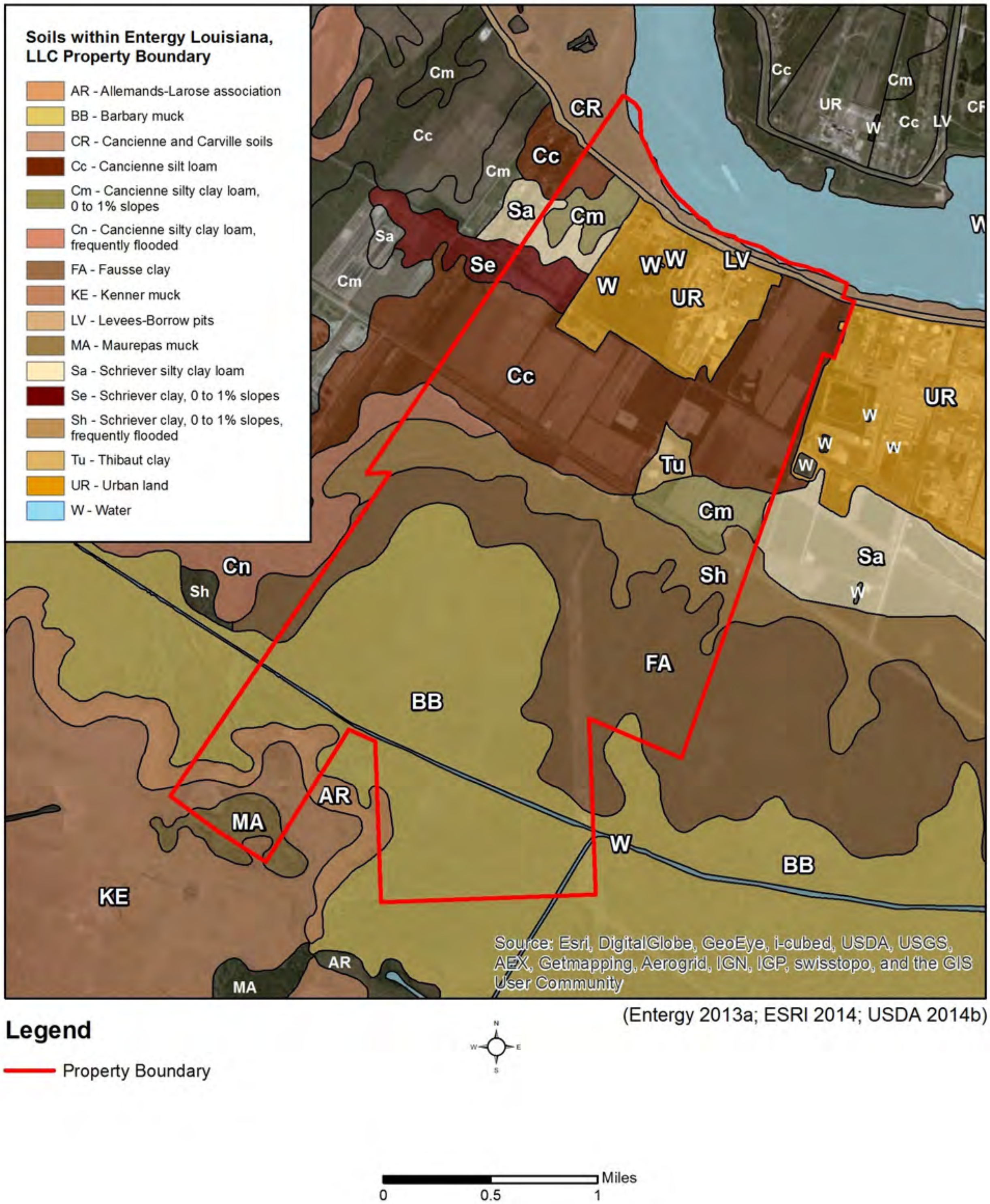


Figure 3.4-4
Distribution of Soil Units, Entergy Louisiana, LLC Property

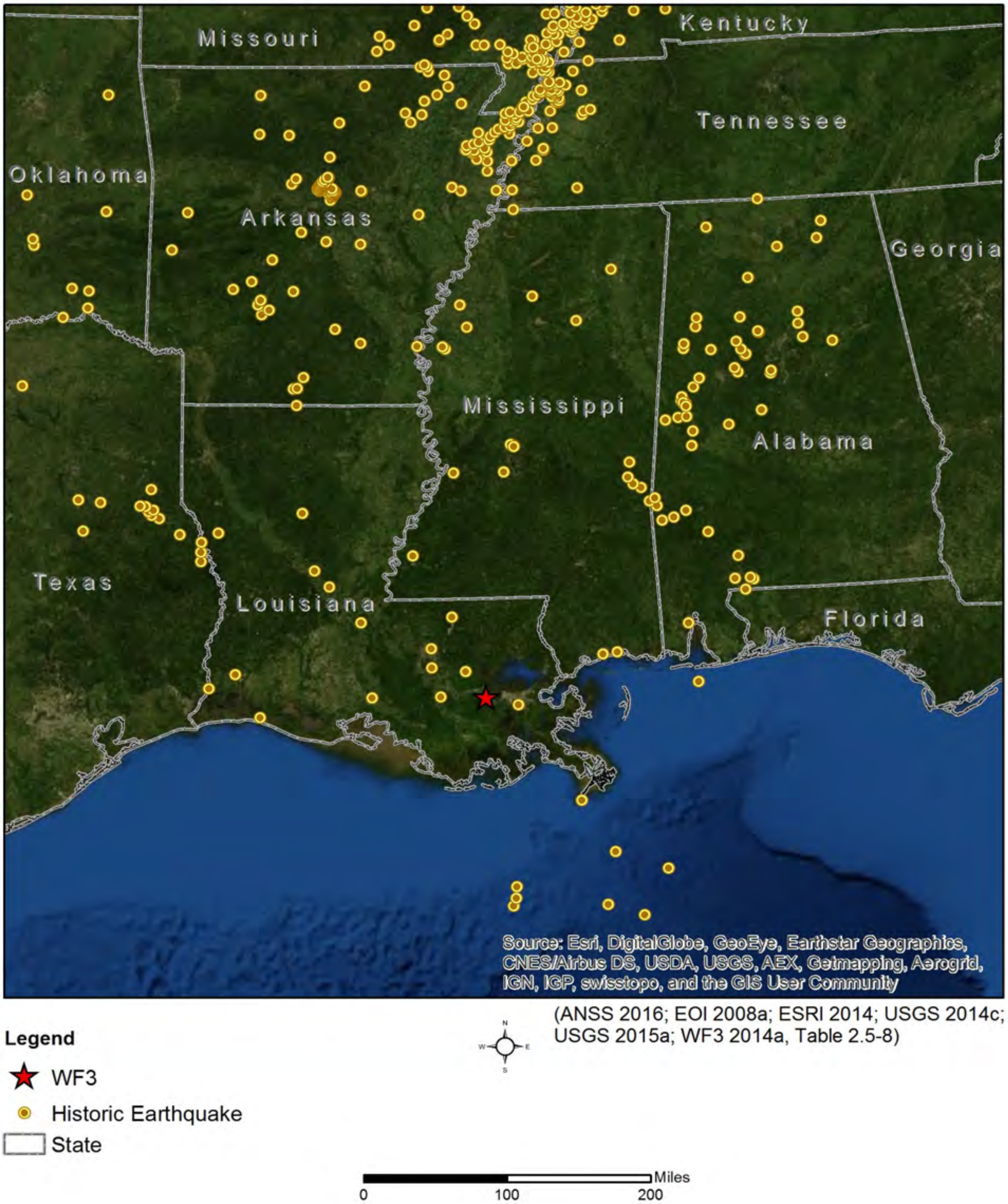


Figure 3.4-5
Central Gulf Coastal Plain Historic Earthquakes ≥ 3.0 Mb, 1811–2015

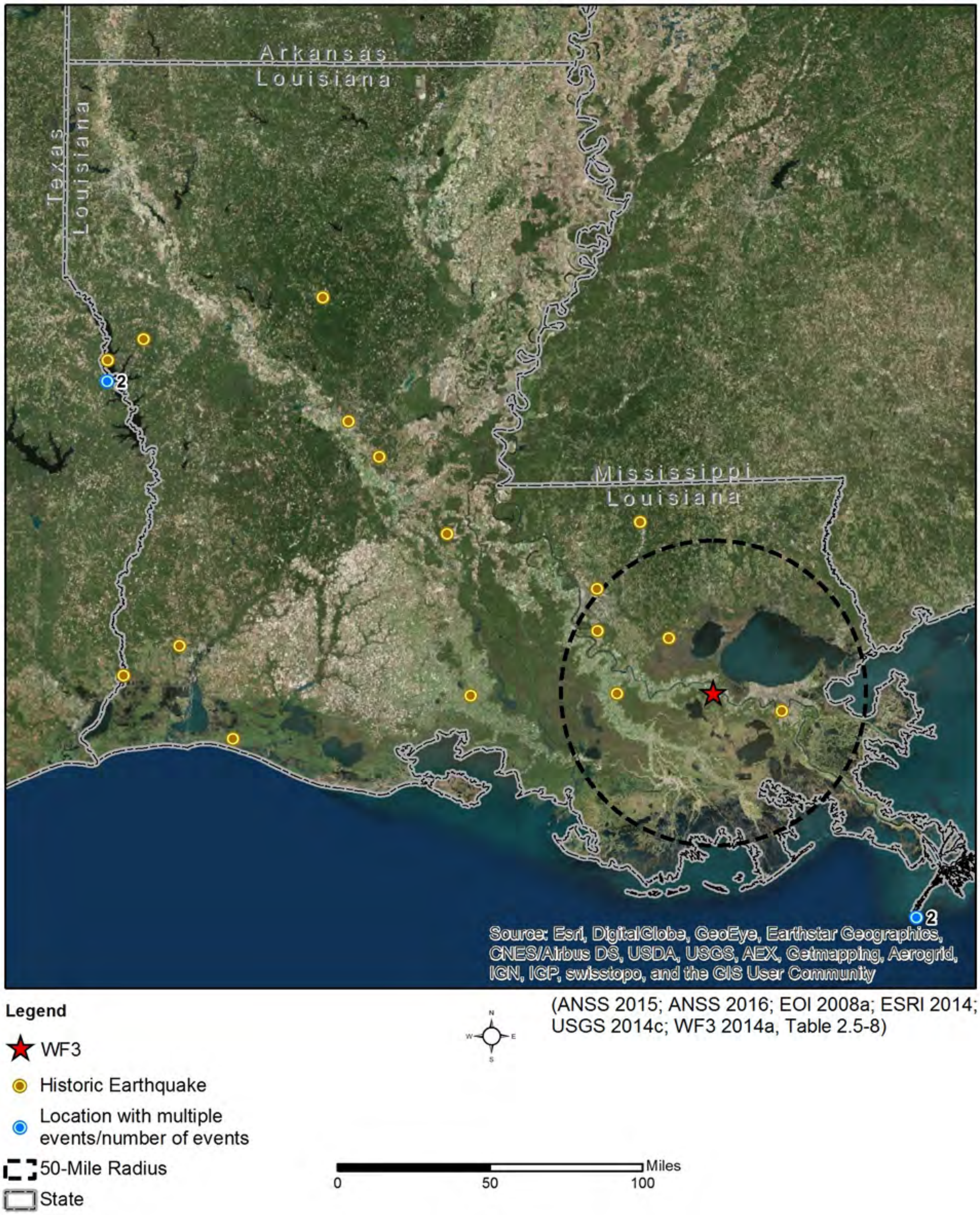


Figure 3.4-6
Louisiana Historic Earthquakes ≥ 3.0 Mb, 1811–2015

3.5 Water Resources

3.5.1 Surface Water Resources

WF3 is located on the west (right descending) bank of the Mississippi River at River Mile 129.6 AHP, approximately 25 miles upstream of New Orleans on Entergy Louisiana, LLC owned property. The Entergy Louisiana, LLC property consists of approximately 3,560 acres with approximately 7,500 feet of river frontage, and the Mississippi River is the primary hydrologic feature with which the plant interacts (Figure 3.5-1). WF3 is protected from river flooding by levees adjacent to the plant. (WF3 2014a, Sections 2.4.1.1 and 2.4.1.2)

The Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States (USACE 2014b). Beginning in Minnesota, the headwaters of the Mississippi flow southward for approximately 2,300 miles into the Gulf of Mexico (USGS 1998). Because the river is so vast, it has been broken into three segments, which contain a variety of habitat conditions and fisheries. The upper 512 miles from Lake Itasca to St. Anthony Falls in Minnesota is considered the headwaters of the Mississippi River. This portion of the Mississippi flows alternately through forests and wetlands. Dams have been built to form 11 small reservoirs and modify the elevation and discharge of several natural river lakes. These dams variously function for flood control, electricity generation, water supply, or recreation. (Schramm 2004)

The Upper Mississippi River reach stretches 668 miles from St. Anthony Falls, Minnesota, to Alton, Illinois, a few miles above the confluence with the Missouri River. The Upper Mississippi River is impounded by 28 locks and dams built for commercial navigation and one dam (at Keokuk, Iowa) built for commercial navigation and hydropower generation. These dams are operated to maintain minimum navigation channel depth (9 feet); thus, the dams have little effect on the river stage and discharge during spring floods. (Schramm 2004)

Downstream from the confluence of the Missouri River near West Alton, Missouri, north of St. Louis, the Mississippi flows un-dammed to Head of Passes in Louisiana where it branches into several distributaries that carry water to the Gulf of Mexico. The 195 miles reach from the mouth of the Missouri River to the mouth of the Ohio River is referred to as the Middle Mississippi River by management agencies. At the Missouri River confluence, water volumes in the Mississippi River almost double. The 976 miles reach from the Ohio River to Head of Passes is referred to as the Lower Mississippi River (LMR). Water from the Ohio River increases Mississippi River discharge 150 percent. Although discharge and channel size differ between the two reaches, they share similar hydrologic conditions, methods and levels of channelization, and loss of connectivity with the historic floodplain. (Schramm 2004)

With an average discharge of 593,000 cfs, the Mississippi River is the largest river in the United States (NRC 2006, Section 2.6.1.1). The width of the Mississippi River at the WF3 plant is approximately 1,850 feet, the average stage is approximately 9.9 feet, and the average velocity is approximately 3.65 fps. Based on 1992 USACE bathymetric information for the Mississippi River at the WF3 plant (River Mile 129.6), the average maximum depth is approximately

129 feet. (Entergy 2005, Section 2.2) Based on the WF3 LPDES permit fact sheet (Attachment A), the 7-day, 10-year low flow is 141,955 cfs.

The existing comprehensive flood control and navigation plan for the Mississippi River consists of a levee system along the main stem of the river and its tributaries in the alluvial plain; reservoirs on the tributary streams; floodways to receive excess flow from the river; and channel improvements such as revetment, dikes, and dredging to increase channel capacity. Below Baton Rouge, Louisiana, 92 miles of operative revetment works are in place and a low-water navigation channel 9 feet deep and 300 feet wide between Cairo, Illinois, and Baton Rouge, Louisiana, is maintained by dredging and dikes. Other flood control programs consist of control structures, cutoffs, pumping plants, floodwalls, and floodgates. The channel cutoff program inaugurated in the 1930s consisted of 16 cutoffs which, along with two major chutes, have reduced the river distance between Memphis, Tennessee, and Baton Rouge, Louisiana, by 170 miles. This program has lowered river stages by 10 feet at Vicksburg, Mississippi, at project design flood stages. Besides the flood control features, the plan provides for construction and maintenance of a navigable channel from Baton Rouge, Louisiana, to Cairo, Illinois. The following are major flood control levee systems, floodways, and control structures near WF3 (WF3 2014a, Section 2.4.1.2):

Levees

The levee line on the west bank of the Mississippi River begins just south of Cape Girardeau, Missouri, and except for gaps where tributaries join the Mississippi, extends almost to Venice, Louisiana, near the Gulf of Mexico. Below Baton Rouge, about 134 miles of levee are protected against river wave wash. (WF3 2014a, Section 2.4.1.2)

Floodway and Diversion Structures

Four primary flooding control structures, operated by the USACE are located in the lower alluvial valley of the Mississippi River. The Bonnet Carre Spillway, Old River Control Structure, Morganza Floodway, and Atchafalaya Basin Floodway (Figure 3.5-1) are major flood control works which control Mississippi River flooding near WF3 (WF3 2014a, Section 2.4.1.2).

a. Bonnet Carre Spillway

The Bonnet Carre Spillway is located on the east bank, near the site of old Bonnet Carre Crevasse and in a straight reach of the Mississippi River approximately 25 miles above New Orleans, Louisiana, and three-quarters of a mile downstream from WF3. The structure is 7,700 feet long and contains 350 bays, each 20 feet wide with a weir crest elevation of +18.0 feet to 16.0 feet msl. The Bonnet Carre Spillway and structure were constructed to divert approximately 250,000 cfs of floodwaters from the Mississippi River to Lake Pontchartrain to prevent overtopping of levees at and below New Orleans, assuring the safety of New Orleans and the downstream delta area during major floods on the LMR. The spillway and floodway are operated to prohibit the river stage on the

Carrollton gauge from exceeding 20 feet, a stage about 5 feet below levee grade. (WF3 2014a, Section 2.4.1.2)

b. *Old River Control Structure*

The Old River Control Structure is located on the west bank of the Mississippi River at approximately River Mile 314 AHP. The structure was built to prevent the Atchafalaya River from capturing the Mississippi River flow and to control flows into the Atchafalaya River and Basin. These structures consist of a low-sill control structure and an overbank control structure, and are designed to carry about 620,000 cfs of floodwaters. The low-sill control structure was designed to distribute mainly low and moderate flows. The structure consists of 11 gated bays, each having a 44-foot clear width between piers, and a weir crest elevation of +5.0 to 10 feet msl. The overbank control structure was designed to distribute flood flows between the Mississippi and Atchafalaya rivers. The structure consists of 73 gated bays, each having a 44-foot clear width between piers, and a weir crest elevation of +52.0 feet msl. (WF3 2014a, Section 2.4.1.2)

c. *Morganza and West Atchafalaya Floodways*

The flow diverted from the main channel near Old River is carried by the Atchafalaya River through the Morganza Floodway and the West Atchafalaya Floodway. These two floodways follow down to the end of the levee system along the Atchafalaya River and merge into a single broad floodway that passes the flow to the Gulf through two outlets: Wax Lake and Lower Atchafalaya River. In major floods, the Morganza Floodway would be the first of these two floodways to be used. (WF3 2014a, Section 2.4.1.2)

The Morganza Floodway structure, located just above the town of Morganza, Louisiana, and between the Mississippi River and the Atchafalaya Basin Floodway, is designed to convey approximately 600,000 cfs of Mississippi River floodwaters to the Gulf of Mexico via the Atchafalaya Basin Floodway, thence through the lower Atchafalaya River and Wax Lake Outlet. At the control structure, the floodway is about 4.4 miles wide and the control structure is approximately 3,900 feet in length and consists of 125 gated concrete weirs, each 28.25 feet in width, with a weir crest elevation of +37.5 feet msl. The Morganza Floodway was first used during the 1973 flood. (WF3 2014a, Section 2.4.1.2)

The Atchafalaya River starts from the confluence of the Red and Old rivers. The Atchafalaya Basin Floodway extends from the confluence to the Gulf of Mexico. The Floodway is designed to carry half of the project flood (1,515,000 cfs) to the Gulf. These floodwaters enter the floodway through the Red and Old rivers and the Morganza Floodway. Guide levees constructed on the east and west sides of the basin are approximately 15 miles apart. The West Atchafalaya Basin Floodway lies parallel to and on the west side of the Atchafalaya River channel. (WF3 2014a, Section 2.4.1.2)

The thalweg of the LMR is below sea level from the Gulf of Mexico to about River Mile 350 AHP. This topographic feature permits salt water from the Gulf, which is denser than the fresh river water, to intrude into the LMR during periods of low flow. This intrusion takes the form of a well-defined saltwater wedge with little mixing occurring at its boundary, and this boundary is defined by the USACE as that depth at which the salinity equals 5,000 parts per million (ppm) chloride. In general, salt-water encroachment is indicated if observed chloride concentrations significantly exceed the value of 50 ppm, which represents the maximum chloride concentration normally found in the river and which persists for only 2 percent of the time. (WF3 2014a, Section 2.4.1.2)

The maximum intrusion of the salt water wedge was detected in October 1939 at River Mile 120 AHP, approximately 10 miles downstream of the plant site. During this time, the discharge varied between 75,000 and 90,000 cfs for 30 consecutive days. Due to the existence of the Old River Control Structure, completed in 1963, minimum low flows should not fall below 100,000 cfs. Therefore, the possible presence of the salt wedge at WF3 is considered highly unlikely. (WF3 2014a, Section 2.4.1.2)

Potential for Flooding

A potential cause of flooding in the Mississippi River Delta Basin is hurricane-induced surge flooding. Although the plant is approximately 60 miles from the open coast, hurricane surges have, historically, flooded large portions of the LMR Delta area. (WF3 2014a, Section 2.4.1.2)

Based on Federal Emergency Management Agency (FEMA) data, the 100-year flood level is 5 feet (NAVD88) and covers the southwestern portions of the Entergy Louisiana, LLC property, as shown in Figure 3.5-2. Levees present along the western shoreline of the Mississippi River at WF3 are designed to protect the site against high water levels associated with the 100-year floods, but are subject to overtopping during larger flood events. (FEMA 1992a; FEMA 1992b; FEMA 1992c)

As discussed in Section 2.2, all safety-related components are housed in the NPIS, which is flood protected up to elevation +29.27 feet msl. All exterior doors and penetrations below elevation +29.27 feet msl leading to areas containing safety-related equipment are watertight. The plant grade around the structure varies from elevation +17.5 feet msl on the north side to elevation +14.5 feet msl on the south side. (WF3 2014a, Section 2.4.1.1)

3.5.1.1 Surface Water Discharges

3.5.1.1.1 LPDES-Permitted Outfalls

Chemical additives approved by the LDEQ 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 LDEQ-approved concentrations are monitored and discharged to the Mississippi River via LPDES Outfall 001, or to 40 Arpent Canal via LPDES Outfalls 004 and 005 in accordance with the site's LPDES Permit No. LA0007374 (Attachment A). The current LPDES permit authorizes discharges from 13 outfalls (3 external and 10 internal). The outfalls (Figure 3.5-3) and their associated effluent limits are shown in Table 3.5-1.

Certain low-volume and chemical wastewaters from the WF3 facility with no detectable radioactivity, as defined by the NRC plant effluent release limits, may be comingled and treated with similar wastes from Waterford 1, 2, and 4, and controlled under the terms of Waterford 1, 2, and 4 LPDES Permit No. LA0007439. These type wastewaters are pumped to an onsite aboveground concrete holding basin where they are then transferred to the Waterford facility (Units 1, 2, and 4) for processing. There are no subsurface ponds, basins, or lagoons associated with WF3 wastewater discharges or plant operations.

LPDES Outfall 901 (mobile metal cleaning wastewater), which is permitted to receive metal cleaning wastewaters, is a mobile outfall to allow wastewater treatment skids to be installed prior to discharging to Outfall 001 (once-through non-contact cooling water). The last time a metal discharge occurred at WF3 was associated with the cleaning of the steam generators in 2003. The wastewaters generated from the steam generators were collected in tanks and treated to meet LPDES permit limits prior to discharging. Discharges to Outfall 901 occurred during the months of October 2003, November 2003, December 2003, and January 2004 (WF3 2003; WF3 2004b). The amount of metal chemical wastewaters generated from the cleaning of the steam generators was approximately 254,419 gallons (WF3 2003; WF3 2004b).

3.5.1.1.2 Stormwater Runoff

Stormwater discharges associated with WF3 industrial activities are regulated and controlled through LPDES Permit No. LA0007374 (Attachment A) issued by the LDEQ. WF3 samples stormwater runoff on a quarterly basis at LPDES Outfall 004, which receives runoff from the entire industrial area, and analyzes for pollutants as specified in the permit. WF3 also maintains and implements a SWPPP that identifies potential sources of pollution, such as erosion, that would reasonably be expected to affect the quality of stormwater, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges (WF3 2007b).

3.5.1.1.3 Sanitary Wastewaters

With the exception of the Energy Education Center (EEC), sanitary wastewater from all plant locations is collected and discharged to the St. Charles Parish publicly owned treatment works (POTW), where it is managed appropriately. Sanitary wastewater from the EEC, which is regulated by WF3's LPDES Permit No. LA0007374 (Attachment A), flows to an onsite sewage treatment unit prior to discharging to 40 Arpent Canal via LPDES Outfall 005. No pretreatment permit is required in association with WF3's sanitary wastewater discharges to the St. Charles Parish POTW. However, WF3 continuously monitors the effluent for radioactivity.

3.5.1.1.4 Dredging

As previously discussed in Section 2.2.2.1, because the average flow in the Mississippi River in the vicinity of the WF3 plant is estimated to be approximately 500,000 cfs, there is no significant deposition of sediment at the intake structure. As a result, no dredging activities at the intake structure to remove sediment deposition have been necessary.

3.5.1.1.5 Compliance History

As discussed in Chapter 9, there has been no notice of violations or noncompliances associated with WF3 wastewater discharges to receiving surface waters over the previous 5 years (2010–2014).

However, WF3 did receive a Notice of Deficiency from LDEQ regarding the improper cooling of biological oxygen demand, total suspended solids, and fecal coliform samples during delivery to the laboratory (LDEQ 2015a). This deficiency was promptly resolved by revising WF3's sampling procedure to require that samples be cooled upon collection (Entergy 2015j).

3.5.2 Groundwater Resources

3.5.2.1 Groundwater Aquifers

Groundwater in southeastern Louisiana is available in deltaic and shallow marine deposits. The major aquifers in this region are unconsolidated sands that dip southward. In general, these sand deposits are separated and confined by relatively impermeable clays and silts. There are four principal aquifer systems identified at WF3: the Shallow Aquifers, the Gramercy Aquifer, the Norco Aquifer, and the Gonzales-New Orleans Aquifer. (GZA 2007, Section 4.2)

The Shallow Aquifers include point bar deposits and other shallow deposits of sand. Localized sand deposits below depths of about 150 feet have small yields of poor quality water and are not recognized as important aquifers in the region. The shallow deposits occur frequently in the Mississippi River deltaic plain, but are not interconnected regionally. The point bar deposits accumulate on the inside of river bends in the area of WF3, have a maximum thickness of about 130 feet, and are overlain by 20 to 30 feet of natural levee deposits. (GZA 2007, Section 4.2)

The Gramercy Aquifer is the principal freshwater bearing sand in the Gramercy area and has previously been called the "200-foot" sand, but has little use in the region. The top of the aquifer occurs at about -200 feet msl beneath the southern portion of the Entergy Louisiana, LLC property and is about 100 feet thick. The aquifer is a medium- to very fine-grained sand and generally increases in thickness in the north to south direction. In the area of WF3, the Gramercy Aquifer is irregular in thickness and discontinuous. (GZA 2007, Section 4.2)

The Norco Aquifer is the principal aquifer in the Norco area and has been called the "400-foot" sand in New Orleans. The top of the Norco Aquifer in both the New Orleans and Norco areas is encountered between depths of about 300 to 400 feet. The top of the aquifer occurs at about -325 feet msl beneath WF3 and is about 125 feet thick. It is a medium- to fine-grained sand in the area of New Orleans and grades to a medium to coarse sand in Norco, where it is the principal aquifer. The Norco Aquifer is usually separated from the overlying Gramercy Aquifer by clay beds with interbedded sand. In the Norco area, a large area of convergence exists between the two aquifers. The Norco Aquifer is the principal aquifer in the area of WF3. The regional thickening and dip of the aquifer is to the south. (GZA 2007, Section 4.2)

The Gonzales-New Orleans Aquifer is a fine-grained quartz sand of uniform texture, which underlies the Norco Aquifer in the region, and it has previously been called the Gonzales Aquifer or the "700-foot" sand. The depth to the top of the aquifer in the New Orleans Norco area ranges from about 450 to 800 feet. The top of the aquifer occurs at about -600 feet msl beneath WF3 and is about 250 feet thick. It is the principal aquifer in the New Orleans area. The Gonzales-New Orleans Aquifer is separated from the overlying Norco Aquifer by 200 to 300 feet of clay with interbeds of sand. (GZA 2007, Section 4.2)

3.5.2.2 Hydraulic Properties

Estimates of permeability in the Shallow Aquifers are based on the texture of the soils composing the deposits and are generally reported as low, with typical sustained yield for wells in the point bar deposits being reported at only a few gallons per minute. The permeability of the Shallow Aquifers in the area of WF3 is estimated to be about 100 gallons per day per square foot (gpd/ft^2), again based on the texture of the deposits. (GZA 2007, Section 4.2.2)

Fifty feet beneath the recent deposits is a reported aquiclude of fairly uniform Pleistocene clay with occasional discontinuous sand lenses (see Figure 3.4-3, Sheet 2). The reactor foundation mat bears upon the Pleistocene clay at elevation -47 feet msl. This layer is approximately 40 feet thick and exhibits an average permeability of about 1 x 10^{-8} centimeters per second (cm/sec). (GZA 2007, Section 4.2.2)

A continuous dense to medium dense silty sand layer with some clay and approximately 19 feet in thickness is situated immediately beneath the uppermost Pleistocene clay, starting at elevation -89 feet msl. This layer reportedly exhibits an average permeability of about 3.0 x 10^{-5} cm/sec. (GZA 2007, Section 4.2.2)

A stiff clay stratum from elevation -108 feet msl to elevation -330 feet msl is characterized as a local aquiclude. The layer is soft at the upper contact with the medium dense silty sand layer discussed above and has a continuous sand layer approximately 10 feet thick located at approximate elevation -240 feet msl. The Norco Aquifer is locally manifested as a dense silty sand beneath an approximate elevation of -330 feet msl. (GZA 2007, Section 4.2.2)

The Gramercy Aquifer is about 100 feet thick in the Norco area and ranges from 30 to 150 feet thick in New Orleans. Values of transmissivity for the Gramercy Aquifer range from 20,000 gallons per day per foot (gpd/ft) in the vicinity of New Orleans to as high as 240,000 gpd/ft near Norco. Well yields from the Gramercy Aquifer in the area of WF3 range from several hundred to more than 1,000 gpm. A transmissivity on the order of 150,000 gpd/ft is indicated for the aquifer in the vicinity of Destrehan. (GZA 2007, Section 4.2.2)

Data from pumping tests in the Norco Aquifer indicate that the transmissivity increases from 50,000 gpd/ft in the New Orleans area to as much as 225,000 gpd/ft in the Norco area, where the aquifer is continuous. Well yields as high as 3,000 gpm have been obtained from wells tapping the Norco aquifer in the vicinity of Norco; however, the yield of most wells in the area range from 1,000 to 1,500 gpm. Hydrostatic pressures in the Gramercy and Norco aquifers have been reversed by large-scale pumping activities which began at Norco in 1920. The transmissivity of the Norco Aquifer in the area of WF3 is about 200,000 to 224,000 gpd/ft, and the permeability is about 1,600 to 1,800 gpd/ft^2. Most wells in the Norco Aquifer yield from 1,000 to 1,500 gpm, and most specific capacities range from 45 to 75 gpm/ft. (GZA 2007, Section 4.2.2)

Values of transmissivity of the Gonzales-New Orleans Aquifer range from 90,000 gpm/ft to 180,000 gpd/ft. Higher values of transmissivity are noted in the Geismer-Gonzales area, where the aquifer ranges in texture from a fine to very coarse sand and gravel. The transmissivity in the area of WF3 is lower than that of the Norco Aquifer, averaging about 148,000 gpd/ft. The permeability is on the order of 680 gpd/ft^2, with most wells yielding between 1,000 and 1,500 gpm. (GZA 2007, Section 4.2.2)

3.5.2.3 Potentiometric Surfaces

Topographically, the WF3 area is relatively flat at an elevation of approximately +12 feet msl. The land slopes slightly downward away from the river levee. The Entergy Louisiana, LLC property to the south of the plant location, once a swamp area, has been reclaimed. The Entergy Louisiana, LLC property is immediately underlain by deposits of clay, silt, and sand of recent geological age. Based on information obtained from piezometric levels measured since June 1972, this formation is discontinuous and generally unresponsive to fluctuations in the level of the Mississippi River. (GZA 2007, Section 4.2.3)

Water levels in shallow aquifers downstream of Baton Rouge area closely follow the stage of the Mississippi River. Water from the Mississippi River seeps into shallow aquifers during periods of high river stage and from these aquifers into the river during periods of low river stage. (GZA 2007, Section 4.2.3)

Historically, shallow groundwater flow at WF3 has been described as flowing generally south-southwest away from the Mississippi River, except during low river stages when a transient groundwater divide is created. Water-level data collected as part of the Nuclear Energy Institute (NEI) groundwater protection initiative (GPI) program indicate two general groundwater flow scenarios. In the first scenario, the elevation of the Mississippi River is higher than onsite groundwater potentiometric elevations, and hydraulic gradients direct flow across the site away from the river (Figure 3.5-4). In the second scenario, the highest water-level elevations form a groundwater mound typically coincident with northern portions of the plant foundation excavation. This groundwater mound creates a divide where hydraulic gradients direct a portion of groundwater flow away from the mound toward the Mississippi River (Figure 3.5-5). (WF3 2014f, Section 2.2)

Deeper Aquifer Units: Prior to inception of heavy pumping in the New Orleans and Norco areas, groundwater movement in the regional aquifers was generally down-dip to the south. As groundwater usage has increased, the direction of movement has been altered and is now generally towards the major centers of pumpage. An increase in vertical leakage through the confining beds has also occurred in some areas where head differentials between adjacent aquifers have resulted from heavy pumpage from one aquifer. (GZA 2007, Section 4.2.3)

3.5.2.4 Groundwater Protection Program

In May 2006, the NEI approved the 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, WF3 performs groundwater monitoring from 10 onsite locations to monitor for potential radioactive releases via groundwater pathways at the site in accordance with site procedures (Entergy 2014d). Figure 3.5-6 shows locations of these groundwater monitoring wells, including two basemat wells (BW-01 and BW-02) that are used for water-level data, with construction details presented in Table 3.5-2.

3.5.2.5 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 (EPA 2015c). 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 (EPA 2015d).

WF3 is located in EPA Region 6, which has oversight responsibilities for the public water supply in Arkansas, Louisiana, New Mexico, Oklahoma, Texas, and 68 federally recognized Tribal Nations within these five states (EPA 2015d). The EPA has designated six aquifers in Region 6 as SSAs. Two of these SSAs (Chicot Aquifer and Southern Hills regional aquifer system) are located in the state of Louisiana. (EPA 2008) The SSA closest to WF3 (EPA 2008) is the Southern Hills regional aquifer system, the primary source of public and domestic water supplies in the northern 10 counties of southeastern Louisiana and western Mississippi (USGS 1983). The Southern Hills regional aquifer system is jointly managed with EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee) (EPA 2008).

The Southern Hills regional aquifer system is a gulfward dipping and thickening, complexly interbedded aquifer system extending from the northern limit of its recharge area near Vicksburg, Mississippi, to as far south as the Baton Rouge area in southeastern Louisiana. As many as 13 interdependent aquifer units compose the system in the southern part of the area and are known to coalesce or pinch out northward (updip) into fewer units. (USGS 1983) The southern boundaries of the Southern Hills regional aquifer system are approximately 16 miles north of WF3 on the northern shorelines of Lake Maurepas and Lake Pontchartrain (EPA 2008). Entergy Louisiana, LLC's property is not situated over this designated sole source aquifer.

3.5.3 Water Use

3.5.3.1 Surface Water Use

The Mississippi River is used as a drinking water source at many locations downstream and is also a source for water to support industrial operations. The drinking water intakes nearest to WF3 are located at Dow Chemical (immediately downstream 1.5 miles and on the same side of the River), and the New Sarpy municipal water treatment plant (the closest municipal user, on the opposite bank, 4.5 miles downstream). (GZA 2007, Section 4.3.1)

In St. Charles Parish, the Mississippi River is by far the dominant surface water supply. In 2013, surface water withdrawals were reported as 2,704.98 MGD, of which 2,130.95 MGD was used for power generation. With the exception of power generation, industrial and public water supply companies were the next largest users of surface water in St. Charles Parish with none utilized for rural domestic purposes. (USGS 2015b) A summary of surface water use in St. Charles Parish and the adjoining parishes along the Mississippi River is presented in Table 3.5-3.

As previously discussed in Section 2.2.2.1, WF3 withdraws cooling water from the Mississippi River through a series of intake pipes at a design flow rate of 1,555.2 MGD. The average flow in the Mississippi River in the vicinity of the WF3 plant (River Mile 129.6) is estimated to be approximately 500,000 cfs. Based on this information, it is determined that WF3 withdraws a maximum of approximately 0.48 percent of the flow in the Mississippi River and, in actuality, this percentage is probably much less because of the additional, unaccounted for, stream flow contributions entering the Mississippi River downstream of the Vicksburg station and upstream of the WF3 plant. In Louisiana, there is no general permitting system for surface water withdrawals from the Mississippi River.

3.5.3.2 Groundwater Use

Groundwater usage in St. Charles Parish is substantially less than surface water usage. In 2013, groundwater withdrawals were reported as 3.03 MGD. Industrial facilities were the largest users of groundwater in St. Charles Parish, accounting for 99 percent of the parish groundwater withdrawals in 2013. The remaining water use was for rural domestic purposes. (USGS 2015c 2015c) A summary of groundwater use in St. Charles Parish and the adjoining parishes along the Mississippi River are presented in Table 3.5-4.

A list of registered groundwater wells within a 2-mile band around the Entergy Louisiana, LLC property boundary (Figure 3.5-7) is presented in Table 3.5-5. These wells withdraw from the Norco and Gramercy aquifers and are primarily used for non-domestic purposes. (LDNR 2014) The shallow aquifers in the area of WF3 are not commonly used because of poor quality. The potential for development of these aquifers is slight; their utility is restricted by their limited extent, poor water quality, and low permeability. (GZA 2007, Section 4.3.2)

WF3 does not withdraw groundwater from the site for plant operational purposes. Once-through cooling water to remove heat from the condensers is supplied from the Mississippi River, while potable water is provided by St. Charles Parish Water System.

3.5.4 Water Quality

3.5.4.1 Surface Water Quality

While the Mississippi River does have some problems with certain contaminants and nutrients, overall the river is cleaner and healthier than it has been in decades. Recent Louisiana State University studies of the Mississippi River show healthy fish populations, including important recreational and commercial species such as bass, catfish, buffalo, and shad. In recent LDEQ tissue analyses, fish from the Mississippi River were analyzed for more than 100 toxic chemicals, most of which (95 percent) were undetected. Samples with detectable toxins were at relatively low concentrations, falling below the U.S. Food and Drug Administration (FDA) standard for edible fish. (Caffey et al. 2002)

Nutrient concentrations in the Mississippi River are believed to be primarily derived from non-point source pollution sources such as runoff from the landscape, and not attributed to point-source, or end-of-the-pipe discharges. However, some nutrient load from the Mississippi River is vital to maintaining the productivity of the extremely valuable Gulf of Mexico fisheries. Approximately 40 percent of the U.S. fisheries landings come from this productive zone influenced by nutrient-rich Mississippi River outflow located in the north-central Gulf of Mexico. Public concern exists over the potential for nutrient pollution (eutrophication) where river water is used in coastal restoration projects. Yet, recent research suggests that under current flow regimes these inputs are rapidly assimilated. (Caffey et al. 2002)

Median fecal coliform bacteria concentrations in the Mississippi River have dropped significantly since the mid-1970s. Much of this improvement can be attributed to the addition and upgrading of numerous municipal sewage treatment facilities, rural septic systems, and animal waste management systems all along the river and its tributaries over the past 25 years. Additionally, no known fisheries impacts are directly associated with bacterial pollution in the river. (Caffey et al. 2002)

Concentrations of trace metals in the Mississippi River are well below EPA guidelines for both drinking water and aquatic life. No trace metal concentrations found in fish tissue exceeded the FDA standard for edible fish. Mercury concentrations in Mississippi River fish averaged well below the state advisory level of 0.5 ppm and the FDA alert level of 1.0 ppm. (Caffey et al. 2002)

WF3 is located on segment 070301 of the Mississippi River that stretches from Monte Sano Bayou to Head of Passes. This segment of the river is classified suitable for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply.

(Attachment A) As such, the river is suitable for the propagation of fish, aquatic life and wildlife; for fishing, fish consumption; for drinking water; and primary and secondary contact recreation. Primary contact recreation is defined as direct contact with the water as a result of swimming, bathing, surfing, or similar water contact activities. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing, and boating, that are not likely to result in full body immersion. Based on LDEQ's *2014 Louisiana Water Quality Inventory: Integrated Report Fulfilling Requirements of the Federal Clean Water Act, Sections 305(b) and 303(d)*, which was finalized in 2015, the Mississippi River segment on which WF3 is located is not impaired (LDEQ 2015b, Appendix A, page 69).

3.5.4.2 Groundwater Quality

The water quality of the Shallow Aquifers is low in chloride but is characteristically hard and usually has a high iron content. Small deposits of potable water are sometimes found in abandoned distributary channel deposits. Rainwater directly recharges the distributary channel deposits and may locally flush or displace brackish or salty water from shallow aquifers which are connected to the distributaries. Large quantities of fresh water cannot be developed in these deposits because salt water which underlies or is adjacent to these areas would move into the area after a period of continuous pumping. (GZA 2007, Section 4.3.2)

Fresh water (less than 250 ppm chloride) occurs in the Gramercy Aquifer, in the Gramercy area. Little use has been made of the Gramercy Aquifer as a water supply in the New Orleans and Norco areas because the water of both areas is generally high in magnesium and calcium. The salinity of the water increases in a southerly direction. (GZA 2007, Section 4.3.2)

Limited use is made of the Norco Aquifer in the New Orleans area; concentrations of chloride are generally greater than 250 ppm except in the extreme northwest portion of Jefferson Parish where fresh water occurs. Heavy pumping in the Norco area and hydraulic connections between the Gramercy and Norco aquifers have resulted in mixing of the water in these aquifers. Salty water from the Gramercy Aquifer has moved into the Norco Aquifer. Hard water in point-bar deposits, in turn, has replaced the salty water in the Gramercy Aquifer. (GZA 2007, Section 4.3.2)

Fresh water (less than 250 ppm chloride) in the Gonzales-New Orleans Aquifer is generally encountered north of the Mississippi River in the region. The freshwater in the New Orleans area is not entirely satisfactory for public supply because the water has a yellow color of organic origin. (GZA 2007, Section 4.3.2)

As part of the WF3 radiological groundwater monitoring program, groundwater samples are collected from selected monitoring wells on site and analyzed for radionuclides to detect potential impacts to groundwater from inadvertent leaks or spills. Samples are collected on at least a quarterly basis, or more frequently if deemed necessary, by chemistry site personnel. (WF3 2014f, Section 4.4) As discussed in Section 4.5.2.4.3, no tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected since the groundwater monitoring program was initiated in 2007.

Industrial practices at WF3 that involve the use of chemicals are those activities typically associated with painting, cleaning of parts/equipment, refueling of onsite vehicles/generators, fuel oil and gasoline storage, and the storage and use of water-treatment additives. The use and storage of chemicals at WF3 are controlled in accordance with Entergy's fleet chemical control procedure and site-specific spill prevention plans (Entergy 2015c; WF3 2007b; WF3 2015b). In addition, as discussed in Section 2.2.4, nonradioactive wastes are managed in accordance with Entergy's waste management procedure which contains preparedness and prevention control measures (Entergy 2015a).

3.5.4.2.1 History of Radioactive Releases

In May 1997, there was a liquid radioactive release of approximately 800 gallons due to the overfilling of the spent fuel pool. The release eventually flowed under the fuel handling building train bay doors, and across the asphalt outside of the doors. Some the release also made it to the storm drain system. The spill contained a variety of radioisotopes released at a total count of 3.59E-02 curies (including tritium). Remediation efforts included removal of 5,000 cubic yards of affected pavement and soil outside the fuel handling building train bay door, flushing of the storm drains, and remediation of the drainage ditch. (GZA 2007, Section 3.3)

The tritium concentration in this release was approximately 22,000 picocuries per liter; however, as of June 2015, the tritium is no longer detectable (NRC 2015b). As previously discussed, the WF3 radiological groundwater monitoring program has not detected any tritium or plant-related gamma isotopes or hard-to-detect radionuclides since the groundwater monitoring program was initiated in 2007.

3.5.4.2.2 History of Nonradioactive Releases

Based on the review of site records over the previous 10 years (2005–2014), there has been only one inadvertent release that would not be classified as an incidental spill. In September 2008, it was estimated that greater than 42 gallons of diesel fuel oil was inadvertently released from the Emergency Operations Facility underground emergency diesel generator fuel oil storage tank as a result of the fuel transfer pump being tampered with during a theft event. None of the fuel oil reached navigable waters, and the diesel fuel oil spilled onto the ground was recovered. (WF3 2008) This event did not require LDEQ oversight or result in a notice of violation.

Historically, nonradioactive spills that have occurred at WF3 have been minor in nature and immediately remediated, and no spill events at WF3 have required a regulatory agency overseeing the incident or resulted in a notice of violation.

Table 3.5-1
LPDES-Permitted Outfalls

Outfall	Description	Parameter	Permit Requirement
001	Once-through non-contact cooling water[(a)]	Flow Temperature Heat Total residual chlorine	Report monthly average and daily maximum in MGD 118ºF daily maximum 9.5 x 10^3 MMBtu/hr daily maximum 211 lbs/day daily maximum
004	Stormwater runoff, potable water, and maintenance wastewaters	Flow Total organic carbon Total suspended solids Oil and grease pH	Report daily maximum in MGD 50 mg/l daily maximum 100 mg/l daily maximum 15 mg/l daily maximum (6.0–9.0 SU)
005	Energy Education Center treated sanitary wastewater	Flow Biological oxygen demand Total suspended solids Fecal coliform pH	Report daily maximum in MGD 30 mg/l monthly average 45 mg/l daily maximum 30 mg/l monthly average 45 mg/l daily maximum 200 colonies/100 ml monthly average 400 colonies/100 ml daily maximum (6.0–9.0 SU)
101	Liquid waste management system	Flow Total suspended solids Oil and grease pH	Report daily maximum in MGD 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)
201	Boron management system	Flow Total suspended solids Oil and grease pH	Report daily maximum in MGD 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)
301	Filter flush water	Flow Clarifying agents	Report daily maximum in MGD Record types and quantities used

Table 3.5-1 (Continued)
LPDES-Permitted Outfalls

Outfall	Description	Parameter	Permit Requirement
401	Steam generator blowdown	Flow Total suspended solids Oil and grease pH	Report daily maximum in MGD 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)
501	Auxiliary cooling water basin A	Flow Total organic carbon Total suspended solids Oil and grease pH	Report daily maximum in MGD 50 mg/l daily maximum 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)
601	Auxiliary cooling water basin B	Flow Total organic carbon Total suspended solids Oil and grease pH	Report daily maximum in MGD 50 mg/l daily maximum 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)
701	Dry cooling sump #1	Flow Total organic carbon Total suspended solids Oil and grease Free available chlorine[(b)] Total chromium[(b)] Total zinc[(b)] pH	Report daily maximum in MGD 50 mg/l daily maximum 100 mg/l daily maximum 20 mg/l daily maximum 0.5 mg/l daily maximum 0.2 mg/l daily maximum 1.0 mg/l daily maximum (6.0–9.0 SU)
801	Dry cooling sump #2	Flow Total organic carbon Total suspended solids Oil and grease Free available chlorine[(b)] Total chromium[(b)] Total Zinc[(b)] pH	Report daily maximum in MGD 50 mg/l daily maximum 100 mg/l daily maximum 20 mg/l daily maximum 0.5 mg/l daily maximum 0.2 mg/l daily maximum 1.0 mg/l daily maximum (6.0–9.0 SU)

Table 3.5-1 (Continued)
LPDES-Permitted Outfalls

Outfall	Description	Parameter	Permit Requirement
901	Mobile metal cleaning wastewater	Flow Total suspended solids Oil and grease Total copper Total iron pH	Report daily maximum in MGD 100 mg/l daily maximum 20 mg/l daily maximum 1.0 mg/l daily maximum 1.0 mg/l daily maximum (6.0–9.0 SU)
1001	Miscellaneous intermittent wastewater	Flow Total suspended solids Oil and grease pH	Report daily maximum in MGD 100 mg/l daily maximum 20 mg/l daily maximum (6.0–9.0 SU)

(Attachment A)

a. Whole effluent toxicity testing is also a permit condition associated with Outfall 001.

b. Required only during cooling tower blowdown discharge.

MMBtu/hr: million British thermal units per hour

MGD: million gallons per day

mg/l: milligrams per liter

SU: standard unit

Table 3.5-2
Onsite Well Construction Details

Well	Well Diameter (inches)	Elevations (feet NGVD29)						Well Construction Material
		Top of Casing	Ground	Top of Filter (approx.)	Top of Screen (approx.)	Bottom of Screen (approx.)	Bottom of Filter (approx.)	
BW-01	4	20.66	17.50	-35.0	-36.0	-40.0	-40.0	PVC screen and riser
BW-02	4	20.27	17.50	-35.0	-36.0	-40.0	-40.0	PVC screen and riser
MW-03	2	16.59	14.01	-8.8	-10.7	-20.7	-21.0	Sch 40 PVC screen and riser
MW-04	2	18.31	15.58	-7.2	-9.2	-19.2	-19.4	Sch 40 PVC screen and riser
MW-05	2	12.24	9.65	-13.2	-15.1	-25.1	-25.4	Sch 40 PVC screen and riser
MW-06	2	14.01	11.61	-9.4	-11.1	-21.1	-21.4	Sch 40 PVC screen and riser
MW-07	2	19.46	16.31	-9.2	-11.4	-21.4	-21.7	Sch 40 PVC screen and riser
MW-08	2	19.84	16.37	-8.6	-11.3	-21.3	-21.6	Sch 40 PVC screen and riser
MW-09	2	15.87	13.65	-7.4	-14.1	-24.1	-24.4	Sch 40 PVC screen and riser
MW-10	2	18.47	15.96	-7.0	-9.8	-19.8	-20.0	Sch 80 PVC screen and riser
MW-11	2	18.77	15.93	-7.1	-9.9	-19.9	-20.1	Sch 80 PVC screen and riser
MW-12	2	18.13	15.22	-11.8	-14.5	-24.5	-24.8	Sch 80 PVC screen and riser

(WF3 2014f, Table 1)

Table 3.5-3
Mississippi River Water Usage Summary, 2013

Category	Jefferson Parish (MGD)	St. Charles Parish (MGD)	St. John the Baptist Parish (MGD)
Public supply	59.87	8.11	3.41
Industrial	4.57	565.92	52.32
Power generation	845.74	2,130.95	0.00
Domestic, rural	0.00	0.00	0.00
Total	**910.18**	**2,704.98**	**55.73**

(USGS 2015b)

Table 3.5-4
Groundwater Usage Summary, 2013

Category	Jefferson Parish (MGD)	St. Charles Parish (MGD)	St. John the Baptist Parish (MGD)
Public supply	0.00	0.00	4.92
Industrial	1.44	3.01	8.60
Power generation	4.79	0.00	0.00
Domestic, rural	0.03	0.02	0.08
Total	**6.26**	**3.03**	**13.60**

(USGS 2015c)

Table 3.5-5
Registered Groundwater Wells, 2-Mile Band around Entergy Louisiana, LLC Property Boundary

Water Well Number	Distance[a] (miles)	Well Depth (feet)	Use Description	Aquifer Name
089-34	0.25	387	Industrial	Norco
089-159	0.82	440	Industrial	Norco
089-87	0.87	400	Livestock	Norco
089-6047Z	1.37	130	Domestic	Gramercy
089-6048Z	1.41	60	Domestic	Gramercy
089-167	1.49	464	Fire protection	Norco
089-182	1.54	400	Industrial chemical manufacturing	Norco
089-164	1.55	410	Industrial	Norco
089-192	1.61	400	Industrial	Norco
089-6205Z	1.67	405	Domestic	Norco[b]
089-179	1.90	460	Industrial chemical manufacturing	Norco
089-146	2.06	400	Livestock	Norco
089-5257Z	2.20	350	Domestic	Norco
089-191	2.51	368	Aquaculture	Norco
089-6132Z	2.97	240	Irrigation	Gramercy
089-5021Z	3.94	231	Oil/gas well rig supply	Gramercy
089-5109Z	5.18	150	Oil/gas well rig supply	Gramercy

(LDNR 2014)

a. Distance is from the WF3 NPIS. Wells listed are limited to those wells within a 2-mile band around the property boundary.

b. Registration information states the well is completed in the New Orleans Aquifer system surficial confining unit; however, based on well depth and reported depth of nearby wells, it is assumed this well is completed in the Norco Aquifer.

Figure 3.5-1
Regional Hydrologic Features

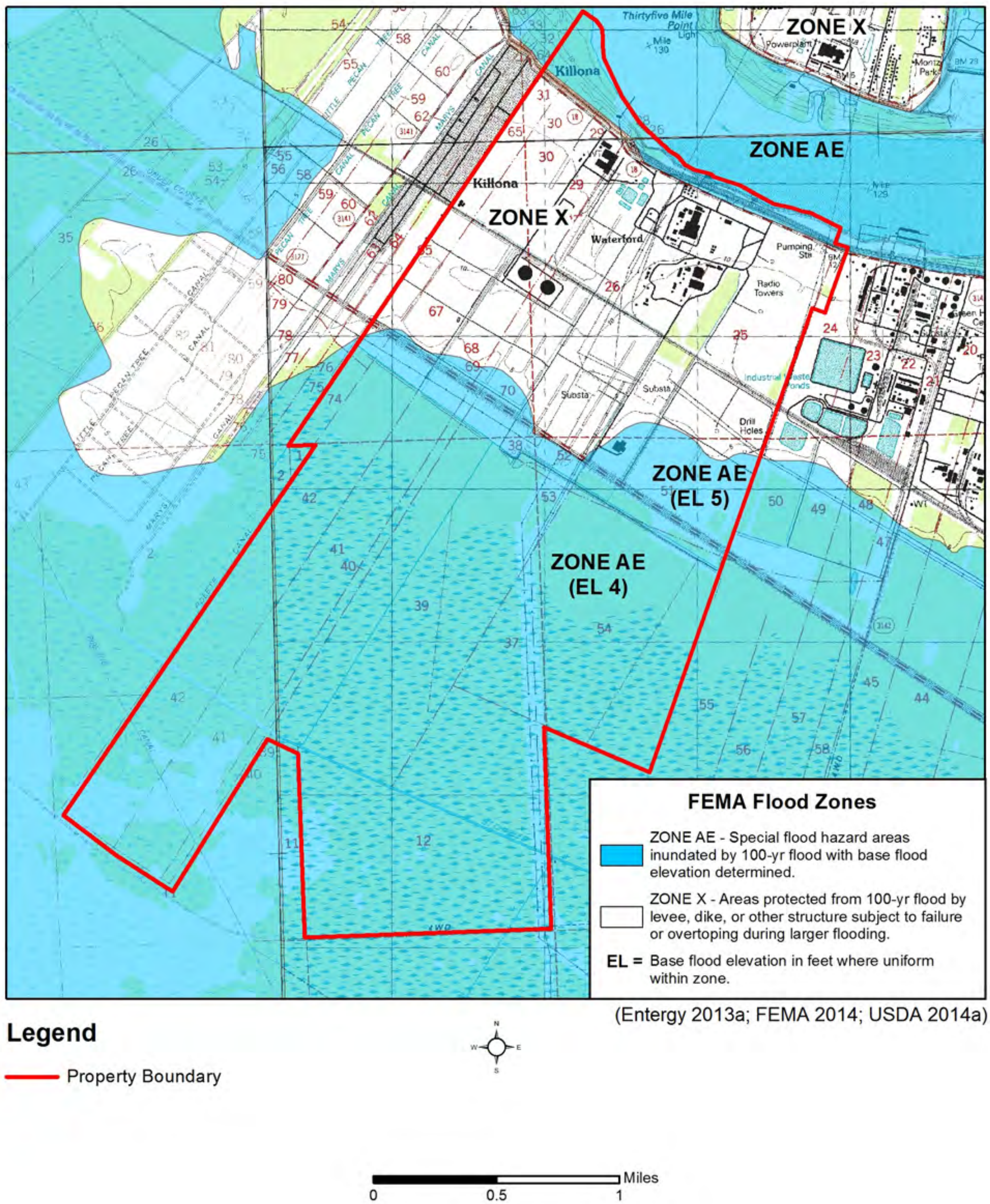


Figure 3.5-2
FEMA Flood Zones, Entergy Louisiana, LLC Property

(Entergy 2009a, Figure 2; Entergy 2013a; ESRI 2014)

Figure 3.5-3
LPDES-Permitted Outfalls

Well	TOC Elevation (ft NGVD 29)	Depth to Water (ft below TOC)	WL Elevation (NGVD 29)
BW-01	20.66	7.74	12.92
BW-02	20.27	7.45	12.82
MW-03	16.61	6.08	10.53
MW-04	18.34	8.92	9.42
MW-05	12.26	5.90	6.36
MW-06	14.02	4.24	9.78
MW-07	19.51	5.55	13.96
MW-08	19.88	4.95	14.93
MW-09	15.88	5.16	10.72
MW-10	18.47	9.90	8.57
MW-11	18.77	10.13	8.64
MW-12*	NM	NM	NM
River	NA	NA	17

* MW-12 not installed at time of measurment

Figure 3.5-4
WF3 Potentiometric Surface Map, Shallow Groundwater Elevation

Well	TOC Elevation (ft NGVD 29)	Depth to Water (ft below TOC)	WL Elevation (NGVD 29)
BW-01	20.66	8.34	12.32
BW-02	20.27	7.95	12.32
MW-03	16.61	5.63	10.98
MW-04	18.34	8.41	9.93
MW-05	12.26	5.83	6.43
MW-06	14.02	4.2	9.82
MW-07	19.51	6.25	13.26
MW-08	19.88	7.12	12.76
MW-09	15.88	5	10.88
MW-10	18.47	9.49	8.98
MW-11	18.77	9.71	9.06
MW-12*	NM	NM	NM
River	NA	NA	3.94

* MW-12 not installed at time of measurment

(Entergy 2013a; ESRI 2014; WF3 2014f, Figure 6)

Figure 3.5-5
WF3 Potentiometric Surface Map, Highest Groundwater Elevation

(Entergy 2013a; ESRI 2014; WF3 2014f, Figure 1)

Figure 3.5-6
Onsite Groundwater Monitoring Wells

Figure 3.5-7
Registered Water Wells, 2-Mile Band around Entergy Louisiana, LLC Property Boundary

3.6 Ecological Resources

Regional ecology is greatly influenced by the geomorphic and physiographic characteristics of the region. Soils determine the basic fertility of the region which, in turn, determines the types of plants that may grow. The plants that are present greatly influence the types and number of animals that reside in the region. Soil types also greatly influence the basic fertility of aquatic ecosystems and the species present. Climatological factors, such as temperature and precipitation, further refine the plants and animals that may live in a locale. St. Charles Parish, where WF3 is located, is in the LMR valley, and the site is adjacent to the Mississippi River (Figure 3.0-3). The regional ecology is described below.

3.6.1 Region

3.6.1.1 Geomorphology

The Mississippi River has dominated the development of geologic and physiographic features in the region since the beginning of Neogene period. The region is underlain by a complex layering of sand, silt, and clay from former Mississippi River delta lobes, levee, and overbank flood deposits. Typically, deltaic sediments vary from a few feet to more than 700 feet along the course of the Mississippi River. The various geologic and physiographic provinces in the region are discussed in Section 3.4.

3.6.1.2 Soils

Soils are important for defining the general ecological characteristics of the region. Soils in the region generally contain interbedded, interdistributary peat and clay; natural levee silt and clay; distributary sand; and delta-front and prodelta mud and clay with higher sandy silt, silt, clayey silt, silty clay within the natural levees and overbank and point bar deposits along the Mississippi. The soil units in the region include Holocene-aged deposits consisting of sand, sandy silt, silt, clayey silt, silty clay, and clay deposited by the Mississippi River (Section 3.4.1.1.2). The distribution of surface soil units within and surrounding the Entergy Louisiana, LLC property is shown in Figure 3.4-4.

3.6.1.3 Climate

As discussed in Section 3.2, the climate of southeastern Louisiana is classified as humid subtropical, and it is influenced to a large degree by the many water surfaces provided by lakes and streams and by proximity to the Gulf of Mexico. From mid-June to mid-September, the prevailing southeast to southwest winds carry inland warm, moist tropical air favorable for sporadic development of thunderstorms. The hotter drier conditions are usually caused by the formation of a high pressure system over the western Gulf of Mexico. Cool continental air rarely reaches the site region in summer. From about mid-November to mid-March, the area is subjected alternately to tropical air and cold continental air in periods of varying length. Bursts of cold air do reach southeastern Louisiana from late fall until early spring, but the resulting cool temperatures seldom last more than a few days. Even during these seasons, the weather is still usually dominated by maritime tropical air from the Gulf of Mexico.

In the New Orleans area, during the 30-year period 1981–2010, the greatest number of days in New Orleans with temperatures of 90°F or higher was 74 days in 1974 and, on average, there are only about 7 days per year when the temperature rises to 95°F or higher. About 80 percent of the December–February hourly temperatures range from 41°F to 69°F. Freezing temperatures are not common and are generally restricted to the period mid-December to mid-March. Some years have no temperatures below freezing. The mean date of the first occurrence of 32°F or lower temperature is about December 12, and the mean date of the last occurrence is about February 13. Between these dates, however, temperatures are above freezing more than 6 out of 7 days, with some afternoon temperatures in the 70s and 80s.

Relative humidity of less than 50 percent occurs in each month of the year; however, it is less frequent in the summer than during the other seasons. Rather frequent and sometimes very heavy rains are typical for this area. A fairly definite rainy period occurs from mid-December to mid-March. April, May, October, and November are generally dry. Climate is discussed in greater detail in Section 3.2.

3.6.1.4 Regional Water Systems

The Mississippi River is the primary hydrologic feature with which the plant interacts (Figure 3.5-1). The Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States (USACE 2015). Downstream from the confluence of the Missouri River near West Alton, Missouri, north of St. Louis, the Mississippi flows un-dammed to Head of Passes in Louisiana where it branches into several distributaries that carry water to the Gulf of Mexico.

The Bonnet Carre Spillway is located on the east bank, near the site of old Bonnet Carre Crevasse and in a straight reach of the Mississippi River approximately three-quarters of a mile downstream from WF3 and moves floodwater from the Mississippi River to Lake Ponchartrain.

There are many miles of frontage on the Mississippi River and it is important for commercial navigation and for recreation. In addition, the cooling water source for WF3 plant operations is the Mississippi River. Lac Des Allemandes is the only lake in the vicinity of the Entergy Louisiana, LLC property (Figure 3.0-3). Detailed discussions of these waters may be found in Section 3.5.1.

3.6.1.5 Regional Ecosystems

The area surrounding WF3 is part of the Southern Holocene Meander Belts. The flood plain of the Mississippi River consists of cypress-tupelo swamps and freshwater wetlands on the backside of a natural levee. In front of the levee is the river and an ever-changing mosaic of forested areas, wetlands, and erosion/deposition areas at the river's edge. (Daigle et al. 2006)

A brief description of the regional ecosystems, including state-listed natural communities, is provided below.

3.6.1.5.1 Cypress-Tupelo Swamp

Cypress-tupelo swamp is a forested, alluvial swamp that grows on intermittently exposed soils, most commonly along rivers and streams but also occurs in backswamp depressions and swales. Soils are inundated or saturated by surface water or groundwater on a nearly permanent basis throughout the growing season, except during periods of extreme drought. All swamps, even deepwater swamps with almost continuous flooding, experience seasonal fluctuations in water levels. Cypress-tupelo swamps generally occur on mucks and clays, and also silts and sands with underlying clay layers (Alfisols, Entisols, Histosols, and Inceptisols). (LDWF 2015a)

This natural community exhibits relatively low floristic diversity, and associate species may vary widely from site to site. Undergrowth is often sparse because of low light intensity and long hydroperiod. Establishment of young trees can only occur during periods of exceptionally long drought, because neither bald cypress nor tupelo gum seeds germinate underwater, nor can young seedlings of these trees survive long submergence. These swamps tend to be even-aged stands because the environmental conditions favorable for germination and establishment of saplings occur very infrequently, and also bald cypress is an intolerant tree species requiring high light conditions for establishment and successful growth. They provide important ecosystem functions including maintenance of water quality, productive habitat for a variety of fish and wildlife species, and regulation of flooding and stream recharge. (LDWF 2015a)

Pre-settlement cypress-tupelo swamp may have covered approximately 2.5 million acres (Keim et al. 2006). Sizeable areas of cypress-tupelo swamp still remain, even though the historic extent is considerably reduced. Statewide estimates of swamp loss range from 25 to 50 percent of the original pre-settlement acreage, and old-growth examples are very rare. Threats to cypress-tupelo swamp are agricultural, industrial, and residential development; saltwater intrusion and subsidence; hydrological alterations (to include adjacent areas); construction of roads, pipelines, or utilities; logging on permanently flooded sites where natural or artificial regeneration is not feasible; soil damage from timber harvesting or industrial activities; contamination by chemicals (herbicides, fertilizers); and invasive exotic species. (LDWF 2015a)

Cypress-tupelo swamps may be found throughout Louisiana in all river basins (LDWF 2015a) but were not observed on the Entergy Louisiana, LLC property during the October 2014 threatened and endangered species habitat survey (Entergy 2014e).

3.6.1.5.2 Live Oak Natural Levee Forest

Live oak natural levee forest occurs principally in southeastern Louisiana on natural levees or frontlands, and on "islands" within marshes and swamps. This community is similar in some respects to coastal live oak-hackberry forest in that both develop on natural ridges in the coastal zone, and overstory dominants are comparable; however, natural levee forests have a greater species richness and diversity. Composed primarily of sandy loams and clays, these ridges range from 4 to 6 feet above sea level. Soil pH is circumneutral (6.6–7.0), and organic matter content is high. Live oak natural levee forest is important wildlife habitat and serves as vital resting habitat for trans-Gulf migratory birds. (LDWF 2014b)

These forests occur in the Deltaic Plain of extreme southeastern Louisiana parishes from Orleans and St. Bernard parishes westward to St. Mary Parish. Of the original 500,000 to 1 million acres in Louisiana, currently only 1 to 5 percent of pre-settlement extent remains. Threats to live oak natural levee forests are residential development; roads and utility construction; coastal erosion and saltwater intrusion; invasive and exotic species; and overgrazing which damages understory vegetation and inhibits natural stand regeneration. (LDWF 2014b)

Live oak natural levee forests may be found in the Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, and Vermilion-Teche river basins (LDWF 2014b), but were not observed on the Entergy Louisiana, LLC property during the October 2014 threatened and endangered species habitat survey (Entergy 2014e).

3.6.1.5.3 Brackish Marsh

Brackish marsh is usually found between salt marsh and intermediate marsh, although it may occasionally lie adjacent to the Gulf of Mexico. This type of marsh, which is dominated by salt-tolerant grasses, experiences irregular tidal flooding and may have small pools or ponds scattered throughout. Plant diversity and soil organic matter content are higher in brackish marsh than in salt marsh, and wire grass (*Spartina patens*) is typically dominant. Two other major autotrophic groups in brackish marsh are epiphytic algae and benthic algae. Vertebrate species population levels are generally higher in brackish marsh compared to salt marsh. (LDWF 2014c)

Salinity averages about 8 parts per thousand (ppt), and this community may be changed to another marsh type by shifts in salinity levels. Brackish marsh acts as a nursery area for myriads of larval forms of shrimp, crabs, redfish, seatrout, menhadden, etc., and also as important waterfowl habitat. This habitat functions as a nitrogen and phosphorus sink, thereby improving the quality of water that passes through this ecosystem, and it can alleviate the effects of storms and flooding by acting as a buffer and providing storage for large amounts of water. (LDWF 2014c)

The pre-settlement extent of brackish marsh is estimated to have been between 500,000 and 1 million acres, with 50 to 75 percent remaining today. At present, the total acreage of brackish marsh appears to be increasing due to shifts in marsh salinity levels. However, stable viable examples of brackish marsh are becoming rare in Louisiana. Threats to brackish marsh are shoreline erosion and subsidence; commercial and industrial development; construction of roads, pipelines, or utilities; hydrological alterations (channelization and leveeing of waterways, canal dredging); contamination by chemicals or industrial discharge; fire suppression; and invasive exotic species. (LDWF 2014c)

Brackish marshes may be found in the Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Vermilion-Teche, Mermentau, Calcasieu, and Sabine river basins (LDWF 2014c), but were not observed on the Entergy Louisiana, LLC property during the October 2014 threatened and endangered species habitat survey (Entergy 2014e).

3.6.1.5.4 Intermediate Marsh

As a natural community, intermediate marsh lies between brackish marsh and freshwater marsh, although it infrequently may be adjacent to the Gulf. Intermediate marsh has an irregular tidal regime and is oligohaline (salinity of 3 to 10 ppt). Dominated by narrow-leaved, persistent species, particularly wire grass, this marsh may have small pools or ponds scattered throughout. Soil organic matter content in intermediate marsh is higher than in brackish marsh. (LDWF 2014d)

Intermediate marsh is characterized by a higher diversity of species than salt or brackish marsh, although many of the same species are found in freshwater marsh, and some of the species are found in brackish marsh. This marsh type is important to many species of avian wildlife; it supports large numbers of wintering waterfowl and is critical nursery habitat to larval marine organisms. Gradual changes in salinity conditions can cause this habitat to shift towards brackish marsh. Two other major autotrophic groups in intermediate marsh are epiphytic and benthic algae, and intermediate marsh is the smallest in extent of the four marsh types. (LDWF 2014d)

Intermediate marsh pre-settlement acreage was estimated at 100,000 to 500,000 acres, but has been reduced by 50 to 75 percent of this original extent. The largest contiguous tracts of intermediate marsh occur in Cameron, Vermilion, Terrebonne, and Lafourche parishes. Threats to intermediate marsh are saltwater intrusion and subsidence; canal dredging; commercial, industrial, and residential development; construction of roads, pipelines, or utilities; contamination by chemicals or industrial discharge; fire suppression; and invasive exotic species. (LDWF 2014d)

Intermediate marshes may be found in Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, and Sabine river basins (LDWF 2014d), but were not observed on the Entergy Louisiana, LLC property during the October 2014 threatened and endangered species habitat survey (Entergy 2014e).

3.6.1.5.5 Freshwater Marsh

Freshwater marsh is generally located adjacent to intermediate marsh along the northernmost extent of the coastal marshes, although it may occur beside coastal bays where freshwater input is entering the bay (e.g., Atchafalaya Bay). Small pools or ponds may be scattered throughout this community. Floristic composition of these sites is quite heterogeneous and is variable from site to site. Salinities are usually less than 2 ppt and normally average about 0.5 to 1.0 ppt. Frequency and duration of flooding, which are intimately related to microtopography, seem to be the primary factors governing species distributions. Substrate, current flow, salinity, competition, and allelopathy are also important in determining species distribution patterns. (LDWF 2014e)

Freshwater marsh has the greatest plant diversity of any of the marsh types. One report claims 92 plant species in freshwater marsh versus only 17 different species in salt marsh. This community has the highest soil organic matter content of any marsh type, and it is frequently dominated by maidencane (*Panicum hemitomon*). Epiphytic and benthic algae are two other major autotroph groups in freshwater marsh. A significant portion of freshwater marsh is floating marsh (flotant), which occurs in the Deltaic Plain of southeast Louisiana. (LDWF 2014e)

Wildlife populations are generally highest in this marsh type and it supports high numbers of wintering waterfowl. Freshwater marsh acts as important nursery areas for the young of many marine species, such as croaker, seatrout, blackdrum, flounder, and juvenile brown and white shrimp. Saltwater intrusion may cause a change to a more saline marsh type or even open water, if the increase in salinity levels is rapid and persistent. (LDWF 2014e)

Freshwater marsh has undergone the largest reduction in acreage of any of the marsh types over the past 20 years. Pre-settlement acreage was estimated at 1 to 2 million acres, but has been reduced by 25 to 50 percent of this original extent. The largest contiguous tracts of freshwater marsh occur in Terrebonne, St. Mary, Vermillion, Cameron, Lafourche, and St. Charles parishes. Threats to freshwater marshes are shoreline erosion and subsidence; commercial and industrial development; construction of roads, pipelines, or utilities; hydrological alterations (channelization and leveeing of waterways, canal dredging); contamination by chemicals or industrial discharge; fire suppression; and invasive exotic species. (LDWF 2014e)

Freshwater marshes may be found in the Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, and Sabine river basins (LDWF 2014e), but were not observed on the Entergy Louisiana, LLC property during the October 2014 threatened and endangered species habitat survey (Entergy 2014e).

3.6.1.5.6 Wetlands

As discussed in Section 3.6.4, the LMR once was dominated by swamps, marshes, and bottomland forests. Today, the ecoregion is heavily converted, with just under half of the ecoregion covered by forest. One-third has been converted to agriculture, and the remaining areas are composed of water, wetlands, urban, and barren areas. (FEOW 2014) The primary wetland types are freshwater emergent and freshwater forest/shrub. Wetlands are discussed in greater detail in Section 3.6.5.1.

3.6.1.5.7 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 Entergy Louisiana, LLC property if appropriate habitats are available. Animals that may be found in the vicinity and on the Entergy Louisiana, LLC property are presented in Table 3.6-1 and described in Section 3.6.7.

3.6.2 Site and Vicinity

WF3 is located on the west (right descending) bank of the Mississippi River between New Orleans, Louisiana, and Baton Rouge, Louisiana, at River Mile 129.6. New Orleans is approximately 25 miles east of the site and Baton Rouge is approximately 50 miles northwest (Figure 3.0-4). The site is in the northwestern portion of St. Charles Parish, Louisiana, near the towns of Killona and Taft.

WF3 is located in an industrial complex adjacent to the Mississippi River, which includes a number of large chemical and power plants that are near the WF3 plant. These plants collectively have transformed the local area into a large industrial complex that lines the river with some agricultural fields, primarily sugarcane and soybeans, which are located away from the river. As discussed in Section 3.1.1, approximately 660 acres of the Entergy Louisiana, LLC property is currently leased to Raceland Raw Sugar LLC for growing sugarcane crops, milo, or soybeans as stipulated in the lease agreement.

Generally, the Entergy Louisiana, LLC property is separated into two distinctly different tracts of land. The Entergy Louisiana, LLC property on the south side of LA-3127 is a large forested wetland which is of ecological interest. On the north side of the highway is the industrial plant and agricultural fields that are ecologically disturbed areas.

3.6.3 Potentially Affected Water Bodies

The major water resource in the area near the WF3 plant site is the Mississippi River. Water from the river is used for a variety of industrial uses at the plant, but primarily for once-through cooling water. Other than drainage ditches, there are no other significant water bodies on the Entergy Louisiana, LLC property where WF3 is located.

3.6.4 Ecological Resources History

The LMR ecoregion once was dominated by swamps, marshes, and bottomland forests (primarily oak-hickory-pine forests). The pre-settlement ecological conditions included approximately 2.5 million acres of cypress tupelo swamp (Keim et al. 2006); up to 1 million acres of live oak natural levee forest (LDWF 2014b); as much as 1 million acres of brackish marsh (LDWF 2014c); up to 500,000 acres of intermediate marsh (LDWF 2014d); and up to 2 million acres of freshwater marsh (LDWF 2014e). Although these areas still exist in many places, they are not as extensive as in pre-settlement times (FEOW 2014). Today, these five natural communities are state-listed (LDWF 2015b).

Ten thousand years ago, the Mississippi River was a continuum typical of a floodplain river. Beginning as a small stream in the forested headwaters of Lake Itasca, Minnesota, the river flowed through virgin forests and unbroken prairie to its deltaic outlet into the Gulf of Mexico in

Louisiana. From headwaters to the mouth, the river increased in size and discharge, and decreased in slope. Initially, the young river flowed through a small valley bordered by wetlands and lakes. Along its downstream course, the river changed from a single to a braided channel in its midreaches and finally to a meandering, constantly changing channel downstream. Its valley changed rather steadily from a narrow floodplain flanked by tall bluffs upstream to a vast, flat floodplain downstream. (Schramm 2004, page 303)

Historically, the LMR overflowed onto a 30- to 125-mile-wide alluvial valley and, along with its tributaries, encompassed the largest floodplain fishery in North America. Because the river was continually creating and abandoning channels in its 15- to 30-mile-wide meander belt, the area was interspersed with permanent and seasonal wetlands. These wetlands flooded shallowly for extended periods almost annually, and there was a great diversity of aquatic habitat types. More than 150 species of fishes were present. (USFWS 2014a)

Following European exploration and settlement of the area, sugarcane production, rice cultivation, and logging became the primary economic activities that affected the landscape, along with increased settlement (Section 3.7). Floods of 1849 and 1850, which caused widespread damage in the Mississippi River Valley, revealed the national interest in controlling the mighty river. By 1879, the need for improvement of the Mississippi River had become widely recognized. The necessity for coordination of engineering operations through a centralized organization had finally been accepted and, accordingly, in that year the U.S. Congress established the Mississippi River Commission. (USACE 2015)

By the early 20th century, most of the area had been timbered out, and the plantations and truck farms began to give way to industrial complexes, especially those related to petroleum (Section 3.7). Major floods occurred again in 1912, 1913, and 1927. The flood of 1927 was the most disastrous in the history of the LMR valley at the time: an area of about 26,000 square miles was inundated; levees were breached; cities, towns, and farms were laid waste; crops were destroyed, and industries and transportation paralyzed. Out of that flood event grew the Flood Control Act of 1928, which committed the federal government to a definite program of flood control. (USACE 2015)

In its present form, the Mississippi River changes dramatically and rather incrementally along its journey from headwaters to the Gulf of Mexico. Dams have been built to form 11 small reservoirs and modify the elevation and discharge of several natural river lakes. These dams variously function for flood control, electricity generation, water supply, or recreation. (Schramm 2004, page 303) As a result, river-control structures have largely locked the river in place. River control structures are discussed in detail in Section 3.5.1. Construction of levees along the Mississippi River and many of its tributaries has severed the river from more than 90 percent of its floodplain (Schramm 2004, page 305), denying fish and other aquatic species access to millions of acres of foraging, spawning, and nursery habitat. Virtually no new habitat is being created while existing floodplain lakes and secondary channels are gradually being lost due to sedimentation.

The LMR is particularly prone to point-source pollution because, over time, Arkansas and Louisiana have become home to many highly polluting industries (Janvrin 2009). In terms of human health, nitrate is the only nutrient compound that represents a problem in the Mississippi River system likely due to extensive agricultural areas adjacent to the Mississippi River basin. In addition to the public health question, nitrate represents an ecological problem as well. Because it is not removed quickly, nitrate is accumulating in the Gulf of Mexico. (Antweiler et al. 1995) Based on USGS monitoring, nitrate levels continue to increase in the Mississippi River, including the Mississippi's outlet to the Gulf of Mexico. Monitoring indicates that nitrate concentrations have increased at the Mississippi River outlet by 12 percent between 2000 and 2010. Factors contributing to these increases include fertilizer use, livestock waste, agricultural management practices, and wastewater treatment. (USGS 2015d)

The terrestrial ecology of the LMR and the Entergy Louisiana, LLC property has also been changed over time. The construction of LA-3127, which traverses the property, created minor alterations in certain drainage patterns in the area. Furthermore, use of this highway by vehicles has caused varying forms of pollution and has the potential to result in mortality to adjacent wildlife populations. (LP&L 1978, page 2.2-6)

The introduction of nutria (*Myocastor coypus*) into Louisiana may be the most important infestation that occurred in the area. The first appearances of this animal were the result of escapes and releases, the latter representing efforts to control undesirable aquatic plants, such as the water hyacinth (*Eichornia crassipes*). With few natural predators to control the growth of nutria populations, the number of these animals soon reached an estimated 20 million. The importance of nutria has been the subject of considerable controversy, and it has been blamed for significant damage to rice and sugarcane crops. The nutria was also implicated as the cause of the decline in the muskrat (*Ondatra zibethicus*) population. (LP&L 1978, page 2.2-6)

Natural catastrophes have also had considerable impact on the terrestrial communities in the site area. These disturbances have taken the form of meteorological phenomena, such as tropical storms or hurricanes. Hurricane winds have increased the spread of animals such as nutria, damaged a great deal of vegetation by blowing over trees and shrubs, and spread salt or brackish water over large areas of freshwater marshes or land. (LP&L 1978, page 2.2-7)

As previously discussed, today the swamps, marshes, wetlands, and bottomland forests are not as extensive as in pre-settlement times. The LMR region is heavily converted, with just under half of the area covered by forest. One-third has been converted to agriculture and the remaining area comprises water, wetlands, urban, and barren areas. (FEOW 2014)

3.6.5 Places and Entities of Special Ecological Interest

On and within the vicinity of the Entergy Louisiana, LLC property are places and entities of special interest. These include wetlands and WMAs as described below.

3.6.5.1 Wetlands

Wetlands historically have been prevalent throughout southern Louisiana. Wetlands are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (USACE 1999)

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 and shellfish habitat; sediment/toxicant/pathogen retention; nutrient removal/retention/transformation; production export (nutrient); sediment/shoreline stabilization; wildlife habitat; recreation (consumptive and nonconsumptive); educational/scientific value; uniqueness/heritage; visual quality/aesthetics; and threatened or endangered species habitat. (USACE 1999)

Based on National Wetlands Inventory (NWI) data (USFWS 2015a), there are approximately 49,018 acres of wetlands within a 6-mile radius of WF3 composed of the following types (Figure 3.6-1):

- Freshwater forested/shrub wetlands covering approximately 32,013 acres (65.3 percent).
- Freshwater emergent wetlands covering approximately 9,135 acres (18.6 percent).
- Riverine area covering approximately 4,537 acres (9.3 percent).
- Ponds and lakes covering approximately 3,242 acres (6.6 percent).
- Other wetland types covering approximately 91 acres (0.2 percent).

The Entergy Louisiana, LLC property is a roughly rectangular-shaped parcel that lies adjacent to the Mississippi River on the north and is bisected by LA-3127. The WF3 plant and several agricultural fields make up the northern portion of the property. Based on NWI data (USFWS 2015a), there are also two small parcels of freshwater forested/shrub wetlands in the northern portion of the Entergy Louisiana, LLC property: one borders the Mississippi River in the northernmost corner of the property, and a second is adjacent to the north side of LA-3127 and the eastern side of the Entergy Louisiana, LLC property boundary (Figure 3.6-2).

The southern portion of the Entergy Louisiana, LLC property (south of LA-3127) is a large area of freshwater forested/shrub wetlands that contains two relatively small areas of freshwater emergent wetlands (Figure 3.6-2). These wetlands are part of a larger wetland complex, as shown in Figure 3.6-1.

Based on NWI data (USFWS 2015a), there are approximately 2,311 acres of wetlands on the Entergy Louisiana, LLC property composed of the following types:

- Freshwater forested/shrub wetlands covering approximately 2,063 acres (89.3 percent).
- Freshwater emergent wetlands covering approximately 234 acres (10.1 percent).
- Riverine covering approximately 11 acres (0.5 percent).
- Freshwater ponds encompassing approximately 3 acres (0.1 percent).

3.6.5.2 Wildlife Management Areas

Louisiana has numerous WMAs and wildlife refuges. As shown in Figure 3.0-6, the WMA closest to WF3 is the 122,098-acre Maurepas Swamp WMA, a portion of which lies within a 6-mile radius of WF3 northeast of the plant. The next closest is the 30,192-acre Salvador WMA located approximately 17 miles southeast of the site. Both sites provide extensive recreational opportunities.

3.6.6 Aquatic Communities

The Mississippi River is the most prominent natural waterbody near WF3 and is the primary hydrologic feature with which the plant interacts. As discussed in Section 3.5.1, the Mississippi River at WF3 is approximately 1,850 feet wide, average stage is approximately 9.9 feet, and average velocity is approximately 3.65 fps. Average maximum depth at WF3 (River Mile 129.6) is 129 feet.

Flow records have been maintained on the LMR at Red River Landing (1900–1963) and Tarbert Landing (1964–1976). Because there are no major tributaries below these points, these flows are characteristic of the lower reach of the river and at WF3, except for flood flows. For a 77-year period of record starting in 1900, the mean annual discharge was 494,000 cfs. Flood season is from mid-December to July, and typically flows are generally above the mean from February to June and below the mean for the remainder of the year. (LP&L 1979, page 3-2)

The flow in the Mississippi River has substantial variations throughout the course of the year. Based on 45 years of combined monthly data from Tarbert Landing and Red River Landing, flows are above 200,000 cfs approximately 85 percent of the time. A typical low flow (200,000 cfs) is estimated to occur about every 4 years during the summer and fall seasons. If all months of the year are considered, the typical low flow would have a recurrence interval of about 6.7 years. This flow may be compared to seasonal average flows which have been calculated to be 580,000; 650,000; 280,000; and 240,000 cfs for winter, spring, summer, and fall, respectively. (LP&L 1979, page 3-2)

Sediment is transported by the Mississippi River as either a bed load or a suspended load. The amount of material in suspension is generally a function of river discharge, turbulence, particle size, and whether or not the flow is increasing or decreasing also appears to influence suspended sediment concentrations. During high flow, the sediment concentration generally increases downstream; the converse is true for low flows. Sediment size varies with depth, river mile, and discharge. In general, the percentage of coarser particles increases with increasing depth and river discharge. At a given discharge rate and depth, particle size decreases with increasing distance downstream. (LP&L 1979, page 3-3) The Mississippi River has always carried sand and sediment to the Gulf of Mexico. Agricultural development of the Mississippi River basin has increased sediment inputs; however, for the LMR, some increases have been offset by impoundment of the Upper Mississippi River, the Ohio River and, principally, the Middle Missouri River. (Schramm 2004, page 319)

The Mississippi River is a highly turbid water body, with high current velocity and low habitat diversity. The productivity of the system is limited by light penetration and high suspended solids concentration, as well as the stability and habitability of the substrate. The Mississippi River food chain is considered to be detrital based, because phytoplankton occur in low densities and do not seem to be the major energy source that they constitute in more lake-like environments. This is typical of larger southeastern and midwestern rivers. (LP&L 1979, page 3-4)

The populations of aquatic organisms in the LMR appear to be limited mainly by the poor spawning habitats and the effects of high turbidity, high concentrations of total suspended solids, high current velocities, and fluctuating water levels. The high turbidities restrict phytoplankton and periphyton growth due to very limited light penetration. Productivity of the phytoplankton is further limited by the high turbulence and mixing in the Mississippi River, which may prevent phytoplankton from remaining in the euphotic zone for sufficient lengths of time to effectively photosynthesize. High concentrations of suspended solids (as high as 345 ppm) and high current velocities (2.78 to 7.01 fps) result in scouring of fish eggs and larvae (in nests or attached to submerged objects), scouring of benthic and periphyton communities, clogging of filter-feeding mechanisms of invertebrates, and shifting bottom sediments. Resultant sediment deposition in areas with slower currents smother fish eggs and larvae as well as benthic organisms (both fauna and flora), further limiting their composition and density. (LP&L 1979, pages 3-12 and 3-13)

Preoperational studies found extremely low concentrations of phytoplankton and attached algae, low zooplankton densities, and an absence of macrophytes. The dominant benthic invertebrates collected, i.e., *Corbicula* and oligochaetes, are prey for fish and also play a role in processing organic matter. However, their numbers were so low as to make their contribution minimal, although river shrimp (*Macrobrachium ohione*), is probably an important pelagic forage species. (LP&L 1979, pages 3-13 and 3-14)

No unique habitats in the river exist near WF3 and there are typically no good spawning areas (NRC 1981, page 4-26). Riverine habitat near WF3 includes a small area of seasonally inundated floodplain on the upstream side along the river levee, revetment banks on the downstream side, and the mainstem river channel. The floodplain area on the upstream side of the plant contains some areas of forested wetland. However, this area is adjacent to Waterford 1, 2, and 4, and is routinely cleared for security reasons. The floodplain area does not contain any oxbow lakes, sloughs, borrow pits, or ponds. The revetment banks downstream are composed of crushed concrete and cover a substantial portion of the bank above and below the water surface. Generally, this portion of the Mississippi River is characterized by high river flows, relatively cool water temperatures, high turbidity, high suspended solids and mobile bed materials. (Entergy 2007, page 2-3)

The LMR is distinguished by its extraordinary species richness with regard to fish (FEOW 2014). Plentiful habitat is available for fishes that thrive in swiftly flowing water, but few species can tolerate the high current velocities of the upper and middle water column of the channel (Entergy 2007, page 3-9). The LMR is noted for its assemblages of large river fish, which include lamprey species (Petromyzontidae), sturgeon (Acipenseridae), the North American paddlefish (*Polyodon spathula*), gar (*Lepisosteus* spp.), and the bowfin (*Amia calva*). Many of these large river fish exhibit adaptations for the constantly turbid character of the Mississippi River. (FEOW 2014) Species less tolerant of high current velocities likely inhabit areas near the banks and channel bottom where the current is less severe. (Entergy 2007, pages 3-9 and 3-10)

3.6.6.1 Lower Mississippi River Aquatic Species

Aquatic populations in the LMR near WF3 are categorized as vascular aquatic plants, invertebrates, benthic invertebrates (macroinvertebrates), and fish. They are discussed below.

3.6.6.1.1 LMR Vascular Aquatic Plants near WF3

Attached aquatic vegetation in the LMR near WF3 is severely limited in growth by high turbidity and widely fluctuating water levels. The relatively high density of suspended sediments and other particulates, as well as the fast currents tend to limit the penetration of sunlight into the water, which greatly reduces light-exposure regimes for submerged primary producers. For these reasons, macrophytes are sparse in the region of the site. (NRC 1981, page 4-24)

3.6.6.1.2 LMR Invertebrate Populations near WF3

Plankton are small organisms that float throughout a water body. They can be broadly characterized as phytoplankton (autotrophic organisms), zooplankton (heterotrophic organisms), and ichthyoplankton (fish or invertebrate eggs and larvae).

Phytoplankton

Phytoplankton communities of the Mississippi River main channel from Cairo, Illinois, to the Gulf of Mexico are limited due predominantly to high turbidity (LP&L 1978, page 2.2-15).

Phytoplankton in the area of WF3 are dominated during most of the year by diatoms, including *Cyclotella* and/or *Melosira*. During the 1973–1976 preoperational study, they were the most abundant genera (> 20 percent) each month except August during the period 1973–1974; *Melosira* was also dominant during 1975 and 1976. Other relatively abundant genera at various times were *Scenedesmus*, *Coscinodiscus*, *Chrsococcus*, and *Trachelomonas*. About 20 genera were represented each year. (NRC 1981, page 4-24)

During the preoperational study, phytoplankton densities averaged from a low of approximately 1×10^5 organisms/liter to somewhat less than 4×10^5 during the 3-year study. The dominant phytoplankton genera near St. Francisville, Louisiana, (about 30 miles north of Baton Rouge) were fairly similar to those at WF3 (e.g., *Cyclotella* spp. and *Melosira* spp.). Average overall densities were greater: about 5×10^6/liter in the last quarter of 1975 and 3.8×10^5/liter during the first three quarters of 1976. (NRC 1981, page 4-24)

Downstream, in the Mississippi River mainstem at New Orleans, the phytoplankton density also was greater than in the preoperational study area. The centric diatoms (round with radial symmetry), *Cyclotella* spp. and *Melosira* spp. were dominant, as in the study area. In 1976, the same taxa were dominant during the first 4 months, but dominance was shared through summer with green and blue-green algae. By September 1976, the centrics (*Cyclotella* spp. and *Melosira* spp.) were again dominant (85 percent of total). (NRC 1981, page 4-24)

A list of phytoplankton species collected in the LMR in the vicinity of WF3 is presented in Table 3.6-2. The dominant plankton genera found in the Mississippi River near WF3 are generally similar to the most frequently encountered true plankton in larger rivers. The genera present also are similar to those found in other studies on the Mississippi River. During the preoperational period 1973–1976, phytoplankton densities ranged from 24.6 to 1,446.8 cells per cubic centimeter (cells/cm^3) in the Mississippi River near WF3. The mean (average) and median (50th percentile) densities were 260 and 150 cells/cm^3, respectively. (LP&L 1979, page 3-5)

The generally low phytoplankton densities reported in the preoperational period 1973–1976, as well as several factors limiting production, suggested that this community is of relatively low importance to the Mississippi River ecosystem. These densities can be compared to those found in lakes where phytoplankton usually occur in much higher densities and, consequently, make a more significant contribution to the food web than in rivers. For example, phytoplankton densities typically range from 500–8,000 cells/cm^3 in some lakes which have been studied. (LP&L 1979, page 3-5)

Zooplankton

Low densities of zooplankton were identified in the Mississippi River near the site (River Mile 129.6) during preoperational studies (NRC 1981, page 4-25), and many likely originated from areas of slower current upstream of the sampling area (LP&L 1978, page 2.2-16). From June 1973 to May 1974, there was an average of 921 zooplankton organisms/m^3 (26 per cubic foot [ft^3]) in the study area of the river; from June 1974 to August 1974, the average was 1,056/m^3 (30/ft^3); and from October 1975 to September 1976, it was 298/m^3 (8/ft^3). Zooplankton were randomly distributed at the site throughout the different sampling stations, as well as vertically in the water column but not throughout time. However, the peaks and valleys of zooplankton abundances were essentially simultaneous at all sampling stations. (NRC 1981, page 4-25)

Species of zooplankton at the site, other than rotifers and protozoa were the copepods and cladocerans, common to rivers and lakes. Calanoid and cyclopoid copepods were dominant. The common cladocerans were *Daphnia*, *Ceriodaphnia*, *Bosmina*, and *Daphanosoma*. Some decapod larvae (river shrimp) appeared in the summer samples. None of the species of zooplankton were rare, threatened, endangered, or considered commercially important (NRC 1981, page 4-25).

Ichthyoplankton

The Mississippi River at WF3 does not provide habitat suitable for spawning by many fish species. It lacks the riffle areas preferred for spawning by many catfish (ictalurids) and most suckers (catastomids), the shallow backwaters and flood areas preferred by pikes (esocids) and some of the shads (clupeids) and sunfishes (centrarchids), and the vegetated areas preferred by other sunfishes and perch (percids). To the extent that sheltered locations (including cans, snags, etc.) are available, a limited number of catfish may spawn near WF3. Other species that may be capable of spawning in this portion of the river include freshwater drum (*Aplodinotus grunniens*), gizzard shad (*Dorosoma cepedianum*), threadfin shad (*Dorosoma petenense*), river carpsucker (*Carpiodes carpio*), and skip jack herring (*Alosa chrysochloris*). However, the spawning habitat appears not to be optimal even for these species. This is supported by the low ichthyoplankton densities found. Average densities for all stations ranged from a low of 0.002/m^3 to 0.106/m^3 over the 3 years of preoperational sampling (1974–1976). It was found that the five stations did not differ significantly. Therefore, these data indicated no significant spatial differences in ichthyoplankton densities in the Mississippi River in the WF3 vicinity. (LP&L 1979, pages 3-9 and 3-10)

Ichthyoplankton were identified and densities measured at intervals near WF3 from 1974 to 1976. Collected ichthyoplankton were identified to family taxa level only (LP&L 1978, page 2.2-30). There is a strong consensus in the literature and among fisheries experts that the fishery of the LMR has not undergone substantial changes since the 1970s when data for WF3 were collected. Dominant species as well as their population densities are therefore unlikely to have changed since the 1970s. (Entergy 2007, page 3-23)

Densities of fish larvae were low in the WF3 area throughout a 1974–1976 preoperational sampling period (NRC 1981, page 4-26). Dominant families in the 1974–1975 samples include Centrarchidae or sunfish family (sunfish, bass, and crappies) and Clupeidae or herrings (shads and skipjack herring). Highest densities were measured in November 1974 and August 1975. Through the 1975–1976 survey, Cyprinidae or minnow family (carp, chubs, minnows, and shiners) and Centrarchidae were the dominant families identified. During the later survey, ichthyoplankton appeared on samples only from March through August, with peaks occurring in April and May. (LP&L 1978, page 2.2-30) There were no significant differences identified in spatial distribution of the ichthyoplankton adjacent to WF3 (NRC 1981, page 4-26).

3.6.6.1.3 LMR Benthic Invertebrate Populations near WF3

Larger invertebrate animals that live in association with the bottom or submerged substrates, benthic macroinvertebrates, are the least studied organisms of the LMR (LP&L 1978, page 2.2-17). Limited studies in the region indicate this ecoregion does support a moderate number of unionid mussel and crayfish species compared to the Tennessee, Cumberland, and Teays-Old

Ohio ecoregions to the north, but an impressive 58 percent of its crayfish species are endemic (FEOW 2014).

High currents result in scouring of the river bottom, removing the sheltering substrate needed by many aquatic invertebrates (LP&L 1978, page 2.2-18). Benthic macroinvertebrates collected in the vicinity of the site in the 1973–1976 time period consisted predominantly of aquatic worms (Oligochaetes) and Asian clams (*Corbicula*). However, these organisms were present in relatively low densities. For example, during the first year of preoperational sampling (1973–1974), the average density of all benthic organisms was 59/m^2. The 3-year average (1973–1976) was somewhat higher (92/m^2) due to an increase in aquatic worms. (NRC 1981, page 4-25)

Harrison and Morse (2012) studied the food habits of sturgeon in the Mississippi River to assess benthic macroinvertebrates. They found in 75 young-of-year sturgeon stomachs and guts a total of 215 taxa of invertebrates representing nine classes. They found 10 taxa not previously reported from the Mississippi River. Chironomids were the best represented family in the study.

The river shrimp has been consistently found in high numbers at WF3. Both females "in berry" and decapod larvae, probably river shrimp, were observed during the WF3 preoperational sampling program indicating that spawning takes place near the site. (LP&L 1979, page 3-7)

3.6.6.1.4 LMR Fish Populations near WF3

As would be expected for a river that grows from a first to a tenth or eleventh order stream and flows more than 2,174 miles from its origin in a cool temperate climate to its subtropical outlet, the Mississippi River supports a rich fish assemblage. In a comprehensive assessment, there are listed 193 freshwater species in 27 families for the Mississippi River. Although no thorough ichthyofaunal surveys have been conducted in at least the past 30 years, additional inventories have been compiled since 1989. (Schramm 2004, page 307)

Limited biological data for the LMR are available due to lack of appropriate sampling equipment and the availability of inland boats sized to handle a water body as vast as the Mississippi River. High water velocities, heavy boat and barge traffic, and the presence of obstacles and debris in the water column and on the bottom are common in the LMR and create safety concerns for routine sampling efforts. (Entergy 2007, page 3-1)

During a 3-year fish preoperational sampling effort conducted from 1973 to 1976, 61 species of fish were identified. The more abundant fish identified near WF3 were gizzard shad, threadfin shad, blue catfish (*Ictalurus furcatus*), freshwater drum, and striped mullet (*Mugil cephalus*). All of these fish have a statewide distribution. Significant differences in the distribution of dominant fish between sampling stations within years, or between years were not detected (Freidman's two-way analysis of variance). (LP&L 1979, pages 3-7 and 3-8) Additionally, most of the fish species sampled at the site are also found upstream in the River Bend (River Mile 262) and Grand Gulf (River Mile 406) reaches of the river (NRC 1981, page 4-26) and downstream at the

Luling station (River Miles 117–125) (LP&L 1978, page 2.2-19). Table 3.6-3 presents a list of probable fish species in the LMR.

Seasonal trends in the abundance of gizzard shad, freshwater drum, and striped mullet either were nonexistent, or were obscured by high month-to-month variability in the numbers of these species caught by gill netting and electroshocking. In two of the three sampling years, the number of blue catfish caught by electroshocking was usually higher during the fall and winter months than during the spring and summer. The number of threadfin shad caught by electroshocking appeared to decrease during the winter months. (LP&L 1979, page 3-8) In summary, significant differences in the distribution of dominant fish species among stations within years could not be detected. The relationship between stations did not vary between Years 1 and 3. (LP&L 1979, page 3-9)

No typical spawning areas have been identified near WF3 and evidence indicates only limited spawning activity. The shads, minnows, carp, catfish, sunfish, and drum spawn to a small extent in the site area. (NRC 1981, page 4-26) Of the fish species that occur in the WF3 area, most species spawn in shallow areas, sheltered areas, smaller streams, backwaters, areas of aquatic vegetation, or over gravel and sand bottoms. The only abundant (A), commercial (C), sport (S), or threatened (T) species that might spawn over the clay or mud substrate in the waters found in the vicinity of the WF3 area are threadfin shad (A), gizzard shad (A) and possibly blue catfish (C). These were the most abundant groups of ichthyoplankton captured during the preoperational monitoring program. (LP&L 1979, page 3-12)

Based on the length distribution of the abundant, commercial, sport, or threatened fish species collected in the WF3 area, it would appear that blue catfish, freshwater drum, gizzard shad, and threadfin shad juveniles utilize the area as a nursery area during specific times of the year. Life history information on sport (S), commercial (C), abundant (A), or threatened (T) species in the WF3 area suggests that some species may undertake spring or summer migrations through the WF3 area. These include longnose gar (*Lepisosteus osseus*) (C), gizzard shad (A), bigmouth buffalo (*Ictiobus cyprinellus*) (C), channel catfish (*Ictalurus punctatus*) (C), and striped mullet (A). Actual data collected in the WF3 area indicated, however, that longnose gar and bigmouth buffalo apparently do not pass through the area in sizeable numbers. (LP&L 1979, page 3-12) It is also likely that paddlefish and sturgeon may pass by the WF3 plant. Comparison of WF3 preoperational data to other studies of fishery resources in the LMR and fish collected in the area, suggests that the Mississippi River at WF3 is not unique fish habitat (LP&L 1979, page 3-12).

In a study by Miranda and Kilgore (2014) to identify patterns in fish benthic distribution along depth gradients in the LMR, fish were collected over 14 years in depths down to 88 feet. Fish exhibited non-random depth distributions that varied seasonally and according to species. Species richness was highest in shallow water, with about 50 percent of the 62 species no longer collected in water deeper than 26 feet, and about 75 percent no longer collected in water deeper than 39 feet. Although richness was highest in shallow water, most species were not restricted to shallow water. Rather, most species used a wide range of depths. A weak depth zonation occurred, not as strong as that reported for deep oceans and lakes. Larger fish tended to occur in deeper water during the high-water period of an annual cycle, but no correlation was evident during the low-water period.

3.6.6.1.5 LMR Commercially Important Species

The freshwater commercial industry in the LMR corridor naturally depends on the Mississippi River. However, most of the freshwater catch takes place away from the main stem of the Mississippi. The strong and fast-moving current of the river, along with heavy commercial navigation traffic, puts fishing vessels and fishing equipment at high risk. Consequently, most freshwater commercial fishing takes place on LMR tributaries. (IEC 2014) Table 3.6-4 lists the commercially important fish species in the vicinity of WF3.

Except for Louisiana, the LMR states do not report freshwater fishing data at county/parish level. Louisiana's landing from the LMR parishes in 2011 was 8.8 million pounds of crayfish and almost 11 million pounds of finfish, producing $13.2 million total in revenues. (IEC 2014) These harvest amounts vary from those reported in 2004.

In 2004 as now, the largest freshwater fishing harvest in the LMR was in Louisiana. Crayfish (approximately 14 million pounds, valued at about $7.1 million) and catfish (approximately 6 million pounds, valued at about $2.3 million) were the two most prominent commercial species harvested in Louisiana. Other significant commercial species reported in 2004 include buffalo (*Ictiobus* sp.) (1.35 million pounds, valued at about $318,000) and gar (*Lepisosteus* sp.) (393,000 pounds, valued at about $427,000). The total economic value of the freshwater harvest in Louisiana reported for 2002 was approximately $10.3 million. (IEC 2004)

Schramm (2004, page 318) reported that estimated fish harvests from the Mississippi River fell within the realm of expected harvests, based on global harvest-drainage area and harvest-river length relationships developed for large rivers. Further, small and trendless variations in catch over 25 years (1954–1977) and stable catch at varying effort levels have led to the conclusion that the Mississippi River was harvested at near optimal levels. The average harvest for the LMR was 12,125 tons, and average effort was 7,000–8,000 fishers per year during the 25-year period. At this time, the commercial fish stocks in the Mississippi River appear stable and, at least in portions of the LMR, may support additional harvest.

3.6.6.1.6 LMR Recreationally Important Species

Fishing on the main LMR channel with its deep waters, fast current, and commercial navigation traffic is challenging. However, there are numerous options for LMR anglers to fish in tributaries, secondary channels, oxbows, backwaters, and along sandbars. The main species of sportfish fish in the LMR corridor include bass, freshwater drum, sunfish, crappie, bluegill, and catfish. Catfish is probably the most popular fish among anglers on the LMR and includes blue catfish, channel catfish, and flathead catfish (*Pylodictis olivaris*). (IEC 2014) Table 3.6-4 lists the recreationally important fish species in the vicinity of WF3.

Findings during the WF3 preoperational monitoring program in the 1970s indicated that the only sportfish that can be considered common in the WF3 area (i.e., more than 200 collected during any sampling year) are blue catfish and freshwater drum. Largemouth bass (*Micropterus salmoides*), another valued sport fish, was collected only occasionally during the program. (LP&L 1979, page 3-11)

Schramm (2004, page 319) reported that although the Mississippi River is a bountiful recreational fishing resource, the recreational fishery has not been measured in the LMR reaches of the open river. Personal observations (i.e., by Schramm) on the LMR suggest that freshwater fishing catch rates are relatively high, but effort and thus catch and harvest, are extremely low. Because of the large size, swift and dangerous currents, the presence of large commercial craft, and lack of public access, recreational fishing on the LMR has been largely discouraged. Providing access is difficult because of the large annual fluctuations in river level and separation of many of the remaining floodplain lakes from the river during low water stages. Management agencies are only beginning to recognize the potential fisheries that the Mississippi River offers, and measures are being initiated to improve access and public education regarding the recreational fishing opportunities. Although catfishes are important to both recreational and commercial fisheries, and channel catfish suffered overfishing before increasing the minimum length limit, recreational fish stocks do not presently appear overfished and, especially in the LMR, can withstand increased harvest.

3.6.6.2 Impingement, Entrainment, and Thermal Studies

A general description of the habitat surrounding the offshore intake structure (based on conditions as determined during mean flow) includes a small area of seasonally inundated floodplain on the upstream side, revetment banks on the downstream side, and the mainstem river channel. The floodplain area on the upstream side of the plant contains some areas of forested wetland communities. However, this area is adjacent to Waterford 1, 2, and 4, and is routinely cleared for security reasons. (Entergy 2007, page 2-3)

The floodplain area does not contain any oxbow lakes, sloughs, borrow pits, or ponds. The revetment banks downstream of the CWIS are composed of crushed concrete rocks and cover a significant portion of the bank above and below the water surface. There is little vegetation associated with the revetment bank. The natural steep bank habitat is adjacent and parallel to shore (within 100 feet from the main bank) and is crossed by the cofferdam. The opening to the offshore intake structure is estimated to be at least 50 feet out from the natural steep bank and located within the main channel habitat. This habitat is characterized by high river flows, relatively cool water temperatures, high turbidities, high suspended solids, and mobile bed materials. (Entergy 2007, page 2-3)

There have been a total of 63 species of fish associated with natural steep banks and channels, 55 species for revetments, and 70 species within the seasonally inundated floodplains. The smaller seasonally inundated floodplain areas (flooded areas lacking ponded waters) associated with the WF3 plant typically support fewer permanent species. Of the species associated with natural steep banks and revetments, a total of 25 are considered to be common to abundant.

Similarly, only 13 are common to abundant in the channel habitats, and 24 are common to abundant in the floodplain areas. Review of the data collected for the WF3 plant ecological study conducted from 1975 to 1976 suggests that the common-to-abundant species documented during the study are not significantly different from those found 30 years later. (Entergy 2007, page 2-3)

As previously discussed in Section 3.6.6.1, the Mississippi River at WF3 does not provide habitat suitable for spawning by many fish species. In the 1991 WF3 National Pollutant Discharge Elimination System (NPDES) permit issued by the EPA, the agency approved the intake structure as being best technology available (BTA) in accordance with Section 316(b) of the Clean Water Act (WF3 1991). In 2010, LDEQ determined that the WF3 CWIS was also BTA based on best professional judgment; however, that determination was based on current information available and would be re-evaluated upon promulgation of revised 316(b) Phase II Rule (Attachment A), which was finalized on August 15, 2014 (79 FR 48300). These two separate determinations would tend to recognize that the Mississippi River does not offer suitable habitat for fish species at WF3, and thus would not expect to impact fish populations in the river.

3.6.6.2.1 Impingement

Impingement studies and/or 316(b) demonstration studies conducted at several Entergy facilities on the LMR demonstrated that impingement rates are low at facilities in the LMR, the species impinged are common, and that impingement varies seasonally with fish abundance. Each of these studies evaluated impingement for 1 year and assessed both seasonal and diel variation in impingement. (Entergy 2007, page 3-1) Although historical impingement studies have been conducted at several Entergy Louisiana, LLC owned plants along the LMR, the information presented below is based on the results of a 2006–2007 impingement study conducted at Waterford 1 and 2, which is located at River Mile 129.9.

Due to the proximity of the two plants and the similar habitat settings of their CWIS, the annual impingement rate for WF3 was estimated from the impingement data documented for Waterford 1 and 2. The Waterford 1 and 2 impingement rate was then applied to an impingement formula in conjunction with the design intake capacity of WF3 to estimate the number of organisms impinged annually at WF3. (Entergy 2007, Appendix C, page 4-1)

Impingement sampling was conducted within the sluiceway of the fish return systems as close to the mesh traveling screens as was safely and logistically manageable. Screens were washed for 10 to 15 minutes and rotated prior to each 12-hour sampling interval. Screens were then washed and rotated for 30 minutes at the end of the 12-hour interval prior to processing and identification of the impinged organisms. Twelve-hour intervals were chosen as they were the most representative of the actual operations of the plant and screens. Samples were collected once during the early morning at 5:00 a.m. and once during the evening at 5:00 p.m. to allow for characterization of diel migratory patterns, if present. (Entergy 2007, Appendix C, page 4-1)

Taxonomic identification to the lowest possible taxa level was recorded along with the length of each specimen. An average weight for all specimens of a given species was also recorded (batch weight). Data analysis examined trends in species composition and abundance on both a diel and seasonal basis, and annual impingement rates were determined for each species. (Entergy 2007, Appendix C, page 4-1)

Impingement rate (IMR) was calculated based on the number of organisms captured during a set time period per volume of water pumped through the intake screens (see formula below). Volume of water pumped was based on the number of circulating waters pumps operating during each sampling period. This rate was expressed as number of organisms per 10,000 cubic meters of water. This rate was then annualized to reflect impingement of the facility on a yearly basis. (Entergy 2007, Appendix C, page 4-3)

$$\text{IMR} = (\text{\# organisms captured} \div \text{volume of water sampled in cubic meters}) \times 10{,}000$$

Because impingement sampling was not performed at WF3, IMR calculations were performed using the impingement rate documented in the most recent Waterford 1 and 2 impingement study (2006–2007) and the total design intake capacity for WF3. Design intake capacity for WF3 was utilized in place of the "volume of water sampled" in the above IMR calculation to illustrate impingement during peak facility operation (all intake pumps running 24 hours per day annually). (Entergy 2007, Appendix C, page 4-3)

The total number of organisms impinged over the course of sampling at the Waterford 1 and 2 facility was 18,608 individuals comprising 32 species identified from 20 families. No federally listed or state-listed threatened, or endangered species were impinged during the sampling period. (Entergy 2007, Appendix C, page 5-1)

Based on findings of the 2006–2007 Waterford 1 and 2 study, annual impingement was estimated to be 16.16 organisms per 10,000 m^3. This was a sizeable increase from the 1976–1977 study in which the average annual impingement rate was 4.22 organisms per 10,000 m^3. This disparity is likely the result of dynamic fish populations near the CWIS which would have a marked impact upon the observed impingement rate. Such a difference is consistent with inter-annual variations perceived in impingement rates and ambient populations observed elsewhere, where some systems exhibit more than ten-fold increase or decrease of these parameters. Such variations can be correlated with the magnitude of spring flooding and summer drought events, which may alter river flows, water temperature, and suitable reproductive habitat, among other conditions. Improvements in tributary water quality (made possible by changes in legislation governing permitted discharges into streams and rivers and more stringent standards for fertilizers available for use on food crops) could also indirectly contribute to increased impingement rates by allowing fish communities that were once stressed by poor water quality to recover. In fact, recent condition assessments of the Mississippi River from bordering states suggest that improvements in the quality of the Mississippi River system (both water quality and habitat) are evident. The dynamic nature of the LMR could also be considered a contributing factor. A water system that is constantly subjected to perturbations will always exhibit some range of instability which, in turn, will affect ambient populations and thus impingement rates as well. (Entergy 2007, Appendix C, page 5-1)

Lowest impingement rates were documented in late winter to early spring (0.45 organisms per 10,000 m^3 during April 2007). During this time (late February through early April), adult species are involved in spawning activities, and most organisms present in the river are of significant size, as recruits from the previous year have reached or are close to reaching spawning size. Organisms of this size typically exhibit strong swimming ability and are able to avoid the intake structure altogether. Increased river flows also allow for more shoreline and backwater habitat to be utilized by small organisms typically subject to impingement, such as river and grass shrimp, aiding in preventing impingement of these organisms. (Entergy 2007, Appendix C, page 5-1)

At the start of sampling in September, impingement rates were high (27.53 organisms per 10,000 m^3). As water temperatures cooled and seasons began to shift, impingement rates slowly declined through late fall into winter and early spring (November 2006–April 2007). A sharp increase in impingement was exhibited from April to May, with the highest documented impingement rate recorded in August (42.25 organisms per 10,000 m^3). Fall and springtime impingement rates were also the highest documented in a previous historical Waterford 1 and 2 study. This suggests that organisms in the LMR are most active and susceptible to impingement from spring to fall months, as would be expected as a result of spawning activity and low water conditions. On the LMR, low water conditions typically drive fish from more favorable habitats in shoreline and backwater areas into deeper, more channelized areas, causing a greater concentration of fishes near the intake pipes which may result in increased impingement rates. (Entergy 2007, Appendix C, pages 5-1 and 5-2)

The 5 months with the highest impingement rates (September, October, May, June, and August) accounted for 81 percent of total organisms impinged during the 12-month study period. It should be noted that these months also exhibited the lowest water conditions during the study, providing further evidence of the correlation between river stage and perceived impingement rates. An impingement rate of less than 6 organisms per 10,000 m^3 was observed throughout the rest of the sampling period (December 2006–April 2007). Historical studies performed during the period 1976–1977 show similar peaks in impingement rates and river stage data when compared with those documented in the most recent study. (Entergy 2007, Appendix C, page 5-2)

The average daytime impingement rate (16.02 organisms per 10,000 m^3) was nearly identical to the nighttime impingement rate (16.30 organisms per 10,000 m^3), and the species composing greater than 1 percent of all organisms impinged were consistent. River shrimp, threadfin shad, grass shrimp (*Palaemonetes* sp.), blue catfish, channel catfish, freshwater drum, and bay anchovy (*Anchoa mitchilli*) composed greater than 1 percent during both the daytime and nighttime samples. Grass shrimp composed a greater percentage of the daytime samples, while threadfin shad and freshwater drum composed a greater percentage of the nighttime samples. Variation in nighttime and daytime observations can be explained by differences in feeding behavior between organisms. Fish are more active when feeding and thus exhibit a higher impingement rate. (Entergy 2007, Appendix C, page 5-2)

Species composing greater than 1 percent of all organisms impinged during the 2006–2007 study include river shrimp, threadfin shad, channel catfish, freshwater drum, blue catfish, bay anchovy and grass shrimp. The historic impingement studies performed during the period 1976–1977 indicated a similar balance of species with a few noticeable differences. In the historic study, gizzard shad and skipjack herring each accounted for greater than 1 percent of the total impingement sample. Additionally, grass shrimp did not account for more than 1 percent of the sample. When monthly impingement rates are totaled using only these species, respective current and historical impingement rates of 15.96 and 4.42 organisms per 10,000 m^3 are obtained. A more specific discussion of impingement, by species, is provided below. (Entergy 2007, Appendix C, page 5-2)

River Shrimp

River shrimp composed nearly 56 percent of all organisms impinged during the 2006–2007 study. The annual impingement rate was calculated to be 9.06 organisms per 10,000 m^3. In historic studies, the river shrimp was also the most frequently impinged species, composing approximately half of the number of organisms impinged. (Entergy 2007, Appendix C, page 5-2)

Threadfin Shad

The average annual impingement rate for threadfin shad was calculated to be 3.26 organisms per 10,000 m^3, with threadfin composing more than 13 percent of all organisms impinged. Average monthly impingement rates during the current study closely mirrored historic monthly impingement rates, as seasonal impingement rates exhibited the same trends throughout the study. (Entergy 2007, Appendix C, page 5-3)

Channel Catfish

The average annual rate of impingement for channel catfish was calculated to be 0.44 organisms per 10,000 m^3, with peak impingement occurring in October (1.72 organisms per 10,000 m^3). Channel catfish accounted for 4.4 percent of all organisms impinged during the 2006–2007 study, but only 2.1 percent during the 1976–1977 study. (Entergy 2007, Appendix C, page 5-3)

Bay Anchovy

The average rate of impingement for the bay anchovy was calculated to be 0.16 organisms per 10,000 m^3. This species accounted for 1.2 percent of all organisms impinged. Peak impingement for this species was recorded in the fall (September). Historically, the bay anchovy accounted for 6.1 percent of all impinged organisms, with an average impingement rate of 0.31 organisms per 10,000 m^3. Impingement also peaked in the fall during historic studies. (Entergy 2007, Appendix C, page 5-3)

Grass Shrimp

The grass shrimp accounted for 8 percent of all organisms impinged during sampling events. The average rate of impingement for the species was 1.31 organisms per 10,000 m^3 with a maximum impingement rate of 7.52 organisms per 10,000 m^3 during June. In the historic impingement study, grass shrimp did not compose greater than 1 percent of impingement. (Entergy 2007, Appendix C, page 5-3)

The current impingement rate at the Waterford 1 and 2 plant was calculated to be 16.16 organisms per 10,000 m^3, while the historic study obtained a rate of 4.22 organisms per 10,000 m^3. The disparity between the current and historical impingement rates at the site is attributable to inter-annual variations documented in the Mississippi River. Such variations can be correlated with the magnitude of spring flooding and summer drought events, which may alter river flows, water temperature, and suitable reproductive habitat, among other conditions. Based on these calculations and the proximity and habitat similarity of the plants, the current impingement rate at Waterford 3 was also estimated to be 16.16 organisms per 10,000 m^3. However, due to the differences in intake capacity of the two plants, the estimated number of organisms impinged annually at WF3 differs from that of Waterford 1 and 2. When the rate of 16.16 organisms per 10,000 m^3 and the annual design intake capacity of the WF3 CWIS are incorporated into the impingement formula, the number of organisms estimated to be impinged at WF3 is 3,472,951. This corresponds to about 2.5 times the number of organisms estimated to be impinged annually at Waterford 1 and 2 (1,379,533). (Entergy 2007, Appendix C, page 6-1)

As discussed in Section 2.2.2.1, the mean annual flow of the Mississippi River for the proximity of WF3 is estimated to be approximately 500,000 cfs. This can then be calculated in terms of MGD to make a comparison of facility water use and the proportion of organisms impinged at the WF3 facility. Based on the flow rate, the relative calculation for the amount of water at the WF3 plant would be approximately 323,000 MGD. Using the design WF3 intake flow of 1,555.2 MGD indicates that WF3 is using approximately 0.48 percent of the flow of the Mississippi River. Using the impingement rate previously determined from the 2006–2007 Waterford 1 and 2 study, the number of organisms estimated to be annually impinged at WF3 is 3,472,951 (Entergy 2007, page 4-1). When trying to compare the proportion of fish impinged at WF3 to the number of fish in the river at the same time, this value is proportional to the amount of water actually being used by the plant relative to the amount of water flowing by the plant; therefore, the 0.48 percent value of plant water use to river flow quantity would also be representative of the total fish population in the river at the same time and location in the river. In terms of actual numbers, WF3 impinges 3,472,951 organisms annually compared to the estimated 723,531,458 total number of fish in the river at the same time as the water that is used by WF3. Thus, the total number of fish in the river is approximately 208 times greater than the number of fish impinged at WF3.

In summary, the Mississippi River's main channel harbors much lower densities of fish than the river's edges and backwaters. Data suggest that population densities in the main channel are less than 5 percent of what is observed in channel borders. This trend appears to be a consensus view among fisheries biologists. The relatively low densities are driven by the high velocities and reduced preferred habitat, as well as significant suspended sediment load. This suggests that the current location of the WF3 CWIS in the main channel does significantly reduce the rates of impingement relative to placement along the shore or in a backwater. (Entergy 2007, page viii)

3.6.6.2.2 Entrainment

As previously discussed, the Mississippi River at WF3 does not provide habitat suitable for spawning by many fish species.

The primary period of reproduction and peak abundance for most aquatic organisms in the LMR is in the spring and summer months (typically March through June). Peak egg recruitment occurs in early spring (channel-oriented species); larval recruitment occurs from late spring into early summer (all species). Therefore, spring and summer months are typically when the highest levels of entrainment would be documented. (Entergy 2007, page C-6)

The spawning period in the LMR typically correlates to the seasonal flooding/high water period. At WF3, seasonal average flows have been calculated to be 580,000; 650,000; 280,000; and 240,000 cfs for winter, spring, summer, and fall, respectively. Elevated flows increase the flood zone of the river and are most likely responsible for pushing the eggs and larval fish past the CWIS during this time. (Entergy 2007, page C-6)

In Louisiana Power & Light Company's (LP&L's) 1979 316(b) demonstration that the intake structure at WF3 reflected BTA, ichthyoplankton sampling was conducted at five stations in the vicinity of WF3 from November 1974 to September 1976. (LP&L 1979, Table 3-21) These sampling stations, which were established between River Miles 126 and 132, represented low-current, soft-bottomed, shallow areas; and high-current, dense clay sediment areas. (LP&L 1979, page 3-4) Ichthyoplankton collected during this sampling period consisted of Centrarchidae, Clupeidae, Cyprinidae, Esocidae, Iictaluridae, Sciaenidae, and unidentifiable fish. (LP&L 1979, Table 3-22).

The average densities for all stations ranged from a low of 0.002/m^3 to 0.106/m^3 over the 3 years of sampling. No ichthyoplankton were found during the period September to February. Spatial variation by station in total ichthyoplankton concentration was examined by Friedman's two-way analysis of variance using Year 3 (1976) data. It was found that the results at the five stations did not differ significantly. Therefore, the data indicated no significant spatial differences in ichthyoplankton densities in the Mississippi River in the WF3 vicinity. (LP&L 1979, page 3-10)

No comprehensive ichthyofaunal surveys have been conducted on the LMR in at least the past 30 years (Schramm 2004, page 307). The most difficult habitat to sample for any life stage of fish is the main channel, where current velocities and debris loads are highest, and extensive commercial navigation occurs. Because researchers historically could not effectively sample the main channel, relatively little is known about the extent to which fish use this habitat. (Entergy 2007, page 3-11)

3.6.6.2.3 Thermal

The *Demonstration under Section 316(a) of the Clean Water Act* submitted by LP&L in April 1979 classified the Mississippi River near WF3 as "an area of low potential impact for thermal discharges." This classification resulted from (1) the determination that this stretch of the Mississippi River was not "unique" for any shellfish, fish, or wildlife; and (2) the realization that most of the cross-sectional area available for flow in the river would be unaffected by the thermal plume. Therefore, the indigenous population of shellfish, fish, and wildlife, which are present in abundance in areas away from WF3, either would have ample opportunity to pass by the facility without encountering elevated stream temperatures or would only experience the higher temperatures for such brief periods that no deleterious effects would result. (WF3 1998, pages 71 and 72)

The 316(a) demonstration found that no threatened or endangered species were present near WF3, and also determined that no special fish spawning habitat existed near the facility (WF3 1998, page 72). However, there are currently three aquatic species listed by the U.S. Fish and Wildlife Service (USFWS) for St. Charles and St. John the Baptist parishes: West Indian manatee (*Trichechus manatus*) (endangered), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) (threatened), and pallid sturgeon (*Scaphirhynchus albus*) (endangered) (USFWS 2014b); these federally listed aquatic species are discussed in detail in Section 3.6.11.1 and listed in Table 3.6-5.

On August 27, 1996, Louisiana became an NPDES authorized state. Previous to 1996, WF3 discharges were regulated under an EPA-issued NPDES permit and an LDEQ-issued Liquid Waste Discharge Pollutant System permit. During the transition from the EPA NPDES permit to LDEQ's LPDES permitting program, WF3 submitted a permit renewal application to LDEQ in November 1995 with a revised application submitted in February 1998 (WF3 1998, page 2). In an addendum to the 1998 revised permit renewal application (WF3 1998, page 2), WF3 requested that the temperature and heat discharge limits, which the facility was currently operating under (110°F and 8.5 x 10^9 Btu/hour), be increased to 118°F and 9.5 x 10^9 Btu/hour, respectively. The basis of the request for an increase in temperature and heat discharge limits was due to a planned "power uprate" to be implemented at WF3 (WF3 1998, pages 69 and 70).

Both the temperature and heat limitations that were included in the 1991 NPDES permit were technology-based limitations. "Regulation [40 CFR Part 423] promulgated as commanded by Section 304" of the Clean Water Act did not establish temperature or heat limitations. Therefore, best professional judgment was used by the EPA to establish the best available technology, economically achievable, for the current temperature and heat limitations contained in the WF3 NPDES permit. (WF3 1998, page 70)

The heat limit in effect for the EPA-issued WF3 NPDES permit (8.5 x 10^9 Btu/hour) resulted from the 316(a) demonstration. In the 316(a) demonstration, LP&L requested that the EPA establish 8.5 x 10^9 Btu/hour as an alternative thermal limitation for WF3. The EPA concurred with LP&L's conclusion in the 316(a) demonstration that the alternative thermal limitation "adequately regulates the amount of heat discharged to the Mississippi River from this facility such that it protects the balanced indigenous population." However, the EPA stated that "although the demonstration requests no maximum thermal limitation be placed in the permit, it recommended an instantaneous thermal maximum of 110°F be placed in the permit to further ensure protection of the aquatic species." The 110°F stems from a maximum instantaneous heat discharge of 8.5 x 10^9 Btu/hour, an instantaneous flow rate of 1,000 MGD for the once-through non-contact cooling water, and a typical maximum stream temperature of 86°F. (WF3 1998, pages 70 and 71)

LDEQ determined that applying the same EPA methodology for a heat limit of 9.5 x 10^9 Btu/hour and a maximum fresh water stream temperature of 90°F, specified in Louisiana Title 33 Environmental Regulatory Code LAC 33:IX.1113.C.4 produces a discharge temperature of approximately 118°F. Using a flow of 1,000 MGD in these calculations was considered reasonable because the long-term average flow for Outfall 001 was 1,085 MGD. To further ensure attainment of Louisiana Title 33 Environmental Regulatory Code LAC 33:IX.1113.C.4.b.i(a), the 5°F allowable rise of temperature above ambient was applied at the edge of the mixing zone. LDEQ determined that a violation of the above citation would not occur with a discharge limitation for temperature at 118°F. (WF3 1998, page 71)

The 1979 316(a) demonstration also documented thermal model results for various flow and temperature conditions reflecting seasonal variations in this stretch of the Mississippi River. The models accounted for the historically calibrated thermal discharges for the nearby Waterford 1 and 2 and Little Gypsy steam electricity generating plants, as well as for the 8.5 x 10^9 Btu/hour anticipated for WF3. A worst-case scenario of an extreme low flow of 100,000 cfs was modeled in the study. This minimum flow in the LMR is maintained by the Old River Control Structure operated by the USACE and is less than the 7Q10 flow for this segment of the river (141,955 cfs). Under this worst case, extreme low-flow situation, the model determined that less than 15 percent of the cross-sectional area of the river would experience temperature increases of 5°F. This thermal plume also stayed near the surface of the river extending no deeper than 10 feet. (WF3 1998, page 72)

In the *Final Environmental Statement Related to the Operation of Waterford Steam Electric Station, Unit No.3* (FES), the NRC documented model studies conducted by its staff to independently confirm the results presented by LP&L in the 1979 316(a) demonstration. Using a different model, the NRC produced results that were "generally in agreement" with those presented by LP&L. The NRC model produced a slightly larger combined thermal plume or mixing zone, but the WF3 FES concluded that operation of WF3 would be "in compliance with the Louisiana Water Quality Criteria relating to temperature." With all three plants operating at peak loads during extreme low-flow conditions, an adequate zone of passage (83 percent of the river cross-sectional area) will still remain for aquatic species to pass by facilities without entering the combined thermal mixing zone. Species entering the mixing zone probably would pass through it in 1 hour or less, minimizing the impact of the elevated temperatures. Also, natural ambient river surface temperatures above 86°F should only occur about 2.5 percent of the time. (WF3 1998, page 72)

Applying the percentage increase of thermal discharge at WF3 to the model worst case, LDEQ determined that the extreme low-flow thermal plume should provide a conservative estimate of the combined thermal mixing zone that would result from the planned power uprate. This estimate is very conservative due to WF3 contributing less heat to the river than Waterford 1 and 2 and Little Gypsy combined. Increasing the heat discharge to 9.5 x 10^9 Btu/hour from 8.5 x 10^9 Btu/hour constituted a 12-percent gain. Applying this proportional gain to the worst-case combined thermal plume (17 percent of river cross-sectional area) yielded an anticipated combined thermal mixing zone of 19 percent. This leaves approximately 81 percent of the river flow unaffected by the temperature increase after the WF3 power uprate, even under extreme low-flow conditions. (WF3 1998, pages 72 and 73)

Louisiana Title 33 Environmental Regulatory Code LAC 33:IX.1115.C.7 specifies the mixing zone for streams with 7Q10 flow greater than 100 cfs as either 100 cfs or one-third of the flow, whichever is greater. The anticipated thermal mixing zone of 19 percent is substantially less than 33 percent of cross-sectional area or one-third of the flow. Therefore, the increased heat discharge and temperature limits requested for Outfall 001 are expected to meet Louisiana Water Quality Criteria for temperature. (WF3 1998, page 73)

With the average flow in the Mississippi River in the vicinity of the WF3 plant estimated at approximately 500,000 cfs and the design of the discharge structure to promote rapid mixing with the ambient water as discussed in Section 2.2.2.1, fish being subject to cold shock is unlikely to occur.

There have been no changes in plant operations that have resulted in a thermal load increase since the study described above was completed in 1998.

3.6.7 Terrestrial Communities

WF3 and its associated in-scope transmission lines lie within the Southern Holocene Meander Belts subset of the Mississippi Alluvial Plains Level III ecoregion. This ecoregion is described as flat plains and river meander belts with levees, point bars, oxbows, and abandoned channels with elevation ranging from 5 to 100 feet above sea level. Within this ecoregion, the more flood prone areas are dominated by water tupelo (*Nyssa* sp.) and bald cypress (*Taxodium distichum*), while overcup oak (*Quercus lyrata*), Nuttall oak (*Q. nuttallii*), willow oak (*Q. phellos*), water hickory (*Carya aquatica*), elm (*Ulmus* sp.), green ash (*Fraxinus pennsylvanica*), and sweet gum (*Liquidamba styraciflua*) are predominately found in less flood-prone zones. Point bars and natural levees are frequently dominated by sweet gum, cottonwood (*Populus deltoides*), and ash (*Fraxinus* sp.) with interspersed areas of live oak (Q. *virginiana*). Some forested canebrakes with open, mixed deciduous trees and giant cane (*Arundinaria gigantea*) also occur. (Daigle et al. 2006) Herbaceous vegetation found along the sandy portions of the alluvium may include fleabane (*Erigeron* sp.), alfalfa (*Medicago sativa*), ragwort (*Senecio* sp.), and sow thistle (*Sonchus* sp.) (NRC 1981, page 4-20).

3.6.7.1 Principal Plant Communities

The Entergy Louisiana, LLC property is composed of two distinct geographical zones: natural levee and wetlands. The distribution of the principal plant communities on the Entergy Louisiana, LLC property is shown in Figure 3.1-1; the most extensive communities are the woody wetlands (i.e., cypress-gum swamp) and agriculture. (LP&L 1978, page 2.2-1)

3.6.7.1.1 Agricultural Land

Historically, most agricultural land was devoted to sugarcane production, but some soybean acreage is rotated in a cyclical manner. Portions of this community have been cultivated for many years and are an important habitat for mourning dove (*Zenaida macroura*), bobwhite (*Colinus virginianus*), eastern cottontail (*Sylvilagus floridanus*), common snipe (*Gallinago gallinago*), and various rodents. (LP&L 1978, page 2.2-1)

3.6.7.1.2 Cypress-Gum Swamp

The cypress-gum swamp community is dominated by bald cypress and tupelo gum, both of which are very tolerant of extended periods of flooding. Other characteristic species include button bush and duckweed. Cypress-gum swamplands are excellent habitats for a number of small, passerine birds, such as northern parula (*Parula americana*) and prothonotary warbler (*Protonotaria citrea*), and larger non-passerines, such as barred owl (*Strix varia*), downy woodpecker (*Picoides pubescens*), yellow-billed cuckoo (*Coccyzus americanus*), and wood duck (*Aix sponsa*). Mammals such as swamp rabbit (*Sylvilagus aquaticus*), northern raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), nutria, North American mink (*Mustela vison*), and common muskrat frequent this habitat type. (LP&L 1978, pages 2.2-1 and 2.2-2)

3.6.7.1.3 Batture, Wax Myrtle, and Marsh Communities

The batture has a variety of vegetation cover. In some areas, willow is the predominant canopy species. The understory is characterized by asters, peppervine, climbing hempweed, beggars lice, and other weedy species. In other areas, sugar berry is the predominant canopy species, with a shrub and herbaceous layer typical of disturbed communities. (LP&L 1978, page 2.2-2)

The wax myrtle community consists of land formerly under cultivation which has reverted to natural vegetation in recent times. This community occupies approximately 420 acres (or about 12 percent) of the Entergy Louisiana, LLC property. Wax myrtle is the predominant species, forming a fairly dense cover. Maple (*Acer* sp.), ash, and dogwood (*Cornus* sp.) also occur with the wax myrtle (*Myrica cerifera*). Giant ragweed (*Ambrosia trifida*) and briars (*Rosa* sp.) are common along the border between the wax myrtle community and the agricultural land. (LP&L 1978, page 2.2-2)

The marsh community occurs near the southern border of the Entergy Louisiana, LLC property. This community occupies approximately 808 acres, or about 23 percent of the Entergy Louisiana, LLC property, and is an overflow area of Lac des Allemands. Common plants found in the marsh area are alligator weed (*Alternanthera philoxeroides*), water hyacinth, giant cutlass (*Pisum* sp.), cattail (*Typha* sp.), pennywort (*Gotu kola*), bull-tongue (*Sagittaria* sp.), maidencane (*Panicum hemitomon*), water hyssop (*Bacopa rotundifolia*), and sprangletop (*Leptochloa* sp.). (LP&L 1978, page 2.2-2)

A large variety of bird and mammal species also occupies these habitat types. The successional state of the plant communities, in addition to the animal tolerance of nearby industrial activity, is a primary force which regulates the species' presence in these habitat types. (LP&L 1978, page 2.2-2)

3.6.7.1.4 Utility

Land denoted as utility is the area occupied by Waterford 1, 2, and 4, and WF3. No special plant community characteristics are associated with this category of land use. This area occupies approximately 402 acres, or 11 percent of the Entergy Louisiana, LLC property. (LP&L 1978, page 2.2-2) This area is illustrated in Figure 3.1-1 and described as developed (low intensity, medium intensity, and high intensity).

3.6.7.2 Amphibians and Reptiles

The wetlands on the Entergy Louisiana, LLC property provide a significant amount of potential habitat for amphibians and reptiles. While there has not been a significant structured study of the amphibians and reptiles on the site in more than 40 years, it would be expected that the populations of these animals on the property would be similar to populations in the surrounding environs. It would not be unusual to find alligators (*Alligator mississippiensis*) or poisonous snakes, such as western cottonmouth (*Agkistrodon piscivorus leucostoma*), or bullfrogs (*Rana catesbeiana*) on the site (Table 3.6-1).

3.6.7.3 Birds

Bird populations in the WF3 area include year-round residents, seasonal residents, and transients (birds stopping briefly during migration). A large percentage of the bird species in southern Louisiana are migratory. While there are resident bird populations, the region serves as a pass-through area for semi-annual migrations of Neotropical birds that may range between South America and Canada, as well as seasonal migrations of waterfowl. Bird populations on the Entergy Louisiana, LLC property would be representative of those found in the region (Table 3.6-1).

The LMR corridor is a part of the Mississippi Flyway, a major bird migratory route. The Mississippi Flyway leads across the United States from the Gulf of Mexico to Canada following the general path of the Mississippi River. It is estimated that about 40 percent of all waterfowl migration in the United States takes place along this flyway. The LMR corridor provides suitable winter habitats for a variety of waterfowl from the Prairie Pothole and Great Lakes. The naturally flooded forests of the Delta region offer desirable conditions for millions of mallards, wood ducks, and other waterfowl. The coastal marshes of Louisiana provide winter habitats for pintail (*Anas acuta*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and green-winged teal (*Anas crecca*). (IEC 2014)

3.6.7.4 Mammals

The area surrounding WF3 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. Because the Entergy Louisiana, LLC property boundary is unfenced, animals have ready access to the site. White-tailed deer, 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*), northern raccoon, eastern cottontail, 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 (Table 3.6-1) is unusual for the region.

3.6.8 Invasive Species

There have been 272 invasive species reported in St. Charles Parish (UGA 2015). The prominent invasive species likely occurring on or adjacent to the Entergy Louisiana, LLC property are described below. There has been no need to implement management controls because the invasive species discussed below do not interfere with plant operations.

3.6.8.1 Invasive Aquatic Species

3.6.8.1.1 Plants

Blue-Green Algae

A blue-green algae (*Cylindrospermopsis raciborskii*), or "Cylindro" for short, is an invasive, subtropical, microscopic blue-green alga. Researchers believe it was introduced to Florida about 30 years ago and has spread rapidly across North America over the last 10–15 years. It is likely that this alga occurs in a wide range of North American water bodies but, due to its size, it is difficult to identify and easily confused with other blue-green algae. It is unclear how this species arrived in the United States, but it is probably spreading to new U.S. water bodies by boats, boat trailers, and waterfowl. This species has been identified in water bodies throughout Florida, parts of Alabama, and central Texas. Unconfirmed reports indicate that this species was found in waters near the Caernarvon Freshwater Diversion in summer 2002. (CBR 2005, page 45)

Like most blue-green algae, Cylindro has no serious adverse effect on water quality or wildlife when found in small concentrations. In fact, blue-green algae are beneficial in small concentrations because they fix nitrogen and add nutrients to the water. However, in higher concentrations, Cylindro can be very detrimental. In some Florida lakes, Cylindro outcompeted other blue-green algae species and now account for 95 percent of the total algal biomass. (CBR 2005, page 45)

Cylindro is known to produce at least three toxins: cylindrospermopsin, anatoxin-a, and saxitoxin, of which the first is the best documented. Cylindrospermopsin is a hepatotoxin which harms the liver and kidneys. Anatoxin-a and saxitoxin are neurotoxins which cause lethargy, muscle aches, confusion, memory impairment, and, at sufficiently high concentrations, death. During Cylindro algae blooms, the concentration of these toxins can reach high levels and adversely impact the ecosystem, agriculture, and human health. For example, researchers suspect that *Cylindrospermopsis* may be linked to the deaths of more than 200 alligators in Lake Griffin, Florida, between 1998 and 2000. Cylindro accounts for 90 percent of all microscopic algae in Lake Griffin, and researchers observed the Lake Griffin alligators behaving erratically and sluggishly, a symptom consistent with neurotoxicity. (CBR 2005, page 45)

In 1997, three cows and 10 calves were found dead near a dam on a cattle farm in Queensland, Australia. Cyanobacteria blooms near the dam consisted of "a virtual monoculture of the cyanobacterium *Cylindrospermopsis raciborskii*." An autopsy on one of the calves and an examination of several of the calf's organs showed damage consistent with hepatotoxin poisoning. In Florida, the Cylindro seems to be resistant to copper sulfate and benomyl, a fungicide, and is non-responsive to other algae poisons. (CBR 2005, page 45)

Brazilian Waterweed

Since as early as 1915, Brazilian waterweed (*Egeria densa*) has been a popular aquarium plant for its rapid growth and oxygenating properties. Pet and aquarium stores sometimes sell this plant under the name "Anacharis". To date, it is one of the most widely distributed and utilized aquarium oxygenator plants. Also known as common waterweed and Brazilian elodea, Brazilian waterweed prefers the slow-moving waters of streams, ponds, and lakes. (CBR 2005, page 38)

The aquarium trade deliberately introduced this aquatic weed, but its establishment in natural ecosystems is likely due to aquarium releases. It may also have been planted for malaria eradication; its oxygenating properties led researchers to believe it could control mosquito larvae. Brazilian waterweed forms thick mats at the water surface, impeding recreational activities such as swimming, boating, and fishing. The weed chokes out native vegetation and degrades water quality and fish habitat. Brazilian waterweed can reproduce vegetatively and is therefore prone to spreading through boat traffic and water currents. (CBR 2005, page 38)

Chinese Tallow Tree

Chinese tallow trees (*Sapium sebiferum*) were first introduced to the United States by Benjamin Franklin in 1772 as ornamentals. Widely sold by nurseries and promoted by landscapers for its attractive red and green foliage, the hardy Chinese tallow (a source of tallow oil and wax) was also planted throughout the Gulf South in the early 20th century in hopes of establishing a local soap industry. Tallow trees escaped tree farms when natural processes (animal interaction, bird consumption, wind, etc.) spread the seeds over long distances. Today, these trees are considered nuisances in many Louisiana prairies, parks, and wetlands. (CBR 2005, page 32)

Still sold by some plant nurseries, Chinese tallow trees grow quickly and resist many pests. Sometimes called "popcorn trees," they can grow to a height of 30 feet, tend to form thick stands, and can easily shade-out native plants. Chinese tallow trees are dispersed throughout almost every Louisiana parish. (CBR 2005, page 35)

Common Salvinia

A floating fern, common salvinia (*Salvinia minima*) is also sometimes called "water spangles" or "water fern." Common salvinia prefers slow-moving freshwaters such as bayous, cypress swamps, marshes, and ponds and lakes. Common salvinia forms thick mats on the water surface, up to almost 10 inches deep in some instances. These mats shade and crowd-out native plants thereby degrading habitat for fish and birds and negatively affecting water quality. (CBR 2005, page 38)

This Central and South American native has been cultivated in the United States since the 1880s for water gardens. Researchers believe common salvinia escaped from cultivation into Florida's St. Johns River in 1928, probably when a water garden flooded, but possibly from an intentional release. It was first recorded in Louisiana in 1980 in the Bayou Teche area of St. Mary Parish, and is now considered a nuisance throughout the state. Introduction into rice and crawfish farms via irrigation practices has caused problems for farmers. One of the most common pathways is boat traffic traversing Louisiana's waterways. (CBR 2005, page 41)

Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*), also called spike watermilfoil, aggressively outcompetes native vegetation and degrades water quality for fish and birds. Eurasian watermilfoil prefers slow moving waters, such as ponds, lakes, bayous, shallow reservoirs, streams, and low-energy rivers, but can tolerate brackish waters. It forms thick, dense mats at the water surface and impedes recreational activities, such as boating and swimming. (CBR 2005, page 38)

Eurasian watermilfoil was first recorded in the United States in Washington, D.C., in 1942, possibly an intentional introduction by federal authorities. Its rapid spread throughout the country may derive from its use as packing material for baitworms sold to fishermen. Today, the most common pathway is vegetative fragments attached to boats and boat trailers. Eurasian watermilfoil is still sold by some pet stores and on the Internet as an aquarium plant. Some introductions may be due to aquarium releases. (CBR 2005, page 38)

Giant Salvinia

Giant salvinia (*Salvinia molesta*) was probably intentionally introduced to the United States as an aquarium plant and, in fact, has been linked to several aquatic plant nurseries. The plant was probably kept in an aquarium until overgrowth occurred, at which point the aquarium contents were dumped into a local stream or pond. Giant salvinia expands its range through reproduction, wind transport, and boaters and fishermen who do not rinse their gear. (CBR 2005, page 41)

Giant salvinia first appeared in Louisiana in 1998 in the Toledo Bend Reservoir on the Texas-Louisiana border. Since then, it expanded into at least 15 locations throughout southern Louisiana. It is a free-floating, rootless plant that reproduces quickly; under ideal conditions, giant salvinia can double its biomass every 7 to 10 days. It chokes bayous and canals, and can cover large portions of lakes and reservoirs, degrading water quality, harming wildlife, and impeding boat traffic. In Cameron Parish, Louisiana, giant salvinia posed a public health threat because it blocked the operation of floodgates. (CBR 2005, page 41)

Hydrilla

Originally from Asia, hydrilla (*Hydrilla verticillata*) is a rooted, aquatic weed that inhabits both deep and shallow waters. In shallower areas, hydrilla forms thick mats that impede boat traffic and swimming. It adversely affects water quality by shading out native vegetation, lowering dissolved oxygen concentrations, and can result in fish kills. (CBR 2005, page 35)

It is believed that hydrilla was first discarded from a home aquarium or possibly was planted in canals in Miami and Tampa, Florida. Accidental introduction through boating, usually when attached to a boat or boat trailer, is the primary pathway spreading hydrilla into new areas. Hydrilla is appearing more frequently in Louisiana drainages, particularly in the Atchafalaya Basin and along LA-1. In Bayou Lafourche, Louisiana, hydrilla clogged an intake pipe for a drinking water treatment plant, causing public health concerns. At times, it made several water bodies virtually unusable for aquatic recreation, in particular, the Spring Bayou WMA and Henderson Lake in the Atchafalaya Basin. (CBR 2005, page 35)

Parrot Feather

Parrot feather (*Myriophyllum aquaticum*) is a submerged aquatic plant that can grow in riparian areas and at water surfaces. Sold at gardening centers, and frequently under an incorrect name, parrot feather is also known as Brazilian watermilfoil and is sometimes mistaken for its "cousin", Eurasian watermilfoil. This aquatic weed is a native of the Amazon River basin in South America, but is now found worldwide. Its exact date of introduction to the United States is unknown, but it was first discovered in a Washington, D.C., pond in 1890. (CBR 2005, page 35)

A popular plant in aquatic gardens and indoor and outdoor aquariums, parrot feather probably escaped cultivation through aquarium releases into open water bodies, and it can reproduce vegetatively, so boat traffic or the natural flow of water may serve as a pathway in spreading it. Parrot feather shades out native submerged aquatic vegetation and seriously disrupts the aquatic food chain. This aquatic weed can block waterways, suspending boat traffic and fishing, and could potentially clog irrigation and drainage canals. Thick growth at the water surface can also provide ideal mosquito breeding habitat. (CBR 2005, page 35)

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is an invasive plant introduced from Europe in the 1800s as an ornamental plant. It also may have arrived in the northeastern United States in ships' ballast.

Loosestrife stalks can grow up to 9 feet tall, and just one mature loosestrife plant can produce an estimated 3 million seeds annually. Seeds are prone to wind, animal, and water dispersal. Purple loosestrife stands disrupt wetland ecosystems by displacing native wildlife, and affect agriculture by clogging irrigation systems or destroying grazing pastures by replacing range grasses. (CBR 2005, page 43)

An easy-to-grow plant with attractive purplish-magenta flowers, purple loosestrife can be purchased in many plant nurseries, garden stores, and over the Internet. Some nurseries claim to sell only sterile loosestrife plants, but these claims have often proven false. While the USFWS reports that purple loosestrife is present in every state except Florida, the USDA and USGS have no record of purple loosestrife in Louisiana. Conflicting reports about the presence of purple loosestrife in Louisiana may be due to two native loosestrife species, wand loosestrife (*Lythrum lineare*) and winged loosestrife (*Lythrum alatum*). (CBR 2005, page 43)

Records from Tulane University's Herbarium in New Orleans indicate two purple loosestrife samples were collected and identified in the mid- to late-1980s. The first sample was collected in 1986 from Plaquemines Parish, approximately 8 miles south of Venice, Louisiana, and about 2 miles east of the Mississippi River. The second specimen was collected from a cultivated garden at Longue Vue House and Gardens in 1988 in New Orleans. (CBR 2005, page 45)

Water Hyacinth

Water hyacinth was first introduced to the United States as an ornamental plant at the World's Industrial and Cotton Centennial Exposition in New Orleans in 1884–1885. A South American native, water hyacinth frequently clogs bayous and canals, impedes boat traffic, slows water currents, and blocks light to native submerged aquatic vegetation which degrades water quality and harms wildlife. Known for its beautiful flowers, hyacinth can be found in almost every drainage basin in Louisiana. (CBR 2005, page 32)

Water Lettuce

Water lettuce (*Pistia stratiotes*) is a floating plant resembling a head of lettuce with thick green leaves. A perennial, water lettuce infestations impede boat traffic, swimming, fishing, and other recreational activities. It degrades water quality for native vegetation and adversely affects fish and bird populations. Some experts believe the plant is native to Africa and was introduced in ballast water by early explorers (there are records of water lettuce in Florida as early as 1765). Although this plant is on the Federal Noxious Weed List, water lettuce is still available through aquarium suppliers and on the Internet. (CBR 2005, page 38)

Wild Taro

Wild taro (*Colocasia esculenta*) was initially introduced to North America in association with the slave trade, but spread when the USDA promoted it as a substitute for potatoes in the early 1900s. Wild taro forms dense growth stands in riparian zones and displaces native vegetation. Many types of taro are sold at garden stores as ornamental plants. (CBR 2005, page 35)

3.6.8.1.2 Invertebrates

Asian Clam

Asian clam is a small (less than 2 inches), light-colored bivalve with shell ornamented by distinct, concentric sulcations, and anterior and posterior lateral teeth with many fine serrations. Dark shell morphs exist but are limited to the southwestern United States. The light-colored shell morph has a yellow green to light-brown periostracum and white-to-light blue or light-purple nacre, while the darker shell morph has a dark-olive green to black periostracum and deep royal-blue nacre. Yellow and brown shell color morphs among specimens collected from Sichuan Province in China have been reported. The shells of the yellow morphs were straw yellow on the outside and white on the inside; those of brown morphs were dark brown and purple, respectively. Further analyses revealed that the yellow and brown morphs are triploid and tetraploid, respectively. (Foster et al. 2014)

The Asian clam is a filter feeder that removes particles from the water column. It can be found at the sediment surface or slightly buried. Its ability to reproduce rapidly, coupled with low tolerance of cold temperatures (36–86°F), can produce wild swings in population sizes from year to year in northern water bodies. Furthermore, Asian clam is able to reproduce by self-fertilization at different ploidy levels. The life span is about 1 to 7 years. The Asian clam is known mostly as a biofouler of many electrical and nuclear power plants across the country. As water is drawn from rivers, streams, and reservoirs for cooling purposes, so are the larvae. Once inside the plant, this mussel can clog condenser tubes, raw service water pipes, and firefighting equipment. (Foster et al. 2014)

Although the Asian clam has found its way into most of the Mississippi River Basin, it has not been detected at the WF3 facility.

Zebra Mussel

Zebra mussels and a related species, the Quagga mussel (*Dreissena rostriformis bugensis*), are small, fingernail-sized animals that attach to solid surfaces in water. Adults are 0.25 to 1.5 inches long and have D-shaped shells with alternating yellow and brownish colored stripes. Female zebra mussels can produce 100,000 to 500,000 eggs per year. These develop into microscopic, free-living larvae (called veligers) that begin to form shells. After 2 to 3 weeks, the microscopic veligers start to settle and attach to any firm surface using "byssal threads". They are native to Eastern Europe and Western Russia and were introduced to the Great Lakes in ballast water of freighters. Populations of zebra mussels were discovered in the Great Lakes about 1988. Zebra mussels have spread throughout the Great Lakes and the Mississippi River from Brainerd downstream, and are now in other rivers and inland lakes. Zebra mussels cause problems in intake structures when the veligers attach to the interior of an intake structure. As the zebra mussel grows and others accumulate, the intake structure may become clogged with organisms that are tightly attached to the structure. (MNDNR 2014a) However, the zebra mussel has seldom been detected at the WF3 facility.

Zooplanktonic Water Flea

Although several species in the Genus *Daphnia* are native to Louisiana and other parts of the United States, the water flea (*Daphnia lumholtzi*) is native to Africa, Asia, and Australia. It was first documented in Texas in 1990, and today can be found in Alabama, Arkansas, Florida, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, Ohio, South Carolina, Tennessee, Texas, and Utah. The water flea was first documented in Louisiana in 1994 when 19 zooplankton samples collected from 30 sites in the Atchafalaya Basin contained this water flea. Although its pathway is not known, scientists believe this daphnid species likely was brought to the United States in shipments of Nile perch from Lake Victoria in Africa. The water flea probably spread throughout the United States through contaminated water used to transport fish stocks, water drained from aquaculture ponds, and/or unwashed recreational boats trailered from one water body to another. (CBR 2005, pages 62 and 63)

The long-term effects of this species' introduction are currently unknown, but negative impacts are possible. Water fleas and other zooplankton are an important food source for many larval fish species, but because of the water flea's head and tail spines, which are much longer and more numerous than those of native daphnid, this species of zooplankton is avoided by fish larvae, thus giving it an evolutionary advantage over natives. However, it was speculated that if this replacement occurs, the amount of food available to larval and juvenile fishes may be reduced. (CBR 2005, page 63)

3.6.8.1.3 Fish

Bighead and Silver Carp

Bighead and silver carp are large filter-feeding fish that can weigh up to 110 pounds (bighead carp) and 60 pounds (silver carp). Both species have low-set eyes below the mouth and large upturned mouths without barbels. They were imported from China in the 1970s for use in aquaculture ponds to control plankton. By the early 1980s, both species had escaped into open waters in southern states. (MNDNR 2014b)

Bighead and silver carp eat huge amounts of plankton and detritus. Because they feed on plankton, these fish compete for food with native organisms including mussels, larval fishes, and some adult fish, such as paddlefish. This competition for food could result in fewer and smaller sport fish. Populations of bighead and silver carp are established in the Mississippi River and its tributaries downstream of Bellevue, Iowa. (MNDNR 2014b)

Black Carp

Recent black carp (*Mylopharyngodon piceus*) collections from the Red River have sparked concern among fisheries managers that this species may soon become established in natural ecosystems. Also known as the snail carp, Chinese black carp, black amur, Chinese roach, or black Chinese roach, the black carp is a freshwater fish native to China, parts of eastern Russia, and possibly northern Vietnam. A bottom-dwelling mollusk eater, black carp also are known to eat freshwater shrimp, insects, and crawfish. In large numbers, black carp could threaten native shellfish and mollusks, including snails and mussels. Black carp host many parasites and flukes, not to mention bacteria and viruses, which may infect commercially valuable sportfish, food fish, or threatened and endangered species. (CBR 2005, page 50)

The first introduction of black carp to the United States, in the early 1970s, was as an accidental specimen in imported grass carp stocks sent to a private fish farmer in Arkansas. The second introduction in the 1980s was deliberate; the carp were imported both as a food fish and as a biocontrol for yellow grubs at aquaculture facilities. The only known introduction of black carp to open waters occurred in 1994 when high waters flooded an aquaculture facility near the Missouri River. An estimated 30 black carp, along with thousands of bighead carp, escaped into the Osage River. (CBR 2005, pages 50 and 51)

In April 2004, a 43-inch black carp was caught by a commercial fisherman in the upper Atchafalaya/lower Red rivers region of Louisiana. A second specimen was caught nearby in early May. Researchers felt that the Osage River population was too far removed from these two Louisiana specimens to explain their origin and suspected a new source. One possible explanation is that the carp escaped from a second aquaculture facility, possibly one to which the Louisiana Department of Wildlife and Fisheries (LDWF) had previously issued a permit to evaluate triploid black carp effectiveness for snail control. The LDWF had permitted one catfish producer for this evaluation in 1996 and a second producer in 2000. Preliminary tests indicate the two black carp specimens may be diploid, indicating that they may be reproducing in open waters. The commercial fisherman who caught the carp reported that he had been catching "strange-looking grass carp in this area for over eight years." (CBR 2005, page 51)

<u>Common Carp</u>

Common carp (*Cyprinus carpio*) were introduced to the United States long ago, and are so widespread they are commonly mistaken as an indigenous species. Records of the earliest common carp introductions are sketchy, but this freshwater fish was certainly introduced to the United States from Asia by at least 1877 and possibly as far back as the 1830s. In 1877, the U.S. Fish Commission began stocking this fish throughout the United States for food purposes. In addition to deliberate stockings, common carp escaped cultivation from fish farms and spread into wild water bodies. More recently, use of juvenile common carp as baitfish has resulted in additional introductions. Also known as German or European carp, mirror carp, leather carp, and koi, common carp have been introduced through the aquarium and water garden trade. Koi are more colorful variations of common carp that sometimes are kept as pets. It must be noted that only a small portion of common carp introductions have resulted from this pathway. (CBR 2005, page 46)

Although a freshwater fish, carp are able to withstand brackish waters in their native range. Their non-native range in the Gulf of Mexico is not limited by temperature; the Gulf of Mexico region's temperate waters are suitable habitat for this fish. An omnivore, carp will consume both zooplankton and phytoplankton, and will frequently disturb bottom sediments while feeding. The increased turbidity and dislodging of plants disturb habitat for native species that require rooted vegetation and clear waters. Common carp also adversely impact native fishes by consuming fish eggs and larvae. Most abundant in manmade water bodies, common carp are also plentiful in waters polluted by sewage and agricultural runoff. Common carp are widely distributed throughout Louisiana. (CBR 2005, page 48)

Grass Carp

The grass carp, or white amur, is a very large fish in the minnow family (Cyprinidae). The body is torpedo shaped with moderately large scales, while the head has no scales. They are silver to olive in color. The adults consume aquatic plants and can weigh up to 70 pounds. The grass carp is native to southeastern Russia and northwestern China, and was introduced to Arkansas in the 1960s to control aquatic plants in reservoirs and aquaculture farms. (MNDNR 2014c)

Wild populations of grass carp exist in many waters of the United States. They have been stocked in waters of other states, escaped or spread to other waters during flood events, and have spread throughout connected river systems. They have a strong preference for densely vegetated inshore areas of backwaters of large rivers, ponds, and lakes 3 to 10 feet in depth. Their herbivorous feeding can dramatically reduce aquatic vegetation. (MNDNR 2014c)

Rio Grande Cichlid

The Rio Grande cichlid (*Cichlasoma cyanoguttatum*) also sometimes called the Rio Grande perch or the Texas cichlid, is native to parts of southern Texas and northeastern Mexico, but its range is expanding due to human activities. Researchers speculate that the Rio Grande cichlid was introduced to Louisiana in the late 1980s or early 1990s through aquarium releases into freshwater bayous and canals on the south shore of Lake Pontchartrain. Less than 20 years after its initial introduction, this fish has been collected in numerous habitats surrounding greater New Orleans, including urban canals, freshwater marshes and bayous, and the Lake Pontchartrain estuary. Reproductive populations have been observed in many of these locations, so clearly aquarium releases are no longer the main cause of range expansion. (CBR 2005, page 46)

An omnivorous fish, the Rio Grande cichlid poses a threat to aquatic vegetation and possibly commercially valuable species such as shrimp. The cichlids also may harbor parasites or diseases that can harm native fish. Recent collection locations indicate this freshwater fish is becoming tolerant of salinities of at least 5 ppt, causing concern that increased salinity tolerance will enable the Rio Grande cichlid to penetrate farther into the Lake Pontchartrain estuary, causing further displacement of native fish. (CBR 2005, page 46)

3.6.8.1.4 Viruses, Bacteria, and Other Disease-Causing Microbes

West Nile Virus is one of the many examples of viruses, bacteria, and other disease-causing microbes that qualify as invasive species (CBR 2005, page 64).

3.6.8.2 Invasive Terrestrial Species

3.6.8.2.1 Plants

Annual Bluegrass

Annual bluegrass (*Poa annua*) is an erect or clump-forming, light-green grass with a boat-shaped leaf tip that resembles other lawn and closely related turf grass species, such as Kentucky bluegrass (*Poa pratensis*), but is much lighter in color and lacks rhizomes. Primarily a weed of lawns and turfgrass found throughout the United States, annual bluegrass tolerates close mowing or may reach 11 inches in height. Leaf blades are 0.5 to 5 inches long, 0.04 to 0.2 inches wide, folded in the bud, and lack hairs on either surface. The seed head is an open panicle (0.75 to 2.5 inches long, and pyramidal in outline). Fruit is an achene. (UGA 2015)

Bermudagrass

Bermudagrass (*Cynodon dactylon*) is a warm-season, prostrate, perennial grass that occurs on almost all soil types. Leaves are gray-green and 1.5 to 5.9 inches long. The ligule has a ring of white hairs, which is one of its identifying characteristics. Flowering occurs in late summer; flowers occur on 1- to 3-inch spikes. This grass spreads by scaly rhizomes and flat stolons that allow it to form a dense resilient turf. (UGA 2015)

The distinguishing characteristics of bermudagrass are the conspicuous ring of white hairs of the ligule, the fringe of hairs on the keel of the lemma, and the gray-green appearance of the foliage. Bermudagrass is native to eastern Africa and prefers moist and warm climates with high light. It was introduced into North America in the mid-1800s as a pasture grass. Bermudagrass is widely used as a turf grass. (UGA 2015)

Chinaberry

Chinaberry (*Melia azedarach*) is a deciduous tree growing to 50 feet in height and 2 feet in diameter. The leaves are alternate, bi-pinnately compound, 1 to 2 feet in length and turn golden-yellow in fall. Flowering occurs in the spring, when showy, lavender, five-petaled flowers develop in panicles. Fruit are hard, yellow, marble-sized, stalked berries that can be dangerous on sidewalks and other walkways. Seeds are spread by birds. (UGA 2015)

Chinaberry invades disturbed areas and is commonly found along roads and forest edges. It has the potential to grow in dense thickets, restricting the growth of native vegetation. Chinaberry is native to Southeast Asia and northern Australia, and was introduced into the United States in the mid-1800s for ornamental purposes. (UGA 2015)

Cogongrass

Cogongrass (*Imperata cylindrica*) is a hardy species tolerant of shade, drought, and high salinities, which tends to invade disturbed ecosystems such as roadway shoulders. Its dense growth pattern creates unsuitable habitat for native plants, insects, mammals, and birds. It has been reported that large infestations of cogongrass can alter the normal fire regime of a fire-driven ecosystem by causing more frequent and intense fires that injure or destroy native plants. Cogongrass was accidentally introduced to the United States in Mobile, Alabama, as a packing material in shipping crates. The USDA also intentionally introduced it for controlling soil erosion and as a foraging grass. Its hardiness and attractive leaves have made it a popular grass sold by plant nurseries. (CBR 2005, page 43)

In Louisiana, cogongrass is rapidly spreading along roads and ROWs through the relocation of soil containing cogongrass rhizomes. Sometimes called "Red Baron" or "Blood Grass" for its striking red foliage, cogongrass is becoming prominent in the "Florida parishes" (West Feliciana, East Feliciana, East Baton Rouge, St. Helena, Livingston, Tangipahoa, Washington, and St. Tammany). (CBR 2005, page 43)

Japanese Climbing Fern

Japanese climbing fern (*Lygodium japonicum*) is a perennial climbing fern that can reach lengths of 90 feet. Vines are thin, wiry, and green to orange to black in color, and they usually die back in winter. The fronds (leaves) are opposite, compound, usually triangular in shape, 3 to 6 inches long, 2 to 3 inches wide, and finely dissected. This plant does not produce flowers, but fertile fronds bear sporangia that produce tiny, wind-dispersed spores. This plant is also spread by rhizomes. (UGA 2015)

Japanese climbing fern often invades disturbed areas such as roadsides and ditches, but can also invade natural areas. It generally is scattered throughout the landscape, but can form dense mats that smother understory vegetation, shrubs, and trees. This plant is native to eastern Asia and was first introduced into the United States during the 1930s for ornamental purposes. (UGA 2015)

Japanese Honeysuckle

Japanese honeysuckle (*Lonicera japonica*) is a woody perennial, evergreen to semi-evergreen vine that can be found either trailing or climbing to more than 80 feet in length. Young stems may be pubescent while older stems are glabrous. Leaves are opposite, pubescent, oval and 1 to 2.5 inches long. Margins are usually entire but young leaves may be lobed or toothed. Flowering occurs from April to July, when showy, fragrant, tubular, whitish-pink flowers develop in the axils of the leaves. The flowers turn cream-yellow as they age. The small shiny globular fruits turn from green to black as they ripen. Each fruit contains two or three small brown to black ovate seeds. (UGA 2015)

Japanese honeysuckle invades a wide variety of habitats including forest floors, canopies, roadsides, wetlands, and disturbed areas. It can girdle small saplings by twining around them and can form dense mats in the canopies of trees, shading everything below. A native of eastern Asia, it was first introduced into North America in 1806 in Long Island, New York. Japanese honeysuckle has been planted widely throughout the United States as an ornamental, for erosion control, and for wildlife habitat. (UGA 2015)

Japanese Privet

Japanese privet (*Ligustrum japonicum*) is a thick, evergreen shrub that grows up to 20 feet in height. The trunks usually occur as multiple stems with many long, leafy branches. Leaves are opposite, oval, up to 2 inches long, with a pointed apex and often with margins that are slightly rolled. Flowering occurs in spring to summer, when very abundant, white flowers occur in clusters at the end of branches. Fruits are 0.2 inches wide, dark purple to black berries (drupes) that persist into winter. (UGA 2015)

Japanese privet commonly forms dense thickets in fields or forest understories. It shades and outcompetes many native species and, once established, is very difficult to remove. Privet was introduced into the United States in the early 1800s. It is commonly used as an ornamental shrub and for hedgerows. Several privet species occur and they are very hard to distinguish. Japanese privet is sometimes set apart by the thickness and glossiness of the leaves. Glossy privet (*L. lucidum*) also has thick, glossy leaves, but the leaves are usually larger (3 to 6 inches long). (UGA 2015)

Johnsongrass

Johnsongrass (*Sorghum halepense*) is a tall, rhizomatous, perennial grass with culms reaching up to 10 feet high that invades open areas throughout the United States. The 2-foot long, lanceolate leaves are arranged alternately along a stout, hairless, somewhat upward branching stem and have distinct, white midribs. Flowers occur in a loose, spreading, purplish panicle (up to 20 inches long). Fruits are also produced in a panicle, and seeds form in the sessile spikelets. (UGA 2015)

Johnsongrass is adapted to a wide variety of habitats including open forests, old fields, ditches, and wetlands. It spreads aggressively and can form dense colonies which displace native vegetation and restrict tree seedling establishment. Johnsongrass has naturalized throughout the world, but it is thought to be native to the Mediterranean region. It was first introduced into the United States in the early 1800s as a forage crop. Johnsongrass is considered to be one of the 10 worst weeds in the world. (UGA 2015)

Kudzu

Kudzu (*Pueraria montana var. lobata*) is a climbing, deciduous vine capable of reaching lengths of over 100 feet in a single season. Its fleshy tap roots can reach 7 inches in width and grow to 9 feet deep, and weigh up to 400 pounds. Leaves are alternate, compound (with three, usually lobed, leaflets), hairy underneath, and up to 5.4 inches long. Flowering occurs in midsummer when 0.5-inch long, purple, fragrant flowers hang in clusters in the axils of the leaves. Fruit are brown, hairy, flat, 3-inch long by 0.3-inch wide seed pods. Each pod can contain 3 to 10 hard seeds. (UGA 2015)

Preferred habitat includes open, disturbed areas such as roadsides, ROWs, forest edges, and old fields. This variant of kudzu often grows over, shades out, and kills all other vegetation, including trees. It is native to Asia and was first introduced into the United States in 1876 at the Philadelphia Centennial Exposition. It was widely planted throughout the eastern United States in an attempt to control erosion. (UGA 2015)

3.6.8.2.2 Animals

Asian Tiger Mosquito

The Asian tiger mosquito (*Aedes albopictus*) was accidentally introduced to the United States in 1985 when used tires containing larvae-infested water were shipped from Japan to Houston, Texas. Further transport of used tires spread Asian tiger mosquito to other southern cities. Within the first year of its introduction, the Asian tiger mosquito was reported in New Orleans, Lake Charles, Baton Rouge, and Shreveport; today it is found in almost every parish in Louisiana. (CBR 2005, page 61)

Asian tiger mosquito breeds in stagnant water pools found in outdoor containers, especially in shady areas. For this reason, this species does particularly well in urban residential settings. This mosquito threatens public health as a known vector of the viruses that cause dengue fever, eastern equine encephalitis, and the agent that causes dog heartworm. Asian tiger mosquito is a suspected vector of other viral diseases, including West Nile virus, yellow fever, and other types of encephalitis. (CBR 2005, page 61)

Feral Hog

Feral hogs (*Sus scrofa*) are sometimes hybrids of wild boars and domestic livestock. Domestic hogs were deliberately introduced as livestock to North America during colonial times; some escaped farms and established feral populations. In the 1940s, sportsmen deliberately introduced Russian black boars to the southeastern United States as a new game animal. Interbreeding between the boars and the feral hogs may have produced the hybrid feral hogs present in Louisiana today. (CBR 2005, page 60)

Feral hogs prefer wooded areas, flat coastal plains, swamps, marshes, and other habitats with plentiful water. Louisiana's warm and moist subtropical climate allows for reproduction almost year-round, and nutrient-rich soils and diverse ecosystems abundantly produce the hogs' favorite foods: roots, leaves, nuts, tubers, snails, insects, frogs, snakes, and rats. Besides competing with deer, bears, rabbits, and other native species for habitat and food, feral hogs can pose a risk to humans. In their quest for food, feral hogs have been known to tear up hurricane protection levees with their snouts and hooves, causing scars which could erode, expand, and weaken the flood-prevention structures. Feral hogs are also vectors for bovine tuberculosis and swine brucellosis, a potential human pathogen which could affect agriculture. (CBR 2005, page 60)

Formosan Termite

Formosan termites (*Coptotermes formosanus*) were introduced to the United States during and shortly after World War II, via wooden shipping palettes on ships returning from East Asia. The termites were introduced at various ports along the Gulf Coast, including Houston and Galveston, Texas; Lake Charles and New Orleans, Louisiana; as well as Charleston, South Carolina. Formosan termites were not detected at the military bases until 1966, and the extent and impact of Formosan termite populations was not fully appreciated until the 1980s. By that time, this "super termite" was well established and spreading throughout Louisiana and the Gulf Coast. (CBR 2005, page 61)

Formosan termites cause an estimated $500 million in damage to Louisiana every year, with $300 million in damages to New Orleans alone. In addition to damaged houses and other buildings, particularly historical structures, Formosan termites infest and structurally weaken native trees, including live oaks and other hardwoods, rendering them more vulnerable to wind damage and other threats. Even cypress are not immune to Formosan termites. (CBR 2005, page 61)

Nutria

Nutria are large semi-aquatic rodents indigenous to South America. In the 1930s, nutria were imported into Louisiana for the fur farming industry and were released by state and federal agencies to provide a new fur resource and to control problem plants such as the water hyacinth and alligator weed. (USGS 2015e)

Nutria live in fresh, intermediate, and brackish marshes and wetlands and are extremely prolific, reaching sexual maturity at 6 months of age. With a gestation period of only 130 days, in 1 year, adult nutria can produce two litters and be pregnant for a third. Litter size averages from four to five young, which are born fully furred with their eyes open. With this high productivity, nutria populations can withstand high predation rates. (USGS 2015e)

Because of the nutria's feeding habits, high population densities can be especially damaging to wetland vegetation and further wetland loss. Nutria predominantly feed on the base of plant stems, and dig for roots and rhizomes in the winter. Their grazing can strip large patches of marsh, and their digging overturns the marsh's upper peat layer. Plant growth can be reduced when grazing is intensive with little recovery time for the plants or when grazing is coupled with other sources of stress. Nutria have also contributed to the failure of several planting efforts of bald cypress, uprooting and eating as many as 500 newly planted seedlings literally overnight. (USGS 2015e)

Recent efforts to control nutria populations in Louisiana have been aimed at creating a market for human consumption of the meat as well as for fur (USGS 2015e).

Red Imported Fire Ant

Red imported fire ants (*Solenopsis invicta*) are thought to be native to Paraguay and the Parana River region in South America and were brought to the United States in the 1930s, probably in soil used as ballast or dunnage in commercial shipping vessels. Red imported fire ants were first detected in Mobile, Alabama, but quickly spread throughout the southeastern United States through the transport of nursery stock and earth-moving equipment. A federal quarantine was implemented in 1958 to prevent the spread of red imported fire ants by restricting the movement of potentially infested hay, sod, soil, equipment, and nursery stock. (CBR 2005, page 60)

Red imported fire ants cause a variety of adverse economic and environmental effects by outcompeting and preying on native species, feeding on agricultural crops (such as okra, cucumbers, corn, and soybeans), sometimes killing livestock, and nesting in electrical equipment such as air conditioners, traffic signal boxes, computers, airport landing lights, and telephone junctions. The total cost associated with fire ants in the southern United States is estimated at $1 billion per year. (CBR 2005, page 60)

3.6.9 Procedures and Protocols

Entergy relies on administrative controls and other regulatory programs to ensure that habitats 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 9.6, 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; USACE permitting programs to minimize dredging impacts; and management of herbicide applications to ensure that the intended use will not adversely affect the environment.

3.6.10 Studies and Monitoring

Other than monitoring associated with the site's REMP described in the WF3 *Offsite Dose Calculation Manual*, there are currently no other active aquatic and terrestrial monitoring programs conducted at the site.

However, as part of the WF3 license renewal activities, Entergy did conduct a survey at the Entergy Louisiana, LLC property in October 2014 to assess the habitat availability and presence of plants and animals that have been listed by the USFWS and the LDWF as being threatened, endangered, or proposed for listing. This survey, which was limited to the Entergy Louisiana, LLC property northeast of LA-3127, included a desktop survey to determine relevant species for St. Charles Parish, Louisiana, as well as the habitat requirements for each federally and state-listed species, and a pedestrian survey to assess the presence or absence of the organism and/or its habitat on the Entergy Louisiana, LLC property northeast of LA-3127. (Entergy 2014e)

In addition, since the mid-1970s, Entergy and others have performed ecological studies of the Mississippi River in the vicinity of WF3. These studies have included efforts to describe the fisheries resources in the Mississippi River including adults, juveniles, and larval life stages. There have also been efforts to describe the habitats that are associated with the Mississippi River. Numerous efforts have been made to monitor water quality and river flows in the LMR. All of these studies have been hampered by the size and flow of the Mississippi River in this lower reach of the river, combined with heavy barge traffic that poses a significant safety hazard to smaller sampling boats. Many of these studies have been summarized by Schramm (2004) and Entergy (2007).

Some of the studies summarized in Entergy (2007) are as follows:

- *Comparative Analysis of Impingement Mortality Studies at WF3, 2007*

  Compared data collected in historic impingement studies conducted at Waterford 1 and 2, and WF3, with current impingement study data collected at Waterford 1 and 2. Historically, impingement rate was documented to be 4.22 organisms per 10,000 m^3 of water pumped through the plant for both units combined. The current rate was calculated to be 16.16 organisms per 10,000 m^3. (Entergy 2007, page 3-2)

- *Annual Data Report—Waterford Power Plant Units 1 and 2, Screen Impingement Studies, February 1976 through January 1977*

  Study results show higher impingement rates in winter and spring. The facility is located at Mississippi River Mile 129.9. Species composition was dominated by river shrimp (49.6 percent of the total catch), blue catfish (20.3 percent), threadfin shad (10.5 percent), bay anchovy (6.0 percent), freshwater drum (4.5 percent), and gizzard shad (2.9 percent). Total annual impingement rates were estimated to be 336,454 organisms, which equates to 4.22 organisms per 10,000 m^3 of water pumped through the plant for both units combined. Daily impinged biomass ranged from 3.6 kilograms to 33.6 kilograms. (Entergy 2007, page 3-2)

- *Willow Glen Power Station 316(a) and 316(b) Demonstrations under Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), 1977*

  Impingement and entrainment data were collected from January 1975 through January 1976 at three of the five units (Units 1 & 2, and Unit 4) at Willow Glen Power Plant. Major species impinged were freshwater drum, gizzard shad, threadfin shad, blue catfish, white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), river shrimp, and crayfish. Impingement rates were relatively low: 1.47 (Units 1 & 2) and 0.13 (Unit 4) organisms per 10,000 m^3. Approximately 126,000 organisms per year were estimated to be impinged with all five units in operation. One pallid sturgeon (endangered) was impinged over the course of the study. (Entergy 2007, page 3-2)

- *Baxter Wilson Impingement Study—Mississippi Power & Light (MP&L), 1974*

  Impingement data were collected from March 1973 through March 1974. Major species impinged were gizzard shad, threadfin shad, freshwater drum, crappie, and channel catfish. The shad species and freshwater drum represented more than 90 percent of the total catch. Impingement was relatively low and calculated to be 160,730 individual organisms per year. No threatened or endangered species were documented on the revolving screens; however, paddlefish (state-listed species of concern) were impinged. Common species were consistent with the literature for the LMR. (Entergy 2007, page 3-2)

- *Grand Gulf Nuclear Plants 1 and 2 Impingement Study—Mississippi Power & Light (MP&L), 1974*

  Information on Mississippi River flow, velocities, stage with surveys of fish populations in different habitats (e.g., backwaters, tributary, and river bank) was presented. Difficulty in sampling the river's main flow was also noted. Gizzard shad contributed 37.4 percent of the total catch, followed by freshwater drum (10.3 percent), blue catfish (8.3 percent), flathead catfish (4.9 percent), and river carpsucker (4.8 percent). (Entergy 2007, page 3-2)

- *Louisiana Power & Light—Demonstration Under Section 316(b) of the Clean Water Act, Waterford Steam Electric Plant Unit No. 3, April 1979*

  Fisheries data were collected in the Mississippi River between Baton Rouge and New Orleans. Common species included gizzard shad, threadfin shad, blue catfish, freshwater drum, striped mullet, skipjack herring, channel catfish, river carpsucker, bluegill, and common carp. The most common species reported were consistent with literature for the LMR. (Entergy 2007, page 3-3)

- *Application Addendum for a Louisiana Pollutant Discharge Elimination System Permit and Comprehensive Demonstration Study under the 316 (b) Rule for Track II, 2002*, for Bonnet Carre Power LLC; LaPlace, Louisiana (Sempra); by CK Associates and URS

  Habitat analysis was conducted at Mississippi River Mile 132.2 using 13 distinct LMR habitats. Six habitats were identified in the study area, and each was reviewed specifically to determine the number of fish species (133 potential species found in the LMR), larval fish, and eggs associated with each habitat type. Each of the six habitat types were determined to have a significantly reduced number of aquatic organisms compared to the total potentially found on the river. Of the six habitats reviewed, the researchers concluded that a CWIS located offshore and at middle depth would minimize the number of organisms potentially impinged and/or entrained. (Entergy 2007, page 3-3)

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

3.6.11.1 Federally Listed Species

Portions of St. Charles and St. John the Baptist parishes fall within a 6-mile radius of WF3. Within these two parishes, there are five federally listed species which are either threatened, endangered, or candidate species: Alabama heelsplitter mussel (*Potamilus inflatus*), Atlantic sturgeon, pallid sturgeon, Sprague's pipit (*Anthus spragueii*), and West Indian manatee. There are no federally listed amphibians, reptiles, or plant species listed in either St. Charles Parish or St. John the Baptist Parish (Table 3.6-5). The ecological requirements for these five species are summarized below.

3.6.11.1.1 Mollusks

Alabama Heelsplitter (Inflated Heelsplitter)

The Alabama heelsplitter, which is referred to as the inflated heelsplitter in the species recovery plan, is a large (sometimes reaching more than 5.5 inches in length) freshwater mussel with a brown to black shell with green rays in young individuals. Like other freshwater mussels, the Alabama heelsplitter feeds by filtering food particles from the water column. The specific food habits of the species are unknown, but other juvenile and adult freshwater mussels have been documented to feed on detritus, diatoms, phytoplankton, and zooplankton. The diet of Alabama heelsplitter glochidia, like other freshwater mussels, comprises water (until encysted on a fish host) and fish body fluids (once encysted). (USFWS 2015b)

The reproductive cycle of the Alabama heelsplitter is similar to that of other native freshwater mussels. Males release sperm into the water column; the sperm are then taken in by the females through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. The specific life history of this species is largely unknown. Gravid females have been collected from the Amite River in Louisiana during October. At that time, they were observed to extend a mantle margin just above the substratum surface in shallow, clear water. Recent investigations indicate that the freshwater drum is a suitable glochidial host for the Alabama heelsplitter. (USFWS 2015b)

The Alabama heelsplitter was known historically from the Amite and Tangipahoa rivers in Louisiana; the Pearl River in Mississippi; and the Tombigbee, Black Warrior, Alabama, and Coosa rivers in Alabama. The presently known distribution is limited to the Amite River in Louisiana, and five sites in the Tombigbee and Black Warrior rivers in Alabama. This species is not abundant within any known habitat. (USFWS 2015b)

It is believed that more than 50 miles of available habitat remain for the species; however, exact population numbers are unknown. The USACE recently discovered 63 live animals during their surveys of the Tombigbee and Black Warrior rivers. In a separate report, two fresh dead specimens were found in two separate locations in the West Pearl River drainage, the first such records since 1911. Recent surveys indicated that the species remains in the lower Amite River where some small individuals were collected indicating successful recruitment. (USFWS 2015b)

The preferred habitat of this species is soft, stable substrata in slow to moderate currents. It has been found in sand, mud, silt, and sandy-gravel, but not in large or armored gravel. It is usually collected on the protected side of bars and may occur in depths greater than 20 feet. The occurrence of this species in silt does not necessarily indicate that the species can be successful in that substratum. Adult mussels may survive limited amounts of silt, whereas juveniles would suffocate. In addition, it is possible that the species was established in an area prior to deposition of the silt. (USFWS 2015b)

The Alabama heelsplitter mussel is not anticipated to be present adjacent to the Entergy Louisiana, LLC property because the Mississippi River does not provide suitable habitat for this species.

3.6.11.1.2 Fish

Atlantic Sturgeon

The Atlantic sturgeon is a long-lived, estuarine dependent, anadromous fish. Atlantic sturgeon can grow to approximately 14 feet long and can weigh up to 800 pounds. They are bluish-black or olive brown dorsally with paler sides and a white belly, and they have five major rows of dermal scutes. (NOAA 2015)

Atlantic sturgeon are similar in appearance to shortnose sturgeon (*Acipenser brevirostrum*), but can be distinguished by their larger size, smaller mouth, different snout shape, and scutes. Atlantic sturgeon have been aged to 60 years. There is generally faster growth and earlier age at maturation in more southern populations. (NOAA 2015)

Spawning adults migrate upriver in spring, beginning in February–March in the south, April–May in the mid-Atlantic, and May–June in Canadian waters. In some areas, a small spawning migration may also occur in the fall. Spawning occurs in flowing water between the salt front and fall line of large rivers. Atlantic sturgeon spawning intervals range from 1 to 5 years for males and 2 to 5 years for females. Fecundity of female Atlantic sturgeon is correlated with age and body size and ranges from 400,000 to 8,000,000 eggs. The average age at which 50 percent of maximum lifetime egg production is achieved is estimated to be 29 years, which is approximately 3 to 10 times older than for other bony fish species. (NOAA 2015)

Atlantic sturgeon are anadromous; adults spawn in freshwater in the spring and early summer, and migrate into estuarine and marine waters where they spend most of their lives. In some southern rivers, a fall spawning migration may also occur. They spawn in moderately flowing water (18 to 30 inches/second) in deep parts of large rivers. Sturgeon eggs are highly adhesive and are deposited on bottom substrate, usually on hard surfaces (e.g., cobble). It is likely that cold, clean water is important for proper larval development. Once larvae begin migrating downstream they use benthic structure (especially gravel matrices) as refuges. Juveniles usually reside in estuarine waters for months to years. (NOAA 2015)

Following spawning, males may remain in the river or lower estuary until the fall; females typically exit the rivers within 4 to 6 weeks. Juveniles move downstream and inhabit brackish waters for a few months and, when they reach a size of about 30 to 36 inches, they move into nearshore coastal waters. These immature Atlantic sturgeon travel widely once they emigrate from their natal rivers. Subadults and adults live in coastal waters and estuaries when not spawning, generally in shallow (33- to 164-foot depth) nearshore areas dominated by gravel and sand substrates. Long distance migrations away from spawning rivers are common. (NOAA 2015)

Atlantic sturgeon are benthic feeders and typically forage on benthic invertebrates such as crustaceans, worms, and mollusks. The Altamaha River supports one of the healthiest Atlantic sturgeon populations in the southeast United States, with more than 2,000 subadults captured in research surveys in the past few years, 800 of which were 1 to 2 years of age. The Atlantic sturgeon population appears to be stable. (NOAA 2015)

Studies have consistently found populations to be genetically diverse and indicate that there are about 10 populations that can be statistically differentiated. However, there is some disagreement among studies, and results do not include samples from all rivers inhabited by Atlantic sturgeon. (NOAA 2015)

Historically, threats to Atlantic sturgeon included overharvesting (which led to widespread declines in Atlantic sturgeon abundance) and commercial fishing from the 1950s to the 1990s. Current threats include bycatch of sturgeon in fisheries targeting other species; habitat degradation and loss from various human activities such as dredging, dams, water withdrawals, and other development; habitat impediments including locks and dams; and ship strikes. Although there are no known diseases threatening Atlantic sturgeon populations, there is concern that non-indigenous sturgeon pathogens could be introduced through aquaculture operations. (NOAA 2015)

The Atlantic sturgeon could potentially be present in the Mississippi River adjacent to the Entergy Louisiana, LLC property; however, the river at this point does not provide suitable habitat for more than a transitory presence. (Entergy 2014e)

Pallid Sturgeon

The pallid sturgeon was first recognized as a species different from shovelnose sturgeon by S. A. Forbes and R. E. Richardson in 1905, based on a study of nine specimens collected from the Mississippi River near Grafton, Illinois. They named this new species *Parascaphirhynchus albus*. Later reclassification assigned it to the genus *Scaphirhynchus*. (USFWS 2014c)

Pallid sturgeon have a flattened, shovel-shaped snout; a long, slender, and completely armored caudal peduncle; and they lack a spiracle. As with other sturgeon, the mouth is toothless, protrusible, and ventrally positioned under the head. The skeletal structure is primarily composed of cartilage rather than bone. (USFWS 2014c)

Pallid sturgeon are a bottom-oriented, large-river obligate fish inhabiting the Missouri and Mississippi rivers and some tributaries from Montana to Louisiana. Pallid sturgeon evolved in the diverse environments of the Missouri and Mississippi river systems. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters formed the large-river ecosystem that met the habitat and life history requirements of pallid sturgeon and other native large-river fishes. Pallid sturgeon have been documented over a variety of available substrates, but are often associated with sandy and fine bottom materials. (USFWS 2014c)

Substrate association appears to be seasonal. During winter and spring, a mixture of sand, gravel, and rock substrates are used. During the summer and fall, sand substrate is most often used. In the Middle Mississippi River, pallid sturgeon transition from predominantly sandy substrates to gravel during May, which may be associated with spawning. In these river systems and others, pallid sturgeon appear to use underwater sand dunes. (USFWS 2014c)

Across their range, pallid sturgeon have been documented in waters of varying depths and velocities. Depths at collection sites range from about 2 feet to greater than 65 feet, though there may be selection for areas at least 2.6 feet deep. Despite the wide range of depths associated with capture locations, one commonality is apparent: this species is typically found in areas where relative depths (the depth at the fish location divided by the maximum channel cross section depth expressed as a percent) exceed 75 percent. Bottom water velocities associated with collection locations are generally less than 4.9 fps with reported averages ranging from 1.9 to 2.9 fps. (USFWS 2014c)

Data on food habits of age-0 pallid sturgeon are limited. In a hatchery environment, exogenously feeding fry will readily consume brine shrimp suggesting zooplankton and/or small invertebrates are likely the food base for this age group. Data available for age-0 *Scaphirhynchus* indicate mayflies (Ephemeroptera) and midge (Chironomidae) larvae are important. Juvenile and adult pallid sturgeon diets are generally composed of fish and aquatic insect larvae with a trend toward piscivory as they increase in size. Based on the above diet data and habitat utilization by prey items, it appears that pallid sturgeon will feed over a variety of substrates. However, the abundance of Trichoptera in the diet suggests that harder substrates like gravel and rock material may be important feeding areas. (USFWS 2014c)

Pallid sturgeon can be long-lived, with females reaching sexual maturity later than males. Based on wild fish, estimated age at first reproduction was 15 to 20 years for females and approximately 5 years for males. Like most fish species, water temperatures influence growth and maturity. Female hatchery-reared pallid sturgeon maintained in an artificially controlled environment can attain sexual maturity at age 6, whereas female pallid sturgeon subject to colder winter water temperatures reached maturity around age 9. Thus, age at first reproduction likely is variable and dependent on local conditions. Females do not spawn each year. (USFWS 2014c)

Observations of wild pallid sturgeon collected as part of the conservation stocking program in the northern part of the range indicates that female spawning periodicity is 2 to 3 years. Fecundity is related to body size. The largest upper Missouri River fish can produce as many as 150,000 to 170,000 eggs, whereas smaller bodied females in the southern extent of the range may only produce 43,000 to 58,000 eggs. Spawning appears to occur between March and July, with lower latitude fish spawning earlier than those in the northern portion of the range. Adult pallid sturgeon can move long distances upstream prior to spawning, and females likely are spawning at or near the apex of these movements. This behavior can be associated with spawning migrations. Spawning appears to occur over firm substrates, in deeper water, with relatively fast, turbulent flows, and is driven by several environmental stimuli including flow, water temperature, and day length. (USFWS 2014c)

Incubation rates are governed by and depend on water temperature. In a hatchery environment, fertilized eggs hatch in approximately 5 to 7 days. Incubation rates may deviate slightly from this in the wild. Newly hatched larvae are predominantly pelagic, drifting in the currents for 11 to 13 days and dispersing hundreds of miles downstream from spawn and hatch locations. (USFWS 2014c)

Douglas (1974) reports that two specimens of the pallid sturgeon were collected from East Carroll Parish in the Mississippi River at Lake Providence. These were young specimens weighing approximately 1.5 and 3.0 pounds, respectively.

The pallid sturgeon could potentially be present in the Mississippi River adjacent to the Entergy Louisiana, LLC property; however the river at this point does not provide suitable habitat for more than a transitory presence. (Entergy 2014e)

3.6.11.1.3 Birds

Sprague's Pipit

Sprague's pipit is the only wholly North American pipit. Males perform a very extraordinary fluttering display flight, circling high above the earth while singing an unending series of high-pitched calls, for periods of up to an hour. The current decline in the population of the Sprague's pipit is quite likely the result of the conversion of tall-grass native prairie to extensive farmland. (Vuilleumier 2009)

The nest consists of a small cup of loose woven grass on the ground and level with it, often attached to standing vegetation to form a sort of dome; four to five eggs and one to two broods are typical. Nesting occurs May through August. Sprague's pipit feeds almost exclusively on insects (especially crickets and grasshoppers) when breeding, but it occasionally eats seeds. (Vuilleumier 2009)

Sprague's pipit breeds along the border of Canada and the United States in dry open, tall-grass upland habitat, especially native prairie systems in the northernmost part of the Great Plains. Most migrate to Mexico in winter, where habitat is similar to breeding grounds. (Vuilleumier 2009)

This bird species prefers native prairie grasslands as its habitat. Although this bird may overwinter in St. Charles Parish in proper habitat conditions, no such habitat was found on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey even though ROWs were specifically evaluated for native grass stands. (Entergy 2014e)

3.6.11.1.4 Mammals

West Indian Manatee

Manatees are protected under the Marine Mammal Protection Act, which prohibits the take (i.e., harass, hunt, capture, or kill) of all marine mammals. Manatees are found in marine, estuarine, and freshwater environments. On August 14, 2013, the USFWS determined that the West Indian Manatee includes two subspecies: the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). While morphologically distinctive, both subspecies have many common features. Manatees have large, seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are typically grey in color (color can range from black to light brown) and occasionally spotted with barnacles or colored by patches of green or red algae. The muzzle is heavily whiskered and coarse, single hairs are sparsely distributed throughout the body. Adult manatees, on average, are about 9 feet long and weigh about 1,000 pounds. At birth, calves are between 3 and 4 feet long, and weigh between 40 and 60 pounds. (USFWS 2014d)

Florida and Antillean manatees range freely between marine and freshwater habitats. Specific habitat types/use areas include foraging and drinking sites, resting areas, travel corridors, and others. Florida manatees, living at the northern limit of the species' range, have little tolerance for cold. (USFWS 2014d)

Historically, this subspecies has sought out natural, warm-water sites, including springs, deep water areas, and areas thermally influenced by the Gulf Stream, as refuges from the cold. In the 1930s and 1940s, industrial plants, including power plants, paper mills, etc., were built along coastal and riverine shoreline areas. Plants discharging large volumes of heated discharge water into areas accessible to manatees have attracted large numbers of wintering manatees to these warm-water sites ever since. In the spring, manatees leave the warm-water sites and may travel great distances during the summer, only to return to warm-water sites in the fall. (USFWS 2014d)

Manatees are herbivores that feed opportunistically on a wide variety of marine, estuarine, and freshwater plants, including submerged, floating, and emergent vegetation. Common forage plants include, but are not limited to, cord grass, algae, turtle grass, shoal grass, manatee grass, eel grass, and other plant types. Calves initially suckle and may start feeding on plants when a few months of age. Weaning generally takes place within a year of birth. Manatees also require sources of freshwater, obtained from both natural and anthropogenic sources. (USFWS 2014d)

The Florida manatees' range is generally restricted to the southeastern United States, although individuals occasionally range as far north as Massachusetts and as far west as Texas. Antillean manatees are found in coastal and riverine systems in South and Central America (from Brazil to Mexico) and in the Greater and Lesser Antilles throughout the Caribbean Basin. (USFWS 2014d)

Manatees mature at 3 to 5 years of age. Mature females go into heat for anywhere from 2 to 4 weeks. Mating activity can occur throughout the year. When in heat, females will attract numerous males and mate repeatedly; aggregations that include an estrus or focal female and numerous males are described as mating herds. Gestation lasts for about 13 months, and cows usually give birth to a single calf, although twinning is known to occur. While calving primarily peaks in the spring, calves may be born at any time of the year. Reproductive senescence is poorly described; a known female has given birth to seven individual calves over a period of about 30 years. A calf may remain with its mother for about 2 years. Calving intervals range from 2 to 3 years. The oldest known manatee is 65 years of age. (USFWS 2014d)

The West Indian manatee prefers calm waters which are not found on the river adjacent to WF3; therefore, it would not be expected to be found at this industrial property (Entergy 2014e).

3.6.11.2 State-Listed Species

Portions of St. Charles and St. John the Baptist parishes fall within a 6-mile radius of WF3. As shown in Table 3.6-6, the LDWF has designated eight plants and six animals as species of special concern within these two parishes. With the exception of the two federally listed species (pallid sturgeon and West Indian manatee) already discussed above in Section 3.6.11.1, below is a discussion of these state-listed species.

3.6.11.2.1 Plants

Correll's False Dragon-Head

Correll's false dragon-head (*Physostegia correllii*) is a member of the mint family (Lamiaceae). It ranges from Louisiana and Texas to Mexico. It is a robust plant, somewhat succulent, up to about 40 inches tall, and stems are often unbranched. It is a hardy perennial with elongate rhizomes. Mid-stem leaves are opposite, sessile (not stalked), and usually widest in the middle with large sharp teeth. Leaves decrease in size from mid- to upper-stem, and flowers are pink and tubular with two lips. It flowers from May to September, requires full sun, and is almost always found in wetlands. (LDWF 2014f)

Louisiana occurrences are all in roadside ditches. Elsewhere it occurs along river banks, often growing in flowing water. Vigorous growth of rhizomes allows Correll's false dragon-head to be competitive in disturbed areas. Non-natural habitats such as drainage and irrigation ditches and wet utility ROWs represent potential habitat. Threats to Correll's false dragon-head are dredging/scraping of ditches for maintenance and installation of water lines and other utilities, herbicides used in roadside management, potentially exotic invasive species, and apparently it is naturally rare. In Louisiana, Correll's false dragon-head is found in the Pearl, Pontchartrain, Barataria, Mermentau, Calcasieu, and Sabine river basins. (LDWF 2014f)

No suitable habitat was identified for this species on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey (Entergy 2014e).

Floating Antler-Fern

Floating antler-fern (*Ceratopteris pteridoides*) is a member of the water fern family (Parkeriaceae). Its range includes Florida and Louisiana and south to the West Indies, Central and South America, and southeastern Asia (Vietnam). It is a dimorphic fern with two types of fronds: fertile and sterile. Sterile fronds form a basal rosette and are broad, thin, and glabrous, with net-like venation; simple with pinnate to palmate lobing; ultimate segments are round, and the basal lobes opposite. Petiole bases are inflated to aid in floating. Fertile fronds are erect, longer than the sterile fronds, and have very narrowly divided segments with in-rolled margins. Buds or small vegetative plantlets are present on sterile frond margins and eventually separate to form new plants. (LDWF 2014g)

Floating antler-fern requires full sun to shade, and is almost always found in wetlands. It occurs in swamps, sluggish bayous, and ditches and canals; it is usually floating, but occasionally stranded in mud during low-water periods. Threats to floating antler-fern are few given its aquatic habitat and ability to float freely, but saltwater intrusion is presumably a threat. In Louisiana, floating antler-fern is found in the Pontchartrain, Barataria, Terrebonne, Atchafalaya, and Vermilion-Teche river basins. (LDWF 2014g)

Although there was potential habitat identified in ditches on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey, this plant species was not observed on the property (Entergy 2014e).

Golden Canna

Golden canna (*Canna flaccida*) is a member of the canna family (Cannaceae). Its range includes the states of Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas, and it is found as an exotic in Virginia. It is a large perennial which grows to nearly 4 feet tall, with green herbaceous stems and large flat leaves. Leaves alternate, to about 24 inches long and with obvious parallel veins; leaves not variegated, which is the case in many cultivated exotic cannas. Flowers are solid yellow (with no red or orange), irregular-shaped, and in terminal racemes. (LDWF 2014h)

Golden canna blooms from May to August, requires full sun, and is almost always found in wetlands. Habitat for golden canna is fresh marsh and open swamps. Because this plant is cultivated and used as an ornamental, some occurrences could be escapes. Records from northern Louisiana are probably escapes. Threats to golden canna are saltwater intrusion, conversion of marsh to open water, and lack of knowledge regarding status in Louisiana. In Louisiana, golden canna is found in the Pearl, Pontchartrain, Barataria, Terrebonne, Vermilion-Teche, Mermentau, Calcasieu, and Sabine river basins. (LDWF 2014h)

No suitable habitat was identified for this species on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey (Entergy 2014e).

Marshland Flatsedge

Marshland flatsedge (*Cyperus distinctus*) is a member of the sedge family (Cyperaceae). Its range includes Florida, Georgia, Louisiana, and South Carolina. It is a stout perennial flatsedge with glabrous, round stems, 16 to 24 inches tall, and inflorescence of hemispheric heads on 5 to 9 stalks (= rays). Achenes are three angled, the body linear oblong, and about 0.06 to 0.08 inches long by 0.01 to 0.02 inches wide, and perched atop a minute stipe (stalk). Achenes are narrowed toward the base then becoming swollen with spongy bases. (LDWF 2014i)

Marshland flatsedge flowers from July to October and requires full sun. It usually is found in wetlands. Louisiana has several known occurrences with very little specific habitat data. One occurrence is from the Bonne Carre Spillway in "low wet areas." Another collection was from a "wet meadow" at Audubon Park in New Orleans. The most recent record is from a wet ditch between U.S. Highway 11 and I-10 in Orleans Parish near Lake Pontchartrain. Threats to marshland flatsedge are characterized as very little basic information on status, habitat preference, and associate species in Louisiana. In Louisiana, marshland flatsedge is found in the Pontchartrain basin. (LDWF 2014i)

No suitable habitat was identified for this species on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey (Entergy 2014e).

Rooted Spike Rush

The rooted spike-rush (*Eleocharis radicans*) is a member of the sedge family (Cyperaceae). Its range includes Arizona, California, Florida, Hawaii, Louisiana, Michigan, Oklahoma, Texas, Virginia, and Central and South America. This plant, about 1 to 3 inches tall, is a mat-forming rhizomatous perennial. The stems, which are 0.01 to 0.02 inches thick, are soft and spongy, becoming wrinkled upon drying. The rooted spike-rush is an achenes with several longitudinal ribs separating shallow valleys with horizontally elongated cells. (LDWF 2015c)

The rooted spike-rush flowers from April to November. It requires full sun to partial shade, and is almost always found in wetlands. Louisiana occurrences are in forested seeps, flotant marshes, and roadside ditches. It was also recently documented on the Atchafalaya River bank at the Delta on Big Island, where it was growing on decaying woody debris and on black willow root systems that anchor sediment. Potential threats to this plant species are marsh loss by subsidence and nutria herbivory. Rooted spike-rush may be found in the Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, and Vermilion-Teche river basins. (LDWF 2015c)

Because this plant species is listed only in St. John the Baptist Parish by the LDWF, it is not anticipated to be present on the Entergy Louisiana, LLC property.

Square-Stemmed Monkey Flower

Square-stemmed monkey flower (*Mimulus ringens*) is a member of the figwort family (Scrophulariaceae). Its range is the eastern half of Canada and the United States, except Florida, and it is found in several western states. This plant is about 12 to 40 inches tall, and a perennial. Leaves are opposite, sessile, sometimes clasping the stem, and angles of the stem are rounded and not winged (the common *M. alatus* has sharp winged angles on the stem). Flowers are lavender, with two lips: upper with two petals and lower with three petals. When fully open, flowers resemble a monkey face. Pedicels (flower stalks) are relatively long, 0.7 to 1.6 inches. (LDWF 2014j)

It flowers from April to September (to November—stage of development depends on water levels) and requires full sun to part shade. It is almost always found in wetlands. Louisiana occurrences are on sand bars, banks, and in batture of large rivers such as the lower Atchafalaya and Mississippi. Threats to square-stemmed monkey flower are channel dredging and soil deposition; lock and dam construction and operation; and shoreline stabilization, such as lining river banks with rock (riprap). In Louisiana, square-stemmed monkey flower is found in the Pontchartrain, Mississippi, Barataria, Atchafalaya, Vermilion-Teche, Red, and Ouachita river basins. (LDWF 2014j)

Although there was potential habitat identified along the Mississippi River shoreline on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey, this plant species was not observed on the property (Entergy 2014e).

Swamp Milkweed

Swamp milkweed (*Asclepias incarnate*) is in the milkweed family (Asclepiadaceae). It ranges from Florida west to New Mexico, and north to Nova Scotia and Manitoba. It is a robust, perennial milkweed from a short rootstock to 6.5 feet tall in Louisiana, and it has milky sap which is characteristic of most milkweeds. Leaves are numerous, opposite, linear-lanceolate to ovate-elliptic, 2.4 to 6 inches long, and to 1.6 inches broad with rounded to heart-shaped bases and acute to acuminate tips. Flower color is bright rose-purple (rarely white). Fruit is an erect follicle ("pod"), having seeds with a long tuft of hairs at one end which allows wind dispersal. (LDWF 2014k)

Swamp milkweed flowers from June to September. It requires full sun to partial shade, and is almost always found in wetlands. Louisiana occurrences are in freshwater swamps and marshes; however, it may also occur in ditches. Threats to swamp milkweed are subsidence of fresh marsh and saltwater intrusion. In Louisiana, swamp milkweed is found in the Pontchartrain, Barataria, and Terrebonne river basins. (LDWF 2014k)

No suitable habitat was identified for this species on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey (Entergy 2014e).

Western Umbrella Sedge

Western umbrella sedge (*Fuirena simplex*) is a member of the sedge family (Cyperaceae). This sedge ranges from Arizona east to Mississippi and throughout the southern Great Plains. It is often found in wetland areas. The western umbrella sedge is a perennial that reaches up to 1 foot tall. It is rather grass-like in appearance with a fibrous root. Leaves are alternate, simple, and linear. Leaf veins are parallel, and inflorescence is a spikelet. The plant blooms August through November and has a green bloom with the perianth absent. (LBJWC 2015)

Although there was potential habitat identified along the Mississippi River shoreline on the Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey, this plant species was not observed on the property (Entergy 2014e).

3.6.11.2.2 Fish

Paddlefish

Paddlefish are one of the most distinctive freshwater fishes in North America. They possess several primitive features including a cartilaginous skeleton, and a heterocercal tail and spiracles. They have an elongate, spatulate snout, which is dorso-ventrally flattened and longer than the rest of the head, small imbedded scales, an elongate operculum, and relatively small eyes. Adults may reach 100 pounds in weight and up to 5 feet in length (without the paddle). Life expectancy is 15 years (although individuals are known to live 30 years or more). (LDWF 2014l)

Paddlefish are usually found in large, free-flowing rivers but they are also frequently found in impoundments. They feed exclusively on zooplankton. Males reach sexual maturity in 7 years, females in 9 to 10 years. They spawn in shallow, fast-moving waters above gravel bars in early spring during high water; preferred temperatures are around 50 to 60°F. Eggs hatch in about 9 days. (LDWF 2014l)

Paddlefish were formerly found throughout the Mississippi River and Great Lakes drainages, but now are restricted to the Mississippi River drainage and apparently declining in the periphery of its range. In Louisiana, this species is probably found throughout most of the major river systems and in larger impoundments. Threats to the paddlefish are habitat alteration through actions such as river modification and the construction and operation of dams; pollution, as well as fertilizer and pesticide runoff; siltation of spawning habitats from soil erosion; and harvesting, which has in the past caused a decrease in population. (LDWF 2014l)

In Louisiana, paddlefish are found in the Atchafalaya, Calcasieu, Mermentau, Mississippi, Ouachita, Pearl, Pontchartrain, Red, and Vermilion-Teche river basins (LDWF 2014l).

The paddlefish could potentially be present in the Mississippi River adjacent to the Entergy Louisiana, LLC property; however, the river at this point does not provide suitable habitat for more than a transitory presence. Further, the current speed would prevent suitable feeding habitat for the paddlefish, in particular, which prefers more backwater-type areas. (Entergy 2014e)

3.6.11.2.3 Reptiles

Alligator Snapping Turtle

The alligator snapping turtle (*Macrochelys temminckii*) has webbed toes and an upper jaw with a strongly hooked beak. The eyes are positioned on the side of the head and therefore cannot be seen from above. It has three peaked heels on the carapace, which is dark brown and usually has algal growth. There are five pairs of plastral scutes. The plastron is small, narrow, and cross shaped with a long, narrow bridge. (LDWF 2015d)

The alligator snapping turtle may be found in swamps with rivers close by, but mainly they are found in large rivers, canals, lakes, and oxbows. They are most commonly found in freshwater lakes and bayous, but also can be found in coastal marshes. Food habits for this species include turtles, fishes, aquatic snails, crustaceans, clams, carrion, and some plant matter. It may actively pursue prey, but is also known to lie concealed underwater and use its tongue's worm like appendage to entice prey. (LDWF 2015d)

In southeastern Louisiana, eggs, which are large and leathery, are laid mid-April to late May and from mid-May to early June in northeastern areas. The alligator snapping turtle may have one clutch per year or one every other year, with the clutch size averaging from 16 to 38. In the past, commercial turtle harvesting and selling has depleted population size, although this practice has since been legally banned. Dredging disturbances to stream ecosystems also present a threat to this species. (LDWF 2015d)

In Louisiana, the alligator snapping turtle may be found in the Pearl, Pontchartrain, Barataria, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine, Red, and Ouachita river basins (LDWF 2015d). However, this species is not state-listed in St. Charles Parish (LDWF 2015b).

3.6.11.2.4 Birds

Bald Eagle

Bald eagle (*Haliaeetus leucocephalus*) is no longer protected as a rare species, but is protected as a migratory bird. It is a very large raptor. Adults exhibit a dark brown body, white head and tail, and a large yellow bill. Immature birds are dark brown with pale underwing coverts, irregular light base of tail, and black bill. Subadults are intermediate between immatures and adults and exhibit various amounts of white mottling on body. The bald eagle requires 4 to 5 years to attain adult plumage. Wings are very long, broad and rounded at the tip with primary feathers often widely separated, and wings are held flat when soaring. Adults grow to 3.5 feet in length with wingspread of 7.5 feet. (LDWF 2014m)

Bald eagles nest primarily in the tops of cypress trees near open water, and feed in open lakes and rivers. Typically they feed on fish (either self-caught or robbed from other birds, especially osprey [*Pandion haliaetus*]), as well as carrion, waterfowl, coots, muskrats, and nutria. (LDWF 2014m)

Bald eagles breed throughout the United States, southern Canada, and Baja California, although it is rare away from the coast. They winter throughout the United States along river systems, large lakes, or coastal areas. In Louisiana, they nest primarily in southeastern coastal parishes and occasionally on large lakes in northern and central parishes; however, such nests are less successful. (LDWF 2014m)

Louisiana birds nest in winter and early spring. Nests are very large (up to about 8 feet across and 11 feet deep), and they are used year after year. Alternate nests may be constructed by a breeding pair, and the birds may alternate between the two nests annually. They usually produce up to three eggs per clutch. Incubation period is about 35 days; young fledge 72 to 78 days after hatching. Threats to the bald eagle are accumulation of pesticide residues (especially dichlorodiphenyltrichloroethane [DDT]) causing thinning of egg shells, which reduces reproductive success rate; loss of habitat; and human disturbances to nesting pairs during nesting season. (LDWF 2014m)

In Louisiana, bald eagles are found in the Atchafalaya, Barataria, Mississippi, Ouachita, Pearl, Pontchartrain, Red, Sabine, Terrebonne, and Vermilion-Teche river basins (LDWF 2014m). Although there are no known nests on the Entergy Louisiana, LLC property, because bald eagles are in the immediate area of WF3, they can occasionally transit the Entergy Louisiana, LLC property.

Osprey

The osprey is a large raptor with long, relatively narrow, rounded wings. The head is mostly white with a dark line though the eye and a dark, mottled nape. Upperparts are dark brownish-black and under parts white. In flight, distinct patches at the wrist, black wingtips, and distinct crook in wings at wrist can be seen. The length of adults can be up to 25 inches with a wingspread of 72 inches. Its habitat varies but common elements include an adequate supply of shallow water prey, open nesting areas without predators, and an ice-free season long enough to allow fledging of the young. The osprey dives for prey feet first and therefore feeds on surface-schooling fish. (LDWF 2015e)

Osprey nest throughout southern Canada and Alaska, the western United States, the Gulf of Mexico and the U.S. Atlantic coast, south along both coasts to Belize, and Old World. Use of artificial sites, such as telephone poles, by these species for nesting has increased recently. Nests are built using large sticks and grasses, are often reused several years, and can weigh up to one-half ton. Two to four eggs are laid per clutch from January through April. Eggs are creamy white to pinkish cinnamon and are heavily dotted in reddish-brown. Both sexes incubate, which lasts 28 to 43 days. Young fledge at 7 to 8 weeks. (LDWF 2015e)

The osprey winters in southern parts of its breeding range and South America. In Louisiana, the osprey winters along the coast and on larger inland lakes. Threats to this species include past chemical pollution such as DDT causing eggshell thinning, nesting around highways where they are vulnerable to vehicle collisions, and loss of nest sites due to agricultural development and logging. (LDWF 2015e)

In Louisiana, the osprey is found in the Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Red, and Ouachita river basins (LDWF 2015e). Although this species is only listed in St. John the Baptist Parish (LDWF 2015b), the possibility exists that the osprey could potentially transit the Entergy Louisiana, LLC property.

3.6.11.3 Essential Fish Habitat

Based on consultation with the National Marine Fisheries Service (NMFS), no essential fish habitat (EFH) has been designated within the vicinity of WF3 (Attachment B).

3.6.11.4 Other Acts

3.6.11.4.1 Species Protected under the Bald and Golden Eagle Protection Act

In addition to being a state-listed species as discussed in Section 3.6.11.2.4, bald eagles are also protected under the Bald and Golden Eagle Protection Act. Although there are no known nests within the Entergy Louisiana, LLC property, because bald eagles are in the immediate vicinity of WF3, they can occasionally transit the Entergy Louisiana, LLC property. As discussed in Section 9.5.15, there are currently no Bald and Golden Eagle Protection Act permitting requirements associated with WF3 operations.

3.6.11.4.2 Species Protected under the Migratory Bird Treaty Act

In addition to the Sprague's pipit (Table 3.6-5) and osprey and bald eagle (Table 3.6-6), there are several bird species that are protected under the Migratory Bird Treaty Act, as shown in Table 3.6-1, that may occur on or within the vicinity of WF3. However, as discussed in Section 9.5.13, there are currently no Migratory Bird Treaty Act permitting requirements associated with WF3 operations.

Table 3.6-1
Common Animals Occurring on or in the Vicinity of WF3

Common Name[a]	**Scientific Name**
Amphibians	
Bullfrog	*Rana catesbeiana*
Eastern spadefoot toad	*Scaphiopus holbrookii*
Peeper	*Hyla crucifer*
Southern chorus frog	*Pseudacris nigrita*
Southern leopard frog	*Rana sphenocephala*
Tiger salamander	*Ambystoma tigrinum*
Woodhouse's toad	*Bufo woodhousei*
Reptiles	
American alligator	*Alligator mississippiensis*
Canebrake rattlesnake	*Crotalus horridus*
Corn snake	*Elaphe guttata*
Eastern garter snake	*Thamnophis sirtalis sirtalis*
Eastern hog-nosed snake	*Heterodon platyrhinos*
Red-eared slider	*Trachemys scripta elegans*
Southern copperhead	*Agkistrodon contortrix contortrix*
Stinkpot	*Sternotherus odoratus*
Western cottonmouth	*Agkistrodon piscivorus leucostoma*
Yellow-bellied water snake	*Nerodia erythrogaster flavigaster*
Birds[b]	
American coot	*Fulica americana*
American robin	*Turdus migratorius*
American wigeon	*Anas americana*
Bald eagle	*Haliaeetus leucocephalus*
Barred owl	*Strix varia*
Belted kingfisher	*Ceryle alcyon*

**Table 3.6-1 (Continued)
Common Animals Occurring on or in the Vicinity of WF3**

Common Name[(a)]	Scientific Name
Black-crowned night heron	*Nycticorax nycticorax*
Blue-winged teal	*Anas discors*
Bobwhite	*Colinus virginianus*
Bufflehead	*Bucephala albeola*
Cardinal	*Cardinalis cardinalis*
Cattle egret	*Bubulcus ibis*
Common crow	*Corvus brachyrhynchos*
Common snipe	*Gallinago gallinago*
Double-crested cormorant	*Phalacrocorax auritus*
Downy woodpecker	*Picoides pubescens*
Eastern meadowlark	*Sturnella magna*
European starling	*Sturnus vulgaris*
Forster's tern	*Sterna forsteri*
Gadwall	*Anas strepera*
Great blue heron	*Ardea herodias*
Great horned owl	*Bubo virginianus*
Green heron	*Butorides virescens*
Green-winged teal	*Anas crecca*
Hooded merganser	*Lophodytes cucullatus*
House sparrow	*Passer domesticus*
Killdeer	*Charadrius vociferus*
Mallard	*Anas platyrhynchos*
Mourning dove	*Zenaida macroura*
Northern mockingbird	*Mimus polyglottos*
Northern parula	*Parula americana*
Pintail	*Anas acuta*

Table 3.6-1 (Continued)
Common Animals Occurring on or in the Vicinity of WF3

Common Name[a]	Scientific Name
Prothonotary warbler	*Protonotaria citrea*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Snow goose	*Chen caerulescens*
Turkey vulture	*Cathartes aura*
White ibis	*Eudocimus albus*
Wood duck	*Aix sponsa*
Yellow-billed cuckoo	*Coccyzus americanus*
Mammals	
American beaver	*Castor canadensis*
Big brown bat	*Eptesicus fuscus*
Bobcat	*Lynx rufus*
Common muskrat	*Ondatra zibethicus*
Coyote	*Canis latrans*
Eastern cottontail	*Sylvilagus floridanus*
Eastern fox squirrel	*Sciurus niger*
Eastern gray squirrel	*Sciurus carolinensis*
Gray fox	*Urocyon cinereoargenteus*
Hispid cotton rat	*Sigmodon hispidus*
House mouse	*Mus musculus*
Least shrew	*Cryptotis parva*
Marsh rice rat	*Oryzomys palustris*
Nine-banded armadillo	*Dasypus novemcinctus*
North American mink	*Mustela vision*
Northern raccoon	*Procyon lotor*
Norway rat	*Rattus norvegicus*

Table 3.6-1 (Continued)
Common Animals Occurring on or in the Vicinity of WF3

Common Name[a]	Scientific Name
Nutria	*Myocastor coypus*
Red fox	*Vulpes vulpes*
Spotted skunk	*Spilogale putorius*
Swamp rabbit	*Sylvilagus aquaticus*
Virginia opossum	*Didelphis virginiana*
White-footed mouse	*Peromyscus leucopus*
White-tailed deer	*Odocoileus virginianus*

(Species' likely presence derived from LP&L 1978, Tables A2.2.1-10, A2.2.1-11, A2.2.1-13, and A2.2.1-18; LDWF 2015f. Scientific names from Dundee and Rossman 1989; LDWF 2015f; Vuilleumier 2009)

a. This is not a comprehensive list of all animals that may be found on or in the vicinity of WF3.

b. With the exception of the bobwhite, European starling, and house sparrow, all bird species are protected under the Migratory Bird Treaty Act.

Table 3.6-2
Phytoplankton Species Collected in the Lower Mississippi River in the Vicinity of WF3

Common Name	Scientific Name
Green algae	*Carteria*
Green algae	*Chlamydomonas*
Green algae	*Chlorogonium*
Green algae	*Eudorina*
Green algae	*Pandorina*
Green algae	*Pleodorina*
Green algae	*Volvox*
Green algae	*Gloeocystis*
Green algae	*Sphaerocystis*
Green algae	*Chlorosarcina*
Green algae	*Dispora*
Green algae	*Ourococcus*
Green algae	*Binucleria*
Green algae	*Geninella*
Green algae	*Ulothrix*
Green algae	*Microspora*
Green algae	*Bulbochaete*
Green algae	*Chlorococcum*
Green algae	*Golenkinia*
Green algae	*Micractinium*
Green algae	*Dictyosphaerium*
Green algae	*Characium*
Green algae	*Schroederia*
Green algae	*Pediastrum*

Table 3.6-2 (Continued)
Phytoplankton Species Collected in the Lower Mississippi River in the Vicinity of WF3

Common Name	Scientific Name
Green algae	*Ceolastrum*
Green algae	*Ankistrodesmus*
Green algae	*Chlorella*
Green algae	*Closteriopsis*
Green algae	*Franceia*
Green algae	*Kirchneriella*
Green algae	*Lagerheima*
Green algae	*Oocystis*
Green algae	*Planktosphaeria*
Green algae	*Quadriqula*
Green algae	*Selenastrum*
Green algae	*Tetraedron*
Green algae	*Treubaria*
Green algae	*Actinastrum*
Green algae	*Crucigenia*
Green algae	*Scenedesmus*
Green algae	*Tetradesmus*
Green algae	*Tetrastrum*
Green algae	*Mougeotia*
Green algae	*Spirogyra*
Green algae	*Arthrodesmus*
Green algae	*Closterium*
Green algae	*Cosmarium*
Green algae	*Euastrum*

Table 3.6-2 (Continued)
Phytoplankton Species Collected in the Lower Mississippi River in the Vicinity of WF3

Common Name	Scientific Name
Green algae	*Hyalotheca*
Green algae	*Micrasterias*
Green algae	*Penium*
Green algae	*Spondylosium*
Green algae	*Staurastrum*
Euglena	*Euglena*
Euglena	*Lepocinclis*
Euglena	*Phacus*
Euglena	*Trachelomonas*
Golden algae	*Ophiocytium*
Golden algae	*Tribonema*
Golden algae	*Centritractaceae*
Golden algae	*Dynobryon*
Golden algae	*Coscinodiscus*
Golden algae	*Cyclotella*
Golden algae	*Melosira*
Golden algae	*Stephanodiscus*
Golden algae	*Biddulphia*
Golden algae	*Tabellaria*
Golden algae	*Meridion*
Golden algae	*Diatoma*
Golden algae	*Opephora*
Golden algae	*Asterionella*
Golden algae	*Fragilaria*

Table 3.6-2 (Continued)
Phytoplankton Species Collected in the Lower Mississippi River in the Vicinity of WF3

Common Name	Scientific Name
Golden algae	*Synedra*
Golden algae	*Eunotia*
Golden algae	*Achnanthes*
Golden algae	*Cocconeis*
Golden algae	*Rhoicosphenia*
Golden algae	*Bebissonia*
Golden algae	*Frustulia*
Golden algae	*Gyrosigma*
Golden algae	*Mastogloia*
Golden algae	*Navicula*
Golden algae	*Neidium*
Golden algae	*Pinnularia*
Golden algae	*Pleurosigma*
Golden algae	*Stauroneis*
Golden algae	*Gomphonema*
Golden algae	*Amphora*
Golden algae	*Cymbella*
Golden algae	*Rhopalodia*
Golden algae	*Hantzschia*
Golden algae	*Nitzschia*
Golden algae	*Cymatopleura*
Golden algae	*Surirella*
Dinoflagellate	*Gymnodiniaceae*
Dinoflagellate	*Glenodinium*

Table 3.6-2 (Continued)
Phytoplankton Species Collected in the Lower Mississippi River in the Vicinity of WF3

Common Name	Scientific Name
Dinoflagellate	*Ceratium*
Blue-green algae	*Agmenellum*
Blue-green algae	*Anacystis*
Blue-green algae	*Aphanocapsa (Anacystis)*
Blue-green algae	*Aphanothece (Coccochloris)*
Blue-green algae	*Chroococcus (Anacystis)*
Blue-green algae	*Coelosphaerium*
Blue-green algae	*Dactylococcopsis*
Blue-green algae	*Gomphosphaeria*
Blue-green algae	*Microcystis (Polycystis)*
Blue-green algae	*Phormidium*
Blue-green algae	*Spirulina*
Blue-green algae	*Anabaena*
Blue-green algae	*Nodularia*

(EOI 2008b, Table 2.4-10)

Table 3.6-3
Fishes of the Lower Mississippi River near WF3

Common Name	Scientific Name[a]
Alligator gar	*Atractosteus spatula*
American eel	*Anguilla rostrata*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black buffalo	*Ictiobus niger*
Blacktail redhorse	*Moxostoma poecilurum*
Blacktail shiner	*Cyprinella venusta*
Blue catfish	*Ictalurus furcatus*
Bluegill	*Lepomis macrochirus*
Bluehead chub	*Nocomis leptocephalus*
Bluntnose minnow	*Pimephales notatus*
Bowfin	*Amia calva*
Bullhead minnow	*Pimephales vigilax*
Carp	*Cyprinus carpio*
Chain pickerel	*Esox niger*
Channel catfish	*Ictalurus punctatus*
Chestnut lamprey	*Ichthyomyzon castaneus*
Creek chubsucker	*Erimyzon oblongus*
Dollar sunfish	*Lepomis marginatus*
Emerald shiner	*Notropis atherinoides*
Fathead minnow	*Pimephales promelas*
Flathead catfish	*Pylodictis olivaris*
Flathead chub	*Platygobio gracilis*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Golden shiner	*Notemigonus crysoleucas*
Goldeye	*Hiodon alosoides*

Table 3.6-3 (Continued)
Fishes of the Lower Mississippi River near WF3

Common Name	Scientific Name[a]
Green sunfish	*Lepomis cyanellus*
Gulf pipefish	*Syngnathus scovelli*
Largemouth bass	*Micropterus salmoides*
Longnose gar	*Lepisosteus osseus*
Mimic shiner	*Notropis volucellus*
Mississippi silverside	*Menidia audens*
Pugnose minnow	*Opsopoeodus emiliae*
Red shiner	*Cyprinella lutrensis*
Redear sunfish	*Lepomis microlophus*
Redfin pickerel	*Esox americanus*
River carpsucker	*Carpiodes carpio*
River shiner	*Notropis blennius*
Sauger	*Sander canadensis*
Shortnose gar	*Lepisosteus platostomus*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Silver chub	*Macrhybopsis storeriana*
Silverband shiner	*Notropis shumardi*
Silvery minnow	*Hybognathus nuchalis*
Skipjack herring	*Alosa chrysochloris*
Smallmouth buffalo	*Ictiobus bubalus*
Southern brook lamprey	*Ichthyomyzon gagei*
Speckled chub	*Macrhybopsis aestivalis*
Spotted bass	*Micropterus punctulatus*
Spotted gar	*Lepisosteus oculatus*
Spotted sucker	*Minytrema melanops*
Steelcolor shiner	*Cyprinella whipplei*

Table 3.6-3 (Continued)
Fishes of the Lower Mississippi River near WF3

Common Name	Scientific Name[a]
Stoneroller	*Campostoma anomalum*
Striped bass	*Morone saxatilis*
Threadfin shad	*Dorosoma petenense*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
Yellow bass	*Morone mississippiensis*

(Douglas 1974)

a. Scientific names are taken from Page et al. 2013.

Table 3.6-4
Commercial and Recreational Fish Species in the Vicinity of WF3

Common Name	Scientific Name	Commercial Importance	Use
Alligator gar	*Atractosteus spatula*	Commercial fishery	Sportfish
Bigmouth buffalo	*Ictiobus cyprinellus*	Commercial fishery	Sportfish
Blacktail redhorse	*Moxostoma poecilurum*	Food species	Food species
Blue catfish	*Ictalurus furcatus*	Food species	Sportfish
Bluegill	*Lepomis macrochirus*	Food species	Sportfish
Carp	*Cyprinus carpio*	Commercial fishery	Sportfish
Channel catfish	*Ictalurus punctatus*	Commercial fishery	Sportfish
Fathead minnow	*Pimephales promelas*	NA	Baitfish
Flathead catfish	*Pylodictis olivaris*	Commercial fishery	Sportfish
Freshwater drum	*Aplodinotus grunniens*	Commercial fishery	Sportfish
Gizzard shad	*Dorosoma cepedianum*	NA	Baitfish
Green sunfish	*Lepomis cyanellus*	NA	Sportfish
Largemouth bass	*Micropterus salmoides*	Food species	Sportfish
Longnose gar	*Lepisosteus osseus*	Food species	Sportfish
Redear sunfish	*Lepomis microlophus*	NA	Sportfish
River carpsucker	*Carpiodes carpio*	NA	Sportfish
River shiner	*Notropis blennius*	NA	Baitfish
Shortnose gar	*Lepisosteus platostomus*	Commercial fishery	Sportfish
Skipjack herring	*Alosa chrysochloris*	NA	Baitfish
Smallmouth buffalo	*Ictiobus bubalus*	Commercial fishery	Sportfish
Stoneroller	*Campostoma anomalum*	NA	Baitfish
Striped bass	*Morone saxatilis*	NA	Sportfish
White crappie	*Pomoxis annularis*	NA	Sportfish

(Species' likely presence is derived from Douglas 1974; scientific names from Page et al. 2013.)

NA: Indicates a fish which is not commercially important in the vicinity of WF3.

Table 3.6-5
Federally Listed Species in St. Charles and St. John the Baptist Parishes, Louisiana

Group	Common Name	Scientific Name	Parish	Occurrence	Status
Mollusk	Alabama heelsplitter (inflated heelsplitter) mussel	*Potamilus inflatus*	SJB	Possible	Threatened
Fish	Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	SC/SJB	Known	Threatened
Fish	Pallid sturgeon	*Scaphirhynchus albus*	SC/SJB	Known	Endangered
Bird	Sprague's pipit[(a)]	*Anthus spragueii*	SC/SJB	Known	Candidate
Mammal	West Indian manatee	*Trichechus manatus*	SC/SJB	Seasonal	Endangered

(USFWS 2014b)

a. Species also protected under the Migratory Bird Treaty Act.

SC: St. Charles Parish

SJB: St. John the Baptist Parish

Table 3.6-6
State-Listed Species in St. Charles and St. John the Baptist Parishes, Louisiana

Group	Common Name	Scientific Name	Parish	Status
Plant	Correll's false dragon-head	*Physostegia correllii*	SC	S1
Plant	Floating antler-fern	*Ceratopteris pteridoides*	SC/SJB	S2
Plant	Golden canna	*Canna flaccida*	SC	S4?
Plant	Marshland flatsedge	*Cyperus distinctus*	SC	S1
Plant	Rooted spike-rush	*Eleocharis radicans*	SJB	S1?
Plant	Square-stemmed monkey flower	*Mimulus ringens*	SC	S2
Plant	Swamp milkweed	*Asclepias incarnate*	SC/SJB	S2
Plant	Western umbrella sedge	*Fuirena simplex*	SC	S1
Fish	Paddlefish	*Polyodon spathula*	SC/SJB	S4
Fish	Pallid sturgeon	*Scaphirhynchus albus*	SC/SJB	S1
Reptile	Alligator snapping turtle	*Macrochelys temminckii*	SJB	S3
Bird	Bald eagle[a]	*Haliaeetus leucocephalus*	SC/SJB	S3
Bird	Osprey[a]	*Pandion haliaetus*	SJB	S3
Mammal	West Indian manatee	*Trichechus manatus*	SC/SJB	S1N

(LDWF 2015b)

a. Species also protected under the Migratory Bird Treaty Act.

SC: St. Charles Parish

SJB: St. John the Baptist Parish

State Status Ranks

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation.

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation.

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations).

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations).

S5 = demonstrably secure in Louisiana (1000+ known extant populations).

(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding).

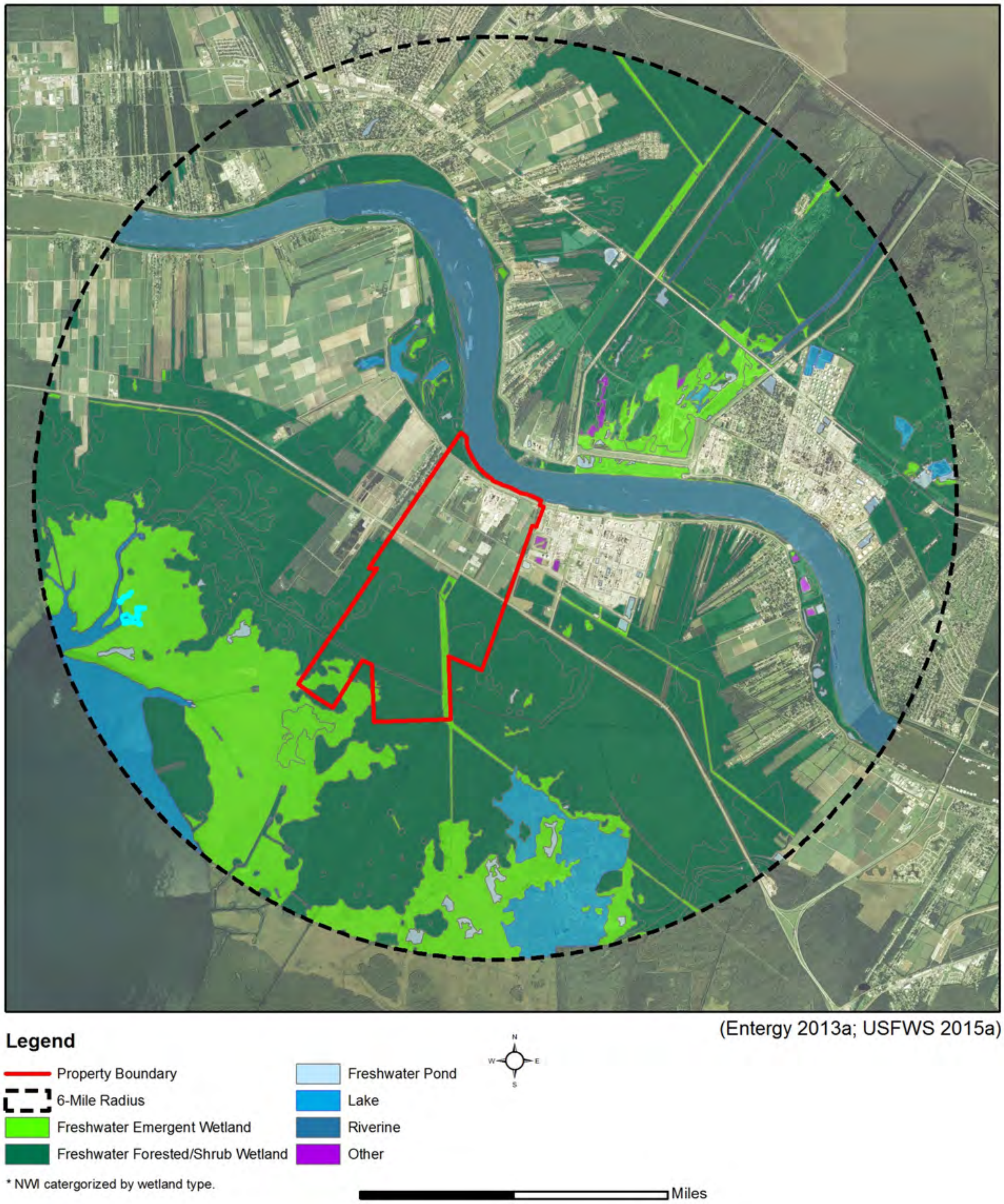


Figure 3.6-1
Wetlands, 6-Mile Radius of WF3

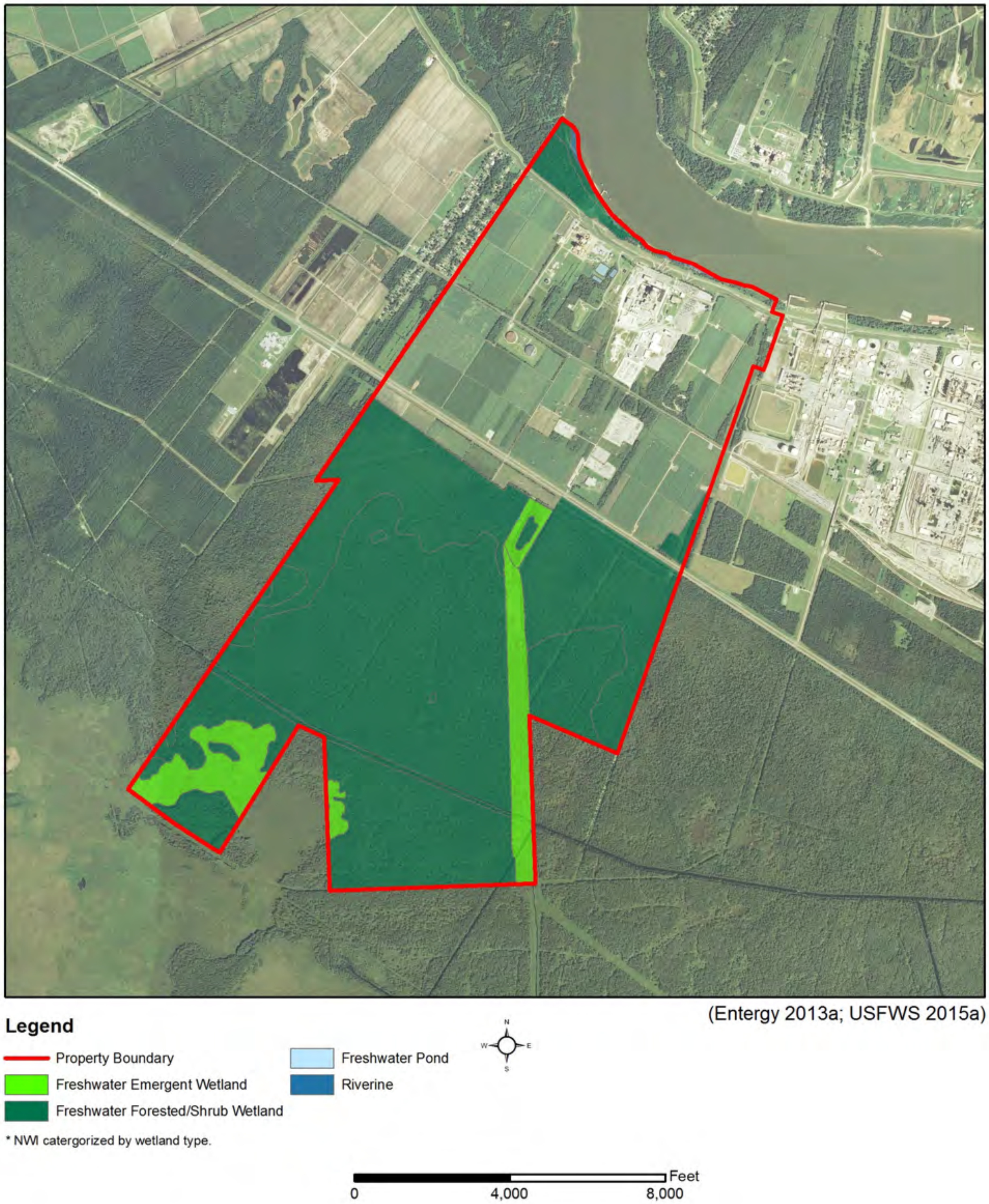


Figure 3.6-2
Wetlands, Entergy Louisiana, LLC Property

3.7 Historic and Cultural Resources

Cultural resources include prehistoric era and historic era archaeological sites and objects, architectural properties and districts, and traditional cultural properties, which are defined as significant objects or places important to Native American tribes for maintaining their culture (USDOI 1998). Of particular concern are those cultural resources that may be considered eligible for listing on the National Register of Historic Places (NRHP). Any cultural resources listed on or eligible for the NRHP are considered historic properties under the National Historic Preservation Act (NHPA) [16 USC 470].

Prior to taking any action to implement an undertaking, Section 106 of the NHPA requires the NRC as a federal agency to do the following:

- Take into account the effects of an undertaking (including issuance of a license) on historic properties, including any district, site, building, structure, or object included in or eligible for inclusion in the NRHP.
- Afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertaking.

To provide early consultation for the Section 106 process, Entergy contacted the Louisiana State Historic Preservation Office (SHPO) for informal consultation concerning the WF3 LRA and potential effects on cultural resources within the approximately 3,560-acre Entergy Louisiana, LLC property and on historic properties within a 6-mile radius of WF3 (Attachment C). Native American groups recognized as potential stakeholders were also consulted by Entergy with the opportunity for comment (Attachment C).

In support of license renewal, Coastal Environments, Inc. (CEI) developed a report, which summarizes the results of a background literature search conducted of previous archaeological investigations made on the Entergy Louisiana, LLC property, a review of archival and secondary historical sources, and a property walkover. Previous cultural resources investigation reports, archaeological site forms, and historic structure records on file with the Louisiana Department of Culture, Recreation, and Tourism were examined for the report. In addition, a variety of internet archival depositories were consulted, as were resources housed at the Louisiana State Library. All of these data sets were used to develop an archaeological sensitivity analysis of the Entergy Louisiana, LLC property and to identify all known archaeological sites within a 6-mile radius of WF3, as well as properties listed on the NRHP within that same radius. (CEI 2014)

The approximately 3,560-acre Entergy Louisiana, LLC property consists primarily of wetlands, agriculture, and developed areas. The land within a 6-mile radius is primarily wetlands (Figure 3.1-2). For the purpose of license renewal, the aboveground area of potential effects (APE) is defined as the entire Entergy Louisiana, LLC property and everything within a 6-mile radius of WF3. The aboveground APE considers the visual integrity of historical properties in relation to WF3's continued operations. The archaeological APE is considered bounded by the approximately 3,560 acres, where ground disturbance, though unanticipated during WF3 operations throughout the license renewal period, might compromise the physical integrity of archaeological data.

The only transmission lines associated with WF3 that are considered within the scope of this 10 CFR Part 51 evaluation are located within the developed industrialized area of the Entergy Louisiana, LLC property and, as such, are already contained within both the aboveground and the archaeological APE. Portions of the Mississippi River and Lac des Allemands are also included within a 6-mile radius (Figure 3.0-3).

Although construction of the existing WF3 facility itself would have impacted any archaeological resources that may have been located within its footprint, much of the surrounding area remains largely undisturbed and is still used for agriculture. Two areas of archaeological deposits on the property, both associated with the former Waterford Plantation (16SC41), have already been identified as being partially eligible for inclusion on the NRHP. Two additional areas that likely contain *in situ* archaeological deposits have also been identified: the Waterford Plantation sugarhouse (16SC41) and the nearby Killona Plantation sugarhouse. Archival research has also identified the potential for early 18th century occupation of the property.

The CEI (2014) literature review for previously recorded archaeological sites included the APE and the area within a 6-mile radius of WF3. The purpose of the literature review was to inventory all previously and newly recorded archaeological sites on the approximately 3,560-acre Entergy Louisiana, LLC property and within a 6-mile radius of WF3, regardless of NRHP status, to help develop an understanding of the local context. Although portions of the Mississippi River and Lac des Allemands are contained within a 6-mile radius, no underwater cultural resources that reflect historical activities on the river or lake were found to have been recorded.

The results of the recent (2014) cultural resource assessment and previous assessments show that within the 3,560-acre APE and 6-mile radius, there are 10 resources that are either NRHP listed, determined eligible, or recommended eligible for the NRHP, or have the equivalent eligibility or potential eligibility under national heritage or legacy commission designations. These 10 resources include six aboveground properties and four archaeological sites (16SC41, 16SC50, 16SC51, and 16SC80) (Tables 3.7-1 and 3.7-2). One of these 10 resources, the former Waterford Plantation (16SC41) and associated areas occupy almost half of the approximately 3,560-acre Entergy Louisiana, LLC property (Figure 3.7-1). Only a portion of site 16SC41 is determined eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown. (CEI 2014)

Beyond the approximately 3,560-acre Entergy Louisiana, LLC property, but within a 6-mile radius, are eight NRHP-listed properties (Figure 3.7-2), including six aboveground properties and the Kenner and Kugler Cemeteries Archaeological District, which comprises two archaeological sites (16SC50 and 16SC51). One more unnamed archaeological site (16SC80) has an eligible status, but is yet unlisted. (CEI 2014)

Finally, 32 archaeological resources that are determined not eligible for the NRHP or remain unevaluated are also located within a 6-mile radius of WF3 (Table 3.7-1). None of these 32 archaeological resources are located on the approximately 3,560-acre Entergy Louisiana, LLC property. Of these 32 resources, seven have been determined ineligible by the SHPO, while two have been determined as partially ineligible/unknown. The remaining 23 resources have not been evaluated and are classified as unknown. (CEI 2014)

No traditional cultural properties have been suggested to date by research or by potentially interested parties for the Entergy Louisiana, LLC property or within a 6-mile radius of WF3, but one area on the Entergy Louisiana, LLC property has a high probability of having been the site of a 1718–1721 Ouacha Indian village (Figure 3.7-3). The location was later the site of two German settlements between 1721 and 1724. (CEI 2014)

3.7.1 Land Use History

The land use history for WF3 and the surrounding region was developed as part of a Phase 1A literature review and archaeological sensitivity assessment of the Entergy Louisiana, LLC property and is summarized here. Section 3.7.2 provides a more detailed discussion of historical land use as part of the cultural history.

The Entergy Louisiana, LLC property and the surrounding region hold evidence of both prehistoric and historic occupation by Native Americans and Euroamericans. Archaeological records suggest that the Entergy Louisiana, LLC property and the surrounding area were potentially occupied by Native American populations for the Paleo-Indian Period (prior to 6000 BC), the Archaic Period (ca. 6000 BC to 1500 BC), the Woodland Period (ca. 1500 BC to AD 1200), and the Mississippi Period (AD 1200 to 1450). The principal aboriginal groups encountered by European explorers in southeastern Louisiana were the Acolapissa, Quinipissa, Bayagoula/Mugulasha, Ouacha (Washa), Chaouacha, Tangipahoa, and Houma. (CEI 2014)

The National Park Service's (NPS's) Native American Consultation Database, developed as part of NPS's national program for compliance with the Native American Graves Protection and Repatriation Act of 1990, identified no federally recognized Indian tribes with judicially established land claims within St. Charles or St. John the Baptist parishes (NACD 2014).

The regional historic era cultural background begins with European exploration and settlement by the French in the early 17th century, followed by Spanish control west of the Mississippi and British control east of the Mississippi in the mid-18th century. In 1800, control reverted to France, which in turn sold the possession to the United States as the Louisiana Purchase in 1803. Louisiana became a state in 1812. Sugarcane production, rice cultivation, and logging were the primary economic activities in the area (Figure 3.7-4). (CEI 2014)

Between 1831 and 1844, area plantations began to be consolidated; the present study area was no different. Waterford Plantation, Killona Plantation, and Providence Plantation were all the result of consolidation. As these plantations expanded their cultivated fields and steam power usage became more widespread, it became both more efficient and economical to build new sugarhouses away from the river and closer to the center of the agricultural fields. Each plantation's big house, however, would have remained near the riverbank. (CEI 2014)

In January 1861, Louisiana seceded from the Union with the rest of the Confederacy, and the American Civil War began in April of the same year. After the war ended in 1865, sugarcane production dropped because planters had lost both financial resources and slaves; many turned to rice cultivation as it was less expensive and less labor intensive. (CEI 2014)

By the turn of the 20th century, timbering had largely overtaken sugarcane cultivation in marginal areas (Figure 3.7-5). Along the river, sugarcane cultivation was still widespread, but not to the extent at which it had once been grown. By the second quarter of the 20th century, however, most of the region had been timbered out and the industry was in decline. Plantations and truck farms began to give way to industrial complexes, particularly those related to petroleum, during the second decade of the century. (CEI 2014)

By 1921, a rail spur had been constructed to connect the Killona sugarhouse to the nearby Texas and Pacific Railroad (now Union Pacific Railroad). A remnant of that spur is still extant. By that same year, the Waterford sugarhouse had been abandoned, and likely demolished, and both Waterford and Killona plantations had become collectively known as Waterford. Although still growing sugarcane, an experiment was made in 1926 to grow sugar beets there. It is presumed that new facilities would have been required, or alterations made to existing ones, to process the beets rather than cane. Where those facilities were located is unknown. (CEI 2014)

What was to become the largest refinery in St. Charles Parish began with the construction of the Marine Terminal, a refinery of several 55,000-barrel storage tanks, near the town of Sellers in 1916. This facility, built by the Roxana Petroleum Company, began operations in 1918. Following World War I, an asphalt refinery was built by the New Orleans Refining Company near the Marine Terminal. This refinery became so important to the local economy that the town of Sellers was renamed Norco—the acronym of the New Orleans Refining Company (Figure 3.7-6). In the spring of 1929, Shell Petroleum Corporation (formerly Roxana Petroleum Company) took over the Norco plant and began modernizing the facility. The plant resumed operations in 1930 with 650 workers. (CEI 2014)

The petrochemical industry soon spread to the west bank of St. Charles Parish. To provide an adequate electrical supply to the area's growing industrial base and to burgeoning residential growth, LP&L (later Entergy Louisiana, LLC) established the Little Gypsy power plant at Montz, Louisiana, in 1960. Three years later, the same company acquired Killona and Waterford plantations in order to construct Waterford 1 and 2 (Figure 3.7-7). In September 1970, it was announced that those two units would be joined by a third unit, WF3. (CEI 2014)

Through the mid-20th century, vehicular access to the Killona area could be gained only via River Road (now LA-18). In May 1968, Governor John McKeithen announced that among the state's highway priorities for 1969 was the acquisition of ROW for a new four-lane highway to be built between Killona and U.S. Highway 90 (US-90). At the same time, it was announced that actual construction was to begin the following year for that segment of highway. An additional segment between Killona and the Sunshine Bridge (Louisiana Highway 70) was to be constructed between 1971 and 1973. Then known alternatively as the Donaldsonville-New Orleans Highway or the West Bank Expressway, construction began on the 11.7-mile section of LA-3127 between US-90 and Killona in 1971 (Figure 3.7-8), and it was opened to traffic in July 1975. (CEI 2014)

While none of the structures associated with the Waterford Plantation were extant by the 1950s (Figure 3.7-9), many of those associated with neighboring Killona Plantation were still standing until the 1970s (Figure 3.7-8). Both properties were acquired by LP&L in 1963. In August 1970, LP&L announced plans to begin construction on the Waterford Generating Station. Now known as Waterford 1 and 2, construction of the first of two 430,000-kilowatt (kW) gas and oil-fired generating units was to be completed in January 1974. The second unit was to be completed in 1975. Before construction began on Waterford 1 and 2, LP&L announced plans to begin construction of WF3 immediately next to them in September 1970. The ground-breaking ceremony for Waterford 1 was held in May 1971. (CEI 2014)

When plans for WF3 were announced, it was anticipated that the facility would be completed by 1977. However, it was not until May 1974 that a limited work authorization was issued to LP&L to begin preliminary construction work for WF3 (Figures 3.7-10 and 3.7-11). Construction was further delayed by major design changes in 1979 and the facility was not brought online until 1985 (Figure 3.7-12). The most recent addition to Entergy Louisiana, LLC's property was the construction of Waterford 4 in 2008. (CEI 2014)

3.7.2 Cultural History

3.7.2.1 Paleo-Indian Period (Prior to 6000 BC)

Initial human occupation of this region occurred in the Paleo-Indian period. Archaeological evidence from other portions of North America suggests that the populations involved were probably small bands of hunter-gatherers adapted to terminal Pleistocene or very early Holocene environments. The early portion of the period is characterized by the widespread fluted-point tradition generally dated prior to 8500 BC. A few of these points resembling the Clovis type have been found in the parishes north of Lake Pontchartrain, generally made of exotic materials. (CEI 2014)

The later Paleo-Indian period is marked by the divergence of the fluted-point tradition into distinct sub-traditions. One of these includes Dalton and related projectile points found widely throughout the Southeast and Midwest. Some researchers have argued that the Dalton horizon dates from approximately 8500 to 7900 BC. Others suggest a slightly later ending date of 7500 BC, and that it represents an adaptation to the changing environments found at the end of the Pleistocene. One indication of this is the addition of a heavy woodworking tool, the Dalton adz, to an otherwise Paleo-Indian tool kit. Within southeast Louisiana, others have proposed the Jones Creek phase based on finds of Plainview, Dalton, and San Patrice points at the Jones Creek (16EBR13) and Blackwater Bayou (16EBR33) sites in East Baton Rouge Parish. (CEI 2014)

3.7.2.2 Archaic (6000 to 1500 BC)

3.7.2.2.1 Early Archaic Period, 6000–5000 BC

In much of eastern North America, the Early Archaic period represents a time of adaptation to the changing environments associated with early post-glacial climatic regimes. The available palynological evidence indicates that the present region lies beyond the southern boundary of boreal forest expansion, suggesting that the transition to Holocene climatic conditions may have been much less marked here than further north. While there is a distinct technological break with the earlier fluted-point tradition during this period, there are obvious continuities with transitional complexes such as San Patrice. The side-notched point style that appeared in the latter becomes one of the marker traits of the Early Archaic. Corner-notched types such as Palmer and Jude developed during this period, as did stemmed types such as Kirk and Hardin. In southeast Louisiana, archaeologists have proposed the St. Helena phase based on surface finds of Kirk and Palmer points in St. Helena Parish and adjacent parishes north of Lake Pontchartrain. (CEI 2014)

3.7.2.2.2 Middle Archaic Period, 5000–3000 BC

The Middle Archaic period is characterized by widespread regional differentiation of cultures, and a number of developments in ground stone technology. The latter includes grooved axes, atlatl weights, and pendants, as well as more extensive use of grinding stones which first appeared in the previous period. This period also roughly corresponds with the Hypsithermal Interval, which brought increased warmth and aridity to areas bordering the Great Plains. The impact of this climatic shift on other portions of the Southeast is not well known at present. It may be that the intensive shellfish collecting evidenced at some riverine sites of this period represents a response to this change. Others have also suggested that plant collecting increased in importance during this time. (CEI 2014)

There are also indications of increased sedentism and more complex social organization during this period in the form of increased site size, midden development, the use of storage pits, utilization of local raw materials, and an increase in the number of burials. Additionally, evidence of Middle Archaic mound building has been found at several sites in southeast Louisiana. The function of these mounds among what are thought to have been hunting and gathering societies is unclear, although one site, Monte Sano Bayou (16EBR17), contained what may be cremation burials. Other Early Archaic mound sites in the region include Hornsby (16SH21) and the LSU Campus mounds (16EBR6) in St. Helena and East Baton Rouge parishes, respectively. (CEI 2014)

3.7.2.2.3 Late Archaic Period, 3000–1500 BC

Research elsewhere in eastern North America suggests that the Late Archaic period was a time of marked population increases and the beginning of extensive trade networks. The evidence for the former is seen in the appearance of large habitation sites such as Indian Knoll, Kentucky, while the latter is reflected in the exotic raw materials that occur at some sites. Cultivation involving several native seed plants, including sumpweed, chenopod, and sunflower, as well as squash, which is now thought to have been independently domesticated in eastern North America, also began during this period. The only Late Archaic phase identified in southeast Louisiana to date is the Pearl River phase, which is based on material from a series of oyster shell middens located near the mouth of the Pearl River. The diagnostic artifacts associated with this phase include Kent, Pontchartrain, Macon, Hale, and Palmillas projectile points and various types of atlatl weights. (CEI 2014)

3.7.2.3 Woodland (1500 BC to AD 1200)

3.7.2.3.1 Poverty Point Period, 1500–500 BC

In much of eastern North America this time interval witnessed a transition from Archaic hunting and gathering cultures to Woodland cultures characterized by food production, pottery manufacture, and mound building. Current interpretations suggest that these three features have different and possibly unrelated origins. Tropical domesticates had reached the East prior to 2000 BC, and there is good evidence of cultivation of native seed plants in the Kentucky and Ohio area by 1000 BC. Ceramics probably appeared somewhat earlier than this in the third millennium BC along the Atlantic Coast, and mound building may have developed independently in several areas by 1000 BC. (CEI 2014)

In the Lower Mississippi Valley, this transition is marked by the development of the distinctive Poverty Point culture. Among the material characteristics of this culture are baked clay balls or Poverty Point objects, microlith and lapidary industries, and earthworks. Pottery is not abundant, but fiber-tempered and sand-tempered wares have been found at several sites. Subsistence data from the J. W. Copes site (16MA47) suggest a continuation of an Archaic pattern of intensive collecting of wild plants and animals, supplemented by the cultivation of squash. (CEI 2014)

Two Poverty Point period phases have been identified in southeast Louisiana. The earlier Bayou Jasmine phase is based on data from the Bayou Jasmine site (16SJB2) in St. John the Baptist Parish and the Linsley site (16OR40) in Orleans Parish. Both of these sites are *Rangia* shell and earth middens located on abandoned distributary channels of the St. Bernard delta. Poverty Point objects have been recovered from both sites. The succeeding Garcia phase is based on data from the Garcia site (16OR34), a *Rangia* midden located near the eastern end of Lake Pontchartrain. One of the distinctive features of the material from this site is the extensive microlith industry. (CEI 2014)

3.7.2.3.2 Tchula Period, 500 BC–AD 1

This period in the Lower Mississippi Valley is characterized by the integration of pottery manufacture and mound building into a single cultural system. In the southern portion of the valley, these developments take place in an archaeological culture called Tchefuncte. Originally defined in southern Louisiana, Tchefuncte culture is now recognized to extend as far north as the vicinity of Clarksdale, Mississippi, and as far west as northeast Texas. The diagnostic artifacts of this and most of the succeeding prehistoric cultures of the Lower Mississippi Valley are the distinctive ceramics. Tchefuncte pottery is characterized by a laminated paste that appears to lack tempering. Replication studies suggest that the laminated texture is simply the result of minimal preparation of the raw material, an expected feature of an incipient ceramic technology. Other diagnostic attributes of Tchefuncte ceramics include the use of podal supports and decorative techniques such as jab-and-drag incising. (CEI 2014)

Evidence for Tchefuncte subsistence comes largely from faunal assemblages recovered from the Bayou Jasmine (16SJB2) and Morton Shell Mound (16IB3) sites and floral remains from the latter site. The faunal assemblages vary somewhat between the two sites, probably due to habitat differences and perhaps to functional differences between the sites (a base camp in the case of Morton Shell Mound and a fishing camp in the case of Bayou Jasmine). The assemblage from Morton Shell Mound is dominated by white-tailed deer, followed by small mammals and fish, while that from Bayou Jasmine indicates an emphasis on fish and shellfish. (CEI 2014)

The floral remains from Morton Shell Mound document collecting of wild fruits and nuts, but also include the remains of two possible tropical cultigens, squash and bottle gourd, and one possible native cultigen, knotweed. Other archaeologists reviewed the evidence from the site and argued that there was not conclusive evidence of the presence of cultigens. (CEI 2014)

Mound construction, now well documented for the preceding Late Archaic and Poverty Point periods, is presently only known from one Tchefuncte site, the Lafayette Mounds (16SM17). Data from this site were recently analyzed and strongly suggests that the mound was built during the Tchefuncte occupation of the site. Evidence was also found for Tchefuncte mounds at three other sites: Coulee Crow (16SM17), located on the Vermilion River, and Lake Louis (16CT24) and Boothe Landing (16CT31), both located on the lower Ouachita River. (CEI 2014)

Two Tchula period phases have been identified in southeast Louisiana. One, the Pontchartrain phase, is based on early work at sites around Lake Pontchartrain, including the Tchefuncte (16ST1), Big Oak Island (16OR6), and Little Woods (16OR1-5) sites. It includes occupations that probably span the entire period and eventually should be subdivided. The other phase, Beau Mire, is based on research at the Beau Mire site (16AN17) in Ascension Parish. This phase is thought to date to the latter portion of the period. (CEI 2014)

3.7.2.3.3 Marksville Period, AD 1–400

In many parts of eastern North America this period is marked by evidence of extensive interregional contact through a phenomenon labeled the Hopewell Interaction Sphere. The focal points of this interaction sphere were societies in the Ohio and Illinois river valleys, which acquired large quantities of exotic raw materials, including obsidian, copper, mica, shark's teeth, and marine shells, in exchange for specialized finished goods such as copper panpipes and ear spools. Various theories have been offered to explain the nature of this interaction, some emphasizing socio-religious systems and others pointing to economic networks, but the problem remains unresolved. Within the Lower Mississippi Valley, the culture that participated in this interaction sphere is termed Marksville. (CEI 2014)

Some have argued that the Marksville culture developed out of Tchefuncte as a result of intermittent contacts with cultures in the Illinois River valley area, but they only speculate on the nature of these contacts. It was emphasized that the evidence for Hopewellian interaction is largely limited to the Marksville mortuary system and aspects of ceramic decoration. Other cultural subsystems, such as subsistence and settlement pattern, may have changed very little. Economic data from Marksville sites are extremely limited, but information from contemporary occupations in the Midwest suggests a pattern of intensive collecting of wild plant foods and high-density faunal resources, such as fish, supplemented by cultivation of native North American seed plants and a few tropical cultigens. Current evidence suggests that while maize may have been present at this time, it was of only minor importance to the economy. (CEI 2014)

Two Marksville period phases, Labranche and Gunboat Landing, have been defined in the vicinity of the present project. Labranche was set up on the basis of collections from sites around Lake Pontchartrain, including Big Oak Island (16OR6), Bayou Labranche Mouth (16SC11), and Bayou Trepagnier (16SC10). Based on the presence of an early variety of Marksville Stamped, the phase is thought to date to the early portion of the period. Gunboat Landing is a late Marksville phase proposed on the basis of excavations at several sites on the lower Amite River. (CEI 2014)

3.7.2.3.4 Baytown Period, AD 400–700

The Late Woodland era has been characterized as a time of cultural decline in much of the Eastern Woodlands. However, research in the last two decades has shown that, to the contrary, the late Woodland was a time of fundamental cultural changes that would transform many of the economies and societies of the native southeastern United States, setting the stage for the complex late historic cultures that were to follow. During the early part of the Late Woodland, maize agriculture began to dominate subsistence economies in the middle Mississippi, Ohio, and Illinois river valleys. Mound-building cultures with indications of incipient social ranking emerged in the Arkansas River lowlands and along the Florida Gulf Coast. (CEI 2014)

Troyville culture dominates the southern half of the Lower Mississippi Valley during this time period, from the northern Tensas and southern Yazoo basins down to the Gulf of Mexico. Troyville ceramics are characterized by the persistence of certain Marksville types such as Marksville Stamped, Marksville Incised, and Churupa Punctated, but in more "broken-down" varieties, such as *Bayou Rouge*, *Anglim*, and *Watson*. The appearance of Mulberry Creek Cord Marked, Larto Red Filmed, and early varieties of Coles Creek Incised and French Fork Incised is also seen during this period, the last two foreshadowing the arrival of Coles Creek culture. (CEI 2014)

Stone tool traditions were also undergoing important changes in this period. Small chipped stone points begin to supplant larger dart points, heralding the arrival of the bow and arrow. Subsistence data, although limited, suggest continuities with the preceding periods and their hunting and gathering economies. Evidence for maize cultivation is lacking in the Lower Mississippi Valley at this time, but it does appear that native seed crops were being cultivated in the northern reaches of the Lower Mississippi Valley. (CEI 2014)

Mound construction continued in the Baytown Period, and there are indications that the function of some of these mounds began to shift from cemeteries to building substructures. Burials appear to become more focused on the interment of individuals rather than large groups, and platform mounds begin to supplant accretional burial mounds, often covering them. These changes have been interpreted by some as important steps in the evolution of ranked societies in the Lower Mississippi Valley, possibly the first signs of important social change since mound construction began in the region. (CEI 2014)

The Troyville-like culture present on the Louisiana coast during Baytown times is poorly understood. To date, most sites yielding examples of painted pottery on a Baytown Plain paste have been assigned to this time frame. The Whitehall phase, named for the Whitehall site (16LV19) on the Amite River, is presently the only phase identified in the vicinity of the present project area. (CEI 2014)

Authorities have proposed dividing the Baytown Period in the Barataria Basin and adjacent areas into early (Grand Bayou) and late (Des Allemands) phases. Both of these phases are considered to be temporal subdivisions of the "coastal Troyville" culture, a somewhat poorly defined entity related to the Troyville culture of the Tensas and lower Red River basins. Grand Bayou phase sites are characterized by the presence of ceramics from the so-called terminal Marksville ceramic tradition. The Des Allemands phase is differentiated by the absence of Marksville/Troyville continuum ceramics (i.e., Marksville Incised, Marksville Stamped, Churupa Punctated), and the initial appearance of early Weeden Island-related ceramics, especially French Fork Incised, and early variants of Mazique Incised, such as *var. Bruly*. Isle Bonne is considered to be the type site for the Des Allemands phase. (CEI 2014)

3.7.2.3.5 Coles Creek Period, AD 700–1200

Elsewhere in eastern North America, this time interval corresponds to the latter portion of the Late Woodland period and the beginning of the Mississippi period. Within the Lower Mississippi Valley a cultural florescence that shows a marked resemblance to Weeden Island culture of northwest Florida occurs during this period. The precise nature of the relationship of Coles Creek culture to Weeden Island is uncertain, but the similarities in ceramic decoration and community pattern are unmistakable. Both were characterized by the use of incised, stamped, and punctuated pottery types in which the decorative zone is largely restricted to a band around the rim of the vessel, and by the construction of small platform mounds around plazas. The latter are generally interpreted as an indication of the development of stratified social systems during this period. These societies were apparently based on economies that included the cultivation of maize. While direct evidence for this is lacking from sites in the Lower Mississippi Valley, the remains of corn have been recovered from Weeden Island sites and from contemporary Late Woodland sites in the Midwest. (CEI 2014)

The development of substantial programs of mound construction, which tend to follow similar patterns from site to site, as well as the inferred presence of mound-top residence, have been interpreted as an indication of the development of ranked social systems during this period. Although mound centers tend to be relatively small, a few Coles Creek mound sites stand out in both the number and size of mounds. Some mound sites, such as Osceola (16TE2), Mott (16FR11), Raffman (16MA20), and Insley (16FR3) had considerably more mounds than most other sites in the Lower Mississippi Valley. Mott supported as many as 13 mounds, and is seen by some authors as a paramount center. The recently rediscovered Bayou Grande Cheniere site (16PL159) is another large multimound (*n*=12) site. At a few sites, such as Mt. Nebo (16MA18) in north Louisiana and Lake George (22YZ557) in the Yazoo Basin, some individuals appear to have been treated differently in death than others, suggesting differential status. (CEI 2014)

Coles Creek societies were once thought to have been based on economies that included the cultivation of maize; however, ethnobotanical data suggest that neither maize nor the native North American seed crops were of importance at this time. Intensive fishing, hunting, and gathering supplemented by cultivation of a few plants, such as squash and gourds, are currently believed to have provided the subsistence base. (CEI 2014)

Three sequential Coles Creek phases (Bayou Cutler, Bayou Ramos, and St. Gabriel) are currently recognized for southeast Louisiana. The earliest of these, the Bayou Cutler phase (AD 700–850), is defined materially by many of the same artifact types noted for contemporary phases to the north, as well as several unique to the area. Present are many of the so-called "classic" Coles Creek markers: Coles Creek Incised, *vars. Coles Creek*, *Serentz*, *Dozier*, *Wade*, and *Athanasio*; Mazique Incised, *vars. Back Ridge* and *Sweet Bay*; Pontchartrain Check Stamped, *var. Pontchartrain*; and French Fork Incised, *vars. French Fork*, *Brashear*, *Wilzone*, and *Larkin*. The popularity of red-filmed pottery waned in this period, and plainwares became somewhat thinner and finer than in preceding periods. Decoration again was largely restricted to the upper third of the vessel, although *var. Pontchartrain* is an all-over decorated variety, perhaps accounting for its large numbers in many collections. (CEI 2014)

The succeeding Bayou Ramos phase was proposed using data from the Bayou Ramos I site (16SMY133). This is a late Coles Creek phase, defined by typical middle to late Coles Creek markers such as Coles Creek Incised, *var. Mott*; Mazique Incised, *var. King's Point*; Beldeau Incised, *var. Beldeau*; Avoyelles Punctated, *var. Avoyelles*; and Pontchartrain Check Stamped, *vars. Tiger Island* and *Crawford Point*. (CEI 2014)

The terminal Coles Creek St. Gabriel phase was set up on the basis of data uncovered from the type site (16IV128) in Iberville Parish. Markers for this phase include Coles Creek Incised, *vars. Hardy* and *Hilly Grove*; Mazique Incised, *var. Manchac*; Evansville Punctated, *var. Wilkinson*; Harrison Bayou Incised, *vars. Harrison Bayou* and *Bunkie*; and minor quantities of Plaquemine Brushed, *var. Plaquemine*. (CEI 2014)

3.7.2.4 Mississippi Period (AD 1200 to 1450)

The Mississippi period represents the apex of Native American social development in much of eastern North America, featuring highly ranked, chiefdom-level societies relying on the cultivation of Mesoamerican domesticates such as corn, beans, and squash. The most dynamic of these societies was probably centered on the massive Cahokia site in the Central Mississippi Valley around AD 1000. Mississippian culture, as this manifestation is called throughout the Southeast, was characterized by the presence of shell-tempered ceramics and a settlement pattern featuring large, often fortified villages, and mound centers which were the focus of ceremonial and political life for a region. During the first half of the second millennium AD, Mississippian culture spread rapidly through the major river valleys of the Southeast, from the Carolina piedmont to northern Florida and west to the Caddo region of northeast Texas and Oklahoma. (CEI 2014)

In the Lower Mississippi Valley, Mississippian culture encountered an indigenous non-Mississippian culture, and a hybridization of the two occurred. The resident culture is considered to have been Plaquemine, an outgrowth of Coles Creek culture that began about AD 1000. The interaction between Mississippian and Plaquemine culture resulted in gradual changes in the Plaquemine ceramic tradition and settlement pattern. Later in the period, after AD 1400, an actual intrusion of Mississippian groups displaced the resident Plaquemine groups. A somewhat different interpretation of this sequence of events is that the Lower Mississippi Valley culture that experienced the initial Mississippian contact about AD 1100 was Coles Creek, and the resulting hybridization produced Plaquemine culture. The remainder of the period saw a gradual increase in Mississippian influence, at least in the Yazoo Basin, until about AD 1400 when a full Mississippian cultural pattern was achieved in the Lake George phase. (CEI 2014)

This reinterpretation of the cultural sequence resulted in a shift in the established chronologies. Phases such as Crippen Point, Preston, and St. Gabriel, which were formerly considered Plaquemine culture manifestations of the early Mississippi period, were placed late in the Coles Creek period and assigned to a late Coles Creek culture that persisted until AD 1200. Some have suggested moving the beginning of the Mississippi period back to AD 1000 in order to bring the Lower Mississippi Valley into agreement with the Central Mississippi Valley chronology. Under this scheme, Coles Creek culture would persist into the Mississippi period until about AD 1200, when Plaquemine culture appeared. (CEI 2014)

While disagreeing somewhat on the origin of Plaquemine culture, authorities concur that it exhibited numerous continuities with the preceding Coles Creek culture. Several of the Plaquemine ceramic types appear to be direct outgrowths of Coles Creek types. However, there are some changes, including the addition of small amounts of finely ground shell and other organic matter to the pottery and the extension of the decorative field to include the body of the vessel. Mound construction continued on an even greater scale than in the previous period. The mounds became larger, there were more at each site, and there were more sites. Intensive agriculture is presumed to be the economic base on which this florescence was built, but there is presently little direct evidence of it in the Lower Mississippi Valley. (CEI 2014)

Several regional phases of early Plaquemine culture have been identified in southern Louisiana. The closest of these to the present study area is the Barataria phase, based on data provided by excavations by the Delta Chapter of the Louisiana Archaeological Society at the Fleming site (16JE36). The principal ceramic markers of these phases include Anna Incised, *vars. Anna*, *Australia*, and *Evangeline*; L'Eau Noire Incised, *vars. L'Eau Noire* and *Bayou Bourbe*; Carter Engraved; Maddox Engraved; Baytown Plain, *var. Addis*; and mixed grog-and-shell varieties of Bell Plain. The Barataria phase can be distinguished from the contemporary Medora phase of the Baton Rouge area by the absence of Plaquemines Brushed and a relative wealth of curvilinear incised types. (CEI 2014)

It is within this time frame that material of the so-called "Southern Cult" can be found. The strongest representation of cult designs in the southern Lower Mississippi Valley occurs on pottery of the Barataria phase. This is not surprising, given the existence of the Bayou Petre phase in the St. Bernard/Plaquemine area to the east, often associated with the Pensacola variant of Mississippian culture. Other Southern Cult items found in the region include fragments of carved stone discs from the Rosedale (16IV1) and Shellhill Plantation (16SJ2) sites. (CEI 2014)

By AD 1500, new influences began to be felt in the Louisiana coastal zone, as aboriginal groups began to take on the appearance, at least in material culture, of the peoples encountered by the early European explorers. This late Plaquemine culture is recognized by one overextended phase, called Delta Natchezan. This phase includes all southeast Louisiana sites with ceramics similar to those recorded for the protohistoric and historic Natchez. The type site for this phase is Bayou Goula (16IV11), the assumed location of the historic Bayagoula, excavated during the Works Progress Administration era. (CEI 2014)

Principal ceramic markers of the Delta Natchezan phase include Fatherland Incised, *vars. Fatherland* and *Bayou Goula*, and those versions of Addis Plain that contain small amounts of shell, *vars. Greenville* and/or *St. Catherine*. Mazique Incised, *var. Manchac* and Plaquemine Brushed may be considered minor elements in the assemblage, as well. A smattering of shell-tempered Mississippian sherds also was noted at Bayou Goula, principally the types Mississippi Plain and Pocahontas Punctated. The presence of minority amounts of shell-tempered pottery at other Delta Natchezan sites, such as Isle Bonne (16JE60) and Fleming (16JE36) in the Barataria region, argue for a great deal of interaction between the resident Plaquemine peoples and the advancing Mississippians to the north and east. (CEI 2014)

3.7.2.5 Protohistoric and European Contact (AD 1450 to 1700)

Rene Robert Cavelier, Sieur de la Salle, and a small group of French explorers were the first Europeans to lay claim to the area that would become southeast Louisiana, although survivors of Hernando De Soto's expedition had passed by on their journey down the Mississippi River in 1542. La Salle, intent on finding a trade route from Canada to China, traveled downriver to the mouth of the Mississippi, arriving there on April 7, 1682. His attempt to establish a colony in the region was unsuccessful, and it was not until 1699 that the French were able to occupy what would later become Louisiana. In that year, Pierre Le Moyne, Sieur d'Iberville, accompanied by his brother, Jean Baptiste Le Moyne, Sieur de Bienville, established a French settlement on Biloxi Bay (Mississippi) and began to explore the lower Mississippi River area. (CEI 2014)

The principal aboriginal groups encountered by European explorers in southeastern Louisiana were the Acolapissa, Quinipissa, Bayagoula/Mugulasha, Ouacha (Washa), Chaouacha, Tangipahoa, and Houma. The first of these groups, the Acolapissa, moved from present-day St. Tammany Parish to the Mississippi River bank in the early decades of the 1700s. There they settled in several villages, including one in the area in the general vicinity of Gramercy and Laplace. The Acolapissa grew corn and beans, and exploited mast crops as well as the lakes and bayous of the area for fish and waterfowl. Like the Acolapissa, the Tangipahoa were originally from the north shore of Lake Pontchartrain, but had settled along the banks of the Mississippi River by the late 17th century. (CEI 2014)

The principal village of the Bayagoula/Mugulasha was located on the Mississippi River near the town that now bears their name (Bayou Goula). It is not known what the range of their territory would have been in prehistoric times. The Mugulasha were encountered first by La Salle in 1682 in their descent of the Mississippi. This group, then called the Quinipissa, became severely reduced in number by disease after this visit and subsequently joined the Bayagoula. The first recorded contact with the Bayagoula occurred in February of 1699 when a group of Bayagoula and Mugulasha discovered the French at Mobile and attempted to make an alliance. Shortly afterward, in March, Iberville ascended the Mississippi and visited their village on the west bank of the Mississippi, near the mouth of Bayou Lafourche. In 1700, the Bayagoula massacred the Mugulasha and 6 years later were themselves massacred by the Taënsa. The few Bayagoula that survived the 1706 massacre fled downriver to seek the protection of the French. The Bayagoula apparently remained there for only a short period of time before returning upriver to the present-day Donaldsonville area. (CEI 2014)

The first recorded encounter with the Ouacha occurred in 1699 when Iberville ascended the Mississippi River. Near the junction of the Mississippi and Bayou Lafourche, called the Ouacha River by his native guide, Iberville encountered two canoes, one filled with Bayagoulas and the other with Ouacha. It was argued that the Ouacha village was located down Bayou Lafourche, near present-day Labadieville. By 1718, the Ouacha had apparently moved their village, settling on the west bank of the Mississippi 11 leagues above New Orleans. (CEI 2014)

Little is known of the Chaouacha, who are generally believed to have been closely allied with the Ouacha. In 1699, the group was recorded as living on Bayou Lafourche near the Chaouacha, and they participated in the punitive expeditions against the Chitimacha after the death of the missionary St. Cosme in 1706. By 1712, Bienville had convinced them to move their village 25 leagues from the mouth to the Mississippi River near New Orleans. In the aftermath of the Natchez uprising of 1729, Étienne Périer de Salvert sent a party of slaves to attack the Chaouacha village, in an attempt to allay the fears of the citizens of the colony. The Ouacha and Chaouacha are recorded only sporadically after this point, and disappeared entirely by the end of the 18th century. (CEI 2014)

After meeting with the Bayagoula and Ouacha in March 1699, Iberville proceeded to the area of present-day Angola, in West Feliciana Parish, Louisiana. There, he found the Houma residing in dispersed villages. In 1706, the Houma moved south from Angola to the Bayou St. John area of present-day New Orleans. The Houma remained on Bayou St. John for only a short while before moving to present-day Ascension Parish. When this move occurred is unknown, but must have taken place by 1712–1713. The Houma eventually established several villages along the Mississippi River, but their village at the Grand Houmas remained at Burnside in Ascension Parish until 1785. (CEI 2014)

3.7.2.6 Historic Era

3.7.2.6.1 French Colonial Period, 1700–1763

Fort Maurepas, on Biloxi Bay, remained the capital of Louisiana until 1702, when the seat of government was moved to St. Louis de la Mobile, situated about 25 miles upriver from the mouth of the Mobile River in present-day Alabama. During the early years of the 18th century, the French colony of Louisiana stretched as far east as the Perdido River, where it was bound by Spanish Florida. In 1719, however, the French captured the community of Pensacola, pushing the boundary farther east. That same year, the capital of Louisiana was moved from Mobile to Ocean Springs, Mississippi, and in 1720 to Biloxi. Following a 1722 hurricane, the French abandoned both Biloxi and Pensacola and moved their capital to New Orleans, which had been established just 4 years earlier. (CEI 2014)

Much of the settlement of the colony during these early years was focused on large concessions granted along the Mississippi River above (i.e., upriver of) New Orleans. Biloxi remained largely abandoned until the late 18th century, and Mobile was supplanted by New Orleans in both size and commercial and political importance. While most settlers in Louisiana during this period were of French or French-Canadian descent, large numbers of Germans and Swiss were settled along the Mississippi River above New Orleans in 1721. That area soon became known as the Côte des Allemands, or the German Coast, and included much of present-day St. Charles and St. John the Baptist parishes. (CEI 2014)

The settlement of the German Coast is closely tied to the career of the Scottish financier, John Law. Law organized the General Bank of Finance in 1716 after convincing Philippe, duc d'Orleans that France would become a very wealthy country by printing paper money. In 1717, Law's paper money was accepted in France, and his bank was made the Royal Bank of France the following year. During this same period, Law organized the Company of the West in order to use some of the bank deposits to develop the French colony of Louisiana. In 1717, the Company of the West was given the proprietorship of Louisiana in return for settling the territory at the company's expense. (CEI 2014)

To attract settlers of good character, the Company of the West and its successor, the Company of the Indies, distributed pamphlets and handbills throughout Germany and the surrounding areas extolling the virtues of Louisiana. Germans responded positively to the advertisements, and in 1719 many made their way to the colony. Large numbers of these immigrants died en route to French ports, and many more died on the transatlantic voyage to the Louisiana colony. Once in Louisiana, many of the survivors died of disease and hunger after disembarking at the settlement of New Biloxi. Originally to settle three concessions, so many died that instead of settling three concessions, as originally planned, only Law's concession on the Arkansas River was settled. (CEI 2014)

When news reached Europe that Louisiana was not as idyllic as had been advertised, French businessmen began withdrawing their holdings from the Royal Bank of France. Gold and silver became scarce, paper money flooded the market, and the French government was forced to devalue its paper money. The bank soon collapsed and Law was forced to flee France for his life in December 1720. When news of the collapse reached the colony, many of the German *engagés* from Law's Arkansas concession descended the Mississippi River to New Orleans and requested that Governor Bienville give them return passage to Europe. Instead, Bienville persuaded them to resettle a recently abandoned Native American village near the Étienne Demeuves Concession (see Figure 3.7-13) in present-day St. Charles Parish. Soon after, the *engagés* from Arkansas were joined by a large group of German *habitants* who arrived in Biloxi in June 1721. (CEI 2014)

Despite the rapidly growing population, it was not until after 1728 that the east bank of the German Coast began to be settled. Prior to this time, a number of large concessions had been made along the Mississippi River to individuals who were to improve and settle their property. However, the concessionaires in many places failed to do so. As a result, a royal edict was passed in 1728 that cancelled many of the large concessions along the river between Bayou Manchac and the Gulf of Mexico. This measure was undertaken as a means of forcing landholders to improve their holdings and of breaking up large, unimproved holdings. It was hoped this would increase the number of settlers in the colony, thereby dissuading the Spanish and English from encroaching on French lands. The 1728 edict effectively opened the east bank up for settlement, and by 1731 several German habitations had been established there. The growth of German settlements on the east bank of the river, however, was hampered by sporadic Indian attacks that continued until the mid-18th century. (CEI 2014)

While the German Coast residents were primarily truck farmers, plantations in surrounding areas cultivated cash crops such as indigo, tobacco, and, to a lesser degree, silk and the candleberry tree. However, both corn and rice were grown throughout the area. Rice agriculture was developed in Louisiana very early in the colony's history (shortly after 1712), because Europeans preferred it to corn, a native cultigen. Rice competed with corn as a staple crop in the young colony by 1720, and it became more important with the introduction of black slaves in 1723. (CEI 2014)

In 1732, Louisiana reverted to the French crown as the Company of the Indies found it could no longer support the colony. By the 1750s, France realized Louisiana was a financial burden and that there had been little return for the millions of *livres* spent on the development and supply of the colony. In 1762, France ceded Louisiana and the Isle of Orleans to Spain in the secret Treaty of Fontainebleau. While France saw Louisiana as a financial drain, Spain saw the colony as a defensive mechanism against British expansionism. Although the legal transfer of the colony took place in November 1762, it was not until October 1764 that the colonists actually found out that the transfer had taken place. (CEI 2014)

3.7.2.6.2 Spanish Colonial Period, 1763–1803

On November 13, 1762, France ceded the Isle of Orleans and Louisiana to Spain in the secret Treaty of Fontainebleau. The 1762 treaty remained a closely guarded secret even as France, Spain, and Great Britain negotiated the 1763 Treaty of Paris, which brought the Seven Years War to a close. As a result of that treaty, France ceded all of her holdings east of the Mississippi River and north of the Isle of Orleans to Great Britain and the remainder of Louisiana to Spain. (CEI 2014)

Spain was slow to assert control over the colony of Louisiana. It was not until 1766 that the first Spanish governor, Don Antonio Ulloa, arrived in Louisiana, and it was not until January 1767 that Ulloa took formal possession of the colony. Unable to enforce Spanish rule on his French subjects, Ulloa had very little real control over Louisiana and, in October 1768, the Superior Council of Louisiana ordered Ulloa to leave the colony. That same month, approximately 500 Germans and Acadians arrived in New Orleans to express their dissatisfaction with Governor Ulloa. The Acadians had been falsely told that Ulloa was withholding specie that was to be used to redeem their worthless Acadian script, and the Germans had been informed that Ulloa had no intention of paying them for their goods that had already been shipped to New Orleans. In fact, Ulloa had no specie for exchange and had sent Gilbert de St. Maxent to the German Coast to pay off Spanish debts. St. Maxent, however, had been abducted by cohorts of Nicholas Chauvin de Lafreniere, and was unable to make the payments. (CEI 2014)

Once in New Orleans, the Acadians and Germans were convinced to support the Superior Council in an effort to rid the colony of Governor Ulloa. Realizing that he had little popular support, Ulloa was forced to evacuate Spanish civil authorities from New Orleans on November 1, 1768. Although this temporarily rid the colony of Spanish authority, a new Spanish Governor, General Alejandro O'Reilly, arrived in August 1769 to take formal possession of Louisiana for Spain. O'Reilly found Lafreniere and five of his cohorts guilty of conspiracy and had five of them executed by firing squad; a sixth had already died of natural causes. (CEI 2014)

By the 1770s, most of the land facing the Mississippi River along the German Coast had been claimed. While many grants along the river were large, most had a depth of only 40 arpents. Some of these smaller landholders had second depth grants of an additional 40 arpents made by the Spanish government; however, this was not a common practice until the American period. Some of the larger landholdings in the German Coast began to break up during the 1770s, as the original owners divided their holdings among their children. (CEI 2014)

German Coast planters continued to grow vegetables for sale in New Orleans as their primary crops until the end of the 18th century. Indigo, one of the more popular cash crops, became unprofitable to grow in Louisiana during the 1790s because of high production costs, soil exhaustion, pollution, and crop infestation. After a 1793 slave revolt in St. Dominique, many residents of the island moved to Louisiana bringing an interest in sugarcane agriculture with them. (CEI 2014)

Etienne de Bore's introduction of a profitable method of growing sugarcane, along with Antoine Morin's refinement of the granulation process, allowed large landholders to begin large-scale production of sugarcane, which soon became the dominant crop in St. Charles Parish. By 1802, indigo was only rarely grown, while sugar and cotton were the main cash crops. (CEI 2014)

3.7.2.6.3 Early American Period, 1803–1861

Louisiana remained under Spanish control until it was transferred back to France by the Treaty of San Ildefonso on October 1, 1800. As when the Spanish acquired the colony in 1763, the French did not take immediate possession of Louisiana. Rather, formal possession was delayed until November 30, 1803, seven months after the United States made the Louisiana Purchase. The American government, in turn, did not take possession of the territory until December 20, 1803. By the time of the Louisiana Purchase, land holdings and artificial levees lined the banks of the Mississippi River from south of New Orleans to as far upriver as White Castle in Iberville Parish. (CEI 2014)

Sugarcane had been grown in Louisiana for many years, but had been used for the production of syrup and tafia, a form of rum. It was not until a successful technique for granulation was introduced in about 1795 that it became truly economically viable to cultivate cane. By 1800, at least 75 planters in the New Orleans area were engaged in sugar planting and, over the next several years, the cultivation of sugar spread over much of the alluvial lands in the southern part of the state. Sugarcane production was given a considerable boost in 1803 when Louisiana was acquired by the United States. Unlike Spain and France, the United States had no other colonies or territories that produced sugar, and the expanding country provided an enormous market for Louisiana sugar. The high price of sugar, coupled with a high tariff, attracted many potential planters to the sugar industry and to Louisiana. Favorable soils and climate, combined with its close proximity to the market in New Orleans via the Mississippi River, offered an ideal environment for sugarcane production in the study region. (CEI 2014)

In October 1804, the United States government created the Territory of Orleans, which consisted of the Isle of Orleans and all of Louisiana below 33 degrees latitude west of the Mississippi River. The remainder of the Louisiana Purchase became the District of Louisiana. In April 1805, the Territory of Orleans was subdivided into 12 counties by the Territorial Legislature. Among the 12 counties were Orleans County and the German Coast. (CEI 2014)

The boundaries of both Orleans County and the German Coast were based on ecclesiastical divisions, which had never actually been precisely defined. Hence, their boundary lines were amorphous and cannot be accurately established. For instance, Orleans County consisted of "all that portion of the country lying on both sides of the river Mississippi from the Balize to the beginning of the parishes of Saint Bernard and Saint Louis." The ecclesiastical Parish of St. Louis refers to St. Louis Cathedral in New Orleans, while the ecclesiastical Parish of St. Bernard was more or less coterminous with present-day St. Bernard Parish. Both ecclesiastical parishes were included within the limits of Orleans County. Similarly, the County of the German Coast included the ecclesiastical parishes of Saint Charles and Saint John the Baptist. This arrangement lasted only until April 1807, when the County of the German Coast was split to form the civil parishes of St. Charles and Saint John the Baptist. Over the years, the boundaries dividing these entities have changed numerous times. (CEI 2014)

Though sugarcane dominated the agriculture of the area, rice was grown well into the early 19th century as well, particularly in St. Charles Parish. Rice fields were flooded during high river stages by trenches cut through the river levee. These trenches, while providing necessary irrigation for the fields, represented weak spots in the river levee system and were the culprit of many crevasses during the 18th and early 19th centuries. Though rice could be grown near the apex of the natural levees of the river and its tributaries, it was generally planted in lower-lying areas nearer the toe of the levees. Farther away from the river and its adjacent levees were deep swamps. As during earlier periods, timbering of those swamps was economically important. Timber removed from the backswamps, particularly cypress, was not only used for building, but was also shipped overseas. Less desirable wood timbered from the swamps and cleared from the ever-expanding agricultural fields was often used as cord wood to fuel the growing need for steam power, whether it be in sugar mills or on steam packets. As the harvesting of timber grew, along with the need to drain the ever expanding number of agricultural fields, so too did the need for canals. (CEI 2014)

3.7.2.6.4 Civil War and Reconstruction, 1861–1900

On April 12, 1861, less than 3 months after Louisiana seceded from the Union, Confederate forces under the command of Louisiana native Brigadier General Pierre Gustave Toussaint Beauregard opened fire on Fort Sumter in South Carolina. The Union garrison surrendered two days later. Despite the importance of New Orleans to the Confederacy, it fell to Union naval forces on April 25, 1862. Several small skirmishes were subsequently fought on the west bank of St. Charles Parish, and numerous buildings were destroyed along both banks of the river by Union gunboats. Other buildings were confiscated for use by Union troops. One of the larger skirmishes to occur in the area transpired near modern-day Hahnville in August 1862 when Union troops learned of a Confederate attempt to gather cattle on the east bank of the river. In September 1862, Confederate forces occupied Boutte Station on the New Orleans, Opelousas & Great Western Railroad and attempted to ambush a Union train heading to Algiers. The ambush failed when a second Union train arrived from Algiers. The Confederates fell back to the St. Charles Parish courthouse at Hahnville where they were subsequently pinned down by additional Union forces. Ultimately, the Confederates were forced to escape through the swamps to evade capture, but had to leave their horses behind. (CEI 2014)

The New Orleans, Opelousas & Great Western Railroad connected New Orleans to Thibodaux and beyond, but it did not pass through the present study area. The Union Pacific Railroad line that passes through the study area was completed by the Western Division of the New Orleans, Mobile and Texas Railroad between New Orleans and Donaldsonville in May 1871. (CEI 2014)

Sugar production fell off dramatically throughout the region during the Civil War and Reconstruction as planters lost their financial resources and their labor supply. In response to these difficulties, some area sugar planters returned their attention to rice cultivation as it was less expensive and less labor intensive than sugar cultivation. (CEI 2014)

The rice industry expanded so rapidly during the early post-bellum years that it rapidly became the most important cash crop in the state. Indeed, in St. Charles Parish alone, rice production increased from 800,000 pounds in 1840 to 2,238,200 pounds in 1870. Still, St. Charles Parish was not the largest producer of rice in the state. That distinction belonged to Plaquemines Parish. (CEI 2014)

With the abolition of slavery and an increasingly mechanized society, many small and large sugar planters in Southern Louisiana struggled to make a profit or even retain their land holdings following the war. However, many planters along the Mississippi River were quick to transform the economic makeup of their plantations. By the late 1870s, some sugar plantations started to resemble the dominant economic and social institutions of the antebellum period. For sugar and even rice growers in Louisiana, securing a reliable source of labor became one of the most difficult tasks. Although some African-Americans remained on the sugar plantations following the war, many migrated to cities, especially to the northeast and west in search of a better life. In response, area planters experimented with several options, including using Chinese labor in the sugar fields. Other groups, following a more racially motivated notion, opted for the use of Portuguese, Italians, and Germans on sugar estates. However, the importation of Chinese and other immigrant groups proved to be unsuccessful, and African-American labor remained the predominant labor source for the majority of sugar estates in south Louisiana. (CEI 2014)

3.7.2.6.5 Twentieth Century and Beyond, 1900–2014

By the turn of the 20th century, timbering had largely overtaken sugarcane cultivation in marginal areas. Along the river, sugarcane cultivation was still widespread, but not to the extent it had once been. By the second quarter of the 20th century, however, most of the region had been timbered out and the industry was in decline. Though timbering was no longer viable for large corporations, smaller companies employing portable sawmills continued to operate in the region into the middle of the 20th century. (CEI 2014)

Plantations and truck farms began to give way to industrial complexes, particularly those related to petroleum, during the second decade of the century (Figure 3.7-6). Destrehan Plantation became the home of the Mexican Petroleum Company in 1914, although production did not commence at the plant until 1916. The Mexican Petroleum Company was later taken over by the Pan American Petroleum Company and continued operations until 1958. In 1920, the Petroleum Import and Export Corporation began construction of a refinery in St. Rose. The St. Rose refinery was opened in 1921 and was later taken over by Cities Services Oil Company. (CEI 2014)

What was to become the largest refinery in St. Charles Parish began with the construction of the Marine Terminal, a refinery of several 55,000-barrel storage tanks, near the town of Sellers in 1916. This facility, built by the Roxana Petroleum Company, began operations in 1918. Following World War I, an asphalt refinery was built by the New Orleans Refining Company near the Marine Terminal. This refinery became so important to the local economy that the town of Sellers was renamed Norco—the acronym of the New Orleans Refining Company. In the spring of 1929, Shell Petroleum Corporation (formerly Roxana Petroleum Company) took over the Norco plant and began modernizing the facility. The plant resumed operations in 1930 with 650 workers. (CEI 2014)

The petrochemical industry soon spread to the west bank of St. Charles Parish. To provide an adequate electrical supply to the area's growing industrial base and to burgeoning residential growth, LP&L (later Entergy Louisiana, LLC) established the Little Gypsy power plant at Montz, Louisiana, in 1960. Three years later, the same company acquired Killona and Waterford plantations in order to construct Waterford 1 and 2 (Figure 3.7-7). In September 1970, it was announced that those two units would be joined by a third unit, WF3. The latter began commercial operation in 1985. (CEI 2014)

3.7.3 Onsite and Offsite Cultural Resources

Onsite cultural resources are those located within the 3,560-acre Entergy Louisiana, LLC property. That property includes the entirety of the archaeological APE, which is also the onsite portion of the aboveground APE (Figure 3.0-2). Although no license-renewal-related refurbishment activities have been identified, such that no adverse effects on cultural resources would occur, the 3,560-acre Entergy Louisiana, LLC property is still considered an APE for the continued operation of the WF3 facility for the purpose of Section 106 compliance for the LRA.

The single NRHP-eligible cultural resource recorded on site is the Waterford Plantation (16SC41), which has been determined partially eligible/unknown for NRHP listing. This site occupies roughly half of the Entergy Louisiana, LLC property, as shown in Figure 3.7-1. There are no additional NRHP-eligible cultural resources on the 3,560-acre Entergy Louisiana, LLC property. (CEI 2014)

A 1980 cultural resources evaluation of the WF3 property identified three areas (Figure 3.7-1) with *in situ* archaeological remains within the limits of the Waterford Plantation site (16SC41): the Waterford Plantation overseer's house (Area 3), the Waterford Plantation quarters area (Area 4), and the foundations of a drainage machine (Area 6). The first two areas (Areas 3 and 4) were subsequently determined eligible for inclusion on the NRHP. The third area (Area 6) is located south of LA-3127 and was not included in the 2014 walkover. In addition, the 1980 investigations identified an area of possible *in situ* deposits at the Waterford Plantation sugarhouse (Area 5). Two other areas (Areas 1 and 2) were found to have been destroyed or heavily disturbed. All of these areas are included within the site limits of Waterford Plantation (16SC41). Adjoining Killona Plantation has not been previously examined. (CEI 2014)

In its 2014 investigation, CEI completed an archaeological sensitivity analysis based on previous archaeological investigations, a review of archival and secondary historical sources, topography, and a walkover of the property. Five zones of sensitivity were identified on that portion of the Entergy Louisiana, LLC property located north of LA-3127 (Figure 3.7-14). These five zones are based upon the presence of known cultural remains and archivally documented settlement, and were developed as a guide for potential future construction activity at WF3 based upon the available data. (CEI 2014)

Offsite cultural resources are those outside the 3,560-acre Entergy Louisiana, LLC property boundary. As a comprehensive Phase 1 cultural resources survey was not conducted and is not considered necessary for renewal of the WF3 OL, a background literature search was conducted to locate offsite cultural resources. Lists of known archaeological sites and historic properties within a 6-mile radius of WF3 are presented in Tables 3.7-1 and 3.7-2. (CEI 2014)

3.7.4 Cultural Resource Surveys

The first recorded cultural resources survey in the immediate area of WF3 was conducted in 1976 for the proposed route of LA-3127. That highway forms the southern limit of the 2014 CEI study area. The 1976 study did not locate any cultural resources in the immediate vicinity of the current WF3 project area. (CEI 2014)

In 1977, another study investigated a small portion of the Entergy Louisiana, LLC property while construction of the WF3 facility was ongoing. This study was limited to observing the ROW for the transmission lines connecting WF3 to a substation on the property and to the facility's intake and discharge structures. Access to the northern half of the transmission line ROW was closed due to construction activities, and the southern half had been already disturbed by the construction of the transmission lines. Excavations for the intake and discharge structures had already been largely completed as well, and the study was limited to observing their approximately 12-foot deep construction trenches. No cultural deposits were noted in either area. In addition, a pedestrian survey of several cultivated fields immediately upriver, downriver, and south of the railroad was conducted, although actual survey locations were unknown. No archaeological remains were located, and it should be noted that this 1977 investigation would not meet current Louisiana Division of Archaeology Phase 1 survey standards. (CEI 2014)

In July 1980, CEI conducted a cultural resources evaluation on the Entergy Louisiana, LLC property. As construction of the WF3 facility was by then well underway, the actual plant site was excluded from those investigations. Instead, the one-day field visit was limited to visiting areas possessing a high probability for containing archaeological remains to confirm the presence of potential sites identified through archival research. The 1980 field examination did not consider neighboring Killona Plantation, which forms part of the present study. Within the limits of Waterford Plantation, potential *in situ* archaeological remains were found at what was thought to be the plantation's overseer's house (Area 3), in the slave quarters area (Area 4), and at the former location of the Waterford sugar mill (Area 5) (Figure 3.7-1). In addition, the structural remains of a drainage machine (Area 6) were located southwest of LA-3127, outside of CEI's 2014 study area. On the basis of these findings, the entirety of Waterford Plantation was assigned site number 16SC41. Two years later, the overseer's house (Area 3) and the workers quarters (Area 4) were determined eligible for inclusion on the NRHP. Like the 1977 investigations, CEI's 1980 evaluation would not meet the current Louisiana Division of Archaeology Phase 1 survey standards. (CEI 2014)

In 1987, R. Christopher Goodwin & Associates, Inc., conducted a survey of six revetment areas along the Mississippi River for the USACE. One of the survey areas was in front of former Killona Plantation, immediately upriver of WF3. That particular survey area was composed of recent batture deposits, and no cultural resources were noted. (CEI 2014)

In early 2004, a helipad was constructed adjacent to the WF3 plant, at the location of the NRHP-eligible Waterford Plantation quarters. CEI subsequently conducted a damage assessment of that work and found that the recent construction work had indeed disturbed the archaeological deposits there (Area 4), but that the locality still contained extensive *in situ* deposits. It was also determined that the locality was much larger than originally designated. Based upon those findings, it was determined that the locality still possessed NRHP integrity. (CEI 2014)

Figure 3.7-15 shows the onsite locations of each of the five cultural resource studies described above.

3.7.4.1 2014 Phase 1A Sensitivity Assessment

Despite the completion of these five investigations, a comprehensive Phase 1 cultural resources survey has not been conducted of either the Waterford Plantation (16SC41) or the Killona Plantation, which together form the bulk of the 3,560-acre Entergy Louisiana, LLC property. Nor has a comprehensive Phase 1 cultural resources survey been conducted of adjoining Providence Plantation, a small part of which is included in the Entergy Louisiana, LLC property. The brief historical overview conducted for the Phase 1A sensitivity assessment has confirmed the identification of the high probability areas first noted at Waterford Plantation in 1980. Of the six high probability areas defined in 1980, two had already been destroyed by that date and two were subsequently determined eligible for inclusion on the NRHP. There are similar areas with a high potential for archaeological remains associated with Killona Plantation that have not been examined in detail. (CEI 2014)

Archival research conducted for the Phase 1A sensitivity assessment identified one area on the property that has a high probability of having served as the site of a 1718–1721 Ouacha Indian village (Figure 3.7-3). That location also served as the site of two German settlements between about 1721 and 1724 (Figure 3.7-14). There are archival accounts of a German cemetery located between the two settlements. Finally, there is also a high probability that both the Waterford and Killona plantations possessed cemeteries for their workers, both slave and freed. The locations of those cemeteries are unknown. (CEI 2014)

The one-day field visit and walkover of the Entergy Louisiana, LLC property north of LA-3127 was conducted on August 19, 2014, and limited to areas possessing high archaeological potential, exclusive of the actual WF3 plant site. The purpose of this walkover was to verify the potential for the presence of archaeological deposits on the property. (CEI 2014)

In addition to the field visit, background information was gathered specific to the Entergy Louisiana, LLC property, and databases at the Louisiana SHPO in Baton Rouge were consulted in an effort to identify previously recorded historic properties and archaeological sites within a 6-mile radius of WF3. Historic properties and archaeological sites within a 6-mile radius of WF3 are listed in Tables 3.7-1 and 3.7-2. Approximately half of the Entergy Louisiana, LLC property is composed of the former Waterford Plantation, which has been assigned archaeological site number 16SC41. Two localities (Areas 3 and 4) (Figure 3.7-1) within 16SC41 have been determined eligible for inclusion on the NRHP. (CEI 2014)

3.7.5 Procedures and Integrated Cultural Resources Management Plans

Entergy has administrative controls in place for management of cultural resources ahead of any future ground-disturbing activities at the plant, although no license-renewal-related ground-disturbing activities have been identified. These controls consist of the following:

- Fleet cultural resources protection plan that requires reviews, investigations, and consultations as needed, and provides instructions to workers when performing ground-disturbing activities in undisturbed or cultural resource sensitive areas (Entergy 2013c). Although there is no required training associated with this program, all employees are required to adhere to the instructions contained in the procedure.

- Site-specific cultural resource protection plan incorporated by reference in Section 4.2.1 of the WF3 Environmental Protection Plan to protect those areas on the property determined to be eligible for the NRHP, specifically the Waterford Plantation. This plan ensures that cultural resource remains are not damaged and are protected from unauthorized removal and that, in the event ground disturbance is required in these areas, remains will be appropriately protected for their cultural resource information value. (LP&L 1983) In addition, the area of the Waterford Plantation that has been determined to be partially eligible has signage warning of the presence of cultural resources and the necessity to contact Chemistry prior to any ground-disturbing activities in these areas.

These administrative controls ensure that existing, or potentially existing, cultural resources are adequately protected, and assists WF3 in meeting state and federal expectations.

For the approximately 660 acres of land leased to Raceland Raw Sugar LLC, as discussed in Section 3.1.1, the tenant is required to comply with all laws, acts, rules, and regulations in accordance with the lease agreement (Entergy 2014c). Therefore, consideration would be given to cultural resources in the event of an inadvertent discovery.

Table 3.7-1
Archaeological Sites, 6-Mile Radius of WF3

Site Number	Parish	Quadrangle	NRHP Status
16SC10	St. Charles	Laplace	Unknown
16SC19	St. Charles	Hahnville	Unknown
16SC21	St. Charles	Hahnville	Unknown
16SC22	St. Charles	Hahnville	Unknown
16SC24	St. Charles	Hahnville	Unknown
16SC31	St. Charles	Laplace	Partially Ineligible/Unknown[a]
16SC39	St. Charles	Hahnville	Unknown
16SC41[b]	St. Charles	Hahnville	Partially Eligible/Unknown[c]
16SC47	St. Charles	Hahnville	Unknown
16SC50	St. Charles	Laplace	Listed
16SC51	St. Charles	Laplace	Listed
16SC52	St. Charles	Laplace	Ineligible
16SC53	St. Charles	Laplace	Ineligible
16SC54	St. Charles	Laplace	Ineligible
16SC55	St. Charles	Hahnville	Ineligible
16SC56	St. Charles	Hahnville	Unknown
16SC57	St. Charles	Hahnville	Unknown
16SC58	St. Charles	Hahnville	Unknown
16SC59	St. Charles	Hahnville	Unknown
16SC65	St. Charles	Hahnville	Ineligible
16SC71	St. Charles	Hahnville	Unknown
16SC72	St. Charles	Hahnville	Partially Ineligible/Unknown[a]
16SC79	St. Charles	Laplace	Ineligible
16SC80	St. Charles	Laplace	Eligible
16SC85	St. Charles	Laplace	Ineligible
16SC86	St. Charles	Hahnville	Unknown

Table 3.7-1 (Continued)
Archaeological Sites, 6-Mile Radius of WF3

Site Number	Parish	Quadrangle	NRHP Status
16SC88	St. Charles	Laplace	Unknown
16SJB6	St. John the Baptist	Reserve	Unknown
16SJB8	St. John the Baptist	Reserve	Unknown
16SJB10	St. John the Baptist	Reserve	Unknown
16SJB12	St. John the Baptist	Reserve	Unknown
16SJB22	St. John the Baptist	Reserve	Unknown
16SJB24	St. John the Baptist	Laplace	Unknown
16SJB25	St. John the Baptist	Laplace	Unknown
16SJB27	St. John the Baptist	Reserve	Unknown
16SJB67	St. John the Baptist	Laplace	Unknown

(CEI 2014)

a. Only a portion of the site is determined not eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

b. Located on Entergy Louisiana, LLC property.

c. Only a portion of the site is determined eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

Table 3.7-2
NRHP-Listed Properties, 6-Mile Radius of WF3

Resource Name	Parish	Quadrangle	NRHP Listed	Distance from WF3[(a)]
Kenner and Kugler Cemeteries Archaeological District (16SC50 and 16SC51)	St. Charles	Laplace	1987	2.0 miles[(b)]
Dorvin House, Mollere House, Rosedon	St. Charles	Hahnville	1990	3.1 miles
Sorapuru House	St. John the Baptist	Reserve/Laplace	1999	3.9 miles
Homeplace Plantation House, Keller Homestead	St. Charles	Hahnville	1970	4.1 miles
Montegut Plantation House	St. John the Baptist	Laplace	1988	4.4 miles
Ormond Plantation House	St. Charles	Hahnville	1990	5.8 miles
Haydel-Jones House	St. John the Baptist	Reserve	2010	6.0 miles

(CEI 2014; NPS 2010; NPS 2014; USACE 2012a)

a. Distances are approximate and based on the WF3 reactor center point and NRHP location data.

b. The NRHP lists Kenner and Kugler Cemeteries as "address restricted." The distance provided was created using GIS to compare the two cemetery locations and background landmarks depicted in the February 8, 2012, USACE Bonnet Carre Public Meeting-Long Term Management Report (USACE 2012a, page 3) to a USGS topographic map. An approximate equidistant point was placed between the two locations to estimate distance.

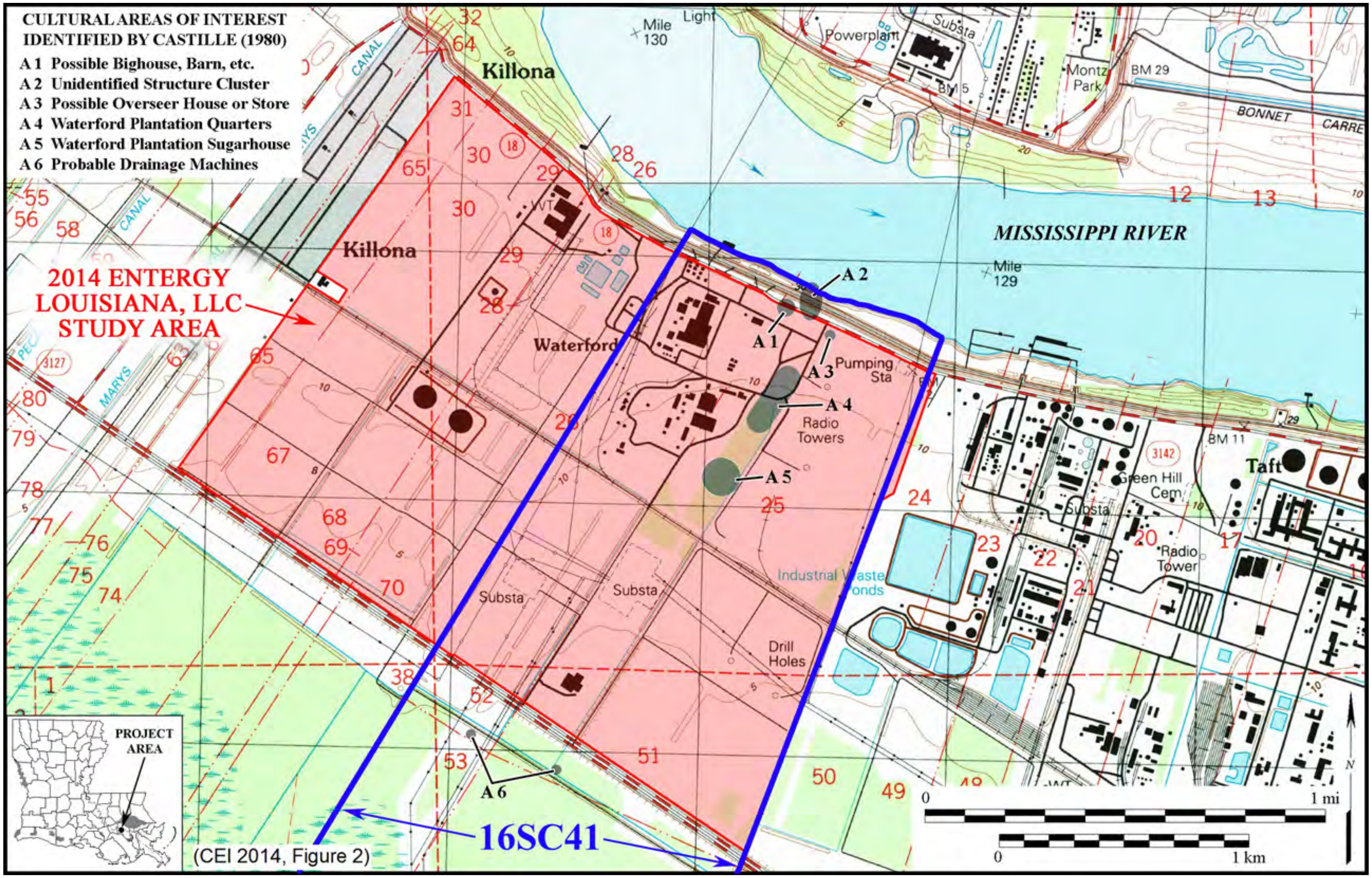


Figure 3.7-1
Cultural Areas of Interest, Entergy Louisiana, LLC Property Northeast of LA-3127

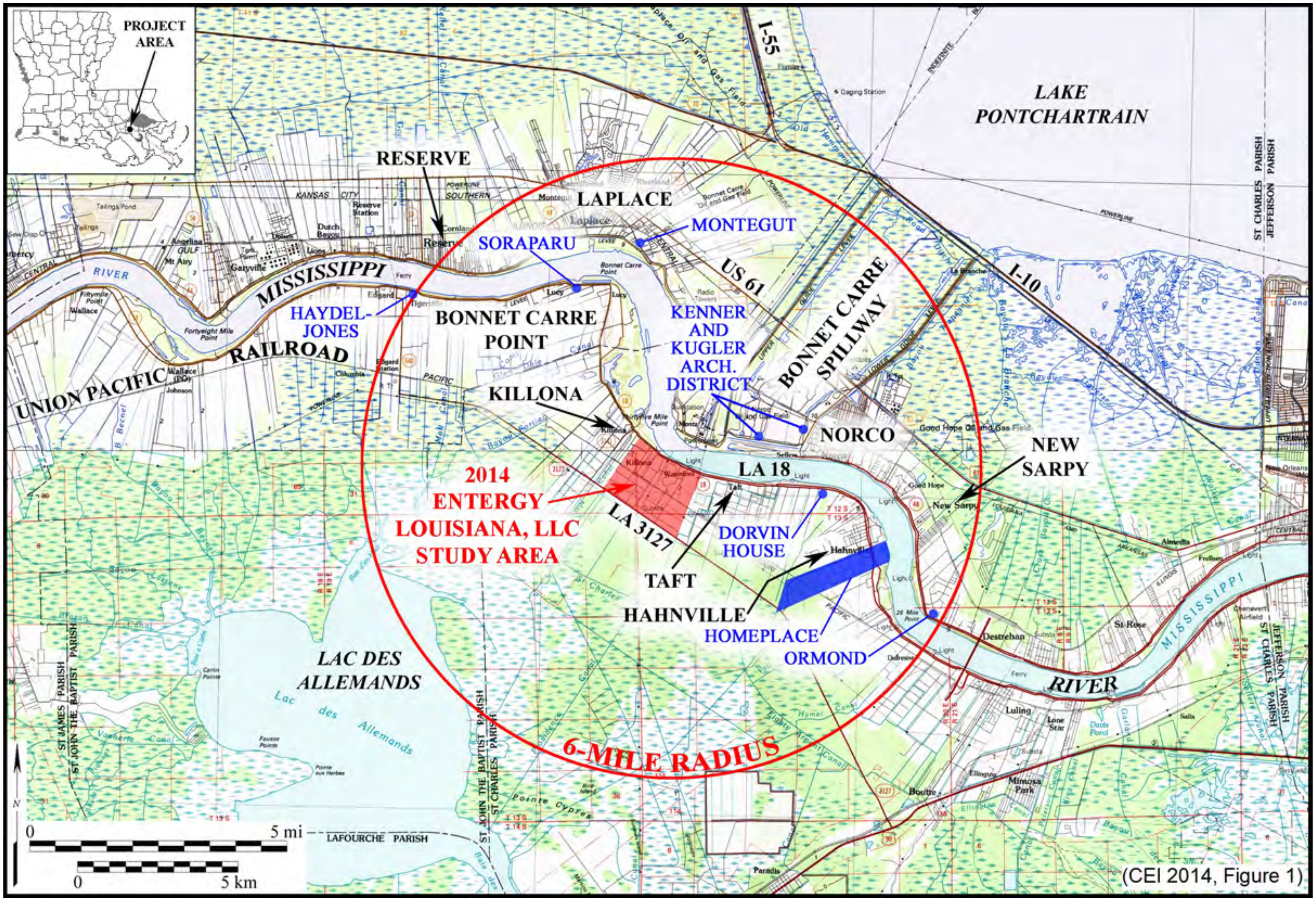


Figure 3.7-2
NRHP-Listed Sites, 6-Mile Radius of WF3

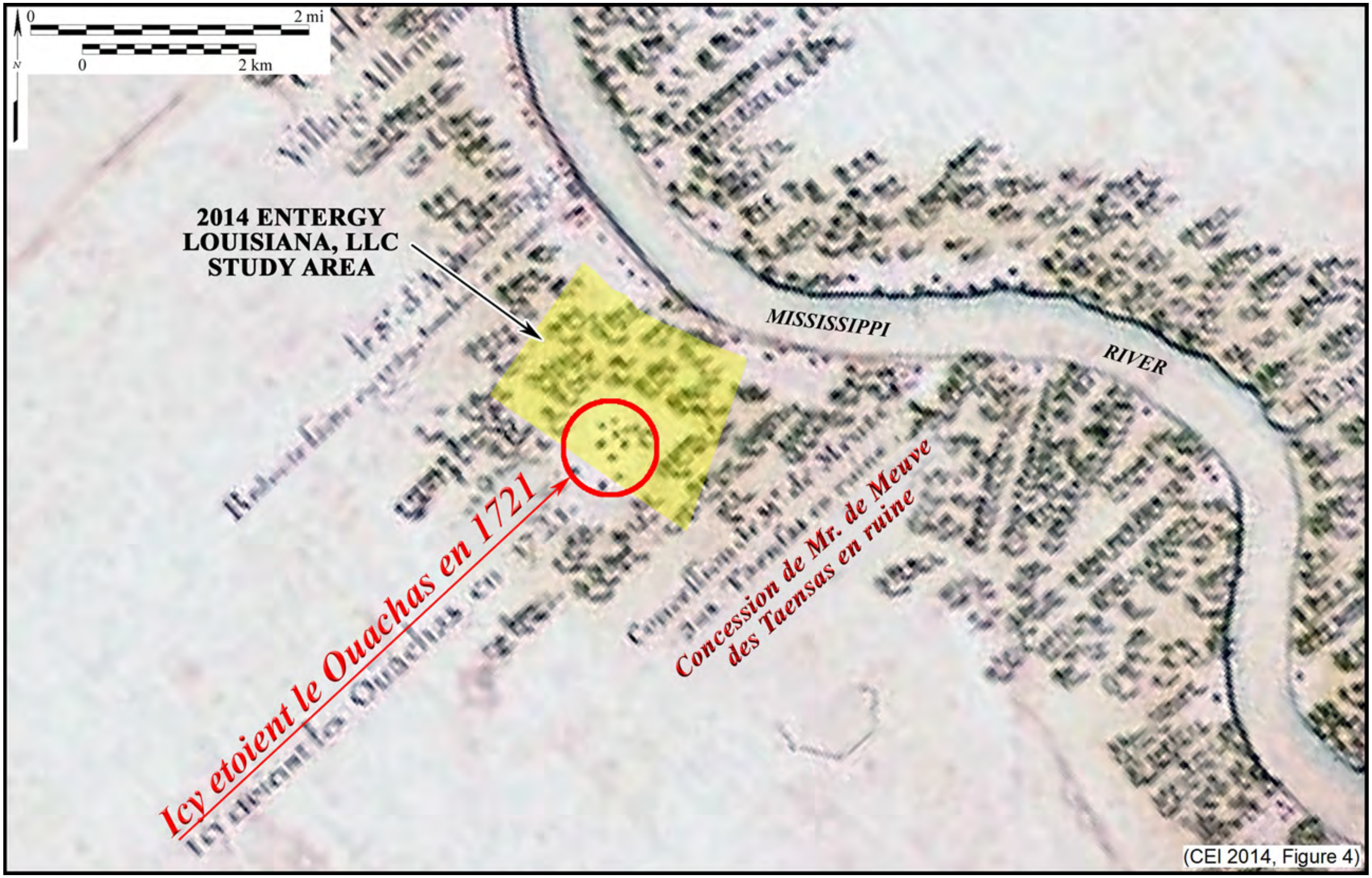


Figure 3.7-3
Ouacha Village Site, 1718–1721

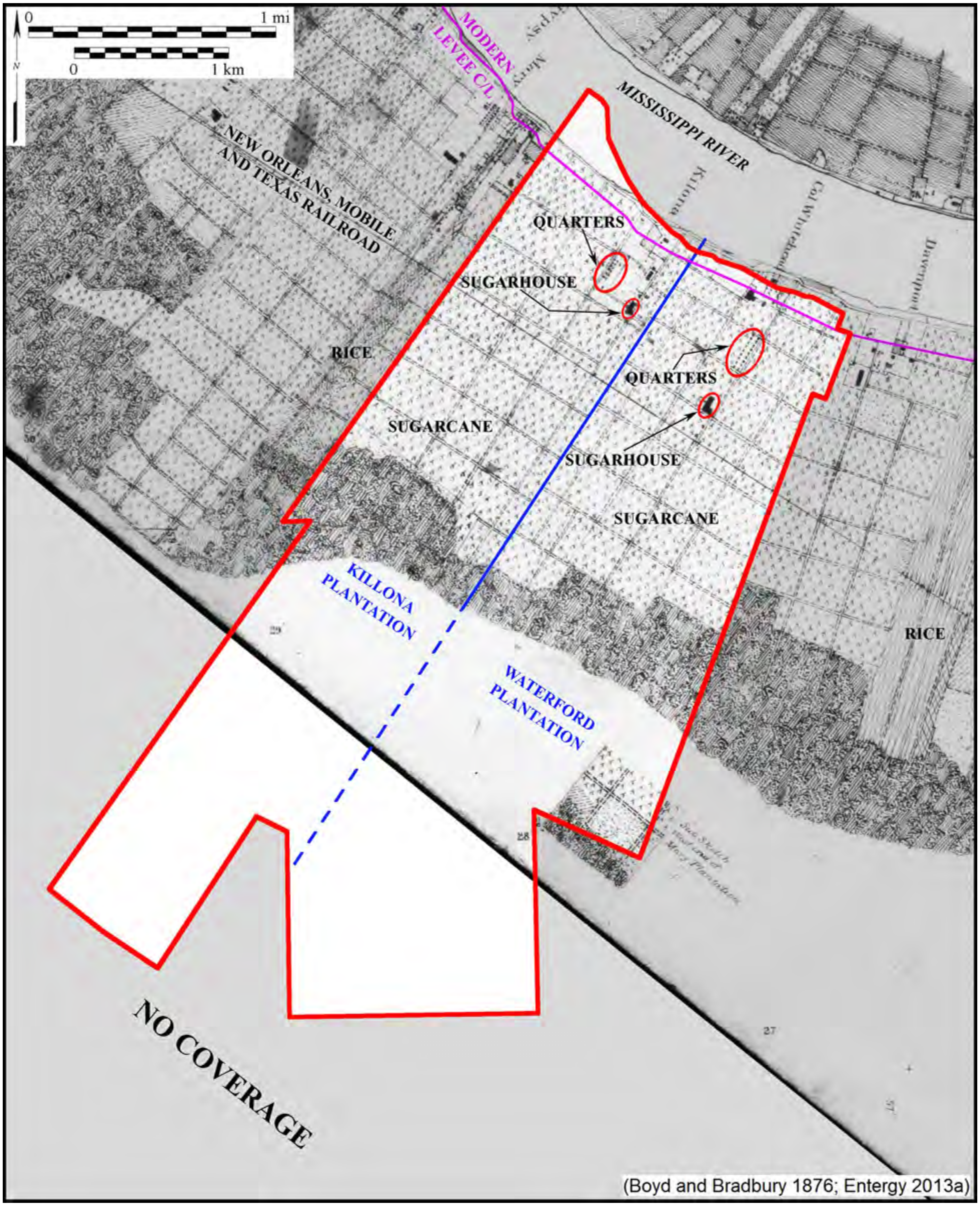


Figure 3.7-4
Entergy Louisiana, LLC Property circa 1876

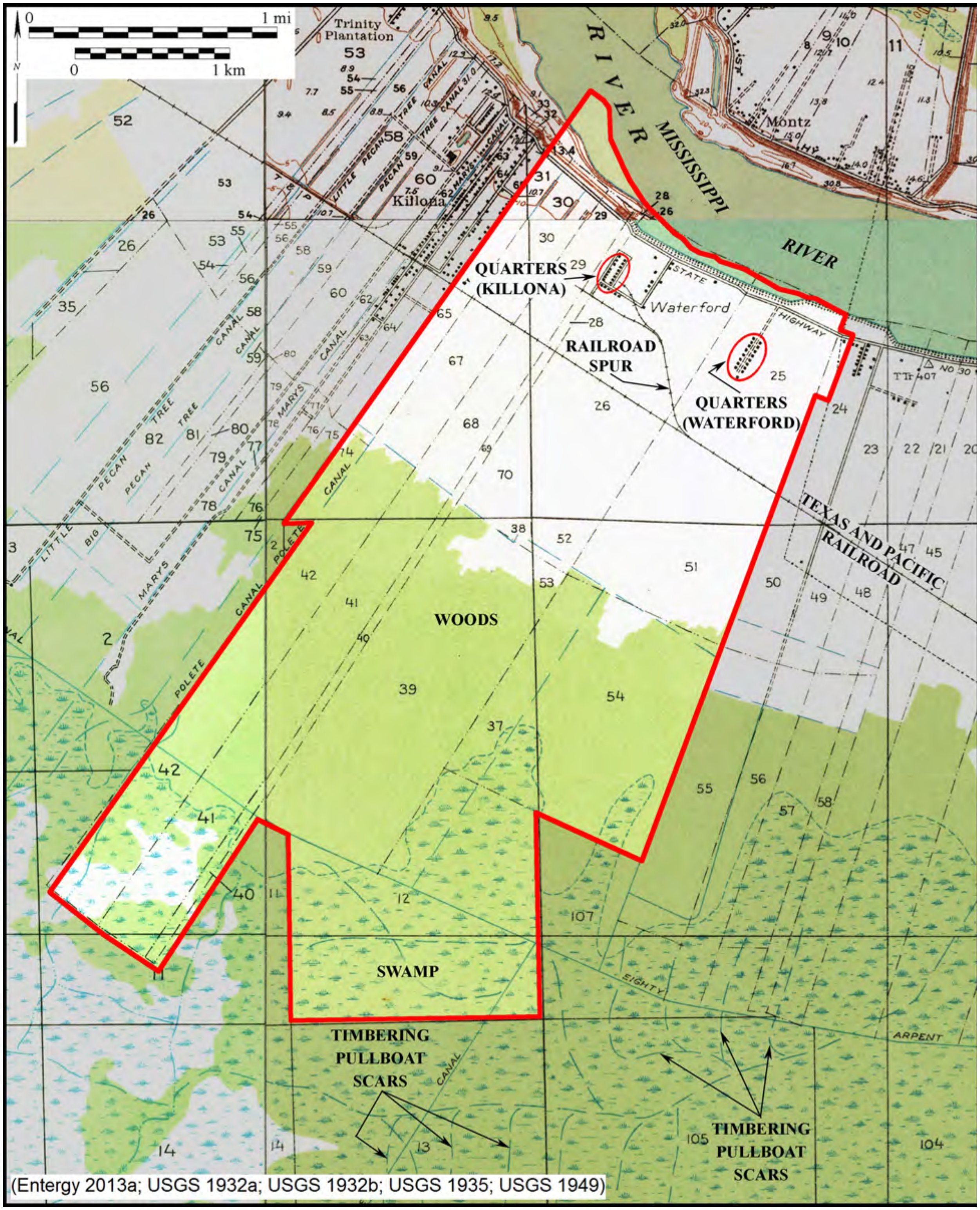


Figure 3.7-5
Entergy Louisiana, LLC Property circa Early 1930s with Evidence of Timbering and Rail Spur

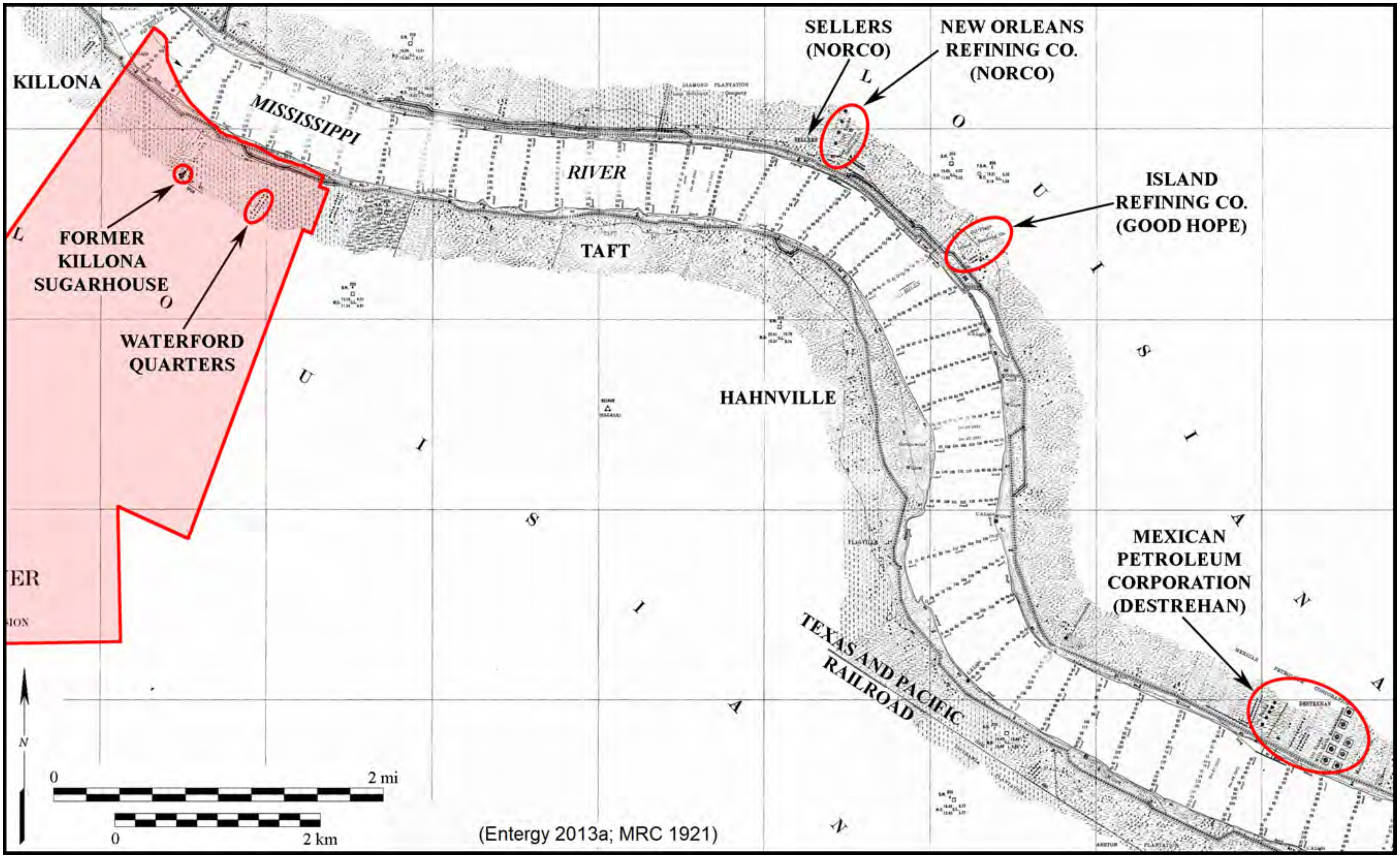


Figure 3.7-6
Growth of Petroleum Industry near the Entergy Louisiana, LLC Property circa 1921

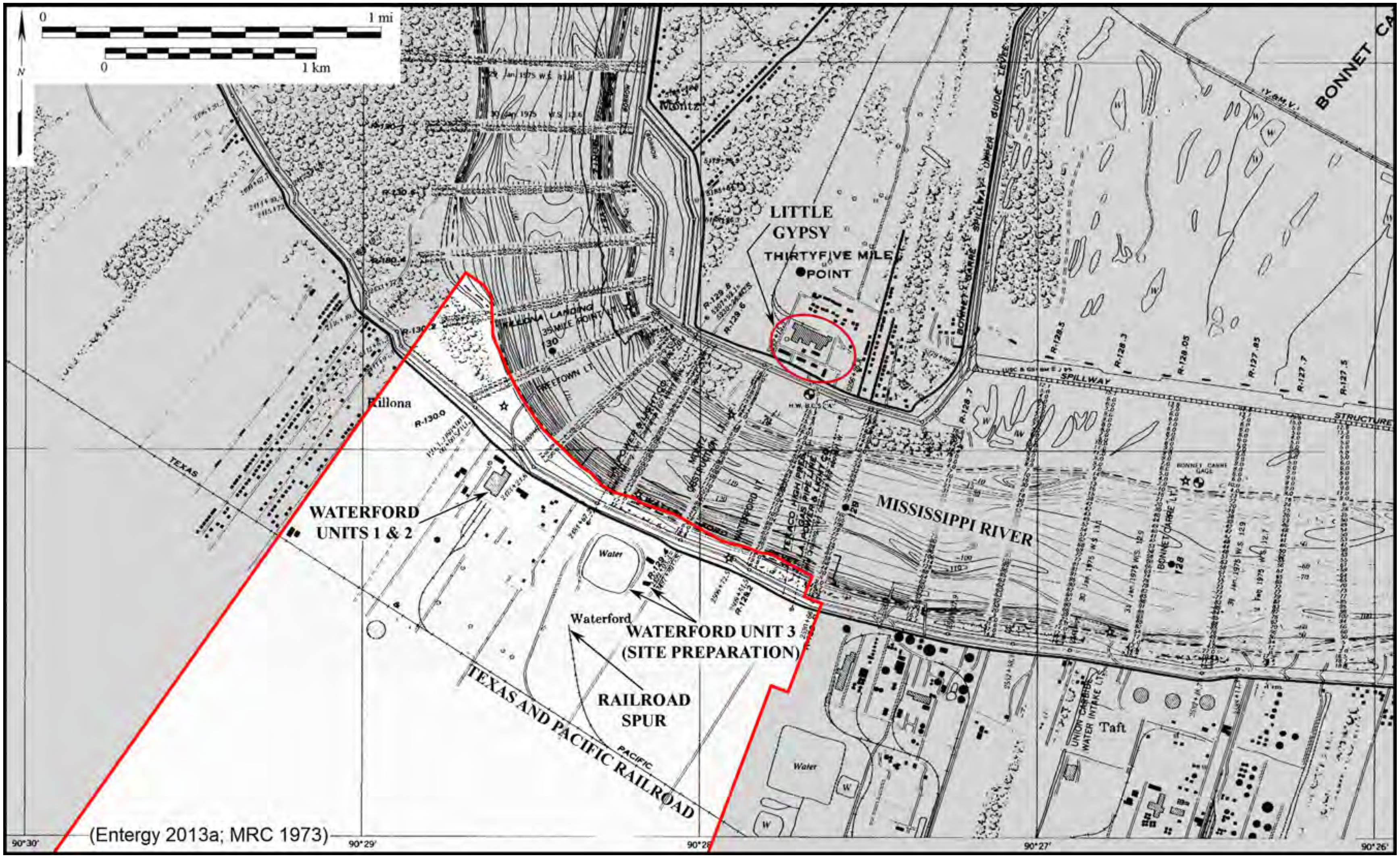


Figure 3.7-7
Utility Ownership and Development circa 1973

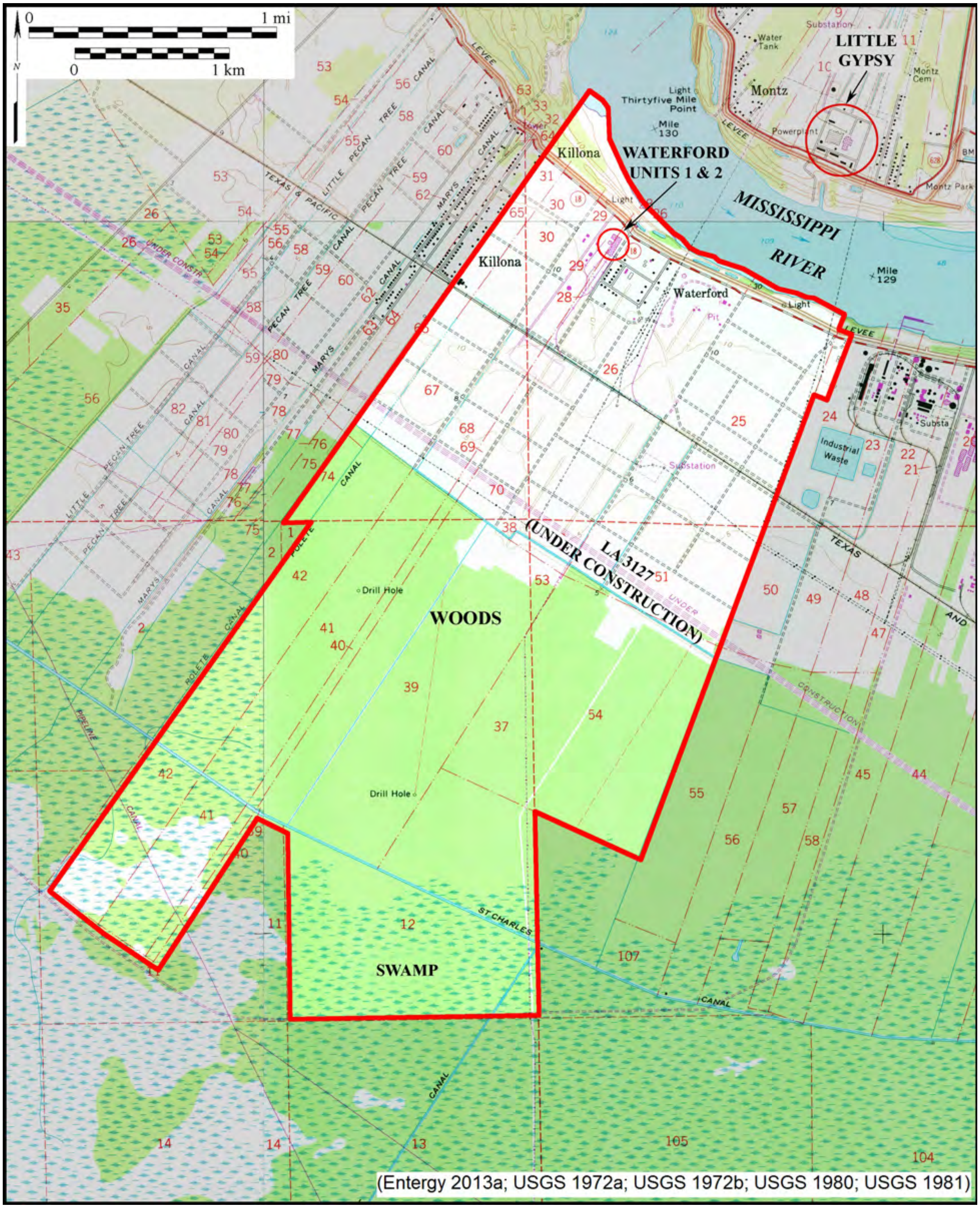


Figure 3.7-8
Transportation Improvements circa early 1970s

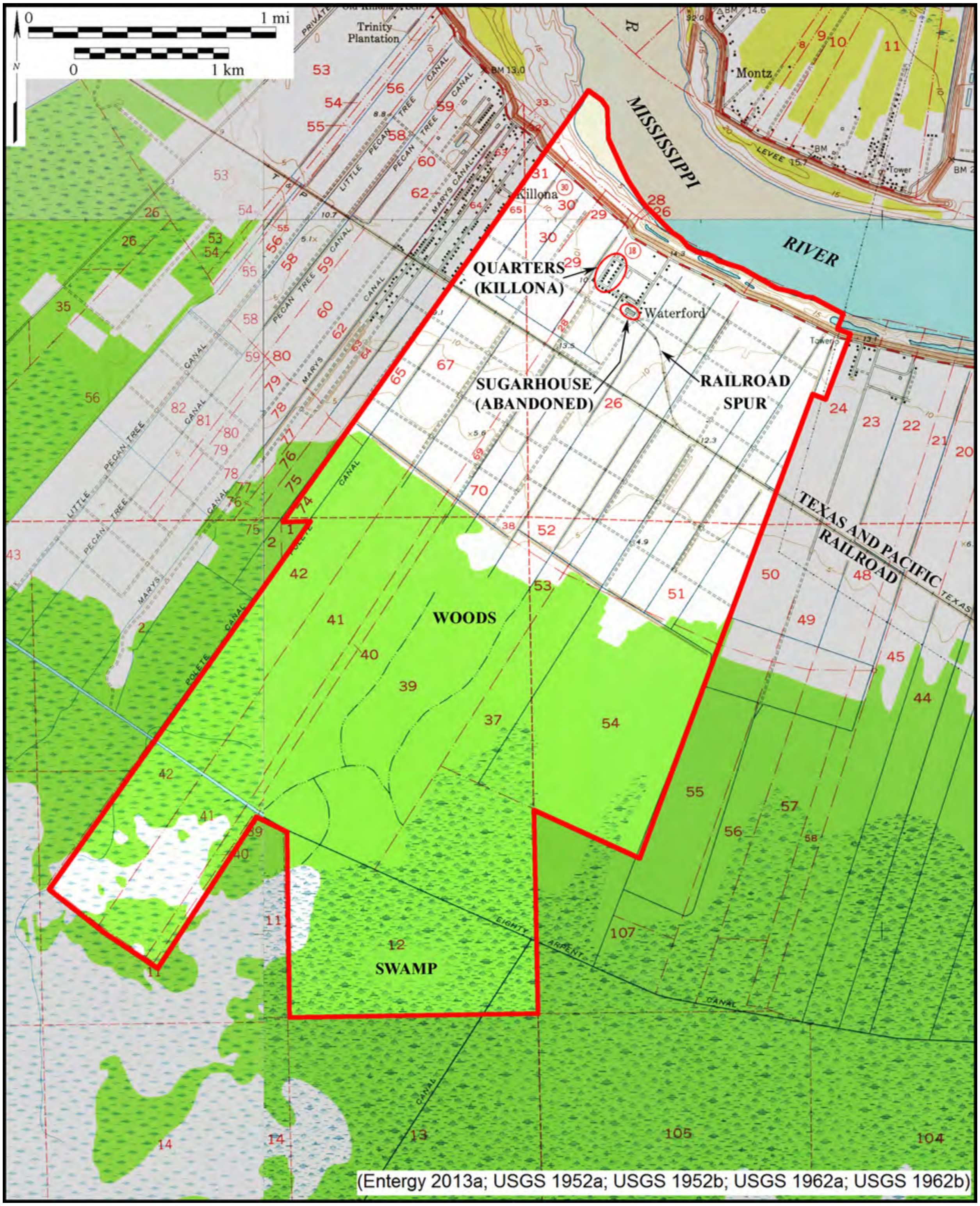


Figure 3.7-9
Entergy Louisiana, LLC Property circa 1950s

Figure 3.7-10
WF3 Plant Construction, 1978

Figure 3.7-11
WF3 Plant Construction, 1978

Figure 3.7-12
Aerial View of WF3 Plant circa 1996

Figure 3.7-13
Vicinity of Entergy Louisiana, LLC Property circa 1720s

Figure 3.7-14
Zones of Archaeological Sensitivity, Entergy Louisiana, LLC Property Northeast of LA-3127

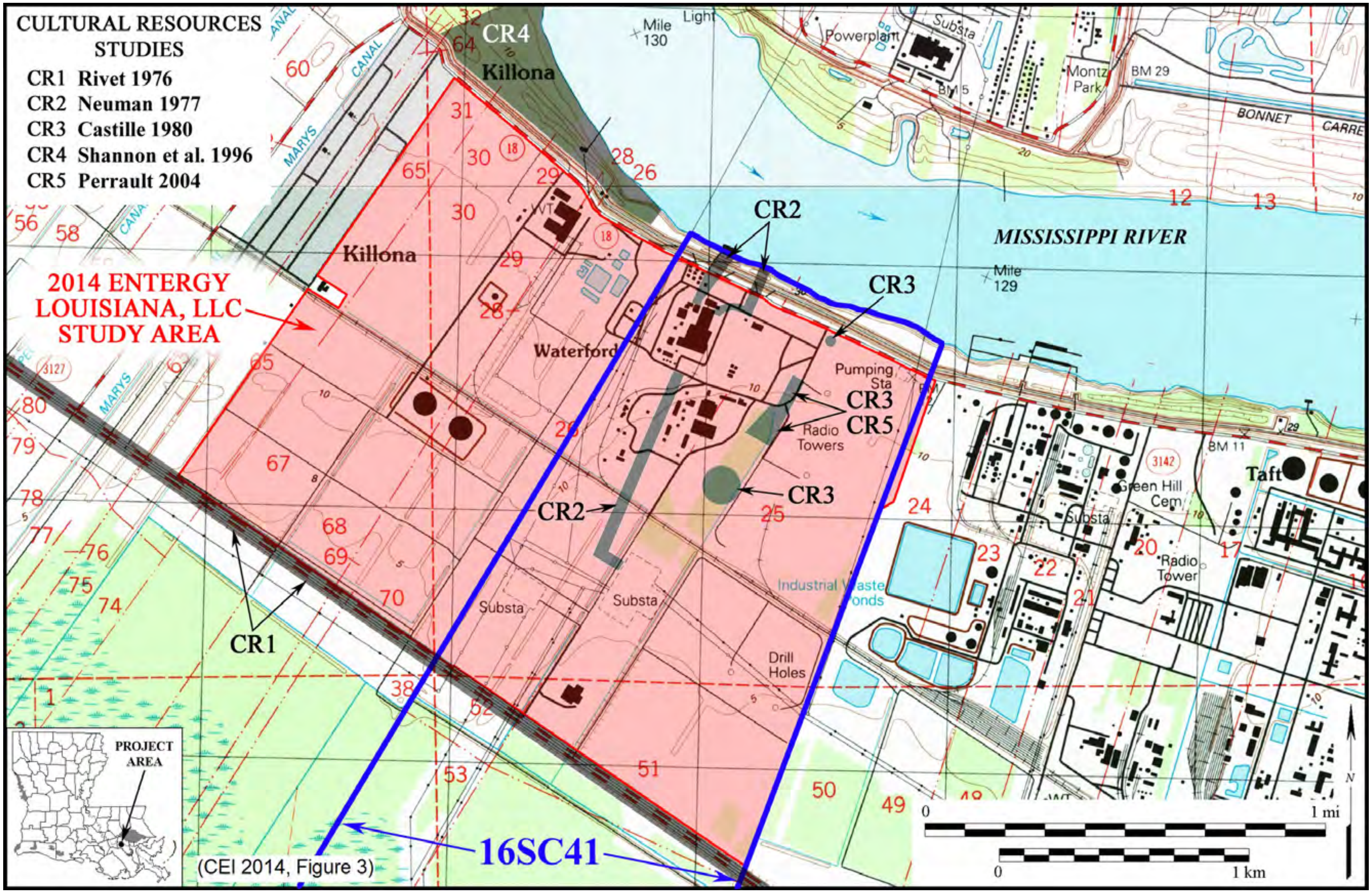


Figure 3.7-15
Location of Cultural Resource Studies, Entergy Louisiana, LLC Property

3.8 Socioeconomics

Socioeconomic descriptions are focused on St. Charles and Jefferson parishes in Louisiana because approximately 44 percent of WF3 employees are located in these two parishes, while the remaining workforce is dispersed throughout 19 surrounding Louisiana parishes and in four other states, as presented in Table 2.5-1. In addition, WF3 is one of Entergy Louisiana, LLC's assets on which property taxes are paid to St Charles Parish.

Refueling outages occur at the plant on an 18-month cycle and historically have lasted approximately 25–30 days. As discussed in Section 2.5, there are approximately 700–900 contractor workers at the plant during outages. The Baton Rouge and New Orleans metropolitan areas are both located within a 50-mile radius of the plant and offer numerous motel, campground, and food service conveniences along the I-10 transportation corridor. Nearby Louisiana communities, Kenner, Luling, and Hahnville, also provide accommodations to workers and are accessible to the plant via LA-18.

3.8.1 Employment and Income

The two parishes most influenced by WF3 operations are St. Charles and Jefferson parishes, because the highest percentage of WF3 employees reside in these two parishes, and WF3 is one of Entergy Louisiana, LLC's assets on which property taxes are paid to St Charles Parish. As discussed in Section 3.10, the populations of both St. Charles Parish and Jefferson Parish are expected to increase during the license renewal period. Low-income populations and poverty thresholds for these two counties are described in Section 3.10.2.

The estimated employed population in St. Charles Parish in 2012 was 31,214 persons, with no particular occupational sector showing employment dominance. The top three occupations each employed approximately 14 percent of parish workers, or 42 percent of the total workforce. Leading in employment was the manufacturing sector with 4,492 persons employed, followed by the construction sector with 4,455 persons employed, and the government and government enterprises sector with 4,012 persons employed. (BEA 2014) The largest employer in St. Charles Parish in 2014 was St. Charles Parish School Board, followed by Motiva/Shell Chemical, Dow St. Charles Operations, and Entergy (SCP 2015b, page 154). The annual payroll in St. Charles Parish was reported to be approximately $2 billion in 2012, and the average wage per job was $62,454 (BEA 2014). In 2012, per capita personal income was $38,332 (BEA 2014), and the annual unemployment rate decreased from 6 percent in 2012 to 5.8 percent in 2013 (BLS 2014).

The estimated employed population in Jefferson Parish in 2012 was 265,747 persons. The leading occupation was the retail trade sector with approximately 12 percent, or 32,300 persons employed. This was followed by the healthcare and social assistance sector with approximately 11 percent, or 29,569 persons employed; and the government and government enterprises sector with approximately 9 percent, or 23,585 persons employed. (BEA 2014) The largest employer in Jefferson Parish in 2013 was Ochsner Health System, followed by Jefferson Parish School Board, Stewart Enterprises, Inc., and Acme Truck Line (JEDCO 2014, page 33). The annual payroll in Jefferson Parish was approximately $19.5 billion in 2012, and the average wage per job was $45,930 (BEA 2014). In 2012, per capita personal income was $45,049 (BEA 2014), and the annual unemployment rate decreased from 6.2 percent in 2012 to 5.8 percent in 2013 (BLS 2014).

Both St. Charles Parish and Jefferson Parish fall within the seven-parish New Orleans-Metairie-Kenner Metropolitan MSA. Periodically, reports tracking post Hurricane Katrina recovery within the seven-parish MSA are released, and include indicators measuring population, economy, housing, and infrastructure. The latest 2013 report, *The New Orleans Index at Eight*, focuses on 8 years after the storm and recovery from the recent multi-year national economic recession. (TDC 2014, page 4)

The recession took hold locally in 2008, and the MSA lost only 1 percent of its jobs before the economy rebounded. By 2012, the MSA had recouped all its recession-era losses and reached 1 percent above its 2008 job level. Job losses due to Hurricane Katrina and the levee failures accelerated the shifting of jobs to suburban parishes. The geographic distribution of jobs in the MSA shows that after Hurricane Katrina, Jefferson Parish surpassed Orleans Parish to become the largest job center in the MSA. Jefferson accounted for 38 percent of MSA jobs compared to 34 percent for Orleans Parish. St. Charles Parish had the third largest share of jobs in the MSA at 5 percent. (TDC 2014, page 22)

Greater New Orleans was recovering from Hurricane Katrina when the region was hit by the Great Recession in 2008 and the Gulf of Mexico Deepwater Horizon oil spill in 2010. While most sectors have gained jobs since 2012, four industries (manufacturing, oil and gas, government, and administrative and waste services) have shed jobs. Nonetheless, government still represents the largest share of employment in the region at 17 percent, followed by wholesale and retail trade at 15 percent, leisure and hospitality at 13 percent, and professional services at 13 percent. (TDC 2014, page 14)

After Katrina, in 2006, average wages in the MSA were 4 percent lower than the U.S. average. The MSA average wage declined from 2006 to 2012, and the MSA average wage of $47,790 in 2012 was approximately 7 percent lower than the U.S. average. In comparison, MSA average wages were approximately 8 percent higher than the average for the state of Louisiana. (TDC 2014; BEA 2014)

3.8.2 Housing

Between 2000 and 2010, the total population for St. Charles Parish grew by approximately 9.8 percent (Table 3.10-2). As seen in Table 3.8-1, total available housing within St. Charles Parish followed the population growth trend, with a 14.1 percent growth in total housing units and a vacancy rate that increased by less than 1 percent. This would indicate enough housing was available to keep up with the increase in parish population. (USCB 2014d)

Jefferson Parish experienced a significant decline in population in the aftermath of Hurricane Katrina in 2005. As seen in Table 3.10-2, between 2000 and 2010, the total population in the parish decreased by approximately 5 percent. With the outmigration of population during this time period, the number of vacant housing units grew by 66.9 percent, even though there was less than a 1 percent gain in the total number of housing units as shown in Table 3.10-2. As indicated by the vacancy rate increase of 4.1 percent, enough housing units were available for the existing population in the parish. (USCB 2014d)

Between 2000 and 2010, median home values in St. Charles Parish grew by 78.5 percent, and home values grew by 63.9 percent in Jefferson Parish (Table 3.8-1). In the same time period, monthly rental rates grew by 71.6 percent in St. Charles Parish and by 60.5 percent in Jefferson Parish. (USCB 2014d)

3.8.3 Water Supply and Wastewater

3.8.3.1 Water Supply

The St. Charles Parish Waterworks Department is the service provider for Parish residents and relies on the Mississippi River as its water source. It is also the potable water service provider for WF3. The St. Charles East Bank Water District serves almost half the Parish population (26,113) and is supported by five facilities. As shown in Table 3.8-2, demand on the East Bank services is currently at approximately 30.7 percent of capacity. The West Bank Water District consists of four facilities and serves a Parish population of 26,584; demand is currently at 41.1 percent of capacity. The East Bank system was recently upgraded and there are no plans to add to the West Bank system. Because the water department is currently meeting population needs in the Parish, there are no plans to expand these systems in the foreseeable future. (ENERCON 2014a)

As discussed in Section 2.2.2.6, the St. Charles Parish water system furnishes a metered supply of potable water to WF3 through municipal water mains. A valve connection supplies the majority of the water via a backflow prevention and metering station located at the southeast corner of the plant site. The potable water distribution system then supplies water to various buildings throughout the site. In 2013 and 2014, the St. Charles Parish water system provided approximately 1,166,090 and 1,346,630 gallons, respectively to WF3 (Entergy 2015k).

The Jefferson Parish Water Department is also organized into East Bank and West Bank districts, and the Mississippi River is the water source. The East Bank water district has four facilities and serves a population of 243,782. Reported demand is currently at approximately 40.6 percent of capacity. The West Bank district consists of two plants, has a population of 188,770, and demand is at 35.7 percent of capacity. Population in the parish has declined since 2000 (Table 3.10-2), and it is expected that consumption will remain relatively steady in the near future. (ENERCON 2014b)

Two municipalities in Jefferson Parish act as the water service providers for their populations: the City of Gretna and the City of Westwego. The Gretna Water Department has its own waterworks system that serves a population of 17,736 and utilizes the Mississippi River as its water source. Gretna has one plant facility with demand currently at 33.3 percent of capacity.

A water system upgrade was completed in 2013. (ENERCON 2014c) The City of Westwego water treatment facility relies on the Mississippi River as the water source and serves a population of 8,354. The demand on the plant is currently at 73.3 percent of capacity, and additional upgrades have been undertaken, with more planned. (ENERCON 2014d)

As discussed in Section 3.5.3.2, groundwater usage in St. Charles Parish and Jefferson Parish is substantially less than surface water use, but some private supply wells are utilized for residents not on public utilities (Table 3.5-4).

3.8.3.2 Wastewater

The St. Charles Parish Wastewater Department is organized similar to the Water Department, providing services through an East Bank complex and a West Bank complex. As shown in Table 3.8-3, the East Bank plant in Destrehan is at 54 percent of capacity. The West Bank has two facilities, with the demand at the Hahnville plant at 92 percent of capacity and demand at the Luling Oxidation Pond at 50 percent of capacity, for a combined average of 71 percent. During wet weather events, all plants in the Parish operate above their design capacity with the Hahnville Plant having to go into bypass mode. The Parish would like to construct an additional treatment facility on the West Bank to support future growth, but there are currently no plans or timeline for when this may take place. (ENERCON 2014e) Currently, adequate capacity is available in the Parish for current population needs.

As discussed in Section 3.5.1.1.3, with the exception of the EEC, sanitary wastewater from all plant locations at WF3 is collected and discharged to the St. Charles Parish POTW where it is managed appropriately. Sanitary wastewater from the EEC, which is regulated by WF3's LPDES Permit No. LA0007374 (Attachment A), flows to an onsite sewage treatment unit prior to discharging to 40 Arpent Canal via LPDES Outfall 005.

As shown in Table 3.8-3, the Jefferson Parish Wastewater Department has one East Bank wastewater plant with demand at approximately 60.6 percent of capacity. The Jefferson Parish West Bank has five plants (three major treatment plants and two minor plants) with a combined average demand on capacity at 56.5 percent. (ENERCON 2014f) The City of Gretna Wastewater Department has one plant providing services for its population and is at 38.5 percent capacity (ENERCON 2014c). The City of Westwego also has one plant in its wastewater system and demand is currently at 66.3 percent of capacity. Some recent upgrades of the system have been undertaken, with more planned. (ENERCON 2014d) Adequate capacity is available in the Parish for current population needs.

3.8.4 Community Services and Education

St. Charles Parish has one public school district. Based on the 2011–2012 school year, there were 17 public schools (pre-kindergarten through 12th grade) in the parish with 9,743 students. The student/teacher ratio was 11.87. (NCES 2014) In addition, the parish operates a facility for high school juniors and seniors to pursue a career-oriented curriculum using state-of-the-art equipment and technologies, and three adult learning centers in Norco, Killona, and Boutte (SCP

2011, page 119). St. Charles Parish also has three private schools, with an additional 717 students during the 2011–2012 school year (NCES 2014). In 2010, the State of Louisiana ranked the St. Charles public school district 10th among 69 school districts, based on performance scores (SCP 2011, page 119). During that same school year, the Louisiana Department of Education began to assign letter grades to schools based on school performance scores, where A is the highest and F is the lowest score. In St. Charles Parish, 98 percent of students attended schools that met state standards in 2012, and this percentage is nearly the same as pre-Katrina. Furthermore, 74 percent of students were in schools that earned an "A" or "B" score. (TDC 2014, page 42) School district projections for the next 5 years indicate a stable level of enrollment, consistent with overall population projections for the parish, which indicates a slow rate of growth (SCP 2011, page 119).

The Jefferson Parish Public School System is one of the state's largest school districts and the only public school district in the Parish. Based on the 2012–2013 school year, there were 80 public schools in the parish totaling 46,389 students. Additionally, during the same time period there were approximately 80 private and parochial schools in Jefferson Parish that served approximately 34,949 students. (JEDCO 2014, page 10) The student/teacher ratio for the 2011–2012 school year was 15.03 (NCES 2014). During the 2012–2013 school year, 90 percent of Jefferson Parish public school students were enrolled in an "academically satisfactory" school that met state standards of quality, an increase from about 80 percent pre-Katrina. Based on Louisiana public school scoring, 36 percent of Jefferson Parish students attended schools that earned a "D" average, indicating the school barely met state standards; another 33 percent attended a "C" school; and 21 percent attended schools that earned an "A" or "B". (TDC 2014, page 42)

No higher education institutions are located within St. Charles Parish. However, 18 colleges and universities are all located within a few hours of St. Charles Parish; 10 are in the New Orleans metro area and can be reached within half an hour or less (SCP 2011, page 119). Two regional technical institutes (JEDCO 2014, page 11) are located in close proximity to St. Charles Parish. Along with access to metro area higher education, the population has access to Herzing University, branches of Louisiana Technical College, and a University of New Orleans Maritime Technical Center, all of which are located in Jefferson Parish (JEDCO 2014, page 11).

In St. Charles Parish, there are no municipalities and the primary law enforcement agency is the St. Charles Parish Sheriff's Office. St. Charles Parish has more than 375 full-time law enforcement personnel. (SCPSO 2014) Serving a 2013-estimated population of 52,617 (USCB 2014a), the ratio of law enforcement personnel per 1,000 residents was approximately 7.1.

In neighboring Jefferson Parish, in addition to the Jefferson Parish Sheriff's Office, six municipalities have a police force. The Jefferson Parish Sheriff's Office has more than 1,500 law enforcement personnel. (JEDCO 2014, page 33) Serving a 2013-estimated population of 434,767 (USCB 2014a), the ratio of sheriff's department law enforcement personnel per 1,000 residents was 3.5 in 2013. The six municipalities with their own police forces in Jefferson Parish are Grand Isle, Gretna, Harahan, Kenner, Lafitte, and Westwego (USACOPS 2014).

The City of New Orleans has the largest fire department in the region, with 32 stations and a staff of 712 full-time paid fire fighters (USFA 2014). St. Charles Parish is divided into 10 fire districts, all of which rely on volunteers (SCP 2011, page 121). In 2014, St. Charles Parish had approximately 229 volunteer fire protection service personnel (USFA 2014) serving a 2013-estimated population of 52,617 (USCB 2014a); the ratio of firefighters per 1,000 residents was 4.4 in 2013. In 2014, Jefferson Parish had approximately 529 paid career fire protection service personnel and another 529 volunteer firefighters for a total of 1,058 (USFA 2014) serving a 2013-estimated population of 434,767 (USCB 2014a); the ratio of firefighters per 1,000 residents in Jefferson Parish was 2.4 in 2013.

The two primary healthcare facilities in St. Charles Parish are the St. Charles Parish Hospital and the Luling Rehabilitation Hospital, both of which are located in Luling. The St. Charles Parish Hospital also operates a medical clinic on the parish's east bank in Destrehan. (SCP 2011, page 121)

St. Charles Parish Hospital has 59 licensed beds and a staff of approximately 478 (SCP 2011, page 119; SCHG 2014); 57 physicians are affiliated with the facility (Healthgrades 2014). As of 2014, the hospital merged with Ochsner Health System, a regional healthcare company which employs 900 full-time physicians and 14,000 other employees throughout southeastern Louisiana (OHS 2014).

Some of the larger medical facilities located in Jefferson Parish include East Jefferson General Hospital; Ochsner Medical Center—Kenner; Ochsner Medical Center—West Bank; Tulane Medical Center—Lakeside Hospital; and West Jefferson Medical Center. In 2012, the American Hospital Directory reported 1,151 beds for Jefferson Parish. (AHD 2014) As discussed in Section 3.8.1, the second largest employment sector in Jefferson Parish was healthcare and social assistance.

3.8.5 Local Government Revenues

For property tax purposes, Louisiana calculates a total entity or unit value for regulated utilities in the state, including Entergy Louisiana, LLC, and does not value WF3 on a standalone basis. All Entergy Louisiana, LLC owned property in Louisiana was assessed at approximately $519 million in 2014 (LTC 2014, page 9). The 2013 taxable assessed value of Entergy Louisiana, LLC property allocated to St. Charles Parish was approximately $179.9 million dollars (SCP 2015b, page 142). Entergy Louisiana, LLC does not receive separate tax invoices from St. Charles Parish for power plants. In 2014, Entergy Louisiana, LLC paid approximately $20.8 million in property taxes to St. Charles Parish (Table 3.8-4).

Total property tax revenues for St. Charles Parish, including parish and local taxes, were approximately $142.9 million in 2014. The two largest programs receiving parish funds were school maintenance at approximately $52.0 million, with total school taxes equaling approximately $70.5 million, and law enforcement at approximately $22.1 million, with total law enforcement equaling approximately $26.8 million. (LTC 2014, page 90) In 2014, Entergy Louisiana, LLC payments to St. Charles Parish in property taxes represented roughly 15 percent of the total parish property tax revenues. Entergy Louisiana, LLC anticipates that continued fluctuations in the company's assessed value and tax rates will impact the tax payments to St. Charles Parish; however, Entergy Louisiana, LLC does not expect these changes to be notable or significant changes to future property tax payments.

WF3 currently employs 641 full-time employees (Table 2.5-1). Additionally, 700–900 contractor workers participate in regularly scheduled 18-month refueling outages. Therefore, employment of current employees and contractor workers at WF3 benefits local and regional economies as employee salaries flow through the communities by purchasing goods and services, and contributing income, sales, and personal property taxes.

State general sales and use tax is levied on the sale of tangible personal property at retail; the use, consumption, distribution or storage of any tangible personal property; the lease or rental within Louisiana of any item or article of tangible personal property; and the sale of services as defined in the statutes under R.S. 47:301(14) (LDR 2014). The state has a sales tax rate of 4 percent, with a combined local rate of 5 percent (LATA 2014). St. Charles Parish collected approximately $27 million in sales taxes in 2014, down from the $35 million in 2013 (SCP 2015c).

Other than taxes, no other significant payments are made by Entergy Louisiana, LLC to St. Charles Parish as it relates to WF3.

3.8.6 Transportation

St. Charles Parish's intermodal location along the Mississippi River provides direct access to major markets throughout the state and the world. Along with the interstate road system, St. Charles Parish is served by freight rail, deepwater, air transportation, and truck/freight carriers (SCP 2014b).

The region within a 50-mile radius of WF3 has a highly developed roadway network (Figures 3.0-3 and 3.0-4). I-10, which extends between the cities of Baton Rouge and New Orleans, is located outside a 6-mile radius of WF3 and traverses St. John the Baptist, St. Charles, and Jefferson parishes, north of the Mississippi River and south of Lake Pontchartrain. US-90, also located outside a 6-mile radius of WF3, supports east-west traffic in the region on the south side of the Mississippi River between New Orleans, Houma, and Morgan City. Along with US-90 providing vehicular access to the state arterial and collector network of roads within a 6-mile radius of WF3, I-10 vehicular traffic has access to areas south of the Mississippi River in St. Charles Parish, and specifically WF3, via Interstate Highway 310 (I-310). (SCP 2011, page 88)

Traffic counts have increased approximately 5 percent per year along the major arterial network (in St. Charles Parish). In contrast, traffic volumes along minor arterials and local roads have grown very little and, in some cases, they have decreased, indicating a relatively slow pace of development in St. Charles Parish in the 7 years prior to 2011. Local traffic analysis notes that the most significant issue related to the functionality of the roadway network is that it is hampered by travel barriers: wetlands, vast expanses of privately owned and restricted industrial property, privately owned railroad lines, and the Mississippi River. The network is alternative-poor and results in circuitous trip patterns that cause increased travel time and distance to travelers. Proactive action on the part of parish and state leadership would be necessary to alter this pattern. (SCP 2011, page 89)

The main vehicular entrance to WF3 is from LA-18 on the north side of the plant. Louisiana Department of Transportation & Development (LaDOTD) average annual daily traffic volumes for the state roads within a 6-mile radius that link to the WF3 plant are listed in Table 3.8-5. LA-3127 has the heaviest east-west traffic within a 6-mile radius of WF3. Counts taken at locations in St. John the Baptist Parish (since 2002) and St. Charles Parish (since 2004) illustrate slow growth in traffic. The LA-18 traffic counts taken at locations east and southeast of WF3 in St. Charles Parish have slowly risen since 2004, whereas the count taken northwest of the plant in St. John the Baptist Parish has decreased since 2002. LA-3142, located east of the plant, is a predominantly north-south collector road and carries the greatest amount of traffic, linking LA-3127 to LA-18. (LaDOTD 2014a)

The U.S. Transportation Research Board has developed a commonly used indicator, called level of service (LOS), to measure how well a highway accommodates traffic flow. LOS is a qualitative assessment of traffic flow and how much delay the average vehicle might encounter during peak hours. LOS categories as defined in the *Highway Capacity Manual*, are listed in Table 3.8-6. (TRB 2010)

No LOS assignments were available for local road sets. However, transportation studies comparing daily traffic volume data to daily capacity for St. Charles Parish roadways suggest that travel flow is generally good and there is very little traffic congestion currently within the parish. Where congestion occurs, it is primarily near major industries at morning and evening workday peak-hours. (SCP 2011, page 89) Based on LOS traffic conditions defined in Table 3.8-6, St. Charles Parish roads near the plant would fall within an LOS "A" to LOS "C" range of conditions. Local studies give no indication that the capacities of roads providing access to WF3 are exceeded by current needs. For years 2015 to 2018, the LaDOTD has no significant road expansion or improvements currently scheduled for St. John the Baptist Parish or St. Charles Parish. (LaDOTD 2014b)

The only transit service in St. Charles Parish is provided by the River Parishes Transit Authority, an on-demand system using a fleet of three 12-passenger buses, which is funded through a cooperative venture between St. Charles and St. John the Baptist parishes. Currently, critical population mass does not exist for other types of mass transit. (SCP 2011, page 91)

Freight rail in St. Charles Parish is served by the Canadian National Illinois Central, Union Pacific, Burlington Northern Santa Fe, and Kansas City Southern railroads, which connect to the six-carrier network of the New Orleans area, the largest in the southern United States (SCP 2014b).

Water transportation is a major means for accessing St. Charles Parish. Cargo can be delivered from St. Charles Parish to all of mid-America via the 19,000-mile Mississippi River system. For international access, the nearby deepwater Port of South Louisiana and Port of New Orleans operate foreign trade zones. (SCP 2014b)

Air transportation is available from the Louis Armstrong New Orleans International Airport, which is located less than 5 miles from St. Charles Parish, providing one- and two-stop service to nearly all major domestic and international destinations (SCP 2014b).

Truck/freight carriers service the St. Charles Parish area with easily accessible interstate highway connectivity via I-310 and I-10 (SCP 2014b).

3.8.7 Recreational Facilities

As shown in Figure 3.0-5, one of the nearest and largest designated recreational areas within a 6-mile radius of WF3 is the Bonnet Carre Spillway. Just west of the spillway is the Maurepas Swamp WMA, a portion of which is located within a 6-mile radius of WF3. As described in Section 3.0.4, several local parks including Killona Park, Montz Park, Bethune Park, Cambridge Park, Greenwood Park, Highway 51 Park, Larayo Park, and Emily C. Watkins Park also fall within a 6-mile radius of WF3.

The Bonnet Carre Spillway was constructed by the USACE in 1931 for flood control. Since then, this 7,623-acre tract of federal land has evolved into an extensively used outdoor recreation area. The USACE estimates that the spillway attracts approximately 400,000 visitors each year. Recreational uses include fishing, crawfishing, hunting, dog training, camping, wildlife observation, boating, and picnicking. Five boat launching sites provide access to the spillway's waterways and western Lake Pontchartrain. A primitive campground is provided by St. Charles Parish. The public is allowed access provided activities do not interfere with the operation of the spillway. (USACE 2012b; USACE 2014c)

Maurepas Swamp WMA totals 122,098 acres of mostly flooded cypress tupelo swamp (ENERCON 2014g). Access into the area is primarily by boat, but several portions can be accessed on foot. Users must obtain self-clearing permits for all activities within the WMA. Recreational activities within the WMA include fishing, hunting, trapping, boating, and bird watching. Two tent-only camping areas were established in 2012. (LDWF 2014a) Visitation numbers for the WMA are based on the number of user activities recorded on the self-clearing permits filed. For the 2013 calendar year, 9,864 activities were recorded. This number is anticipated to be low because boaters and anglers who enter the WMA from outside its boundaries are not required to file self-clearing permits, and some users do not file permits. The LDWF estimates that including those visitors, user activities in 2013 would have been approximately 19,692. (ENERCON 2014h)

In 2013, St. Charles Parish Economic Development and Tourism Department reported that Destrehan Plantation (the Parish's most popular tourist attraction) visitation rose about 10 percent since 2012, to 35,248 visitors. The Parish German Coast Farmers' Market had nearly 27,000 patrons in attendance in 2013. (SCP 2013)

Various local parks are located within a 6-mile radius of WF3 (Table 3.0-1) in both St. Charles and St. John the Baptist parishes.

The existing inventory of St. Charles Parish parks and facilities encompasses 317 acres of land. Currently, the parish parks system includes 50 sites. Of these, 28 sites are owned by St. Charles Parish, and 22 sites are leased from the St. Charles Parish School District, local civic organizations, the Catholic Archdiocese of New Orleans, and private companies. Many of these parks are found within neighborhoods and feature community recreational activities and programs, including youth and adult sports, senior citizen activities, summer camps, and special events. St. Charles Parish has no system that tracks visitor use by park facility. (SCP 2012, pages 5 and 13–21)

Along with local parks listed in Table 3.0-1, St. John the Baptist Parish has a number of major neighborhood parks, smaller parks, and public boat launches. Parish park facilities support organized sports activities, neighborhood playgrounds, and picnic amenities. The master plan recommends a number of future capital improvements for parks located in St. John the Baptist Parish, but currently there are no plans for adding new parks to the parish system. No visitation information specific to St. John the Baptist Parish parks was available. Highway 51 Park is one of St. John the Baptist Parish's premiere parks and is located within a 6-mile radius of WF3. (SJBP 2013) The parish's annual Andouille Festival is a 3-day special event held at the Highway 51 Park and attracts almost 18,000 people each October (SJBP 2014b).

There are also popular multi-use paths atop the Mississippi River levees, on both the east and the west banks of the river. The pathways accommodate walkers, in-line skaters, joggers, and bicyclists. The path on the east bank runs from Jefferson Parish to St. John the Baptist Parish, with construction funded by the LaDOTD. On the west bank, St. Charles Parish and the LaDOTD have completed a 10.7-mile path. The parish continues to seek grant funding to complete the path across the entire parish. Ultimately, the path will span from East Baton Rouge to Audubon Park in New Orleans. (SCP 2012, pages 13–19)

Table 3.8-1
Jefferson and St. Charles Parishes Housing Statistics, 2000–2010

Parish	2000	2010	2000 to 2010 Change
Jefferson			
Total housing units	187,907	189,135	0.7% increase
Occupied units	176,234	169,647	-3.7% decrease
Vacant units	11,673	19,488	66.9% increase
Vacancy rate (percent)	6.2	10.3	4.1% increase
Median house value ($)	105,300	172,600[a]	63.9% increase
Median rent ($/month)	544	873[a]	60.5% increase
St. Charles			
Total housing units	17,430	19,896	14.1% increase
Occupied units	16,422	18,557	13.0% increase
Vacant units	1,008	1,339	32.8% increase
Vacancy rate (percent)	5.8	6.7	0.9% increase
Median house value ($)	104,200	186,000[b]	78.5% increase
Median rent ($/month)	507	870[b]	71.6% increase

(USCB 2014d)

a. 2010 American Community Survey 1-Year Estimates
b. 2008–2010 American Community Survey 3-Year Estimates

Table 3.8-2
Public Water Systems, St. Charles and Jefferson Parishes

Water System	Parish	Source	Number of Plants/Facilities	2010 Population Served	Design Capacity (MGD)	Average Production (MGD)	Demand (Percent Design Capacity)
St. Charles Water District East Bank (New Sarpy)	St. Charles	Surface water	5	26,113	13.0	4.0	30.7
St. Charles Water District West Bank (Luling)	St. Charles	Surface water	4	26,584	9.0	3.7	41.1
Jefferson Water Department East Bank Complex	Jefferson	Surface water	4	243,782	87.0	35.3	40.6
Jefferson Water Department West Bank Complex	Jefferson	Surface water	2	188,770[a]	61.0	21.8	35.7
Gretna Water	Jefferson	Surface water	1	17,736	7.5	2.5	33.3
Westwego Water	Jefferson	Surface water	1	8,354	3.0	2.2	73.3

(ENERCON 2014a; ENERCON 2014b; ENERCON 2014c; ENERCON 2014d)

a. Reported Jefferson Parish west bank population includes City of Gretna and City of Westwego.

Table 3.8-3
Public Wastewater Systems, St. Charles and Jefferson Parishes

Wastewater System	Parish	Number of Plants/Facilities	Design Capacity (MGD)	Average Production (MGD)	Demand (Percent Design Capacity)
St. Charles Wastewater East Bank Complex—Destrehan	St. Charles	1	6.0	3.2	54.0
St. Charles Wastewater West Bank Complex—Hahnville and Luling	St. Charles	2	5.5	3.7	71.0[a]
Jefferson Wastewater Department East Bank—Jefferson	Jefferson	1	33.0	20.0	60.6
Jefferson Wastewater Department West Bank Complex—Bridge City, Marrero, Harvey and Lafitte (Jonathan Davis and Rosethorne)	Jefferson	5	33.2	17.4	56.5[b]
Gretna Wastewater	Jefferson	1	6.5	2.5	38.5
Westwego Wastewater	Jefferson	1	3.0	1.9	66.3

(ENERCON 2014c; ENERCON 2014d; ENERCON 2014e; ENERCON 2014f)

a. Average of Hahnville (92.0 percent) and Luling (50.0 percent) reported demand on capacity.

b. Average of Bridge City (57.1 percent), Marrero (63.5 percent), Harvey (42.4 percent), Jonathan Davis (48.0 percent), Rosethorne (71.4 percent) demand on capacity.

Table 3.8-4
Entergy Louisiana, LLC Property Tax Payments, 2010–2014

Year	Entergy Louisiana, LLC Property Taxes	St. Charles Parish Revenues	Percent of Parish Revenue
2010	$21,366,443	$116,481,724	18
2011	$21,398,845	$125,882,648	17
2012	$20,703,039	$131,423,253	16
2013	$20,458,149	$136,517,151	15
2014	$20,812,041	$142,863,672	15

(Entergy 2015l; LTC 2010; LTC 2011; LTC 2012; LTC 2013; LTC 2014)

Table 3.8-5
Total Average Annual Daily Traffic Counts on State Routes near WF3

State Route	Location (Parish)	Mile Marker	2002	2004	2005	2007	2008	2010	2011	2013
LA-18	Northwest of LA-3141 (St. John the Baptist)	43.14	2,132	NC	2,534	NC	1,617	NC	1,441	NC
LA-3127	Northwest of LA-3141 (St. John the Baptist)	29.18	4,892	NC	5,080	NC	6,359	NC	6,704	NC
LA-3127	West of LA-3141 (St. Charles)	32.16	NC	1,927	NC	6,730	NC	7,586	NC	7,174
LA-3141	West of WF3 (St. Charles)	0.56	NC	1,037	NC	1,830	NC	1,864	NC	1,570
LA-3142	Southeast of WF3 (St. Charles)	0.80	NC	3,404	NC	5,741	NC	5,441	NC	6,240
LA-18	East of LA-3142 (St. Charles)	51.12	NC	4,930	NC	5,698	NC	5,118	NC	5,911
LA-3160	Southeast of WF3 (St. Charles)	0.31	NC	2,255	NC	2,148	NC	1,851	NC	2,862
LA-18	Southeast of LA-3160 (St. Charles)	52.57	NC	8,199	NC	8,707	NC	6,505	NC	9,343
LA-3127	Southeast of LA-3160 (St. Charles)	39.15	NC	11,726	NC	13,098	NC	13,743	NC	13,996

(LaDOTD 2014a)
NC: No Count

Table 3.8-6
Level of Service Definitions

Level of Service	Conditions
A	Free flow of the traffic stream. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The effects of incidents or point breakdowns are easily absorbed.
B	Reasonably free flow of the traffic stream. The ability to maneuver within the traffic stream is only slightly restricted. The effects of minor incidents and point breakdowns are still easily absorbed.
C	Influence of the traffic density on operations becomes marked. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed, but the local deterioration in service quality will be significant. Queues may be expected to form behind any significant blockages.
D	Ability to maneuver is severely restricted due to traffic congestion. Speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuver within the traffic stream is seriously limited. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions.
E	Operations at or near capacity, highly volatile level. There are virtually no usable gaps within the traffic stream, leaving little room to maneuver within the traffic stream. Any disruption to the traffic stream, such as vehicles entering from a ramp or a vehicle changing lanes, can establish a disruption wave that propagates throughout the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown and substantial queuing.
F	Breakdown or unstable flow. Such conditions exist within queues forming behind bottlenecks, which occur when the number of vehicles arriving is greater than the number of vehicles that can be discharged, or when the forecast demand exceeds the computed capacity. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages. Whenever queues due to a breakdown exist, they have the potential to extend upstream for considerable distances. Downstream operations improve (assuming that there are no additional downstream bottlenecks) as discharging vehicles move away from the bottleneck.

(TRB 2010)

3.9 Human Health

3.9.1 Radiological Hazards

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified.

3.9.1.1 Liquid and Gaseous Effluent Releases

A description of the WF3 liquid and gaseous radwaste system is presented in Section 2.2.3 of this ER. All normal liquid and gaseous 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 (WF3 2014a, Sections 11.2.1 and 11.3.1). The controls for limiting the release of radiological liquid and gaseous effluents are described in the WF3 *Offsite Dose Calculation Manual*. Controls are based on (1) concentrations of radioactive materials in liquid and gaseous effluents and projected dose or (2) dose commitment to a hypothetical member of the public. (WF3 2014g)

Regulation 10 CFR 50.36(a) requires nuclear power plants to submit an annual report to the NRC that lists the types and quantities of radioactive effluents released into the environment. Based on review of the WF3 annual radioactive effluent release reports for 2010 through 2014 (Entergy 2011c; Entergy 2012b; Entergy 2013d; Entergy 2014f; Entergy 2015m), doses to members of the public complied with the radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190.

Dose estimates for members of the public are calculated based on radioactive gaseous and liquid effluent release data, and atmospheric and aquatic transport models. The 2014 annual radioactive effluent release report (Entergy 2015m) contains a detailed presentation of the radioactive discharges and the resultant calculated doses. The following summarizes the calculated dose to a member of the public from radioactive gaseous and liquid effluents released during 2014 (Entergy 2015m):

- The maximum whole body dose to an offsite member of the public from radioactive liquid effluents is 8.12E-04 millirem (mrem), which is below the 3-mrem dose criterion in Appendix I to 10 CFR Part 50.

- The maximum organ dose to an offsite member of the public from radioactive liquid effluents is 1.07E-03 mrem, which is below the 10-mrem dose criterion in Appendix I to 10 CFR Part 50.

- The maximum air dose at the site boundary from gamma radiation in gaseous effluents is 3.21E-02 milliradiation absorbed dose (mrad), which is below the 10-mrad dose criterion in Appendix I to 10 CFR Part 50.

- The maximum air dose at the site boundary from beta radiation in gaseous effluents is 7.80E-02 mrad, which is below the 20-mrad dose criterion in Appendix I to 10 CFR Part 50.

- The maximum organ (child bone) dose to an offsite member of the public from carbon-14, radioactive iodine, tritium, and radioactive material in particulate form with half-lives greater than 8-days was 4.57 mrem, which is well below the 15 mrem dose criterion in Appendix I to 10 CFR Part 50.

- The maximum organ (child thyroid) dose to an offsite member of the public from radioactive iodine and radioactive material in particulate form with half-lives greater than 8-days was 0.119 mrem, which is well below the 15 mrem dose criterion in Appendix I to 10 CFR Part 50.

- Maximum total body dose to an offsite member of the public from the combined radioactive releases (i.e., gaseous, liquid, and direct radiation) are only required to be evaluated if quarterly doses exceed 3 mrem to the total body (liquid releases); 10 mrem to any organ (liquid releases); 10 mrad gamma air dose; 20 mrad beta air dose; or 15 mrem to any organ from radioiodines and particulates. At no time during 2014 were any of these limits exceeded; therefore, the evaluation was not required.

3.9.1.2 Radiological Environmental Monitoring Program

The REMP is conducted to assess the radiological impact, if any, to its employees, the public, and the environment from operations. The REMP measures aquatic, terrestrial, and atmospheric radioactivity, as well as ambient radiation. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). The REMP supplements the radioactive effluent monitoring program by verifying that any measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than those calculated using the radioactive effluent release measurements and transport models. (NRC 2014b, Section 4.9.2.1)

WF3 established its REMP prior to the station becoming operational (1985) to provide data on background radiation and radioactivity normally present in the area, and to ensure that plant operating controls properly function to minimize any associated radiation endangerment to human health or the environment. The REMP is designed for the following (Entergy 2015h):

- 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 WF3.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

WF3 has continued to monitor the environment; its REMP includes sampling indicator and control locations. 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. WF3 compares indicator results with control, preoperational, and previous years of operational results to assess any impact WF3 might have on the surrounding environment. (Entergy 2015h)

The WF3 REMP is based on four exposure pathways to the public: airborne, direct radiation, waterborne, and ingestion. The airborne samples taken around WF3 are airborne radioiodine and particulates. Direct radiation is measured at locations around the plant site, one in each meteorological sector, using thermoluminescent dosimeters. The waterborne pathway samples are taken from surface water and drinking water, and shoreline sediment samples also are taken for this pathway. The ingestion pathway samples include milk, fish and invertebrates, and broadleaf vegetation. (Entergy 2015h)

WF3 prepares an annual radiological environmental operating report, which contains a discussion of the results of the monitoring program performed for the previous year, and submits it to the NRC. These annual reports provide a data set that covers a broad range of activities that would occur at a nuclear power plant, including refueling outages, non-refueling outage years, routine operation, and years where there may be significant maintenance activities (NRC 2014b, Section 4.9.2.1). Based on submitted annual radiological environmental operating reports for 2010 through 2014 (Entergy 2011d; Entergy 2012c; Entergy 2013e; Entergy 2014g; Entergy 2015h), WF3 observed no adverse trends (i.e., steadily increasing build-up of radioactivity levels), and the 5 years of data show no measurable impact to the environment from WF3 operations.

3.9.1.3 Groundwater Protection Monitoring Program

In 2007, the NEI established a standard for monitoring and reporting radioactive isotopes in groundwater in NEI 07-07, *Industry Ground Water Protection Initiative Final Guidance Document* (NEI 2007). WF3 implemented the recommendations of this industry standard after initial sampling efforts in 2007. Information on the WF3 groundwater protection program is presented in Sections 3.5.2.4 and 4.5.2.4 of this ER. Results of WF3's groundwater protection program are contained in the annual radioactive effluent release report submitted annually to the NRC. Based on results since the groundwater monitoring program was initiated in 2007, no tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected (Entergy 2008; Entergy 2009b; Entergy 2010; Entergy 2011c; Entergy 2012b; Entergy 2013d; Entergy 2014f; Entergy 2015m).

3.9.1.4 Occupational Exposure

Some workers at WF3 are classified as radiological workers and, depending on their work assignments, receive occupational radiation exposure. The NRC regulations at 10 CFR Part 20 limit the annual total effective dose equivalent (TEDE) for individual radiation workers to 0.05 sieverts (5 roentgen equivalent man [rem]) per year; however, WF3 procedures administratively limit the exposure below the NRC's regulatory limit.

Based on NUREG-0713, the 3-year average (2010–2012) collective TEDE (sum of dose for all exposed workers) for WF3 was approximately 122 person-rem per reactor as compared to the national average collective dose for all PWRs of approximately 55 person-rem for the same 3-year period. (NRC 2014c, Table 4.7) In 2013, the collective TEDE for WF3 was approximately 3.1 person-rem and in 2014, which was an outage year, the collective TEDE was 69.5 person-rem (Entergy 2015n).

The average TEDE per WF3 worker over this period (2010–2012) was 0.111 rem as compared to the national average of 0.093 rem for all PWRs. The average TEDE per megawatt generated per year was 0.12 rem for WF3 as compared to the national average of 0.06 rem for PWRs. (NRC 2014c, Table 4.7)

Contributing cause to the elevated occupational doses at WF3 during this 3-year period was due to a reactor coolant pump replacement in the 2011 refueling outage. Although the NRC requires nuclear plants to keep collective doses as low as reasonably achievable (ALARA), there is no regulatory limit on collective dose.

WF3 is not planning to undergo refurbishment for the license renewal term, and there are no expected increases in occupational exposure because of license renewal. In addition, based on data (1993–2005) in the GEIS, WF3 occupation radiation exposures fall within the range of those for other operating PWRs (NRC 2013b, Table 3.9-8).

3.9.2 Microbiological Hazards

The GEIS discusses microbiological hazards around nuclear power plants, including background information, results of studies of microbiological hazards in cooling towers, hazards to plant workers, and hazards to members of the public. The discussion of specific hazards focuses on the thermophilic microorganisms *Legionella* spp., which can be a hazard in cooling towers, and *Naegleria fowleri*, which can be a hazard in cooling water discharge. (NRC 2013b, Section 3.9.3) There have been no Entergy or state studies conducted to determine the presence of these microorganisms in waters influenced by WF3.

Exposure to *Legionella* spp. from power plant operations is a potential problem for a subset of the workforce. Plant personnel most likely to come in contact with *Legionella* aerosols would be workers who dislodge biofilms, where *Legionella* are often concentrated, such as during the cleaning of condenser tubes and cooling towers. (NRC 2013b, Section 3.9.3.3) Although WF3 does not use cooling towers for condenser cooling, condenser tube maintenance may occur.

Plant workers cleaning condenser tubes are protected by a fleet procedure that provides a standard methodology for identifying industrial hazards prior to performance of jobs. Under this procedure, possible factors that may influence safe execution of the job, including chemical and biological hazards, would be considered and appropriate worker protection measures would be designated for use during performance of the work. (Entergy 2013f) Exposure of members of the public to *Legionella* from WF3 operations would not be expected, because there is no opportunity for these pathogens to be sufficiently concentrated at expected exposure points.

Naegleria fowleri in heated plant effluent can be a hazard to recreational water users. *Naegleria* infection is the cause of primary amebic meningoencephalitis, an extremely rare disease that is usually fatal. *Naegleria* spp. is ubiquitous in nature and can be enhanced in heated water bodies at temperatures ranging from 95°F to 106°F or higher. *Naegleria* is rarely found in water cooler than 95°F, and infection rarely occurs in water temperatures of 95°F or less. (NRC 2013b, Section 3.9.3.1)

As discussed in Section 2.2.2.1, warm water exiting the WF3 condenser is transferred to the discharge structure. The discharge structure (Figure 2.2-6) consists of a concrete seal well where the warm water enters and then exits by overflowing about 95 feet of weirs which run around three of the four sides of the discharge structure. The discharge canal then carries the water from the discharge structure to the river at an approximate discharge velocity of 7 fps to promote rapid mixing with the ambient water, which results in a smaller thermal plume size, thereby limiting the area of conditions necessary for optimal growth of these thermophilic microorganisms.

As discussed in Section 2.2.2.1, the average flow in the Mississippi River in the vicinity of the WF3 plant is estimated to be approximately 500,000 cfs. Therefore, the average heated discharge flow is very small compared to the volume of river water flowing by the plant, thereby creating limited opportunity for rapid growth and population increases of thermophilic microorganisms.

In addition, because the discharge structure area is within WF3's EAB, recreational activities, such as boating, swimming, or fishing by the public are not allowed. Diseases caused by thermophilic microorganisms associated with warm waters are typically contracted via nasal passageway contact with contaminated water (NRC 2013b, Section 3.9.3.3). Therefore due to restricted access at the WF3 discharge structure area there is a very low probability that the public would contact the warm water that could support thermophilic microorganisms.

Based on conversation with the Louisiana State Epidemiologist (Louisiana Department of Health and Hospitals), there have been only three cases of primary amebic meningoencephalitis reported during the period 2004–2013: two cases in 2011 and one case in 2013, none of which was related to recreational surface water use. Instead, the contributing cause in all three cases was insufficient chlorination in public water supplies typically occurring at the end of the distribution system. In addition, the Louisiana State Epidemiologist also stated that no studies have been conducted in the Mississippi River for the *Naegleria* ameba. Studies are only carried out for reported cases of primary amebic meningoencephalitis. (ENERCON 2014i)

3.9.3 Electric Shock Hazards

As discussed in Section 2.2.5.4 of this ER, it was determined that the in-scope transmission lines meet the applicable shock prevention provisions of the NESC. Entergy's analysis determined that the calculated induced short-circuit current was approximately 3.9 mA, which is within the NESC 5-mA standard. In addition, operational requirements associated with OSHA are incorporated into WF3's occupational health and safety program. Specifically, as it relates to transmission lines and acute shock hazards, WF3 has processes in place which limit the potential for plant workers to receive an "induced" current from an object becoming capacitively charged. Also as discussed in Section 2.2.5.4, because all in-scope transmission lines are located completely within Entergy Louisiana, LLC owned property, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

3.10 Environmental Justice

3.10.1 Regional Population

The GEIS presents a population characterization method based on two factors: "sparseness" and "proximity" (NRC 1996, Section C.1.4). Sparseness measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

Demographic Categories Based on Sparseness

		Category
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles.
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles.
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles.
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles.

(NRC 1996, Section C.1.4)

"Proximity" measures population density and city size within 50 miles and categorizes the demographic information as follows.

Demographic Categories Based on Proximity

		Category
Not close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles.
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles.
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles.
Close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles.

(NRC 1996, Section C.1.4)

The GEIS then uses the following matrix to rank the population in the vicinity of the plant as low, medium, or high.

GEIS Sparseness and Proximity Matrix

		Proximity			
		1	**2**	**3**	**4**
Sparseness	**1**	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Light grey (1.1, 1.2, 2.1)	Low Population Area
White	Medium Population Area
Dark grey (3.4, 4.3, 4.4)	High Population Area

(NRC 1996, Figure C.1)

The 2010 census population and TIGER/Line data from the U.S. Census Bureau (USCB) were used to determine demographic characteristics in the vicinity of the site. The data were processed at the state, county, and census block levels using ArcGIS (USCB 2014c; USCB 2014e). Census data include people living in group quarters such as institutionalized and non-institutionalized populations. Examples of institutional populations living in group quarters are correctional institutions (i.e., prisons, jails, and detention centers); nursing homes; mental (psychiatric) hospitals; hospitals or wards for the chronically ill; and juvenile institutions. Examples of non-institutional populations living in group quarters are group homes; college dormitories; military quarters; soup kitchens; shelters for abused women (shelters against domestic violence or family crisis centers); and shelters for children who are runaways, neglected, or without conventional housing.

The 2010 census data indicate that approximately 371,976 people live within a 20-mile radius of WF3, which equates to a population density of 296 persons per square mile (USCB 2014c; USCB 2014e). Based on the GEIS sparseness index, the site is classified as Category 4, least sparse, with greater than or equal to 120 persons per square mile within 20 miles.

The 2010 census data indicate that approximately 2,006,583 people live within a 50-mile radius of WF3, which equates to a population density of 255 persons per square mile (USCB 2014c; USCB 2014e). Three communities within a 50-mile radius have a population greater than

100,000 residents (Table 3.10-1). Based on the GEIS proximity index, the site is classified as Category 4, greater than or equal to 190 persons per square mile within 50 miles.

As illustrated in the GEIS sparseness and proximity matrix, the combination of "sparseness" Category 4 and "proximity" Category 4 results in the conclusion that WF3 is located in a "high" population area.

The area within a 50-mile radius of WF3 totally or partially includes 21 parishes—all within the state of Louisiana (Table 3.10-2). According to the 2010 census, the permanent population (not including transient populations) of the entire 21 parishes was approximately 2,466,402 (Table 3.10-2). By 2045, the end of the proposed license renewal period, the permanent population (not including transient populations) of the entire 21 parishes is projected to be approximately 3,398,807. Based on 2010–2045 population projections, an annual growth rate of approximately 0.92 percent is anticipated for the permanent population in the 21 parishes wholly or partially within a 50-mile radius (WPEI 2014).

As shown in Table 3.10-2, the total population (including transient populations) of the entire 21 parishes, which are totally or partially included within a 50-mile radius, is projected to be approximately 3,453,766 in 2045. The total population (including transient populations) within a 50-mile radius is projected to be 2,882,454 in 2045. (UNO 2014; USCB 2014a; WPEI 2014)

The latest permanent population projections were obtained from Woods & Poole Economics, Inc. (WPEI 2014). Parish-level permanent population values for the parishes within a 50-mile radius are shown in Table 3.10-2. Transient data for the state were obtained from the Louisiana Tourism Forecast 2014–2017 (UNO 2014).

WF3 is located in St. Charles Parish. As shown in Table 3.10-2, the population of St. Charles Parish, Louisiana, as reported in the 2010 census was 52,780. Based on Louisiana's projected data set (Table 3.10-3), St. Charles Parish projected population for 2045 is expected to be 78,562. The average projected annual growth rate for this period is 1.04 percent (WPEI 2014). Estimated projected populations and average annual growth rates for St. Charles and Jefferson parishes are shown in Table 3.10-3.

Cities and towns with centers falling within a 50-mile radius are listed in Table 3.10-1. The towns nearest to WF3 with a census-reported population are Killona and Taft. As shown in Table 3.10-1, their 2010 populations were reported at 793 and 63 residents, respectively. Luling, Louisiana, the largest city in St. Charles Parish, had a 2010 population of 12,119 residents. Three communities within a 50-mile radius have a population greater than 100,000: Baton Rouge, Louisiana (approximately 50 miles); Metairie, Louisiana (approximately 19 miles); and New Orleans, Louisiana (approximately 25 miles). These communities have a 2010 population of 229,493; 138,481; and 343,829 residents, respectively. A total of seven additional communities within a 50-mile radius have a population greater than 25,000.

3.10.1.1 Migrant Labor

Migrant labor, or migrant worker, is defined by the USDA as "a farm worker whose employment required travel that prevented the migrant worker from returning to his/her permanent place of residence the same day." In 2012, St. Charles Parish reported that 10 out of 70 total farms employed farm labor. Jefferson Parish reported that 16 out of 57 total farms employed farm labor. The 2012 Census of Agriculture reported that neither St. Charles Parish nor Jefferson Parish employed migrant farm workers. For these two parishes, an estimated total of 88 farm laborers were hired, of which 45 were estimated to work fewer than 150 days per year. (USDA 2012)

3.10.1.2 Subsistence Consumption

Subsistence refers to the use of natural resources as food for consumption and for ceremonial and traditional cultural purposes, usually by low-income or minority populations. Specific examples of subsistence uses include gathering plants for direct consumption (rather than produced for sale from farming operations), for use as medicine, or in ritual practices. Fishing or hunting activities associated with direct consumption or use in ceremonies, rather than for sport, are other examples.

Determining the presence of subsistence use can be difficult, as data at the county or block group level are aggregated and not usually structured to identify such uses on or near the site, where any potential impacts arising from the continued operation of WF3 would arise. Frequently, the best means of investigating the presence of subsistence use is through dialogue with the local population who are most likely to know of such activity. This may include county officials as well as land owners in the immediate vicinity who would have knowledge of subsistence activity.

Through a series of phone calls and emails, contact was made with a number of individuals associated with local churches, social services and economic development organizations, area commercial fishing businesses, and the LDEQ. No populations involved in subsistence use activities (as described above) were identified on or near the site. This is consistent with the controlled access to WF3, and the use of the adjacent land either for residential or industrial use. (ENERCON 2015a)

3.10.2 Minority and Low-Income Populations

3.10.2.1 Background

The NRC performs environmental justice analyses utilizing a 50-mile radius around the plant as the environmental "impact area." LIC-203 Revision 3 (NRC 2013d) defines a geographic area for comparison as a 50-mile radius (also referred to as "the region" in this discussion) centered on the nuclear plant. An alternative approach is also addressed that uses an individual state that encompasses the 50-mile radius individually for comparative analysis as the "geographic area." Both approaches were used to assess the minority and low-income population criteria for WF3.

LIC-203 guidance suggests using the most recent USCB decennial census data. However, low-income data are collected separately from the decennial census and are available in 5-year averages. The 2010 low-income and minority census population data and TIGER/Line data for Louisiana were obtained from the USCB website and processed using ArcGIS software. Census population data were used to identify the minority and low-income populations within a 50-mile radius of WF3. Environmental justice evaluations for minority and low-income populations are based on the use of USCB block groups for minority and low-income populations.

3.10.2.2 Minority Populations

The NRC procedural guidance defines a "minority" population as Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian/Other Pacific Islander, some other race, two or more races, the aggregate of all minority races, Hispanic or Latino ethnicity, and the aggregate of all minority races and Hispanic ethnicity (NRC 2013d, pages D-4 and D-5). The guidance indicates that a minority population is considered present if either of the following conditions exists:

1. The minority population in the census block group exceeds 50 percent; or
2. The minority population percentage is more than 20 percentage points greater in the census block group than the minority percentage of the geographic area chosen for the comparative analysis.

To establish minimum thresholds for each minority category, the non-white minority population total for each state was divided by the total population in the state. This process was repeated with a 50-mile radius total minority population and 50-mile radius total population. As described in the second criterion, 20 percent was added to the minority percentage values for each geographic area. The lower of the two NRC conditions for a minority population was selected as defining a minority area (i.e., census block group minority population exceeds 50 percent, or minority population is more than 20 percent greater than the minority population of the geographic area). Any census block group with a percentage exceeding this value was considered a minority population. Minority percentages for Louisiana and a 50-mile radius, along with corresponding thresholds, are shown in Table 3.10-4.

A minority category of "Aggregate of All Races" is created when the populations of all the 2010 U.S. Census minority categories are summed. The 2010 "Aggregate of All Races" category, when compared to the total population, indicates 36.4 percent of the population in a 50-mile radius are minorities. The minority population percentage for Louisiana is 37.4 percent (Table 3.10-4). Using the second criterion listed above for identification of a minority population, when a 50-mile radius is used as the geographic area, any census block group with a combined minority population equal to or greater than 56.4 percent would be considered a minority population. Because 56.4 percent exceeds the criterion of 50 percent, the first criterion (50 percent) would be used. The states are evaluated in a similar manner. When the two states are used as the geographic area, any census block group with an "Aggregate of All Races" population exceeding 50 percent in Louisiana would be considered a minority population.

Because Hispanic is not considered a race by the USCB, Hispanics are already represented in the census-defined race categories. However, because Hispanics can be represented in any race category, some white Hispanics not otherwise considered minorities become classified as a minority when categorized in the "Aggregate and Hispanic" category. Also, Hispanics of non-white racial background are included in both the racial group and the Hispanic group, and thereby counted twice. The "Aggregate and Hispanic" category, however, results in the greatest chance of consideration of populations within a block group to be classified as minority.

The number of census block groups contributing to the minority population count was evaluated using the criteria shown in Table 3.10-4 and summarized in Table 3.10-5. The results of the evaluation are census block groups flagged as having a minority population(s). The resulting maps (Figures 3.10-1, 3.10-2, 3.10-3, 3.10-4, 3.10-5, 3.10-6, 3.10-7, 3.10-8, 3.10-9, 3.10-10, 3.10-11, 3.10-12, 3.10-13, 3.10-14, 3.10-15, and 3.10-16) depict the location of minority population census block groups flagged accordingly for each race or aggregate category. Because no block group met the criteria for the Native Hawaiian/Other Pacific Islander race category, no figures illustrating that race category were produced.

The percentage of census block groups exceeding the "Aggregate of All Races" minority population criterion was 37.5 percent when a 50-mile radius was used and 37.5 percent when the individual state was used as the geographic area (Table 3.10-5). For the "Aggregate and Hispanic" category, 42.8 percent of the census block groups contained a minority population when the region was used, and 42.8 percent of the block groups contained minority populations when the individual state was used (Table 3.10-5). The minority population values of the block groups were significantly reduced when races were analyzed individually.

The identified minority population closest to WF3 is the block group the site falls in: census block group 220890627002. The census block group contained a total of 1,302 people, with 1,142 "Black or African American," 1 "American Indian," 1 "Asian," 6 "Two or More Races," and 5 "Hispanic or Latino" individuals. Using either the individual state criteria or the regional criteria, the block group contains a "Black or African American" population, an "Aggregate of All Races" population, and an "Aggregate and Hispanic" population. (USCB 2014e)

There are 16 block groups within a 6-mile radius that meet the criteria for a minority population. There are 645 identified minority population block groups located in, partially within, or adjacent to cities, municipalities, or USCB-defined urban areas (USCB 2014c; USCB 2014e). This leaves several block groups that do not fall within or are not immediately adjacent to cities, municipalities, or USCB-defined urban areas (USCB 2014c; USCB 2014e).

As discussed in Section 3.0.4, there are no Native American Indian lands within a 50-mile radius of WF3.

3.10.2.3 Low-Income Populations

The NRC guidance defines "low-income" using USCB statistical poverty thresholds for individuals or families (NRC 2013d, pages D-5 and D-6). As addressed above with minority populations, two alternative geographic areas (Louisiana individually and the region) were used as the geographic areas for comparison in this analysis. The guidance indicates that a low-income population is considered present if either of the two following conditions exists:

1. The low-income population in the census block group exceeds 50 percent; or

2. The percentage of households below the poverty level in a block group is significantly greater (typically at least 20 percentage points) than the low-income population percentage of the geographic area chosen for the comparative analysis (i.e., individual state and region's combined average).

To establish minimum thresholds for the individual low-income category, the population with an income below the poverty level for the state was divided by the total population for whom poverty status is determined in the state. To establish minimum thresholds for the family low-income category, the family population count with an income below the poverty level for the state was divided by the total family population count in the state. This process was repeated for the regional population with an income below the poverty level and regional total population for whom poverty status is determined. As described in the second criterion, 20 percent was added to the low-income values for individuals and families and each geographic area. None of the geographic areas described in the first criterion exceeded 50 percent.

When the 2006–2010 census data category "income in the past 12 months below poverty level" (individual) is compared to "total population for whom poverty status is determined," 15.5 percent of the population in the region has an individual income below poverty level, as shown in Table 3.10-6. In the state of Louisiana, the percentage of individuals with an income below poverty level is 18.1 percent (Table 3.10-6).

According to the USCB, Louisiana has an estimated 285,360 families, as shown in Table 3.10-6. When the 2006–2010 census data family category "income in the past 12 months below poverty level" is compared to "total family count", 14.7 percent of the families within the region have an income below poverty level (Table 3.10-6). In the state of Louisiana, the percentage of the family population with an income below poverty level is 17.4 percent (Table 3.10-6).

For example, when Louisiana is used as the geographic area, any census block group within the region with a low-income population equal to or greater than 38.1 percent of the total block group population would be considered a "low-income population" (individual) (Table 3.10-6). Using the appropriate criteria for the individual state, 191 of the total 1,602 census block groups (12.0 percent) have low-income individual population percentages which meet or exceed the percentages in Table 3.10-6. These census block groups are illustrated in Figure 3.10-17.

When the region is used as the geographic area, any census block group within a 50-mile radius with populations of low-income individuals equal to or greater than 35.5 percent of the total block group population would be considered a "low-income population." Using these criteria, 208 of the 1,602 census block groups (13.0 percent) were identified within a 50-mile radius of WF3, as shown in Figure 3.10-18. (USCB 2014c; USCB 2014f)

Similarly, these criteria are found using both geographies and family census counts (Table 3.10-6). Using the family individual state and regional criteria, 191 and 208 census block groups, respectively, were identified as having low-income families (Table 3.10-5). These census block groups are illustrated in Figure 3.10-19 and Figure 3.10-20. (USCB 2014c; USCB 2014f)

The closest low-income block group that meets the guidance criteria for individuals or families is located approximately 3.7 miles east-northeast of WF3, inside and adjacent to the New Orleans Urban Area. It is Block Group 220890624001. (USCB 2014f)

As an indicator of community unaffordable housing, post-Katrina analysis in the MSA identified households where housing costs were more than 35 percent of pre-tax income. Since 2004, the share of renters in Orleans Parish paying unaffordable housing costs rose from 43 percent to 54 percent, while the rest of the MSA rose from 36 percent to 49 percent. For homeowners, the share of homeowners paying unaffordable housing in Orleans Parish maintained at 27 percent, while the rest of the MSA rose from 16 percent to 20 percent. For renters, the analysis did not consider the change in values for the "rest of the MSA" category as statistically significant, nor did it consider the change in values for homeowners in Orleans Parish or the "rest of the MSA" category as statistically significant. (TDC 2014, page 38)

Table 3.10-1
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Abita Springs	St. Tammany	1,957	2,365	42	NE
Albany	Livingston	865	1,088	36	NNW
Ama	St. Charles	1,285	1,316	11	ESE
Amelia	St. Mary	2,423	2,459	44	WSW
Amite City	Tangipahoa	4,110	4,141	50	N
Arabi	St. Bernard	8,093	3,635	28	E
Avondale	Jefferson	5,441	4,954	17	ESE
Barataria	Jefferson	1,333	1,109	28	SE
Baton Rouge	East Baton Rouge	227,818	229,493	52	NW
Bayou Blue	Terrebonne	Null	12,352	27	SSW
Bayou Cane	Terrebonne	17,046	19,355	31	SSW
Bayou Country Club	Lafourche	Null	1,396	24	SW
Bayou Gauche	St. Charles	1,770	2,071	13	SSE
Bayou Goula	Iberville	Null	612	44	WNW
Bayou L'Ourse	Assumption	Null	1,978	40	WSW
Belle Chasse	Plaquemines	9,848	12,679	30	ESE
Belle Rose	Assumption	1,944	1,902	35	W
Berwick	St. Mary	4,418	4,946	49	WSW
Bourg	Terrebonne	Null	2,579	31	SSW
Boutte	St. Charles	2,181	3,075	8	SE
Bridge City	Jefferson	8,323	7,706	19	ESE

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Central	East Baton Rouge	Null	26,864	52	NW
Chackbay	Lafourche	4,018	5,177	20	WSW
Chalmette	St. Bernard	32,069	16,751	31	E
Chauvin	Terrebonne	3,229	2,912	39	S
Choctaw	Lafourche	Null	879	18	SW
Convent	St. James	Null	711	22	W
Covington	St. Tammany	8,483	8,765	40	NNE
Cut Off	Lafourche	5,635	5,976	32	SSE
Denham Springs	Livingston	8,757	10,215	45	NW
Des Allemands	St. Charles	2,500	2,505	12	S
Destrehan	St. Charles	11,260	11,535	7	ESE
Donaldsonville	Ascension	7,605	7,436	32	WNW
Dulac	Terrebonne	2,458	1,463	44	SSW
Eden Isle	St. Tammany	6,261	7,041	43	ENE
Edgard	St. John the Baptist	2,637	2,441	6	WNW
Elmwood	Jefferson	4,270	4,635	17	E
Estelle	Jefferson	15,880	16,377	24	ESE
Folsom	St. Tammany	525	716	47	NNE
French Settlement	Livingston	945	1,116	28	NW
Galliano	Lafourche	7,356	7,676	39	SSE
Gardere	East Baton Rouge	8,992	10,580	47	WNW

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Garyville	St. John the Baptist	2,775	2,811	11	WNW
Golden Meadow	Lafourche	2,193	2,101	44	SSE
Gonzales	Ascension	8,156	9,781	32	WNW
Gramercy	St. James	3,066	3,613	14	WNW
Grand Point	St. James	Null	2,473	17	W
Gray	Terrebonne	4,958	5,584	29	SW
Gretna	Jefferson	17,423	17,736	26	E
Hahnville	St. Charles	2,792	3,344	4	ESE
Hammond	Tangipahoa	17,639	20,019	35	N
Harahan	Jefferson	9,885	9,277	17	ESE
Harvey	Jefferson	22,226	20,348	24	ESE
Hester	St. James	Null	498	18	W
Houma	Terrebonne	32,393	33,727	31	SSW
Independence	Tangipahoa	1,724	1,665	44	N
Inniswold	East Baton Rouge	4,944	6,180	45	NW
Jean Lafitte	Jefferson	2,137	1,903	27	SE
Jefferson	Jefferson	11,843	11,193	18	E
Kenner	Jefferson	70,517	66,702	14	E
Killian	Livingston	1,053	1,206	26	NNW
Killona	St. Charles	797	793	1	WNW
Kraemer	Lafourche	Null	934	16	SW

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Labadieville	Assumption	1,811	1,854	31	WSW
Lacombe	St. Tammany	7,518	8,679	38	NE
Lafitte	Jefferson	1,576	972	31	SE
Lafourche Crossing	Lafourche	Null	2,002	24	SW
Laplace	St. John the Baptist	27,684	29,872	5	N
Larose	Lafourche	7,306	7,400	30	SSE
Lemannville	Ascension	Null	860	28	WNW
Livingston	Livingston	1,342	1,769	39	NNW
Lockport	Lafourche	2,624	2,578	24	S
Lockport Heights	Lafourche	Null	1,286	24	S
Luling	St. Charles	11,512	12,119	8	ESE
Lutcher	St. James	3,735	3,559	14	WNW
Madisonville	St. Tammany	677	748	34	NNE
Mandeville	St. Tammany	10,489	11,560	35	NE
Marrero	Jefferson	36,165	33,141	23	ESE
Mathews	Lafourche	2,003	2,209	22	S
Meraux	St. Bernard	10,192	5,816	32	E
Metairie	Jefferson	146,136	138,481	19	E
Montegut	Terrebonne	1,803	1,540	36	S
Monticello	East Baton Rouge	4,763	5,172	48	NW
Montpelier	St. Helena	214	266	48	NNW

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Montz	St. Charles	1,120	1,918	2	NNE
Moonshine	St. James	Null	194	21	W
Morgan City	St. Mary	12,703	12,404	49	WSW
Napoleonville	Assumption	686	660	33	W
Natalbany	Tangipahoa	1,739	2,984	38	N
New Orleans	Orleans	484,674	343,829	25	E
New Sarpy	St. Charles	1,568	1,464	5	ESE
Norco	St. Charles	3,579	3,074	4	E
North Vacherie	St. James	2,411	2,346	15	W
Oak Hills Place	East Baton Rouge	7,996	8,195	45	WNW
Old Jefferson	East Baton Rouge	5,631	6,980	41	NW
Paincourtville	Assumption	884	911	35	W
Paradis	St. Charles	1,252	1,298	8	SSE
Paulina	St. James	Null	1,178	15	W
Pearl River	St. Tammany	1,839	2,506	51	ENE
Pierre Part	Assumption	3,239	3,169	44	W
Plaquemine	Iberville	7,064	7,119	50	WNW
Pleasure Bend	St. John the Baptist	Null	250	11	WSW
Pointe a la Hache	Plaquemines	Null	187	50	SE
Ponchatoula	Tangipahoa	5,180	6,559	31	N
Port Sulphur	Plaquemines	3,115	1,760	57	SE

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Port Vincent	Livingston	463	741	33	NW
Poydras	St. Bernard	3,886	2,351	36	ESE
Prairieville	Ascension	Null	26,895	37	NW
Presquille	Terrebonne	Null	1,807	32	SSW
Raceland	Lafourche	10,224	10,193	20	SSW
Reserve	St. John the Baptist	9,111	9,766	6	NW
River Ridge	Jefferson	14,588	13,494	15	E
Romeville	St. James	Null	130	23	W
Schriever	Terrebonne	5,880	6,853	27	SW
Shenandoah	East Baton Rouge	17,070	18,399	42	NW
Siracusaville	St. Mary	Null	422	46	WSW
Slidell	St. Tammany	25,695	27,068	46	ENE
Sorrento	Ascension	1,227	1,401	27	WNW
South Vacherie	St. James	3,543	3,642	14	WSW
Springfield	Livingston	395	487	30	N
St. Gabriel	Iberville	5,514	6,677	42	WNW
St. James	St. James	Null	828	22	W
St. Rose	St. Charles	6,540	8,122	10	E
Supreme	Assumption	1,119	1,052	33	WSW
Taft	St. Charles	Null	63	1	ESE
Terrytown	Jefferson	25,430	23,319	27	E

Table 3.10-1 (Continued)
Cities or Towns Located Totally or Partially within a 50-Mile Radius of WF3

City/Town/Village/CDP	Parish	2000 Census Population[(a)]	2010 Census Population[(a)]	Distance to WF3 (miles)[(b)(c)]	Direction
Thibodaux	Lafourche	14,431	14,566	25	SW
Tickfaw	Tangipahoa	617	694	40	N
Timberlane	Jefferson	11,405	10,243	28	ESE
Union	St. James	Null	892	27	WNW
Village St. George	East Baton Rouge	6,993	7,104	44	NW
Violet	St. Bernard	8,555	4,973	35	E
Waggaman	Jefferson	9,435	10,015	16	ESE
Walker	Livingston	4,801	6,138	41	NW
Wallace	St. John the Baptist	570	671	11	W
Watson	Livingston	Null	1,047	49	NW
Welcome	St. James	Null	800	24	W
Westminster	East Baton Rouge	2,515	3,008	47	NW
Westwego	Jefferson	10,763	8,534	21	ESE
White Castle	Iberville	1,946	1,883	42	WNW
Woodmere	Jefferson	13,058	12,080	25	ESE

Null: No available data.

a. (USCB 2014b)

b. (USDOT 2014)

c. Distances reported were measured from the WF3 center point to the city center.

Table 3.10-2
Parish Populations Totally or Partially Included within a 50-Mile Radius of WF3

State and Parish	2000 Population[a]	2010 Population[a]	2045 Projected Permanent Population[b]	2045 Projected Total Population[b][c]
Louisiana	2,478,267	2,466,402	3,398,807	3,453,766
Ascension	76,627	107,215	201,994	205,260
Assumption	23,388	23,421	25,649	26,064
East Baton Rouge	412,852	440,171	570,315	579,537
Iberia	73,266	73,240	96,776	98,340
Iberville	33,320	33,387	34,810	35,373
Jefferson	455,466	432,552	478,624	486,363
Lafourche	89,974	96,318	123,153	125,145
Livingston	91,814	128,026	338,058	343,525
Orleans	484,674	343,829	360,740	366,573
Plaquemines	26,757	23,042	24,781	25,182
St. Bernard	67,229	35,897	48,424	49,207
St. Charles	48,072	52,780	78,562	79,832
St. Helena	10,525	11,203	11,631	11,819
St. James	21,216	22,102	23,198	23,573
St. John the Baptist	43,044	45,924	64,750	65,797
St. Martin	48,583	52,160	83,126	84,471
St. Mary	53,500	54,650	57,132	58,056
St. Tammany	191,268	233,740	422,402	429,232
Tangipahoa	100,588	121,097	186,893	189,915
Terrebonne	104,503	111,860	136,973	139,187

Table 3.10-2 (Continued)
Parish Populations Totally or Partially Included within a 50-Mile Radius of WF3

State and Parish	2000 Population[(a)]	2010 Population[(a)]	2045 Projected Permanent Population[(b)]	2045 Projected Total Population[(b)(c)]
West Baton Rouge	21,601	23,788	30,816	31,314
Regional Parishes Total	**2,478,267**	**2,466,402**	**3,398,807**	**3,453,766**

CDP: Census designated place.

Note: For parishes with projected negative population growth, the maximum population values for that parish were held constant.

a. (USCB 2014a)

b. (WPEI 2014; USCB 2014e)

c. (UNO 2014)

Table 3.10-3
Parish Population Growth, 2010–2045

			2015	2020	2025	2030	2035	2040	2045
Louisiana	Jefferson Parish	Population	441,552	451,982	460,987	468,082	473,204	476,646	478,624
		Average Annual Growth %	0.41	0.47	0.40	0.31	0.22	0.15	0.08
	St. Charles Parish	Population	55,512	59,371	63,268	67,121	70,898	74,614	78,562
		Average Annual Growth %	1.01	1.35	1.28	1.19	1.10	1.03	1.04

(WPEI 2014)

Table 3.10-4
Minority Populations Evaluated Against Criterion

	Louisiana			50-Mile Radius (Region)[(a)]		
Total Population[(b)]	4,533,372			2,066,246		
Census Categories	**State Population by Census Category[(b)]**	**Percent[(c)]**	**Criteria**	**State Population by Census Category[(d)]**	**Percent[(c)]**	**Criteria**
Black or African American	1,452,396	32.0	50.0	606,224	29.3	49.3
American Indian or Alaska Native	30,579	0.7	20.7	16,492	0.8	20.8
Asian	70,132	1.5	21.5	46,178	2.2	22.2
Native Hawaiian/Other Pacific Islander	1,963	0.04	20.04	887	0.04	20.04
Some Other Race	69,227	1.5	21.5	46,619	2.3	22.3
Two or More Races	72,883	1.6	21.6	35,705	1.7	21.7
Aggregate of All Races	1,697,180	37.4	50.0	752,105	36.4	50.0
Hispanic or Latino	192,560	4.2	24.2	129,196	6.3	26.3
Aggregate and Hispanic	1,889,740	41.7	50.0	881,301	42.7	50.0

a. (USCB 2014e) Population values reported in this column are from block groups. Block groups located on the 50-mile radius boundary were not area weighted for these calculations.

b. (USCB 2014g; USCB 2014h)

c. Percent values were calculated by dividing each census categories' population by Louisiana, and 50-mile radius total population values.

d. (USCB 2014e)

Table 3.10-5
Minority Census Block Group Counts, 50-Mile Radius of WF3

Individual State Method			50-Mile Radius	
	Census Block Groups[a]		Census Block Groups[a]	
Total block groups with population within 50-mile radius	1,602		1,602	
Census Categories	**Minority and Low-Income Category Block Groups**	**Percent Block Groups within 50-Mile Radius**	**Minority and Low-Income Category Block Groups**	**Percent Block Groups within 50-Mile Radius**
Black or African American	509	31.8	517	32.3
American Indian or Alaska Native	6	0.4	6	0.4
Asian	9	0.6	9	0.6
Native Hawaiian/Other Pacific Islander	0	0	0	0
Some Other Race	5	0.3	5	0.3
Two or More Races	2	0.1	2	0.1
Aggregate of All Races	600	37.5	600	37.5
Hispanic or Latino	41	2.6	33	2.1
Aggregate and Hispanic	685	42.8	685	42.8
Low Income[b] (Individuals)	191	11.9	208	13
Low Income[b] (Families)	165	10.3	191	11.9

a. (USCB 2014e)

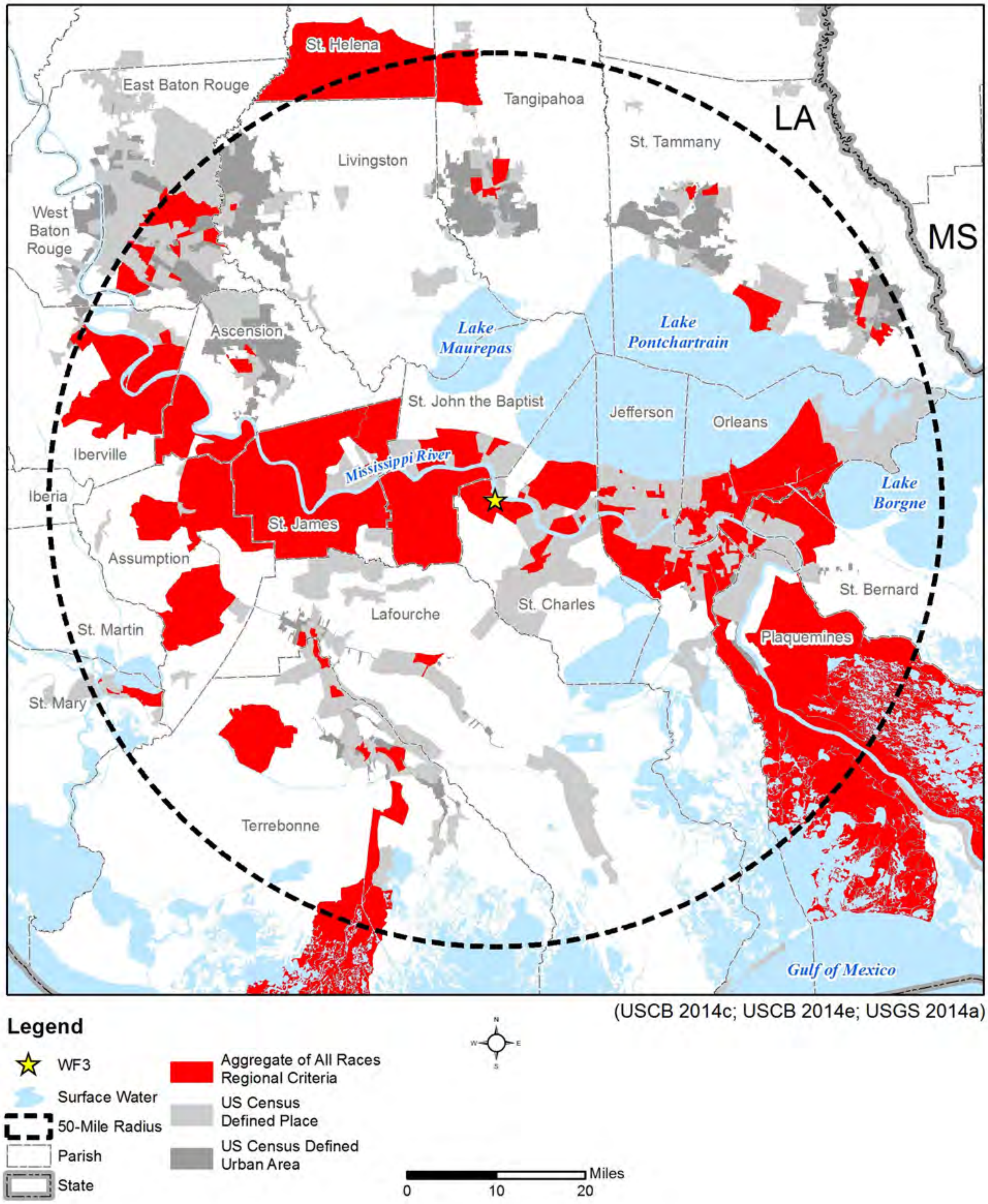
b. (USCB 2014f)

Table 3.10-6
Low-Income Population Criteria Using Two Geographic Areas

	Louisiana			50-Mile Radius (Region)		
(Income) Total Population[a]	4,302,475			1,952,021		
(Income) Total Families[a]	1,641,165			738,660		
Census Category	**State Population by Census Category**	**Percent[b]**	**Criteria**	**State Population by Census Category**	**Percent[b]**	**Criteria**
Low Income—Number of Persons Below Poverty Level	780,359	18.1	38.1	303,226	15.5	35.5
Low Income—Number of Families Below Poverty Level	285,360	17.4	37.4	108,311	14.7	34.7

a. (USCB 2014f)

b. (USCB 2014e) Percent values were calculated by dividing each census categories' population by Louisiana and 50-mile radius total population values.



(USCB 2014c; USCB 2014e; USGS 2014a)

Figure 3.10-1
Census—Aggregate of All Races Populations (Regional)

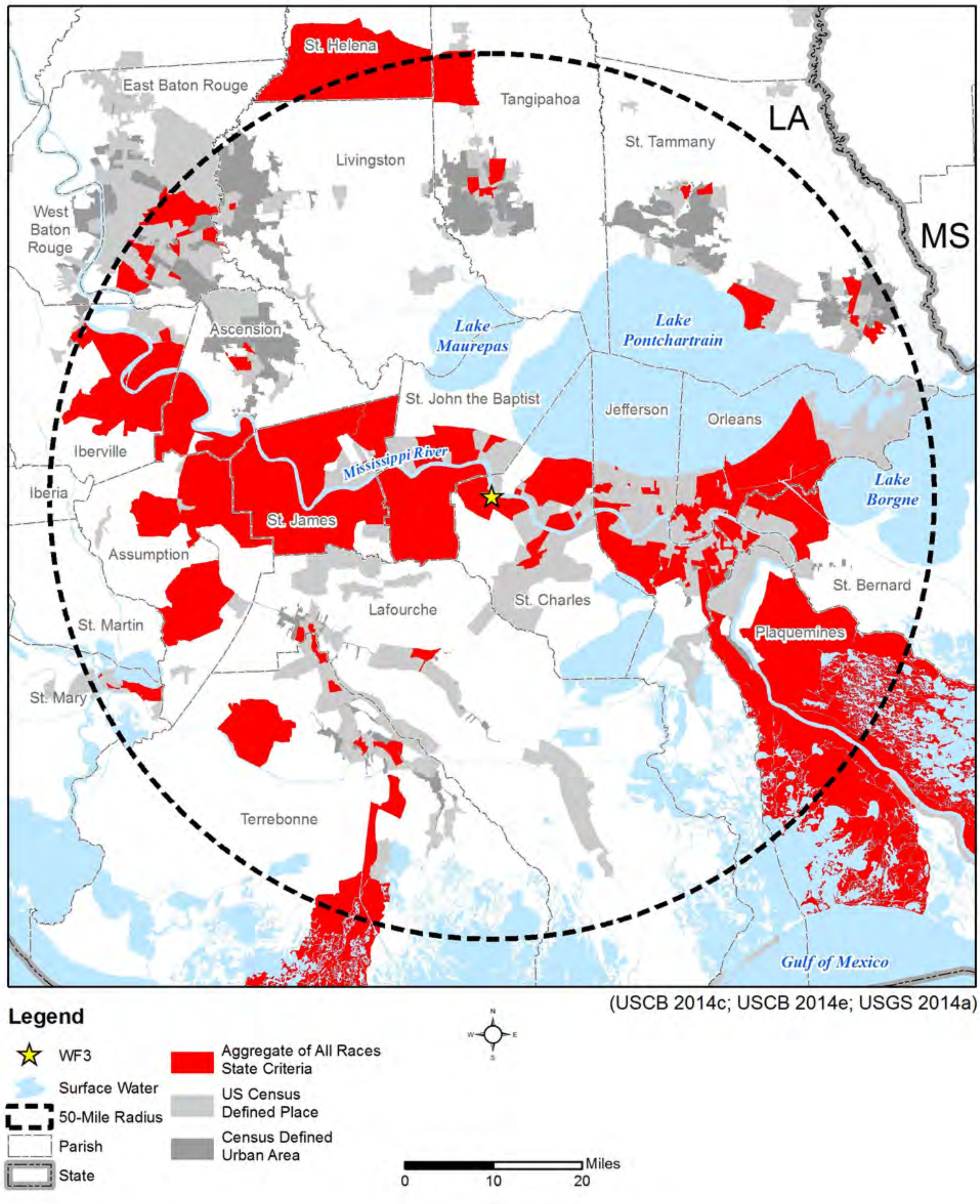
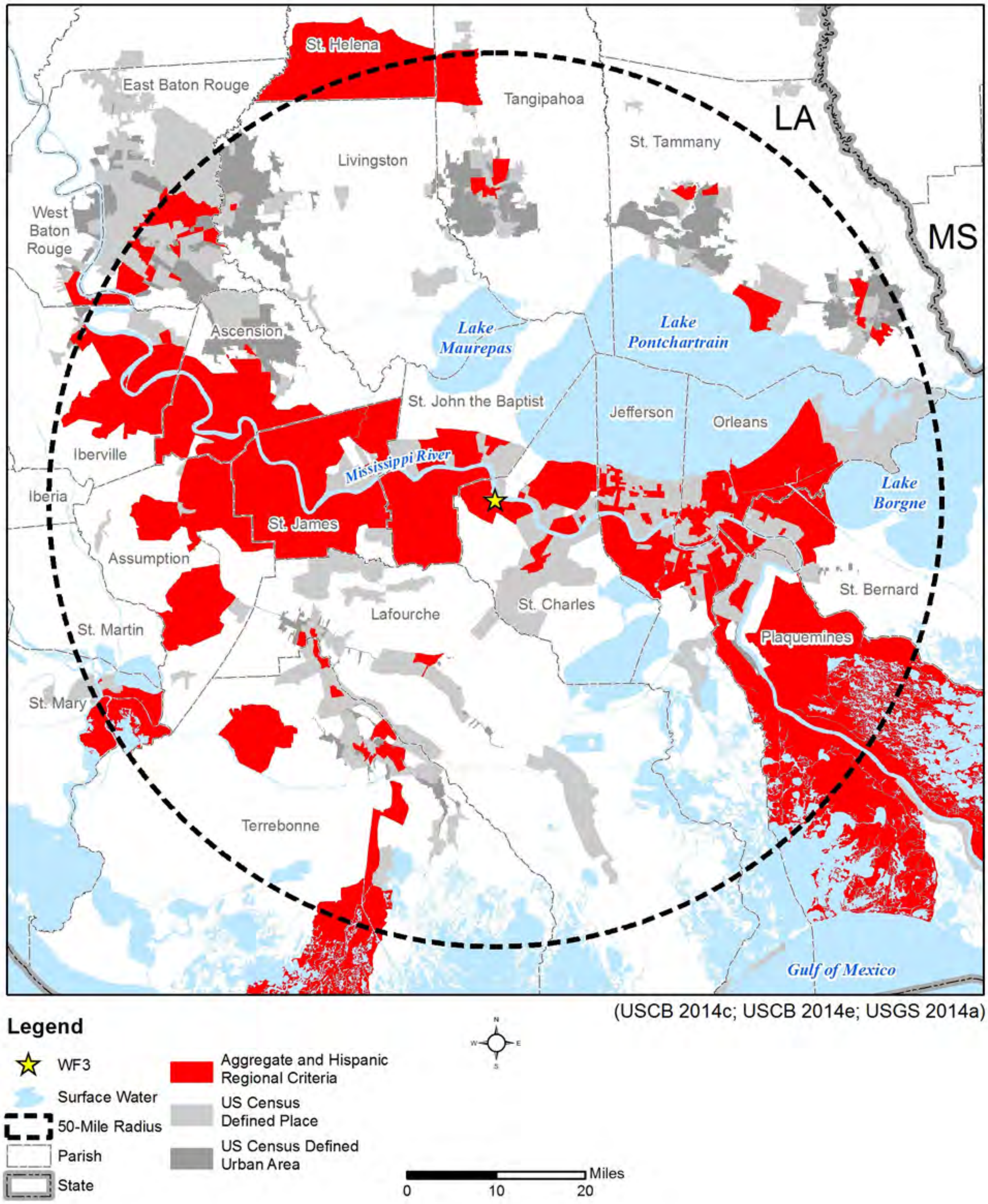


Figure 3.10-2
Census—Aggregate of All Races Populations (Individual State)



(USCB 2014c; USCB 2014e; USGS 2014a)

Figure 3.10-3
Census—Aggregate and Hispanic Populations (Regional)

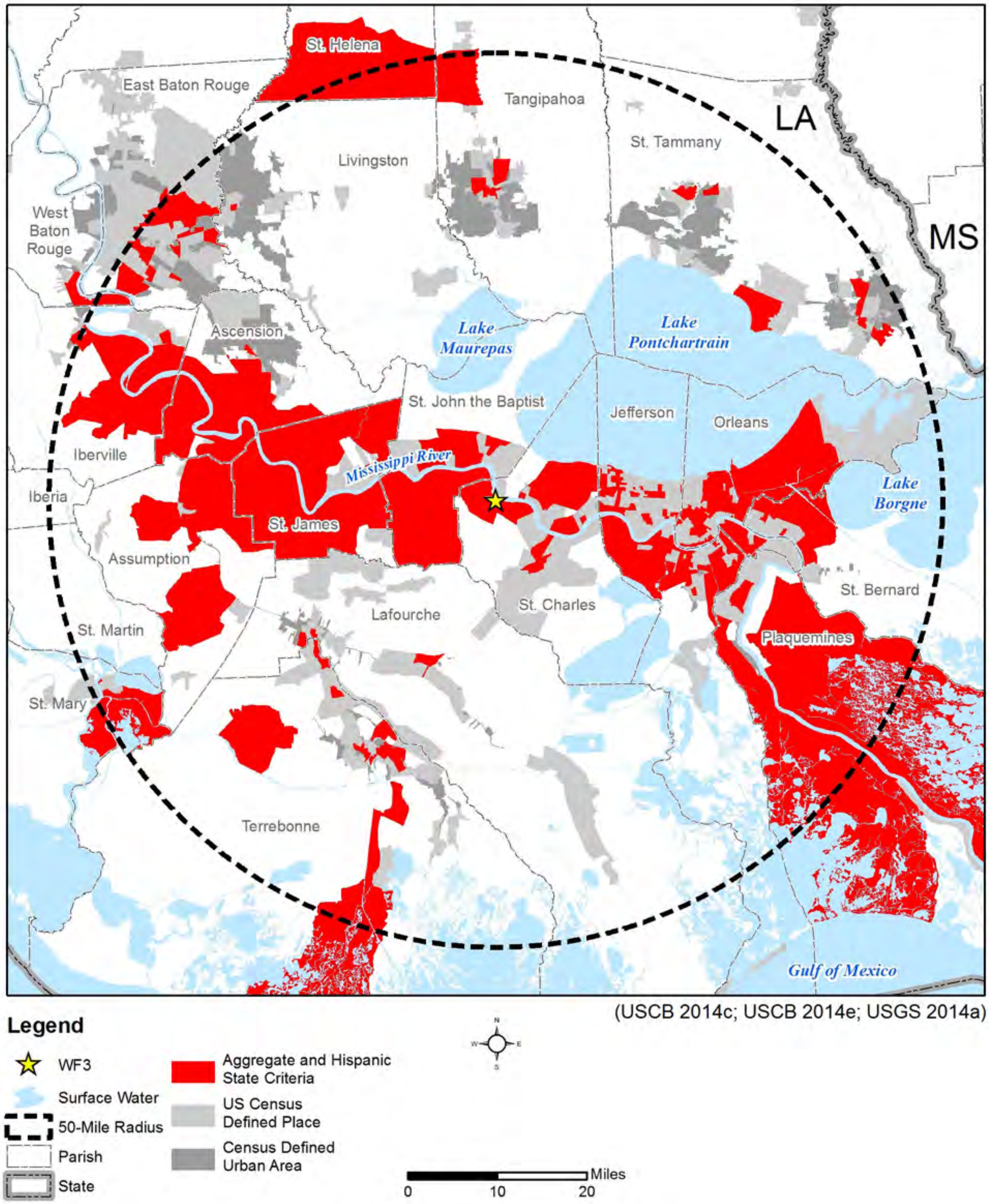


Figure 3.10-4
Census—Aggregate and Hispanic Populations (Individual State)

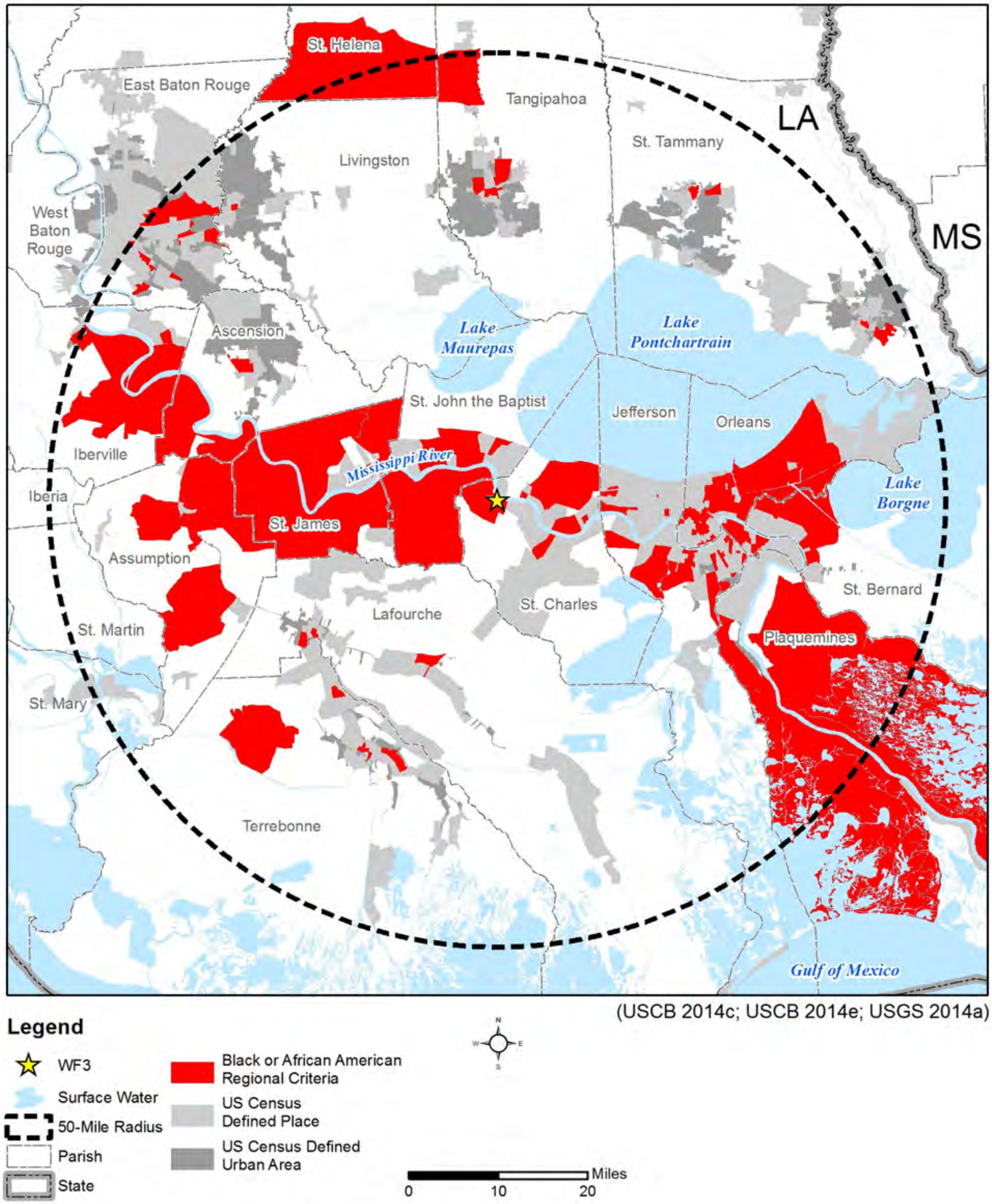


Figure 3.10-5
Census—Black or African American Populations (Regional)

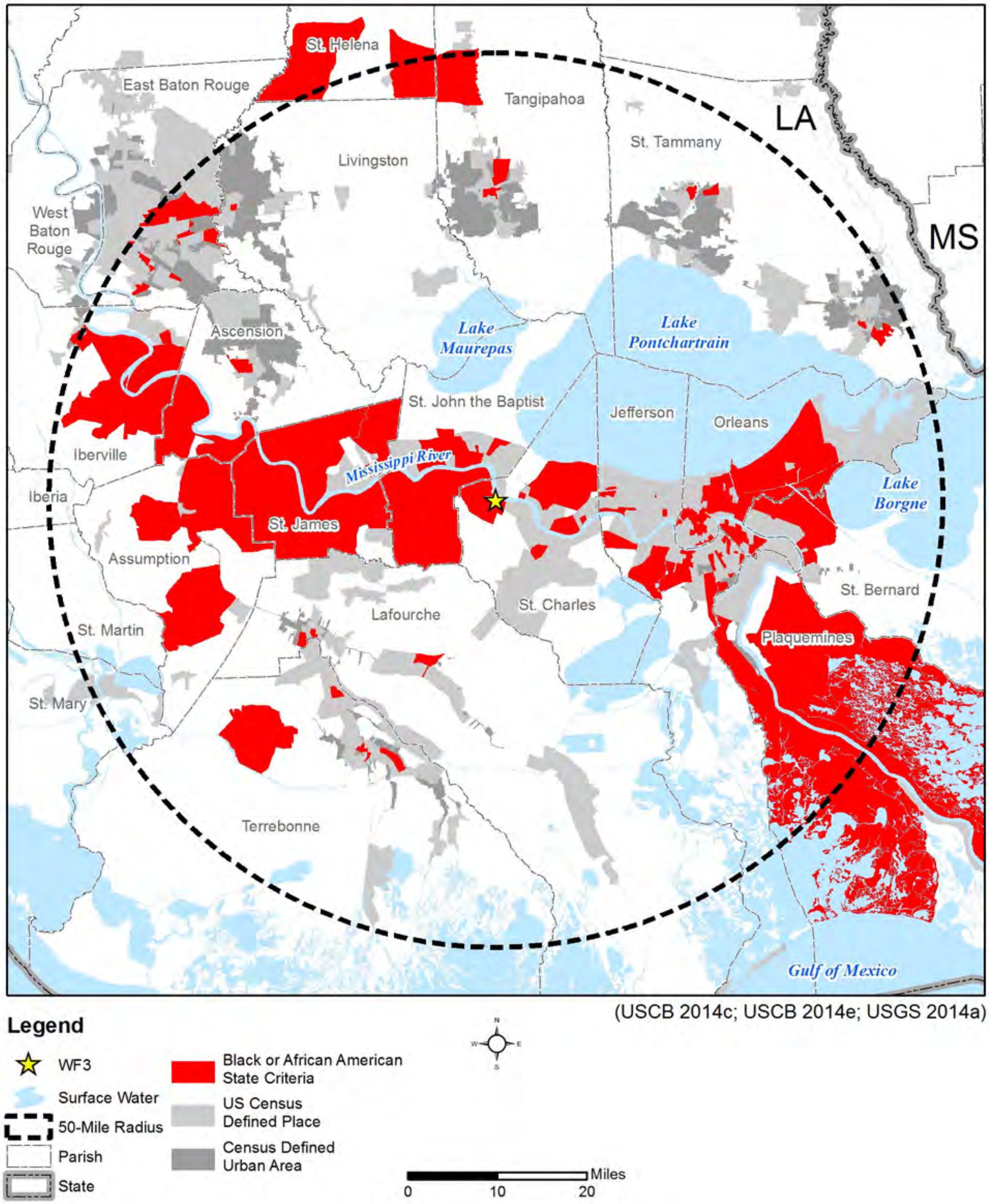


Figure 3.10-6
Census—Black or African American Populations (Individual State)

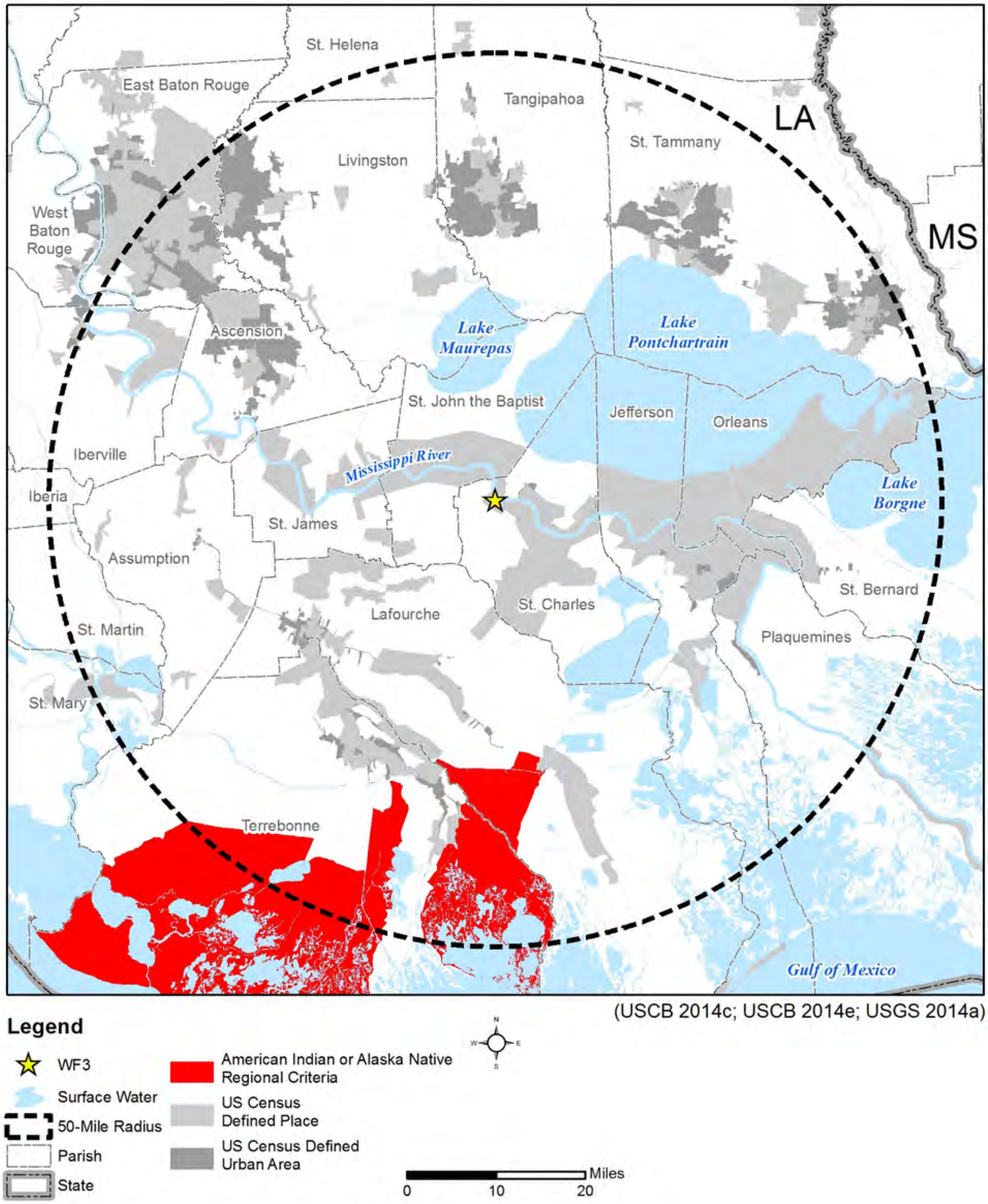


Figure 3.10-7
Census—American Indian or Alaska Native Populations (Regional)

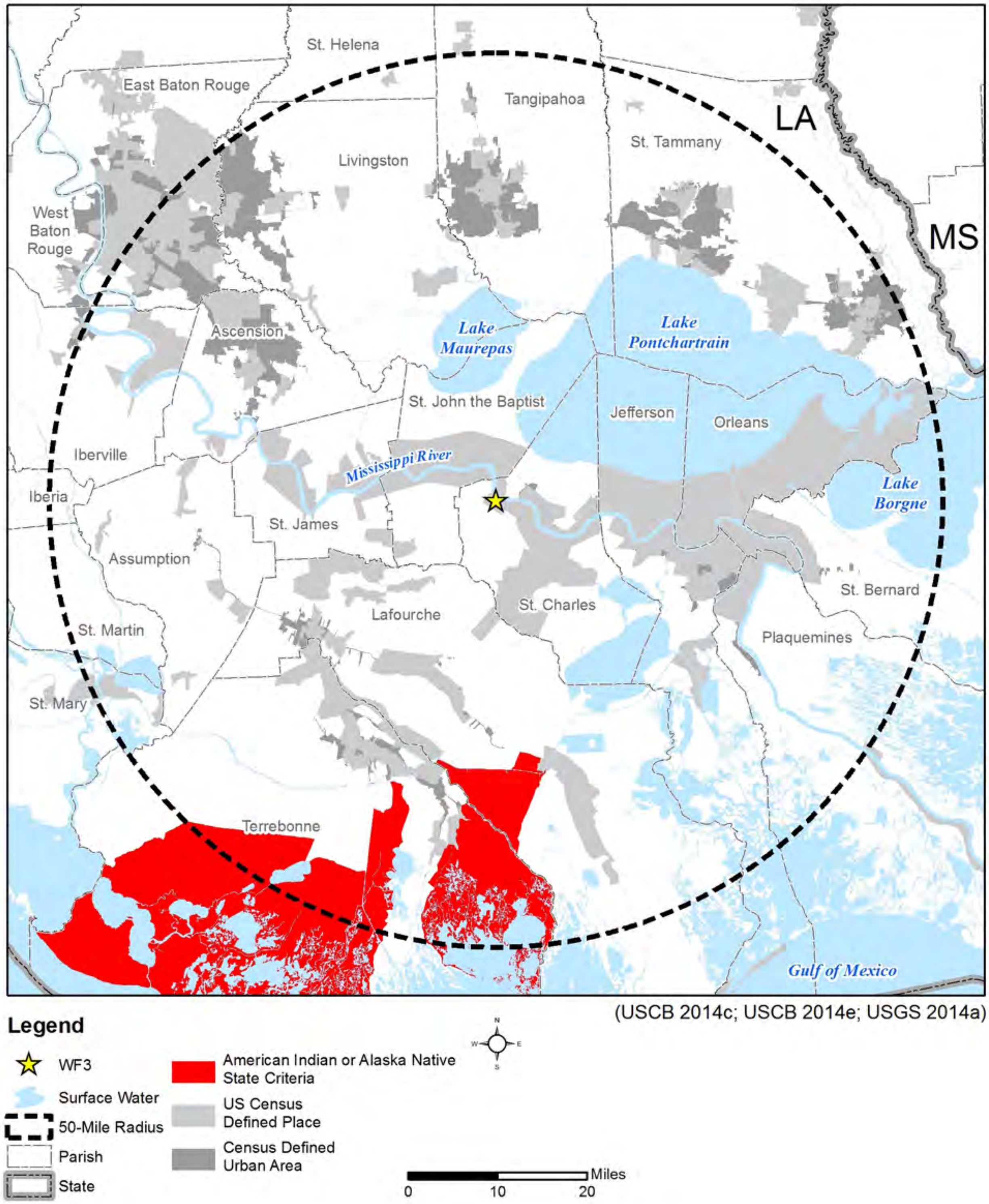


Figure 3.10-8
Census—American Indian or Alaska Native Populations (Individual State)

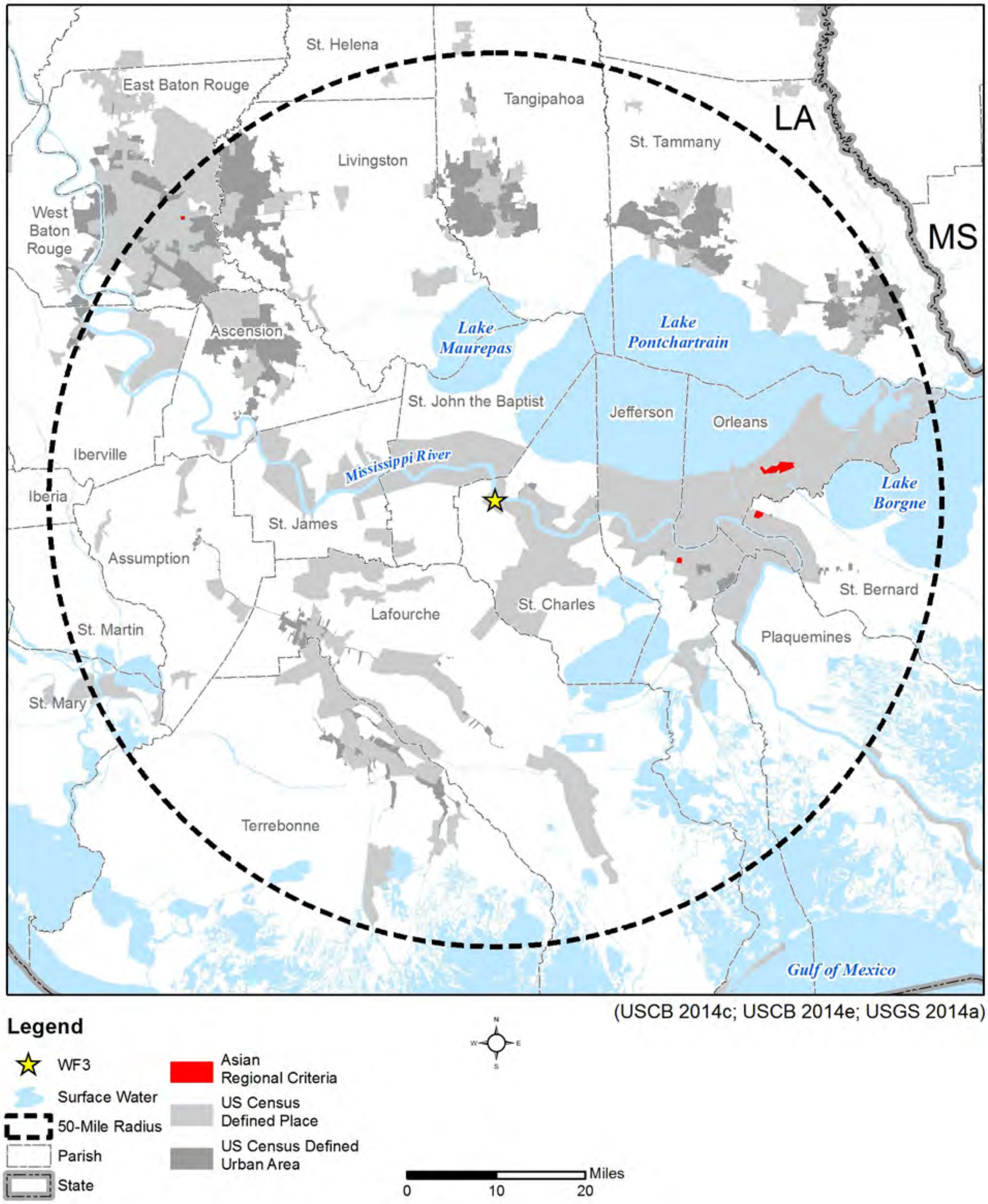
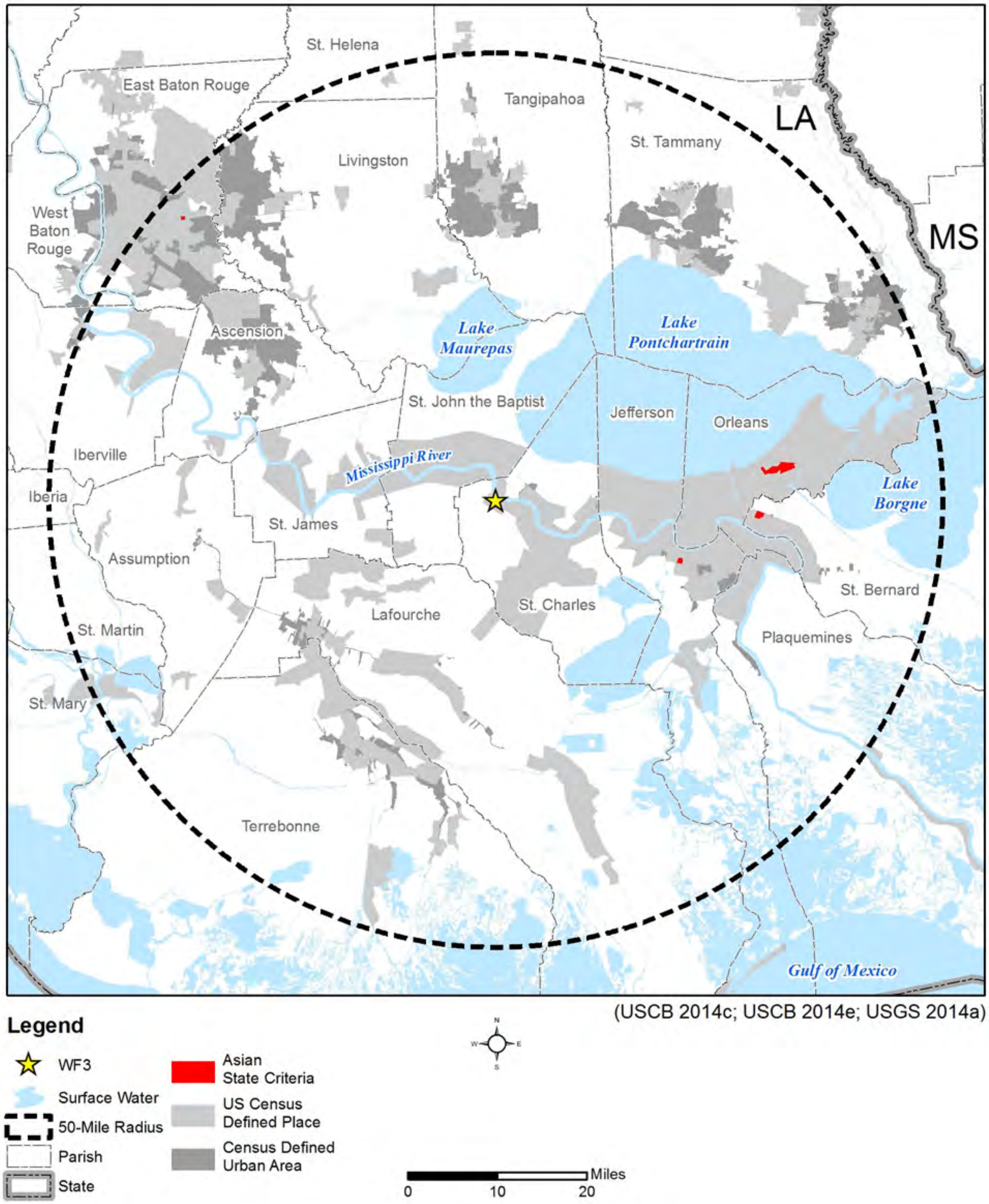
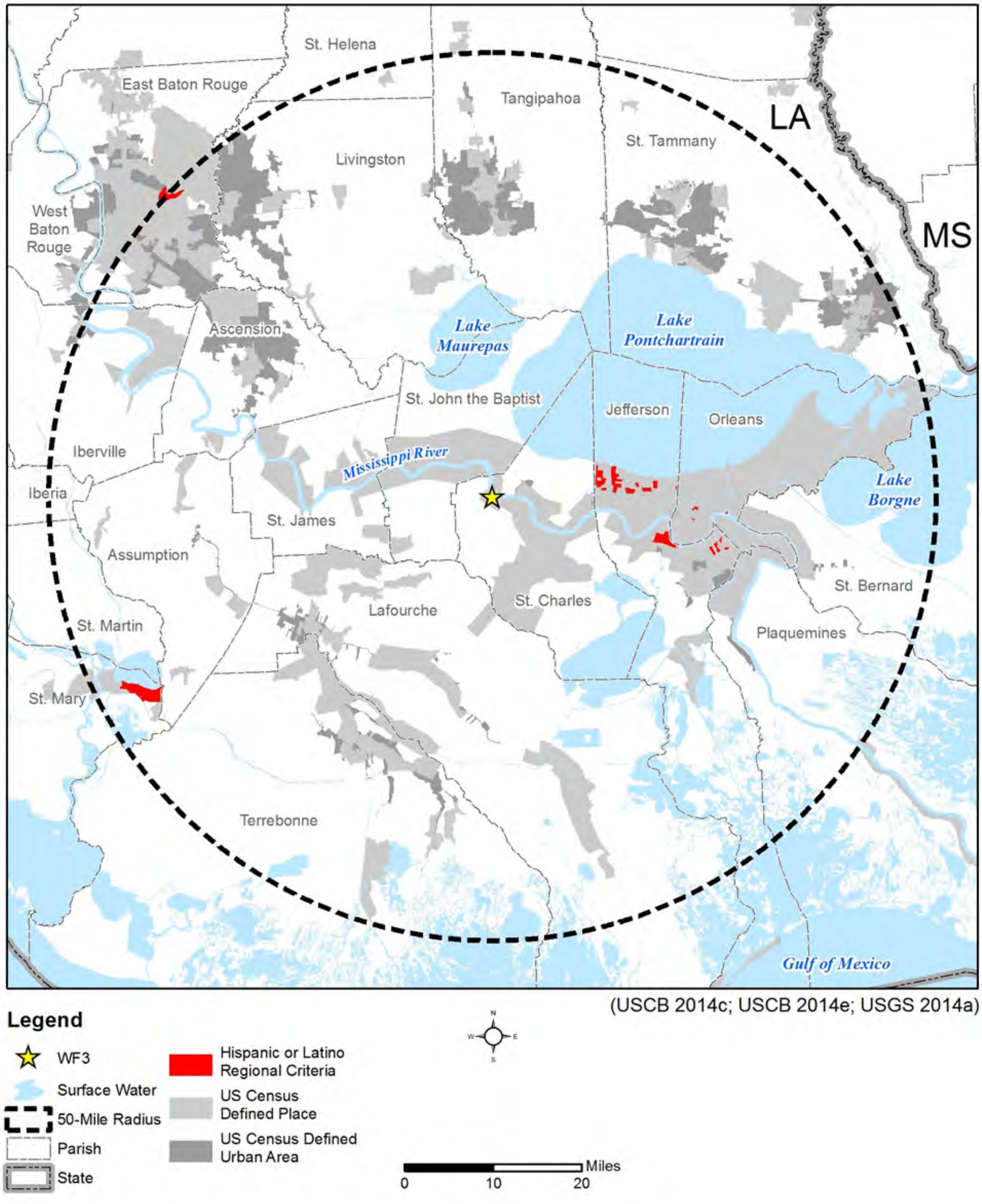


Figure 3.10-9
Census—Asian Populations (Regional)



(USCB 2014c; USCB 2014e; USGS 2014a)

Figure 3.10-10
Census—Asian Populations (Individual State)



(USCB 2014c; USCB 2014e; USGS 2014a)

Figure 3.10-11
Census—Hispanic or Latino Populations (Regional)

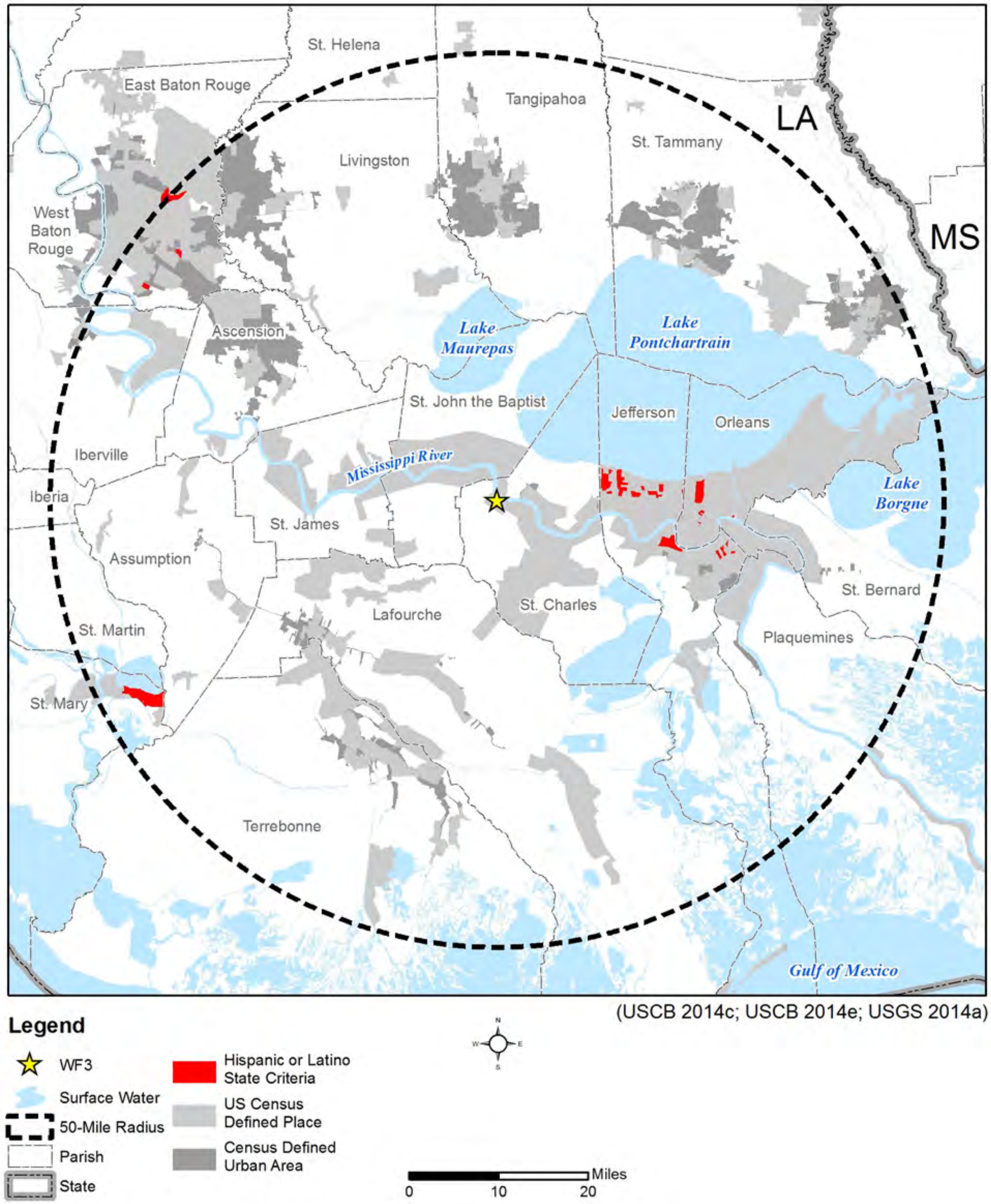


Figure 3.10-12
Census—Hispanic or Latino Populations (Individual State)

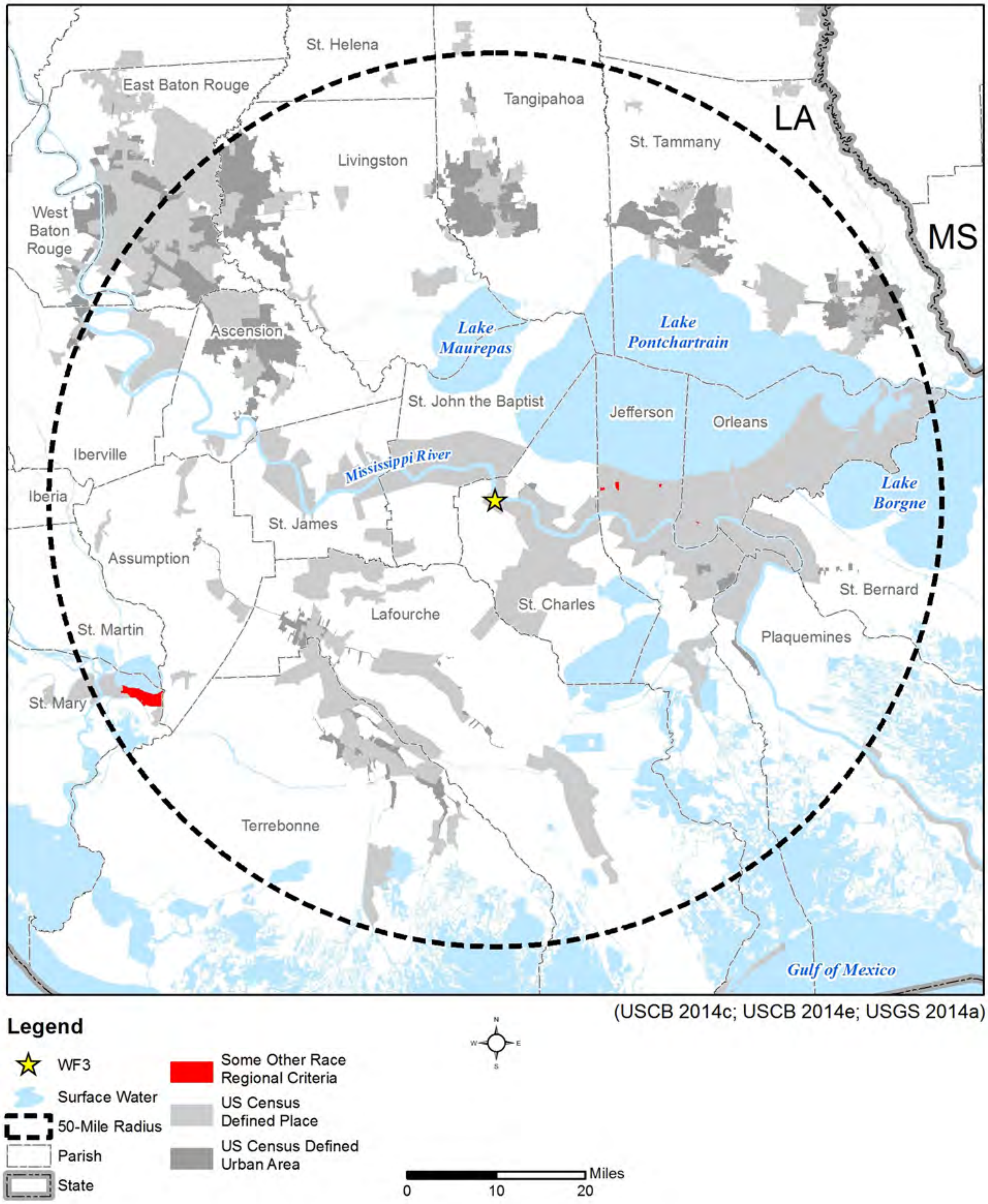


Figure 3.10-13
Census—Some Other Race Populations (Regional)

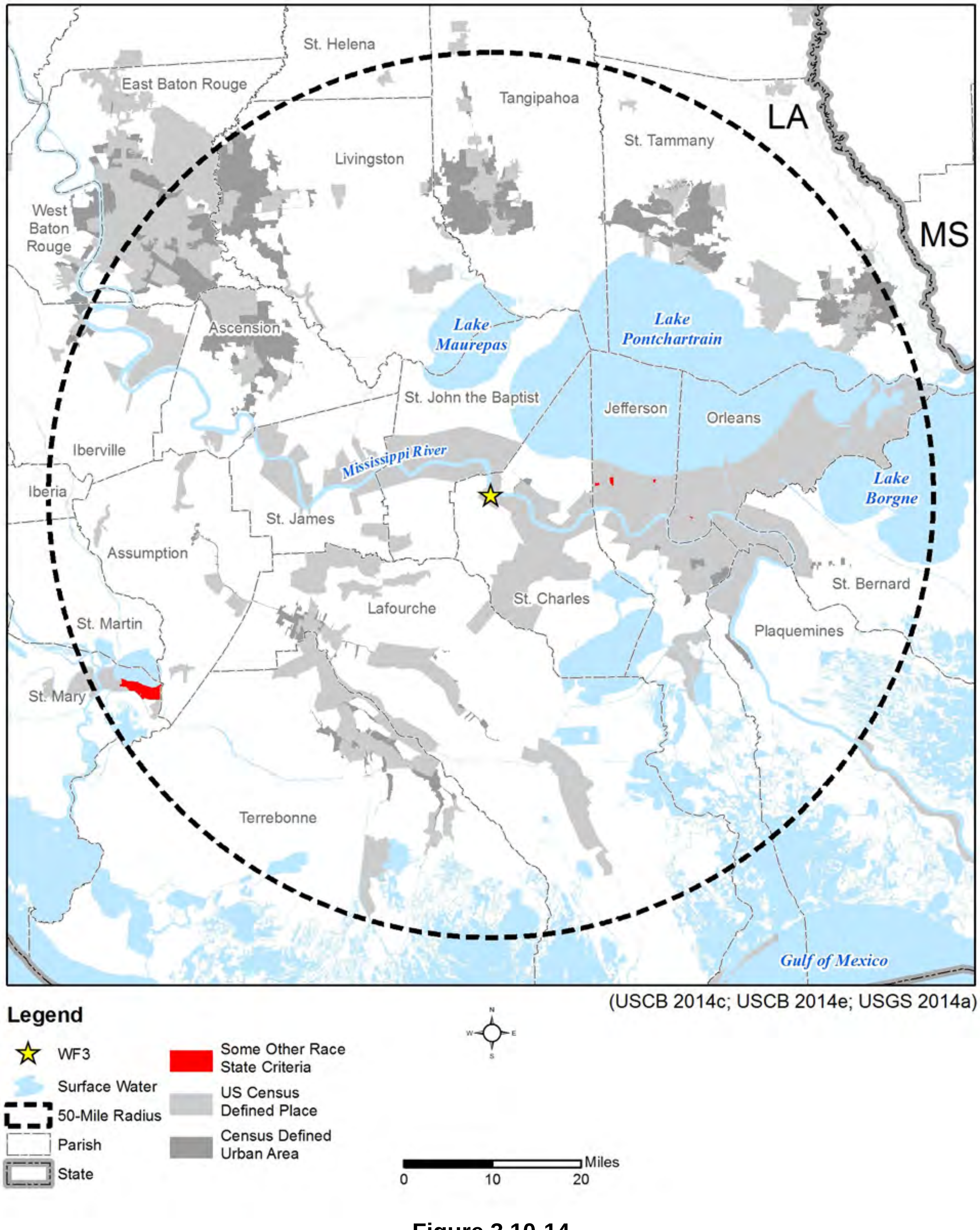
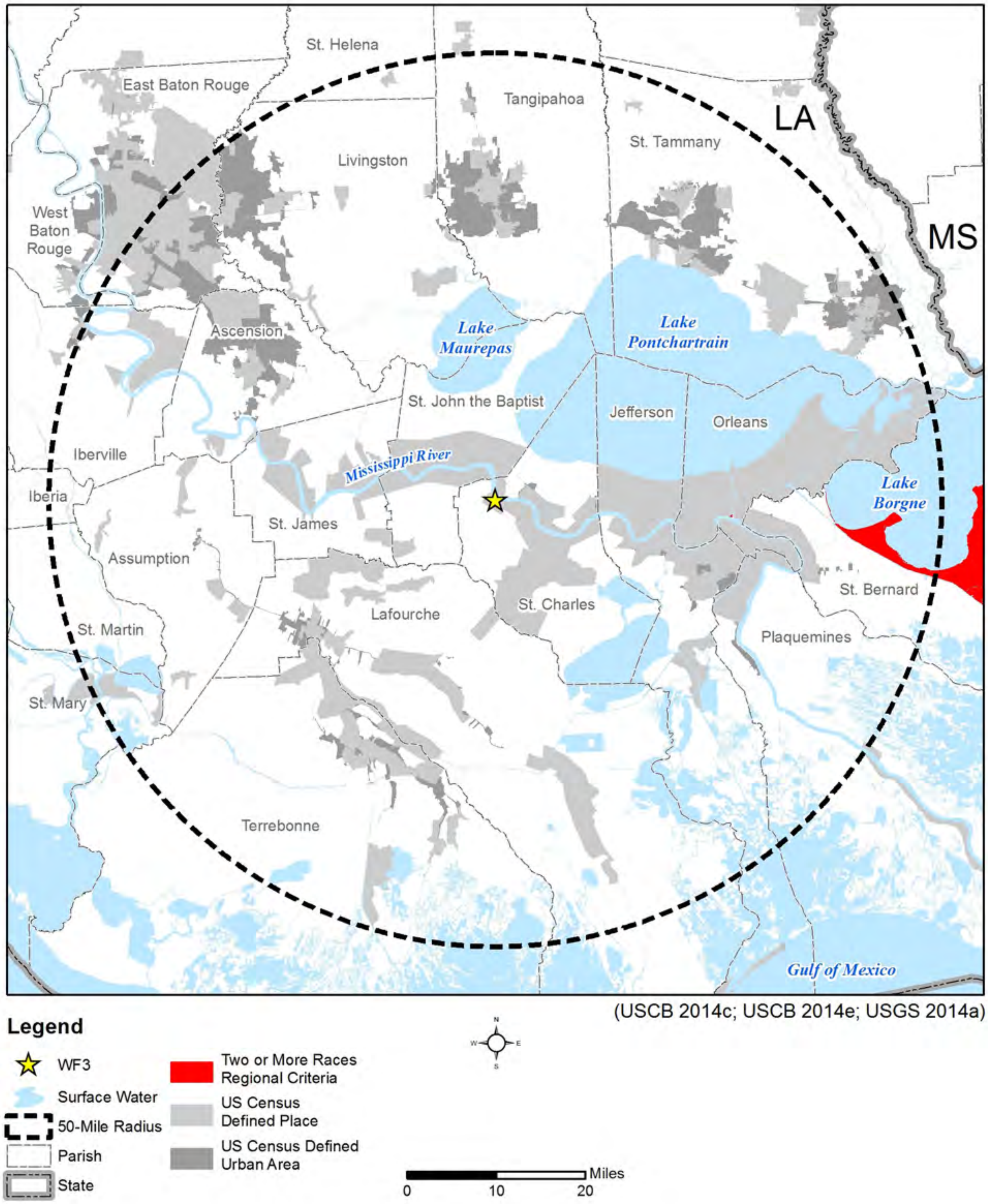


Figure 3.10-14
Census—Some Other Race Populations (Individual State)



(USCB 2014c; USCB 2014e; USGS 2014a)

Figure 3.10-15
Census—Two or More Races Populations (Regional)

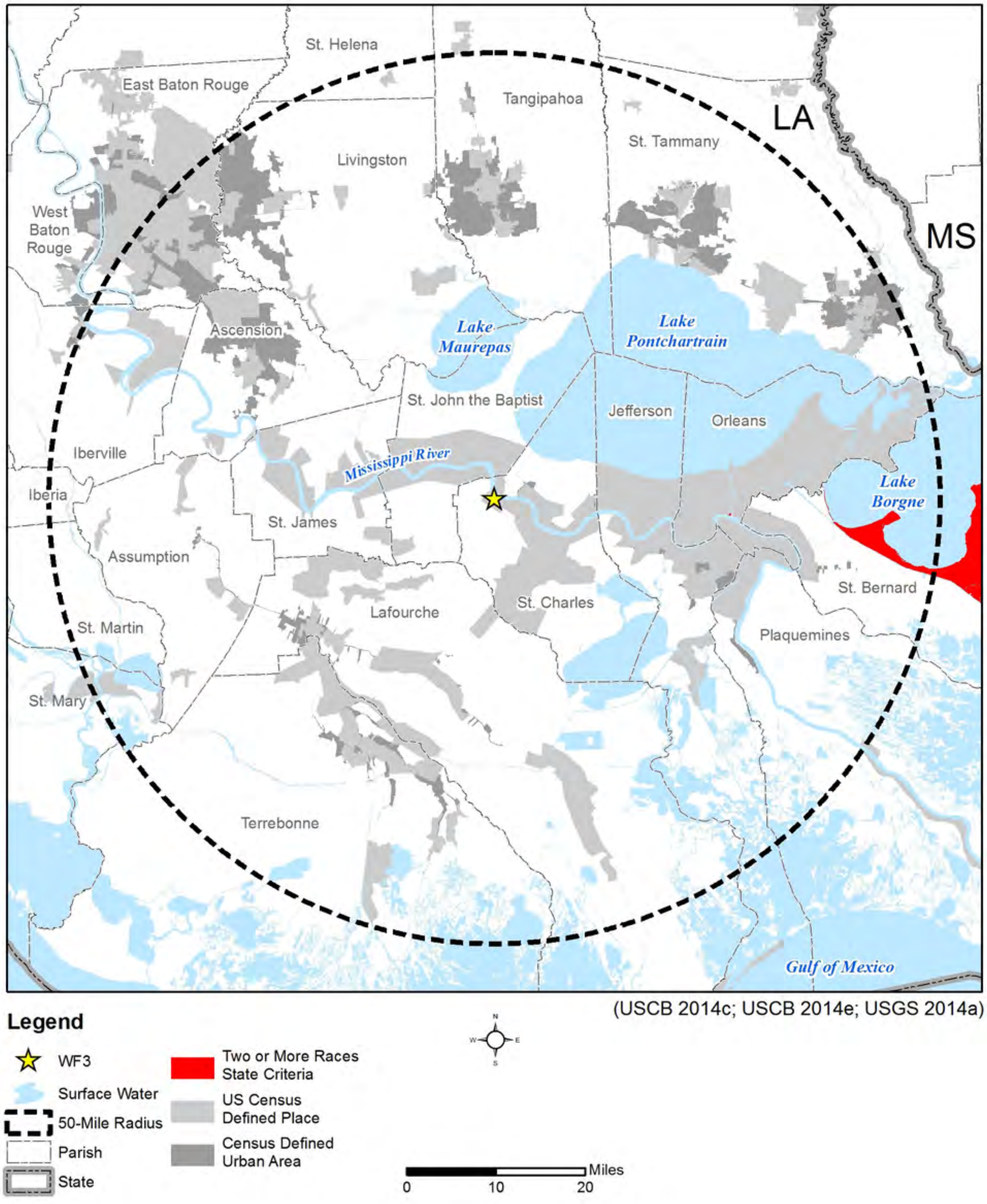
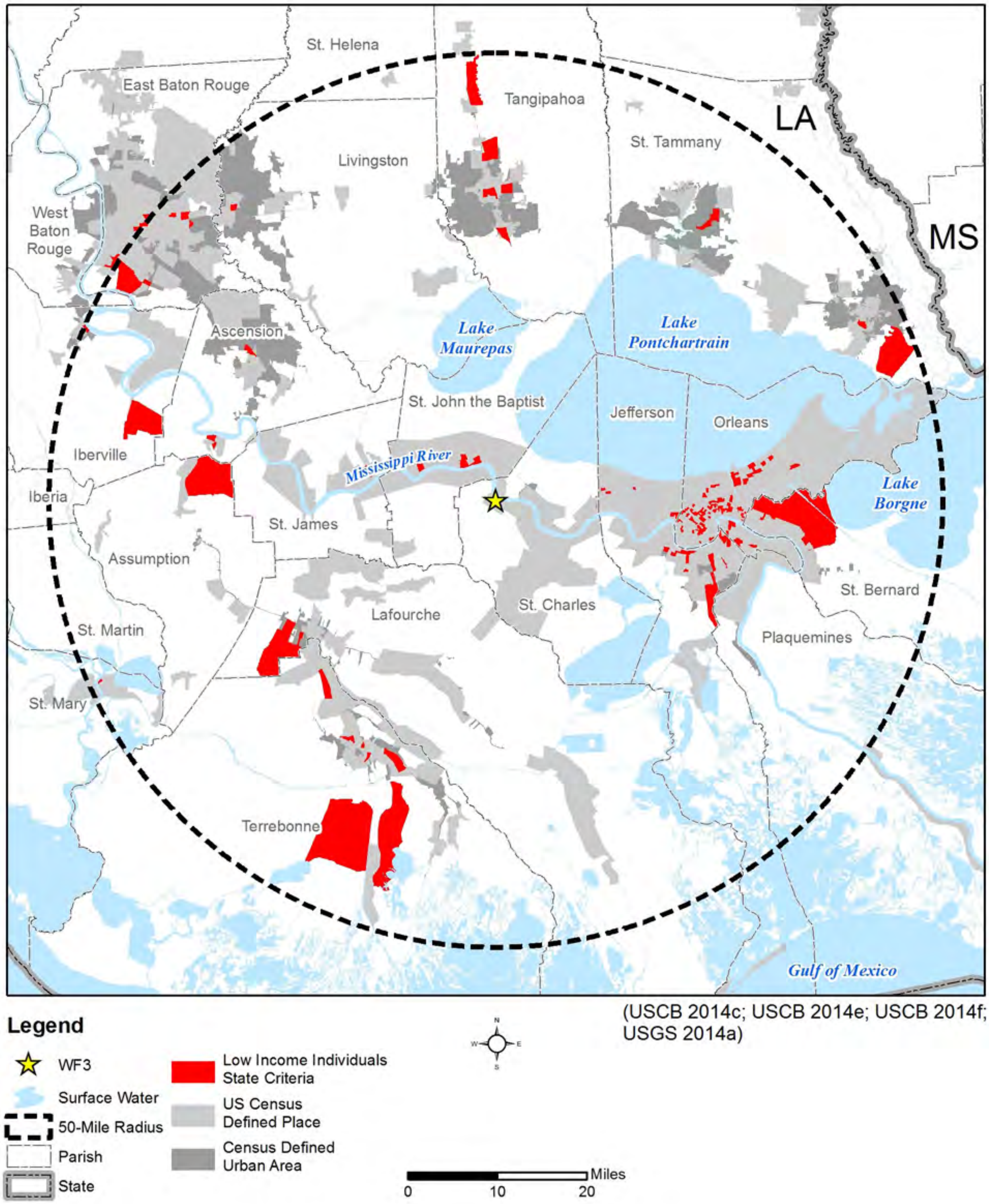
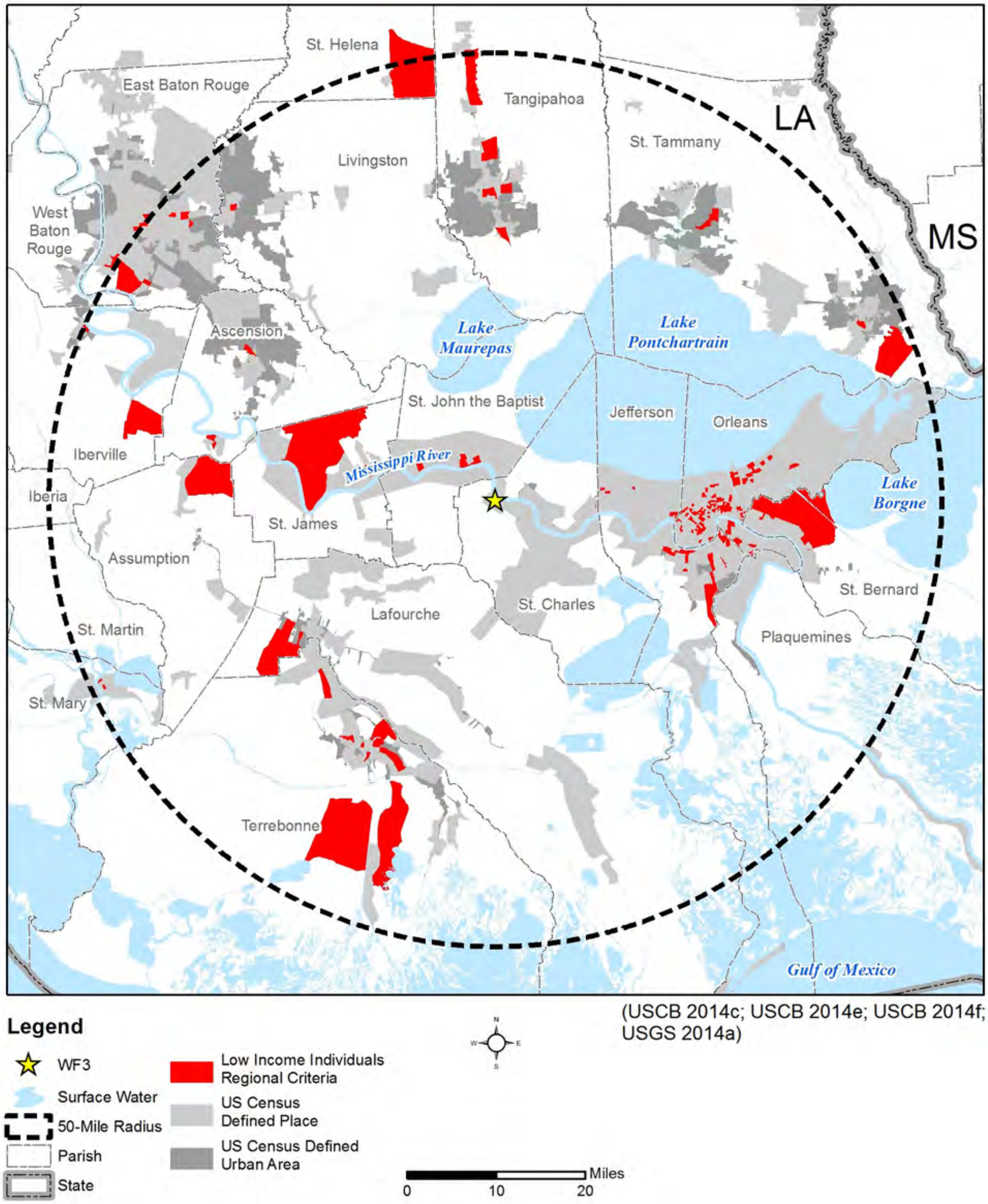


Figure 3.10-16
Census—Two or More Races Populations (Individual State)



(USCB 2014c; USCB 2014e; USCB 2014f; USGS 2014a)

Figure 3.10-17
Census—Low Income Individuals (Individual State)



(USCB 2014c; USCB 2014e; USCB 2014f; USGS 2014a)

Figure 3.10-18
Census—Low Income Individuals (Regional)

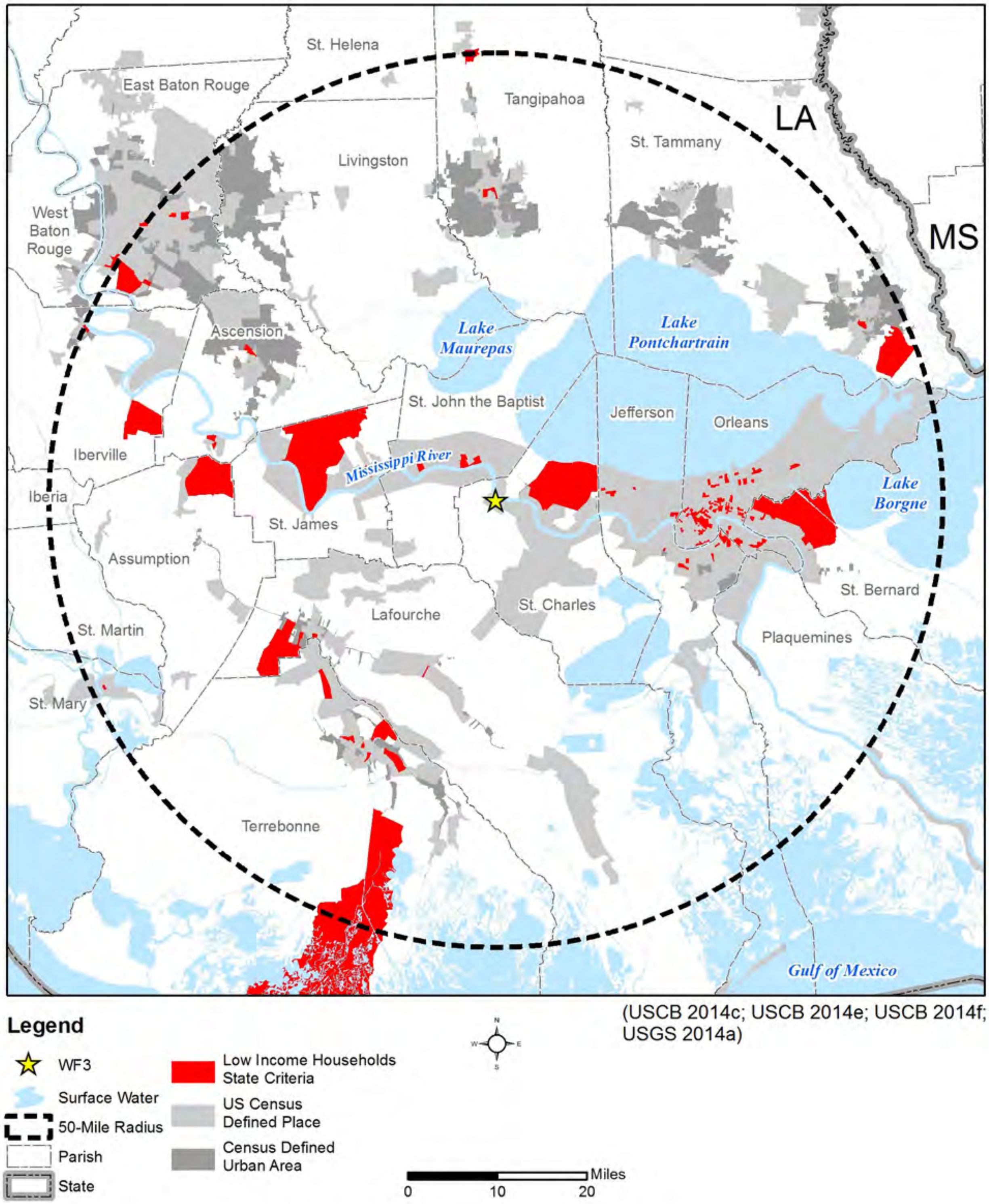


Figure 3.10-19
Census—Low Income Households (Individual State)

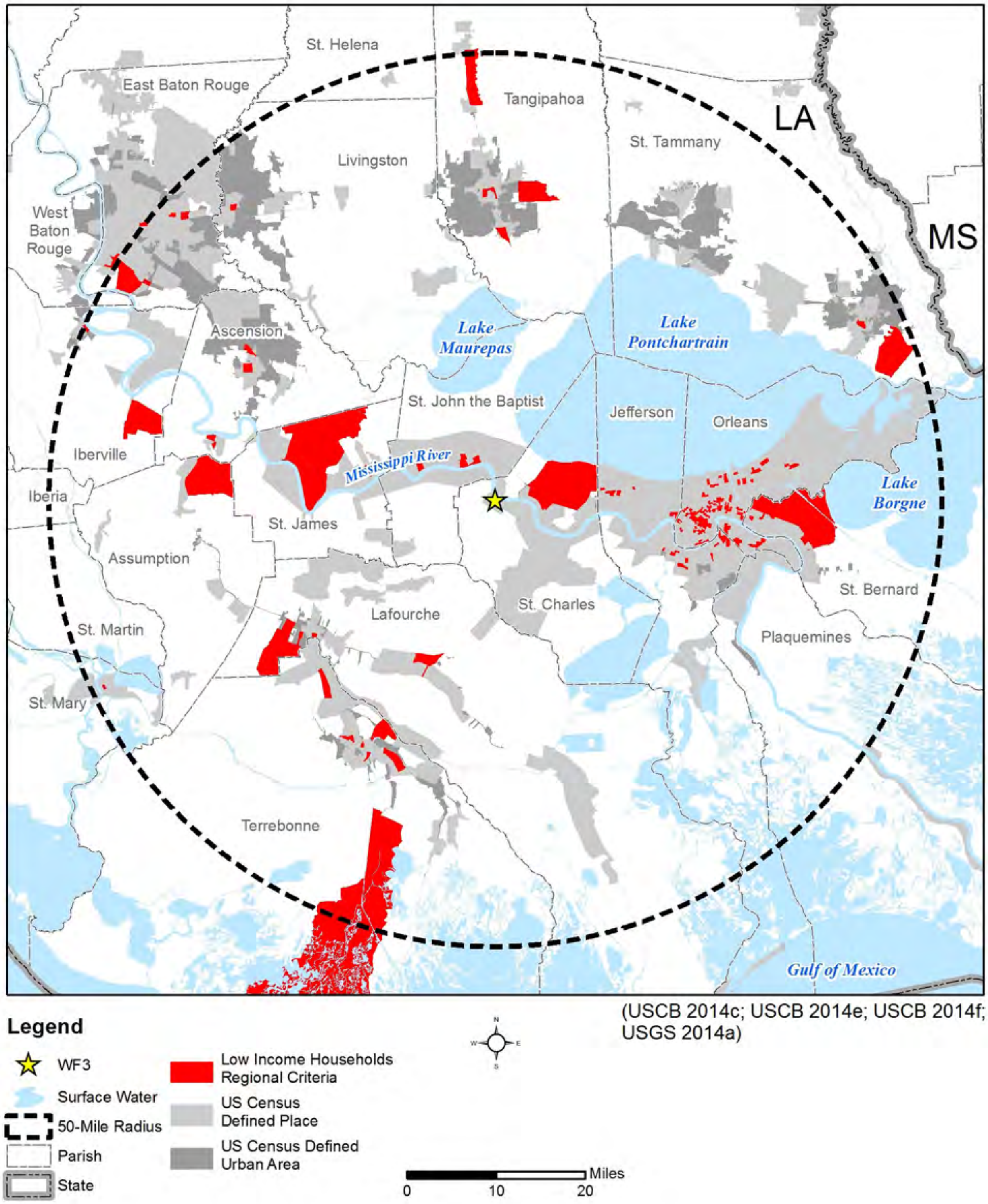


Figure 3.10-20
Census—Low Income Households (Regional)

3.11 Waste Management

In addressing the plant's radioactive and nonradioactive waste management systems and programs, NRC Regulatory Guide 4.2, Supplement 1, Revision 1, specifies that the information being requested in this section can be incorporated by reference to Section 2.2 of the ER (NRC 2013a, Section 3.11). Therefore, consistent with NRC Regulatory Guide 4.2, Entergy is providing the information below to address WF3's radioactive and nonradioactive waste management systems and programs.

Section 2.2.3 includes a discussion of WF3's liquid, gaseous, and solid radwaste systems. The section provides a description of the systems, management of LLMW, radwaste storage, spent fuel storage, and permitted facilities currently utilized for offsite processing and disposal of radioactive wastes.

Section 2.2.4 includes a discussion of WF3's RCRA nonradioactive waste management program, types of wastes generated, waste minimization program, and permitted facilities currently utilized for disposition of wastes.

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND MITIGATING ACTIONS

> The report must contain a consideration of alternatives for reducing adverse impacts . . . for all Category 2 license renewal issues . . . . [10 CFR 51.53(c)(3)(iii)]
>
> The environmental report must include an analysis that considers . . . the environmental effects of the proposed action . . . and alternatives available for reducing or avoiding adverse environmental effects. [10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(2) and 10 CFR 51.53(c)(3)(iii)]
>
> The environmental report shall . . . discuss . . . the impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance. [10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)]
>
> The information submitted . . . should not be confined to information supporting the proposed action but should also include adverse information. [10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)]

The NRC has identified and analyzed 78 environmental issues that it considers to be associated with nuclear power plant license renewal and has designated the issues as Category 1, Category 2, or NA (not applicable). The NRC designated an issue as Category 1 if the following criteria were met:

- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.
- A single significance level (i.e., small, moderate, or large) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste).
- Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to be not sufficiently beneficial to warrant implementation.

If the NRC concluded that one or more of the Category 1 criteria could not be met, the NRC designated the issue Category 2, which requires plant-specific analysis. The NRC designated one issue as NA, signifying that the categorization and impact definitions do not apply to this issue. NRC rules do not require analyses of Category 1 issues that were resolved using generic findings [10 CFR Part 51, Subpart A, Appendix B, Table B-1] as described in the GEIS. Therefore, an applicant may reference the GEIS findings for Category 1 issues, absent new and significant information.

4.0.1 Category 1 License Renewal Issues

> The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in Appendix B to subpart A of this part. [10 CFR 51.53(c)(3)(i)]

> [A]bsent new and significant information, the analyses for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal . . . . (61 FR 28483)

Entergy has determined that, of the 60 Category 1 issues, nine are not applicable to WF3 because they apply to design or operational features that do not exist at the facility. Table 4.0-1 lists these nine issues and provides a brief explanation of why they are not applicable to the site. Table 4.0-2 lists the 51 issues applicable to the site. Entergy reviewed the NRC findings on these 51 issues and identified no new and significant information that would invalidate the findings for the site (Chapter 5). Therefore, Entergy adopts by reference the NRC findings for these Category 1 issues.

4.0.2 Category 2 License Renewal Issues

> The environmental report must contain 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 those issues identified as Category 2 issues in Appendix B to subpart A of this part. [10 CFR 51.53(c)(3)(ii)]

> The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues . . . . [10 CFR 51.53(c)(3)(iii)]

The NRC designated 17 issues as Category 2. Entergy has determined that, of the 17 issues shown in Table 4.0-3, six are not applicable to WF3 because they apply to design or operational features that do not exist at the facility. Where the issue does not apply to the site, the section explains the basis.

For the 11 issues applicable to the site, the corresponding sections contain the required analyses. These analyses include conclusions regarding the significance of the impacts relative to renewal of the WF3 OL for the site and, when applicable, discuss potential mitigative alternatives to the extent appropriate. With the exception of threatened and endangered species/EFH, historic and cultural resources, and environmental justice, Entergy has identified the significance of the impacts associated with each issue as SMALL, MODERATE, or LARGE consistent with the criteria that the NRC established in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 3 as follows:

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.

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

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource. For issues where probability is a key consideration (i.e., accident consequences), probability was a factor in determining significance.

Threatened and endangered species/EFH, historic and cultural resources, and environmental justice were not assigned a significance impact of SMALL, MODERATE, or LARGE in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Therefore consistent with NRC guidance, Entergy identified the significance of the impacts for these three Category 2 issues as follows:

- For threatened and endangered species (Endangered Species Act [ESA]): (1) would have no effect on federally listed species, (2) are not likely to adversely affect federally listed species, (3) are likely to adversely affect federally listed species, or (4) are likely to jeopardize a federally listed species or adversely modify designated critical habitat. For EFH (Magnuson Stevens Fishery Conservation and Management Act): (1) no adverse impact, (2) minimal adverse impact, or (3) substantial adverse impact to the essential habitat of federally managed fish populations.

- For historic and cultural resources (NHPA): (1) no historic properties are present (no effect); (2) historic properties are present, but not adversely affected (no adverse effect); or (3) historic properties are adversely affected (adverse effect).

- For environmental justice, impacts would be based on disproportionately high and adverse human health and environmental effects on minority and low-income populations.

In accordance with NEPA practice, Entergy considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

4.0.3 "NA" License Renewal Issues

The NRC determined that its categorization and impact-finding definitions did not apply to chronic effects of electromagnetic fields. Because the categorization and impact finding definitions do not apply as noted in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 5, applicants are not currently required to submit information on this issue.

4.0.4 Format of Issues Reviewed

The review and analysis of the Category 1 and 2 issues identified in NRC Regulatory Guide 4.2, Supplement 1, Revision 1 (NRC 2013a) are discussed in the following sections. The format for the review of these issues is described below. Although Category 1 issues have been evaluated for new and significant information in Chapter 5, specific issues are also being listed in this chapter for consistency purposes with the recommended NRC Regulatory Guide 4.2 format.

- *Issue*: Title of the issue.
- *Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1*: The findings for the issue from 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants.
- *Requirement*: Restatement of the applicable 10 CFR 51.53 requirement.
- *Analysis*: An analysis of the environmental impact, taking into account information provided in the GEIS, 10 CFR Part 51, Subpart A, Appendix B, as well as current site-specific information. If an issue is not applicable, the analysis lists the explanation. The analysis section also provides a summary conclusion of the environmental impacts, and identifies as applicable, either ongoing or additional planned mitigation measures to reduce adverse impacts. For Category 1 issues listed in this chapter, an analysis is not required absent new and significant information.

Table 4.0-1
Category 1 Issues Not Applicable to WF3

Resource Issue	Comment
Land Use	
Offsite land use in transmission line right-of-ways	All in-scope transmission lines subject to the evaluation of environmental impacts for license renewal are located completely within the Entergy Louisiana, LLC owned property.
Surface Water Resources	
Altered salinity gradients	WF3 does not discharge to an estuary.
Altered thermal stratification of lakes	WF3 is not located on a lake.
Groundwater Resources	
Groundwater use conflicts (plants that withdraw less than 100 gallons per minute)	WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Water System, and once-through cooling water is supplied by the Mississippi River.
Groundwater quality degradation resulting from water withdrawals	WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Water System, and once-through cooling water is supplied by the Mississippi River.
Groundwater quality degradation (plants with cooling ponds in salt marshes)	WF3 is located on a freshwater body and does not utilize cooling ponds.
Aquatic Resources	
Impingement and entrainment of aquatic organisms (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.
Thermal impacts on aquatic organisms (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.
Terrestrial Resources	
Cooling tower impacts on vegetation (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.

Table 4.0-2
Category 1 Issues Applicable to WF3

Resource Issue	Subcategories
Land Use	Onsite land use
	Offsite land use
Visual Resources	Aesthetic impacts
Air Quality	Air quality impacts (all plants)
	Air quality effects of transmission lines
Noise	Noise impacts
Geologic Environment	Geology and soils
Surface Water Resources	Surface water use and quality (non-cooling system impacts)
	Altered current patterns at intake and discharge structures
	Scouring caused by discharged cooling water
	Discharge of metals in cooling system effluent
	Discharge of biocides, sanitary wastes, and minor chemical spills
	Surface water use conflicts (plants with once-through cooling systems)
	Effects of dredging on surface water quality
	Temperature effects on sediment transport capacity
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)
	Infrequently reported thermal impacts (all plants)
	Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication
	Effects of nonradiological contaminants on aquatic organisms
	Exposure of aquatic organisms to radionuclides
	Effects of dredging on aquatic organisms
	Effects on aquatic resources (non-cooling system impacts)
	Impacts of transmission line right-of-way management on aquatic resources
	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses

Table 4.0-2 (Continued)
Category 1 Issues Applicable to WF3

Resource Issue	Subcategories
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides
	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)
	Bird collisions with plant structures and transmission lines
	Transmission line right-of-way management impacts on terrestrial resources
	Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)
Socioeconomics	Employment and income, recreation and tourism
	Tax revenues
	Community services and education
	Population and housing
	Transportation
Human Health	Radiation exposures to the public
	Radiation exposures to plant workers
	Human health impact from chemicals
	Microbiological hazards to plant workers
	Physical occupational hazards
Waste Management	Low-level waste storage and disposal
	Onsite storage of spent nuclear fuel
	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal
	Mixed-waste storage and disposal
	Nonradioactive waste storage and disposal
Uranium Fuel Cycle	Offsite radiological impacts—individual impacts from other than the disposal of spend fuel and high-level waste
	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste
	Nonradiological impacts of the uranium fuel cycle
	Transportation

Table 4.0-2 (Continued)
Category 1 Issues Applicable to WF3

Resource Issue	Subcategories
Termination of Nuclear Power Plant Operations and Decommissioning	Termination of plant operations and decommissioning
Postulated Accidents	Design-basis accidents

Table 4.0-3
Category 2 Issues Applicable to WF3

Resource Issue	Applicability	ER Section
Surface Water Resources		
Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	Not applicable	4.5.1.1
Groundwater Resources		
Groundwater use conflicts (plants that withdraw more than 100 gallons per minute)	Not applicable	4.5.2.1
Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	Not applicable	4.5.2.2
Groundwater quality degradation (plants with cooling ponds at inland sites)	Not applicable	4.5.2.3
Radionuclides released to groundwater	Applicable	4.5.2.4
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	Applicable	4.6.1.1
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	Applicable	4.6.1.2
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	Not applicable	4.6.1.3
Terrestrial Resources		
Effects on terrestrial resources (non-cooling system impacts)	Applicable	4.6.2.1
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	Not applicable	4.6.2.2
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	Applicable	4.6.3
Historic and Cultural Resources		
Historic and cultural resources	Applicable	4.7
Human Health		
Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	Applicable	4.9.1
Electric shock hazards	Applicable	4.9.2
Environmental Justice		
Minority and low-income populations	Applicable	4.10

Table 4.0-3 (Continued)
Category 2 Issues Applicable to WF3

Resource Issue	Applicability	ER Section
Cumulative Impacts		
Cumulative impacts	Applicable	4.12
Postulated Accidents		
Severe accidents	Applicable	4.15.1

4.1 Land Use and Visual Resources

4.1.1 Onsite Land Use

4.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes in onsite land use from continued operations and refurbishment associated with license renewal would be a small fraction of the nuclear power plant site and would involve only land that is controlled by the licensee.

4.1.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.1.1.3 Analysis

Onsite land use information is presented in Section 3.1.1 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, no license-renewal-related construction activities have been identified. Therefore, no changes in onsite land use during the license renewal period are anticipated.

In the GEIS, the NRC determined that onsite land use impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.1). Based on Entergy's review, no new and significant information was identified as it relates to onsite land use, and further analysis is not required.

4.1.2 Offsite Land Use

4.1.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Offsite land use would not be affected by continued operations and refurbishment associated with license renewal.

4.1.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.1.2.3 Analysis

Offsite land use information is presented in Section 3.1.2 of this ER. As discussed in Section 2.5, 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. Therefore, no changes in offsite land use during the license renewal period are anticipated.

In the GEIS, the NRC determined that offsite land use impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.1). Based on Entergy's review, no new and significant information was identified as it relates to offsite land use, and further analysis is not required.

4.1.3 Offsite Land Use in Transmission Line Right-of-Ways

4.1.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Use of transmission line ROWs from continued operations and refurbishment associated with license renewal would continue with no change in land use restrictions.

4.1.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.1.3.3 Analysis

As discussed in Section 2.2.5.1, in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned property. Therefore, this issue is not applicable, and further analysis is not required.

4.1.4 Aesthetic Impacts

4.1.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. No important changes to the visual appearance of plant structures or transmission lines are expected from continued operations and refurbishment associated with license renewal.

4.1.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.1.4.3 Analysis

The visual appearance of the plant and in-scope transmission lines is presented in Section 3.1.3 of this ER. As discussed in Section 3.1.3, the WF3 plant is situated in a heavy industrial and commercial development area. Visual impacts from the site are limited to adjacent properties and traffic, associated with the Mississippi River, LA-18, LA-3127, and LA-628. No refurbishment or construction activities have been identified that would change the aesthetics of the WF3 facility during the license renewal term. Therefore, no changes in visual resources during the license renewal period are anticipated.

In the GEIS, the NRC determined that aesthetic impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.2). Based on Entergy's review, no new and significant information was identified as it relates to visual resources, and further analysis is not required.

4.2 Air Quality

4.2.1 Air Quality Impacts (all plants)

4.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Air quality impacts from continued operations and refurbishment associated with license renewal are expected to be small at all plants. Emissions resulting from refurbishment activities at locations in or near air quality nonattainment or maintenance areas would be short-lived and would cease after these refurbishment activities are completed. Operating experience has shown that the scale of refurbishment activities has not resulted in exceedance of the *de minimis* thresholds for criteria pollutants, and best management practices including fugitive dust controls and the imposition of permit conditions in State and local air emissions permits would ensure conformance with applicable State or Tribal Implementation plans.

Emissions from emergency diesel generators and fire pumps and routine operations of boilers used for space heating would not be a concern, even for plants located in or adjacent to nonattainment areas. Impacts from cooling tower particulate emissions even under the worst-case situations have been small.

4.2.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.2.1.3 Analysis

Air quality information is presented in Section 3.2.4 of this ER. No license renewal-related refurbishment activities have been identified, as discussed in Section 2.3. As discussed in Section 3.2.4, St. Charles Parish is in attainment with the NAAQS for all criteria air pollutants. As discussed in Section 3.2.5, no future upgrade or replacement activities (e.g., diesel generators, diesel pumps) that would increase or decrease air emissions over the license renewal period were identified as necessary for plant operations.

As discussed in Section 3.2.5, the WF3 air permit contains conditions established by the LDEQ to protect Louisiana's ambient air quality standards and ensure impacts are maintained at acceptable levels. These same conditions would regulate any future WF3 activities that may increase air pollutants or threaten the attainment status of St. Charles Parish.

In the GEIS, the NRC determined that air quality impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.1). Based on Entergy's review, no new and significant information was identified as it relates to air quality, and further analysis is not required.

4.2.2 Air Quality Effects of Transmission Lines

4.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

4.2.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.2.2.3 Analysis

Based on the GEIS, it was determined through several studies that the amount of ozone generated by even the largest lines in operation (765 kV) would be insignificant (NRC 2013b, Section 4.3.1.1). As discussed in Section 2.2.5.1, WF3's in-scope transmission lines are 230 kV. Therefore, the production of ozone and oxides of nitrogen would be *de minimis*.

In the GEIS, the NRC determined that air quality effects of transmission lines from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.1). Based on Entergy's review, no new and significant information was identified as it relates to air quality effects of transmission lines, and further analysis is not required.

4.3 Noise

4.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Noise levels would remain below regulatory guidelines for offsite receptors during continued operations and refurbishment associated with license renewal.

4.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.3.3 Analysis

Noise associated with plant operations is presented in Section 3.3 of this ER. No license renewal-related refurbishment activities have been identified, as discussed in Section 2.3. As discussed in Section 3.3, noise associated with WF3 operational activities is within the EPA's 55-dBA threshold level to protect against excess noise during outdoor activities. Based on the previous 5 years (2010–2014), there have been no noise complaints associated with WF3's plant operations.

In the GEIS, the NRC determined that noise impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.2). Based on Entergy's review, no new and significant information was identified as it relates to noise, and further analysis is not required.

4.4 Geology and Soils

4.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The effect of geologic and soil conditions on plant operations and the impact of continued operations and refurbishment activities on geology and soils would be small for all nuclear power plants and would not change appreciably during the license renewal term.

4.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.4.3 Analysis

Geology and soils information is presented in Section 3.4 of this ER. Routine infrastructure, renovation, and maintenance projects would be expected during continued operation. As discussed in Sections 3.4.3.2 and 3.5.1.1.2, WF3 maintains and implements a SWPPP that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges.

In the GEIS, the NRC determined that geology and soil impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.4.1). Based on Entergy's review, no new and significant information was identified as it relates to geology and soils, and further analysis is not required.

4.5 Water Resources

4.5.1 Surface Water Resources

4.5.1.1 Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

4.5.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts could be of small or moderate significance, depending on makeup water requirements, water availability, and competing water demands.

4.5.1.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river . . . must be provided.

4.5.1.1.3 Analysis

As discussed in Section 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

4.5.2 Groundwater Resources

4.5.2.1 Groundwater Use Conflicts (Plants that Withdraw more than 100 GPM)

4.5.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Plants that withdraw more than 100 gpm could cause groundwater use conflicts with nearby groundwater users.

4.5.2.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(C)]

If the applicant's plant pumps more than 100 gallons (total onsite) of groundwater per minute, an assessment of the impact of the proposed action on groundwater must be provided.

4.5.2.1.3 Analysis

As discussed in Section 3.5.3.2, WF3 does not have any onsite wells that are utilized for plant operations. The Mississippi River is the source of makeup cooling water, and potable water is supplied by the St. Charles Parish Water System as discussed in Section 2.2.2.6. Therefore, this issue is not applicable and further analysis is not required.

4.5.2.2 Groundwater Use Conflicts (Plants with Closed-Cycle Cooling Systems that Withdraw Makeup Water from a River)

4.5.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Water use conflicts could result from water withdrawals from rivers during low-flow conditions, which may affect aquifer recharge. The significance of impacts would depend on makeup water requirements, water availability, and competing water demands.

4.5.2.2.2 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands . . . must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow.

4.5.2.2.3 Analysis

As discussed in Section 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize a closed-cycle cooling system for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

4.5.2.3 Groundwater Quality Degradation (Plants with Cooling Ponds at Inland Sites)

4.5.2.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Inland sites with closed-cycle cooling ponds could degrade groundwater quality. The significance of the impact would depend on cooling pond water quality, site hydrogeologic conditions (including the interaction of surface water and groundwater), and the location, depth, and pump rate of water wells.

4.5.2.3.2 Requirement [10 CFR 51.53(c)(3)(ii)(D)]

If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided.

4.5.2.3.3 Analysis

As discussed in Section 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling ponds. Therefore, this issue is not applicable and further analysis is not required.

4.5.2.4 Radionuclides Released to Groundwater

4.5.2.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Leaks of radioactive liquids from plant components and pipes have occurred at numerous plants. Groundwater protection programs have been established at all operating nuclear power plants to minimize the potential impact from any inadvertent releases. The magnitude of impacts would depend on site-specific characteristics.

4.5.2.4.2 Requirement [10 CFR 51.53(c)(3)(ii)(P)]

An applicant shall assess the impact of any documented inadvertent releases of radionuclides into groundwater. The applicant shall include in its assessment a description of any groundwater protection program used for the surveillance of piping and components containing radioactive liquids for which a pathway to groundwater may exist. The assessment must also include a description of any past inadvertent releases and the projected impact to the environment (e.g., aquifers, rivers, lakes, ponds, ocean) during the license renewal term.

4.5.2.4.3 Analysis

A description of the WF3 groundwater protection program is discussed in Section 3.5.2.4. Table 3.5-2 presents well construction details for the WF3 groundwater monitoring wells, while Figure 3.5-6 shows the location of the wells. Table 3.5-5 presents information on registered water wells within a 2-mile band around the Entergy Louisiana, LLC property boundary, while Figure 3.5-7 shows the location of these registered wells.

As discussed in Section 3.5.4.2.1, an inadvertent liquid radioactive release of approximately 800 gallons occurred due to the overfilling of the spent fuel pool which eventually reached the environment, flowing onto the asphalt and into the storm drain system. The spill contained a variety of radioisotopes released at a total count of 3.59E-02 curies (including tritium). Remediation efforts included removal of 5,000 cubic yards of affected pavement and soil outside the fuel handling building train bay door, flushing of the storm drains, and remediation of the drainage ditch. The concentration of the tritium in the release was approximately 22,000 picocuries per liter. As of June 2015, no tritium residual activity from this release remains.

As discussed in Section 3.5.2.3, water levels in shallow aquifers downstream of the Baton Rouge area closely follow the stage of the Mississippi River. Water from the Mississippi River seeps into shallow aquifers during periods of high river stage and from these aquifers into the river during periods of low river stage. Historically, shallow groundwater flow at WF3 has been described as flowing generally south-southwest away from the Mississippi River, except during low river stages when a transient groundwater divide is created. Water-level data collected as part of the NEI GPI program indicate two general groundwater flow scenarios. In the first scenario, the elevation of the Mississippi River is higher than onsite groundwater potentiometric elevations, and hydraulic gradients direct flow across the site away from the river (Figure 3.5-4). In the second scenario, the highest water-level elevations form a groundwater mound typically coincident with northern portions of the plant foundation excavation. This groundwater mound creates a divide where hydraulic gradients direct a portion of groundwater flow away from the mound toward the Mississippi River (Figure 3.5-5).

WF3's groundwater monitoring program encompasses the existing quality of groundwater potentially affected by continued operations (as compared to the EPA primary drinking water standards) as well as the current and potential onsite and offsite uses and users of groundwater for drinking and other purposes. Currently, no groundwater beneath WF3 is radioactively contaminated. Since the groundwater monitoring program was initiated in 2007, no tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected. Therefore, Entergy concludes that impacts from radionuclides to groundwater are SMALL and do not warrant additional mitigation measures beyond Entergy's existing groundwater monitoring program.

4.6 Ecological Resources

4.6.1 Aquatic Resources

4.6.1.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

4.6.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. The impacts of impingement and entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems, depending on cooling system withdrawal rates and volumes and the aquatic resources at the site.

4.6.1.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(B)]

If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations . . . or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from . . . impingement and entrainment.

4.6.1.1.3 Analysis

The following discussion is taken from Section 3.6.6 unless otherwise referenced.

The WF3 CWIS is located offshore in the main channel of the Mississippi River. As would be typical, the river's main channel harbors much lower densities of fish than the river's edges and backwaters. Data suggest that population densities in the main channel are less than 5 percent of what is observed in channel borders. The relatively low densities are driven by the high velocities and reduced preferred habitat, as well as significant suspended sediment load.

The high turbidities also restrict phytoplankton and periphyton growth due to very limited light penetration. Productivity of the phytoplankton is further limited by the high turbulence and mixing in the Mississippi River, which may prevent phytoplankton from remaining in the euphotic zone for sufficient lengths of time to effectively photosynthesize. High concentrations of suspended solids and high current velocities also result in scouring of fish eggs and larvae (in nests or attached to submerged objects), scouring of benthic and periphyton communities, clogging of filter-feeding mechanisms of invertebrates, and shifting bottom sediments. Resultant sediment deposition in areas with slower currents smother fish eggs and larvae as well as benthic organisms (both fauna and flora), further limiting their composition and density. Low densities of zooplankton were also identified in the Mississippi River near the site (River Mile 129.6) during preoperational studies, and many likely originated from areas of slower current upstream of the sampling area.

Previous studies conducted at nearby Entergy facilities demonstrate that impingement rates are low at facilities on the LMR, the species impinged are common, and that impingement varies seasonally with fish abundance. Most species cannot tolerate the harsh conditions of the Mississippi River main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source.

Of the fish species that occur in the WF3 area, most species spawn in shallow areas, sheltered areas, smaller streams, backwaters, areas of aquatic vegetation, or over gravel and sand bottoms. The only abundant commercial or sport species that might spawn over the clay or mud substrate in the waters found in the vicinity of the WF3 area are threadfin shad and gizzard shad. These were the most abundant groups of ichthyoplankton captured during the preoperational monitoring program.

However during the 2006–2007 impingement study conducted at Waterford 1 and 2 (River Mile 129.9) located on the right descending bank of the Mississippi River, the only species composing greater than 1 percent of all organisms impinged included river shrimp, threadfin shad, channel catfish, freshwater drum, blue catfish, bay anchovy, and grass shrimp. The historic impingement studies performed during the period 1976–1977 indicated a similar balance of species with a few noticeable differences. In the historic study, gizzard shad and skipjack herring each accounted for greater than 1 percent of the total impingement sample. Additionally, grass shrimp did not account for more than 1 percent of the sample.

As previously discussed in Section 3.6.6.2, the number of organisms estimated to be impinged annually at WF3 was 3,472,951 as compared to that impinged annually at Waterford 1 and 2 (1,379,533). However, when comparing the proportion of fish impinged at WF3 to the number of fish in the river at the same time, this value is proportional to the amount of water actually being used by the plant relative to the amount of water flowing by the plant. Therefore in terms of actual numbers, WF3 impinges 3,472,951 fish annually compared to the estimated 723,531,458 total number of fish in the river at the same time as the water that is used by WF3. Thus, the total number of fish in the river is approximately 208 times greater than the number of fish impinged at WF3.

Because the Mississippi River at WF3 lacks riffle areas, shallow backwaters and flood areas, and vegetated areas, it does not provide habitat suitable for spawning by many fish species. Although to the extent that sheltered locations are available (including cans, snags, etc.), a limited number of species may spawn near WF3. However, the spawning habitat appears not to be optimal even for these species as ichthyoplankton densities in this area are significantly less than 1 organism/m^3.

During the preoperational monitoring, densities of fish larvae were low in the WF3 area throughout the 1974–1976 sampling period. In addition, there were no important differences in the spatial distribution of the ichthyoplankton in the river in the WF3 vicinity. The spawning period of most native fishes in the LMR typically correlates to the seasonal flooding/high-water period. At WF3, seasonal average flows have been calculated to be 580,000; 650,000; 280,000; and 240,000 cfs for winter, spring, summer, and fall, respectively. Elevated flows increase the flood zone of the river and are most likely responsible for pushing the eggs and larval fish past the CWIS during this time.

The WF3 facility has been issued a number of previous NPDES and/or LPDES permits and has been withdrawing once-through, non-contact cooling water without any identified problems. Based on the information evaluated, there have been no past or current impacts identified associated with the withdrawal of the applicable cooling water. (Attachment A) In the 1991 WF3 NPDES permit issued by the EPA, the agency approved the WF3 intake structure as being BTA in accordance with Section 316(b) of the Clean Water Act. In 2010, LDEQ re-confirmed that the WF3 CWIS was also BTA, based on best professional judgment (Attachment A).

Because of the general lack of appropriate spawning habitat in the vicinity of WF3, the relatively small portion of the river flow utilized by WF3, and the large volume and turbulence of the LMR, it is doubtful that significant larval fish populations exist in this portion of the river.

Due to the dynamics of the Mississippi River at WF3 and the generally low populations of larval fish, Entergy concludes that impacts from impingement and entrainment of aquatic organisms during the license renewal term would be SMALL. Although additional mitigation measures may be implemented in the future as a result of the requirements in the final 316(b) Rule (79 FR 48300), these measures would minimize the already existing SMALL impacts.

4.6.1.2 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

4.6.1.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Most of the effects associated with thermal discharges are localized and are not expected to affect overall stability of populations or resources. The magnitude of impacts, however, would depend on site-specific thermal plume characteristics and the nature of aquatic resources in the area.

4.6.1.2.2 Requirement [10 CFR 51.53(c)(3)(ii)(B)]

If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of . . . a 316(a) variance in accordance with 40 CFR Part 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from thermal changes . . . .

4.6.1.2.3 Analysis

The potential for impacts related to thermal discharges from WF3 have been investigated since 1979. Information presented in this section is based on information discussed in Section 3.6.6.2.3. WF3 does not possess a current 316(a) variance.

A study in 1979 determined that the balanced indigenous population of the Mississippi River would not be disrupted by the thermal discharge of WF3, and was substantiated by the following ecosystem characteristics: low productivity, sparse populations, absence of endangered species critical habitat, the unsuitability and non-uniqueness for fish spawning, and the presence of commercially important species. The combination of these ecological characteristics with the small volume of river to be thermally affected and the lack of potential for significant effects from cold shock demonstrates the low potential for adverse impact from the operation of WF3.

The 1979 study also determined that the benthic community near WF3 was relatively sparse. The river cross-sectional configuration at WF3 places a very small percentage of this community's habitat within the area affected by the thermal discharges. It was estimated that a total of 1 acre of benthic habitat would have contact with water heated greater than 3.6°F above ambient conditions.

Although the 1979 study stated that the thermal characteristics of the Mississippi River ecosystem could be affected by the combined thermal discharges from Waterford 1 and 2, WF3, and Little Gypsy, the plume configuration and detailed supporting data indicate that, with all generating stations operating during typical low flow and average seasonal flow conditions, a zone of passage conservatively estimated to exceed 90 percent of the river area will exist in all seasons. Therefore, because of the relatively small portion of the river profile that is affected by the thermal plumes in the Mississippi River at the WF3 plant, there remains a large portion of the river available for passage by aquatic organisms.

In 1998, WF3 requested that the temperature and heat discharge limits, which the facility was operating under (110°F and 8.5×10^9 Btu/hour), be increased to 118°F and 9.5×10^9 Btu/hour, respectively. The basis of the request for an increase in temperature and heat discharge limits was due to a planned "power uprate" to be implemented at WF3.

Based on LDEQ's evaluation, it was determined that the criteria specified in LAC 33:IX.1113.C.4.b.i.(a), the 5°F allowable rise of temperature above ambient at the edge of the mixing zone, would not occur with a discharge limitation for temperature at 118°F. In addition, it was determined that approximately 81 percent of the river flow would be unaffected by the temperature increase after the WF3 power uprate, even under extreme low-flow conditions.

In LDEQ's evaluation, the combined thermal discharges from Waterford 1 and 2, WF3, and Little Gypsy were considered with respect to the cooling tower operations of a downstream facility, Union Carbide. LAC 33:IX.1115.C.7 specifies the mixing zone for streams with 7Q10 flow greater than 100 cfs as either 100 cfs or one-third of the flow, whichever is greater. Based on LDEQ's evaluation, it was determined that the increased heat discharge and temperature limits would continue to meet Louisiana Water Quality Criteria for temperature.

In conclusion, while there is a small thermal plume associated with the WF3 discharge, it represents a *de minimis* portion of the cross-sectional and vertical area of the Mississippi River. Because of the location of the discharge, it does not block the movement of fish, either upstream or downstream at the WF3 plant. In addition, no thermal exceedances have occurred since the increase in temperature and heat limit was granted by the LDEQ. Because there are no planned operational changes during the license renewal term that would increase the temperature of WF3's existing thermal discharge, impacts are anticipated to be SMALL, and further mitigation measures beyond the conditions outlined in LPDES permit LA0007374 are not warranted.

4.6.1.3 Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

4.6.1.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts on aquatic resources in stream communities affected by water use conflicts could be of moderate significance in some situations.

4.6.1.3.2 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on stream (aquatic) . . . ecological communities must be provided.

4.6.1.3.3 Analysis

As discussed in Section 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling towers for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

4.6.2 Terrestrial Resources

4.6.2.1 Effects on Terrestrial Resources (Non-Cooling System Impacts)

4.6.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Impacts resulting from continued operations and refurbishment associated with license renewal may affect terrestrial communities. Application of best management practices would reduce the potential for impacts. The magnitude of impacts would depend on the nature of the activity, the status of the resources that could be affected, and the effectiveness of mitigation.

4.6.2.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(E)]

All license renewal applicants shall assess the impact of refurbishment, continued operations, and other license-renewal-related construction activities on important plant and animal habitats.

4.6.2.1.3 Analysis

4.6.2.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to important plant and animal habitats, and no further analysis is required.

4.6.2.1.3.2 Operational Activities

Terrestrial resources are described in Section 3.6.7. No license-renewal-related construction activities or changes in operational practices have been identified that would involve disturbing habitats. Entergy would continue to conduct ongoing plant operational and maintenance activities during the license renewal period. However, these activities are expected to have minimal impacts on terrestrial resources because activities are anticipated to occur within previously disturbed habitats.

Operational and maintenance activities that Entergy might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, fencing, and other security infrastructure), would likely be confined to previously disturbed areas of the site. Furthermore, as discussed in Section 9.6, Entergy has administrative controls in place at WF3 to ensure that operational changes or construction activities are reviewed, and the impacts minimized through implementation of BMPs, permit modifications, or acquisition of new permits as needed. In addition, regulatory programs that the site is currently subject to such as stormwater management, spill prevention, dredging, and herbicide usage further serve to minimize impacts to terrestrial resources.

In summary, adequate management programs and regulatory controls are in place to ensure that important plant and animal habitats are protected during the WF3 license renewal period.

Therefore, Entergy concludes the impacts to the terrestrial ecosystems from license renewal are SMALL and no additional mitigation measures beyond current management programs and existing regulatory controls are required.

4.6.2.2 Water Use Conflicts with Terrestrial Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

4.6.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts on terrestrial resources in riparian communities affected by water use conflicts could be of moderate significance.

4.6.2.2.2 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on . . . riparian (terrestrial) ecological communities must be provided.

4.6.2.2.3 Analysis

As discussed in Section 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes. Therefore, this issue is not applicable, and further analysis is not required.

4.6.3 Special Status Species and Habitats

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

4.6.3.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

The magnitude of impacts on threatened, endangered, and protected species, critical habitat, and essential fish habitat would depend on the occurrence of listed species and habitats and the effects of power plant systems on them. Consultation with appropriate agencies would be needed to determine whether special status species or habitats are present and whether they would be adversely affected by continued operations and refurbishment associated with license renewal.

4.6.3.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(E)]

All license renewal applicants shall assess the impact of refurbishment, continued operations, and other license-renewal-related construction activities on important plant and animal habitats. Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with Federal laws protecting wildlife, including but not limited to, the Endangered Species Act, and essential fish habitat in accordance with the Magnuson-Stevens Fishery Conservation and Management Act.

4.6.3.1.3 Analysis

4.6.3.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to threatened, endangered, and protected species, or EFH, and no further analysis is required.

4.6.3.1.3.2 Operational Activities

As discussed in Section 3.6.11.1, there are five federally listed species which are either threatened, endangered, or candidate species within St. Charles and St. John the Baptist parishes. A threatened and endangered species habitat survey was conducted on the Entergy Louisiana, LLC property located in St. Charles Parish in October 2014 (Entergy 2014e). This survey determined that no suitable habitat exists on or adjacent to the Entergy Louisiana, LLC property for the four species listed in St. Charles Parish. For the species listed in St. John the Baptist Parish (Alabama heelsplitter), it would not be anticipated to be present in the Mississippi River because it does not provide suitable habitat.

In addition, as discussed in Section 3.6.11.2, the LDWF has designated eight plants and six animals as species of special concern within St. Charles and St. John the Baptist parishes. For species listed in St. Charles Parish, suitable habitat does not exist on or adjacent to the Entergy Louisiana, LLC property for several of these species and, where suitable habitat is present, none of the species were observed during the October 2014 threatened and endangered species habitat survey. For the species listed in St. John the Baptist Parish (rooted spike-rush, alligator snapping turtle, and osprey), there are no offsite activities associated with license renewal which would affect these species.

Entergy is not aware of any adverse impacts regarding threatened, endangered, and protected species attributable to the site. Maintenance activities necessary to support license renewal likely would be limited to previously disturbed areas on site, and no additional land disturbance has been identified for the purpose of license renewal. In addition, there are no plans to alter plant operations during the license renewal term which would affect threatened, endangered, and protected species.

As discussed in Section 9.6, Entergy has administrative controls in place at WF3 to ensure that operational changes or construction activities are reviewed, and the impacts minimized through implementation of BMPs. In addition, regulatory programs, such as those discussed in Chapter 9 that the site is subject to, further serve to minimize impacts to any threatened, endangered, and protected species.

In an effort to obtain an independent review, the USFWS, LDWF, and NMFS were also consulted. Based on this independent review, it was determined that there would be no effect on federally and state-listed threatened, endangered, and protected species as a result of renewing the WF3 OL, nor was there any designated critical habitat. In addition, NMFS concluded there was no designated EFH in the vicinity of WF3. Copies of the consultation letters to the USFWS, LDWF, and NMFS and their responses are included in Attachment B.

In summary, no license-renewal-related refurbishment activities have been identified. As discussed above, the continued operation of the site would have no adverse effects to any federally or state-listed species. Therefore, Entergy concludes that license renewal would have no effect on threatened, endangered, and protected species in the vicinity of WF3, and mitigation measures beyond Entergy's current management programs and existing regulatory controls are not warranted.

4.7 Historic and Cultural Resources

4.7.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Continued operations and refurbishment associated with license renewal are expected to have no more than small impacts on historic and cultural resources located onsite and in the transmission line ROW because most impacts could be mitigated by avoiding those resources. The National Historic Preservation Act (NHPA) requires the Federal agency to consult with the State Historic Preservation Officer (SHPO) and appropriate Native American Tribes to determine the potential effects on historic properties and mitigation, if necessary.

4.7.2 Requirement [10 CFR 51.53(c)(3)(ii)(K)]

All applicants shall identify any potentially affected historic or archaeological properties and assess whether any of these properties will be affected by future plant operations and any planned refurbishment activities in accordance with the National Historic Preservation Act.

4.7.3 Analysis

4.7.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to historic and cultural resources, and no further analysis is required.

4.7.3.2 Operational Activities

As discussed in Section 3.1.1, the majority of the Entergy Louisiana, LLC property consists of wetlands (63 percent) and cultivated crops (23 percent). As discussed in Section 3.7.4, there have been five previous cultural resource surveys conducted either on the Entergy Louisiana, LLC property or within the vicinity. In addition, a Phase 1A sensitivity assessment was conducted in 2014 in support of license renewal (Section 3.7.4.1). The single cultural resource recorded on the Entergy Louisiana, LLC property was the Waterford Plantation (16SC41), which has been determined partially eligible/unknown for NRHP listing. There are no additional NRHP-eligible cultural resources on the 3,560-acre Entergy Louisiana, LLC property, although there are several areas containing *in situ* archaeologic remains and identified zones of archaeological sensitivity.

As discussed in Section 3.7.5, although no license-renewal-related ground-disturbing activities have been identified, Entergy has administrative controls in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. These consist of a fleet cultural resources protection plan, and a site-specific cultural resource protection plan to protect those areas on the property determined to be eligible for the NRHP, specifically the Waterford Plantation. Therefore, no adverse effects are anticipated to these sites during the WF3 license renewal term.

The area within a 6-mile radius of the site, consisting of land primarily within St. Charles and St. John the Baptist parishes, may be archaeologically sensitive (Table 3.7-1). However, adverse impacts would only occur to such sites as a result of soil-intrusive activities. Because Entergy has no plans to conduct such soil-intrusive activities at any location outside of the property boundary under a renewed license, no adverse effects to these archaeological sites would occur.

There are also seven NRHP-listed aboveground historic properties, including the Kenner and Kugler Cemeteries Archaeological District, within a 6-mile radius of the site (Table 3.7-2). An additional unnamed archaeological site (16SC80) has an eligible status, but is yet unlisted (Table 3.7-1). Because the aboveground historic properties are located at distances ranging from 2.0 to 6.0 miles away from WF3, and WF3 is located in a heavy industrial area, aesthetic and noise impacts to these resources as a result of the continued operations of WF3 are not expected. Therefore, no adverse effects to the physical or historical integrity of these sites are anticipated.

As discussed above, no license-renewal-related refurbishment or construction activities have been identified. No offsite NRHP-listed historic properties will be adversely impacted as a result of continued operations of WF3, and there are no plans to alter operations, expand existing facilities, or disturb additional land for the purpose of license renewal. In addition, administrative procedural controls are in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. Finally, the Louisiana SHPO concurred that the renewal of the WF3 OL will have no effect on historic properties (Attachment C). Therefore, Entergy concludes that there will be no adverse effects as a result of continued operation of WF3 during the license renewal period, and additional mitigation measures beyond Entergy's existing procedural administrative controls are not warranted.

4.8 Socioeconomics

4.8.1 Employment and Income, Recreation and Tourism

4.8.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Although most nuclear plants have large numbers of employees with higher than average wages and salaries, employment, income, recreation, and tourism impacts from continued operations and refurbishment associated with license renewal are expected to be small.

4.8.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.8.1.3 Analysis

Information related to employment and income, and recreation and tourism is presented in Sections 3.8.1 and 3.8.7 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. As previously discussed in Section 3.1.3, the site is situated in a heavily industrialized and commercially developed area. As a result, the site does not visually impact areas that have a high degree of visitor use or recreational areas locally. Therefore, no changes in employment and income, and recreation and tourism during the license renewal period are anticipated.

In the GEIS, the NRC determined that employment and income, and recreation and tourism impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.1). Based on Entergy's review, no new and significant information was identified as it relates to employment and income, and recreation and tourism, and further analysis is not required.

4.8.2 Tax Revenues

4.8.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Nuclear plants provide tax revenue to local jurisdictions in the form of property tax payments, payments in lieu of tax (PILOT), or tax payments on energy production. The amount of tax revenue paid during the license renewal term as a result of continued operations and refurbishment associated with license renewal is not expected to change.

4.8.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.8.2.3 Analysis

Information related to tax revenues is presented in Section 3.8.5 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. Entergy Louisiana, LLC's annual property taxes are expected to remain relatively constant through the license renewal period.

In the GEIS, the NRC determined that tax revenue impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.2). Based on Entergy's review, no new and significant information was identified as it relates to tax revenues, and further analysis is not required.

4.8.3 Community Services and Education

4.8.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to local community and educational services would be small. With little or no change in employment at the licensee's plant, value of the power plant, payments on energy production, and PILOT payments expected during the license renewal term, community and educational services would not be affected by continued power plant operations.

4.8.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.8.3.3 Analysis

Information related to community services and education is presented in Section 3.8.4 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. As discussed in Section 4.8.2.3, Entergy Louisiana, LLC's annual property taxes are expected to remain relatively constant through the license renewal period.

In the GEIS, the NRC determined that community services and education impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.3). Based on Entergy's review, no new and significant information was identified as it relates to community services and education, and further analysis is not required.

4.8.4 Population and Housing

4.8.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to regional population and housing availability and value would be small. With little or no change in employment at the licensee's plant expected during the license renewal term, population and housing availability and values would not be affected by continued power plant operations.

4.8.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.8.4.3 Analysis

Information related to population and housing is presented in Section 3.8.2 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period.

In the GEIS, the NRC determined that population and housing impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.4). Based on Entergy's review, no new and significant information was identified as it relates to population and housing, and further analysis is not required.

4.8.5 Transportation

4.8.5.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to traffic volumes would be small.

4.8.5.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.8.5.3 Analysis

Information related to transportation is presented in Section 3.8.6 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. As discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. In addition, as discussed in Section 3.8.6, roads in the immediate vicinity of the WF3 plant site would operate at acceptable LOSs.

In the GEIS, the NRC determined that transportation impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.5). Based on Entergy's review, no new and significant information was identified as it relates to transportation, and further analysis is not required.

4.9 Human Health

4.9.1 Microbiological Hazards to the Public (Plants with Cooling Ponds or Canals, or Cooling Towers that Discharge to a River)

4.9.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals, or that discharge into rivers. Impacts would depend on site-specific characteristics.

4.9.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(G)]

If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river, an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided.

4.9.1.3 Analysis

As previously discussed in Section 2.2.2.2, WF3 is authorized under LPDES Permit No. LA0007374 to discharge once-through cooling water to the Mississippi River. The public could potentially be exposed to *Naegleria* in the Mississippi River, but most likely not as a result of WF3's thermal discharges. As described in Section 3.9.2, the probability of a *Naegleria* infection in the Mississippi River in the vicinity of WF3 is low for the following reasons: (1) the design of the discharge structure promotes rapid mixing of thermal discharges with the Mississippi River, thereby limiting the area of conditions necessary for optimal growth of these thermophilic organisms; (2) the average heated discharge flow is small compared to the volume of river water flowing by the plant (approximately 500,000 cfs), thereby creating limited opportunity for rapid growth and population increases of thermophilic microorganisms; and (3) the Louisiana Department of Health and Hospitals has stated (as of June 2014) that from 2004 to 2013 there has never been a case of *Naegleria* infection attributable to the Mississippi River.

Section 3.9.2 further concludes that infection by thermophilic microorganisms in the vicinity of the WF3 discharge area has a low probability of occurring because public access is restricted, thus eliminating the nasal exposure pathway.

Therefore, Entergy concludes that the risk to public health from human exposure to thermophilic organisms resulting from the operation of WF3 is SMALL and does not warrant additional mitigation.

4.9.2 Electric Shock Hazards

4.9.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Electrical shock potential is of small significance for transmission lines that are operated in adherence with the National Electrical Safety Code (NESC). Without a review of conformance with NESC criteria of each nuclear power plant's in-scope transmission lines, it is not possible to determine the significance of the electrical shock potential.

4.9.2.2 Requirement [10 CFR 51.53(c)(3)(ii)(H)]

If the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electrical Safety Code for preventing electric shock from induced currents, an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines must be provided.

4.9.2.3 Analysis

Objects located near transmission lines can become electrically charged due to their immersion in the lines' electric fields. The current is called "induced" because there is no direct connection between the line and the object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence can receive an electrical shock due to the sudden discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop, the magnitude of which depends on several factors, including the following:

- Strength of the electric field which, in turn, depends on the voltage of the transmission line as well as its height and geometry.
- Size of the object on the ground.
- Extent to which the object is grounded.

In 1977, the NESC adopted a provision that describes how to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98-kV alternating current to ground. The clearance must limit the induced current due to electrostatic effects to 5 mA if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 mA.

As previously discussed in Section 2.2.5.4, it was determined that the transmission lines meet the applicable shock prevention provisions of the NESC, based on Entergy's analysis performed in conjunction with the proposed increase in the licensed power level. This analysis showed that the calculated induced short circuit current was approximately 3.9 mA, which is within the NESC 5-mA standard. Because there has been no change in operating voltage associated with these transmission lines, Entergy's analysis remains valid.

In addition, as discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned property. Therefore, the public does not have access to this area and as a result, no induced shock hazards would exist for the public. OSHA governs the occupational safety and health of plant operations staff. As discussed in Section 2.2.5.4, all electric shock hazards, including those from induced current shock, are managed by Entergy in compliance with OSHA occupational health and safety requirements to protect onsite workers. It was determined in the GEIS 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).

Therefore, because WF3's existing in-scope transmission lines currently meet the NESC's 5-mA standard, and occupational safety and health measures are in place to address shock hazards from overhead lines at the site, Entergy concludes that impacts from the electrical shock hazard potential are SMALL.

4.10 Environmental Justice

4.10.1 Minority and Low-Income Populations

4.10.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Impacts to minority and low-income populations and subsistence consumption resulting from continued operations and refurbishment associated with license renewal will be addressed in plant-specific reviews. See NRC Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040; August 24, 2004).

4.10.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(N)]

Applicants shall provide information on the general demographic composition of minority and low-income populations and communities (by race and ethnicity) residing in the immediate vicinity of the plant that could be affected by the renewal of the plant's operating license, including any planned refurbishment activities, and ongoing and future plant operations.

4.10.1.3 Analysis

4.10.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to minority and low-income populations, and no further analysis is applicable.

4.10.1.3.2 Operational Activities

The consideration of environmental justice is required to assure that federal programs and activities will not have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. Entergy's analyses of the Category 2 issues defined in 10 CFR 51.53(c)(3)(ii) determined that environmental impacts from the continued operation of WF3 during the license renewal period would either be SMALL or non-adverse. Therefore, high or adverse impacts to the general human population would not occur.

As described in Section 3.9.1.2, Entergy maintains a REMP. In this program, Entergy monitors important radiological pathways and considers potential radiation exposure to plant and animal life in the environment surrounding WF3. There has been no detectable plant-related activity associated with this monitoring. Therefore, no environmental pathways have been adversely impacted and are not anticipated to be impacted during the WF3 license renewal term.

Section 3.10.2 identifies the locations of minority and low-income populations as defined by NRR Office Instruction LIC-203 (NRC 2013d). Section 3.10.1.2 describes the search for subsistence-like populations near WF3, of which none were found. The figures accompanying Section 3.10.2 show the locations of minority and low-income populations within a 50-mile radius of WF3. None of those locations, when considered in the context of impact pathways described in Chapter 4 of this ER, is expected to be disproportionately impacted. Each location is sufficiently distant from WF3 to not present a focal point of impacts that would be disproportionate compared to other locations.

Therefore, no disproportionately high and adverse impacts or effects on members of the public, including minority and low-income populations, are anticipated as a result from the renewal of the WF3 OL.

4.11 Waste Management

4.11.1 Low-Level Waste Storage and Disposal

4.11.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment would remain small during the license renewal term.

4.11.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.11.1.3 Analysis

As discussed in Section 2.2.3.4, Entergy 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.

In addition, as discussed in Section 2.2.3.4, the majority of LLRW generated at WF3 would be Class A waste and can be shipped to licensed processors, such as the EnergySolutions facility in Oak Ridge, Tennessee, for reduction and repackaging, and then shipped to a Class A disposal facility such as the EnergySolutions facility in Clive, Utah. Classes B and C wastes constitute a low percentage by volume of the total LLRW generated, and they are currently stored in the LLRW storage facility at WF3. As indicated in Section 2.2.3.4, Classes B and C wastes can be shipped to the EnergySolutions facility in Oak Ridge, Tennessee, where they can then be shipped to the Waste Control Specialist facility in Texas, which is licensed for disposal of Classes A, B, and C wastes.

In the GEIS, the NRC determined that low-level waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.1). Based on Entergy's review, no new and significant information was identified as it relates to onsite LLRW storage and disposal.

4.11.2 Onsite Storage of Spent Nuclear Fuel

4.11.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

During the license renewal term, SMALL. The expected increase in the volume of spent nuclear fuel from an additional 20 years of operation can be safely accommodated onsite during the license renewal term with small environmental impacts through dry or pool storage at all plants.

For the period after the licensed life for reactor operations, the impacts of onsite storage of spent nuclear fuel during the continued storage period are discussed in NUREG-2157 and as stated in § 51.23(b), shall be deemed incorporated into this issue.

4.11.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.11.2.3 Analysis

Compliance with regulatory requirements for spent fuel storage ensures that environmental impacts are minimized. In the GEIS, the NRC determined that onsite storage of spent nuclear fuel impacts from continued plant operations during the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.2). The environmental impact of this issue for the time frame beyond the licensed life for reactor operations is discussed in NUREG-2157 (NRC 2014a). Based on Entergy's review, no new and significant information was identified as it relates to onsite storage of spent nuclear fuel, and further analysis is not required.

4.11.3 Offsite Radiological Impacts of Spent Nuclear Fuel and High-Level Waste Disposal

4.11.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

For the high-level waste and spent-fuel disposal component of the fuel cycle, the EPA established a dose limit of 0.15 mSv (15 millirem) per year for the first 10,000 years and 1.0 mSv (100 millirem) per year between 10,000 years and 1 million years for offsite releases of radionuclides at the proposed repository at Yucca Mountain, Nevada.

The Commission concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

4.11.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.11.3.3 Analysis

Compliance with regulatory requirements for spent nuclear fuel and high-level waste disposal ensures that offsite radiological impacts are minimized. In the final Continued Storage of Nuclear Spent Rule rulemaking, 10 CFR Part 51, Subpart A, Appendix B, Table B-1 was revised to reclassify the impact determination for this issue as a Category 1 issue with no impact level assigned (79 FR 56238). The environmental impacts of away-from-reactor storage and the technical feasibility of disposal in a geologic repository are discussed in NUREG-2157 (NRC 2014a). Based on Entergy's review, no new and significant information was identified as it relates to offsite radiological impacts of spent nuclear fuel and high-level waste disposal, and further analysis is not required.

4.11.4 Mixed Waste Storage and Disposal

4.11.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal would not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small.

4.11.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.11.4.3 Analysis

As discussed in Section 2.2.3.5 of this ER, although LLMW would be managed and transported to an offsite facility licensed to accept and manage the wastes in accordance with appropriate site and company procedures, there is currently no mixed waste being generated or stored at WF3.

In the GEIS, the NRC determined that mixed waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.4). Based on Entergy's review, no new and significant information was identified as it relates to mixed waste storage and disposal, and further analysis is not required.

4.11.5 Nonradioactive Waste Storage and Disposal

4.11.5.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. No changes to systems that generate nonradioactive waste are anticipated during the license renewal term. Facilities and procedures are in place to ensure continued proper handling, storage, and disposal, as well as negligible exposure to toxic materials for the public and the environment at all plants.

4.11.5.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.11.5.3 Analysis

Section 2.2.4 discusses the type of nonradioactive wastes generated at WF3 and typical quantities generated on an annual basis. These nonradioactive wastes are collected in central collection areas and managed in accordance with appropriate regulatory requirements and BMPs that are specified in company waste management procedures. In addition, waste minimization measures such as material control, process control, waste management, recycling, 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, treated, accumulated, or disposed. No changes to systems that generate nonradioactive waste are anticipated during the license renewal term.

In the GEIS, the NRC determined that nonradioactive waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.5). Based on Entergy's review, no new and significant information was identified as it relates to nonradioactive waste storage and disposal, and further analysis is not required.

4.12 Cumulative Impacts

4.12.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Cumulative impacts of continued operations and refurbishment associated with license renewal must be considered on a plant-specific basis. Impacts would depend on regional resource characteristics, the resource-specific impacts of license renewal, and the cumulative significance of other factors affecting the resource.

4.12.2 Requirement [10 CFR 51.53(c)(3)(ii)(O)]

Applicants shall provide information about other past, present, and reasonably foreseeable future actions occurring in the vicinity of the nuclear plant that may result in a cumulative effect.

4.12.3 Analysis

Entergy considered potential cumulative impacts during the license renewal period in its environmental analysis associated with the resources discussed in the following sections. For the purposes of this analysis, past actions are those related to the resources at the time of plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation, which would include the 20-year license renewal term. The geographic area over which past, present, and future actions would occur is dependent on the type of action considered and is described below for each impact area.

The impacts of the proposed action are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor, but collectively significant, actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.12.3.1 Air Quality and Noise

As described in Section 4.2 and Section 4.3, the incremental impacts on air quality and noise levels from the proposed renewal of the WF3 OL would be SMALL. The geographic area considered in the cumulative air quality analysis is the county of the proposed action, as air quality designations for criteria air pollutants are generally made at the county level. Counties are further grouped together based on a common airshed—known as an AQCR—to provide for the attainment and maintenance of the NAAQS. WF3 is located in St. Charles Parish, Louisiana, which along with 34 other parishes in Louisiana and 15 counties in Texas, is part of the Southern Louisiana-Southeast Texas Interstate AQCR as discussed in Section 3.2.4.

4.12.3.1.1 Air Quality

Section 3.2.4 presents a summary of the air quality designation status for parishes surrounding WF3. As noted in Section 3.2.4, the EPA regulates six criteria pollutants under the NAAQS including CO, Pb, NO_2, particulate matter ($PM_{2.5}$ and PM_{10}), ozone, and SO_2. St. Charles Parish is designated as unclassified or in attainment with respect to all criteria pollutants.

Criteria pollutant air emissions associated with WF3's plant operation are presented in Table 3.2-3. These emissions are from permitted sources such as emergency diesel generators, diesel fire pumps, portable auxiliary boiler, portable diesel/gasoline engines, and gasoline/diesel/lube oil storage tanks. As previously discussed in Section 3.2.5, no increase or decrease of air emissions is expected over the license renewal period. Therefore, cumulative changes to air quality in St. Charles Parish would be the result of changes to present-day emissions, as well as future projects and actions within the parish.

Section 3.0.5 discusses present and reasonably foreseeable projects that could contribute to cumulative impacts to air quality. For example, the planned USACE levee project and urea manufacturing facility would be sources of future criteria air pollutants. Continued air emissions from existing projects and foreseeable projects discussed in Section 3.0.5, as well as proposed new source activities, would contribute to air emissions in St. Charles Parish. Development and construction activities associated with regional growth of housing, business, and industry, as well as associated vehicular traffic, will also result in additional air emissions. Project timing and location, which are difficult to predict, affect cumulative impacts to air quality. However, permitting and licensing requirements, efficiencies in equipment, cleaner fuels, and various mitigation measures can be used to minimize cumulative air quality impacts.

Climate change can affect air quality as a result of changes in meteorological conditions. Air pollutant concentrations are sensitive to winds, temperature, humidity, and precipitation. Ozone levels have been found to be particularly sensitive to climate change influences. Sunshine, high temperatures and air stagnation are favorable meteorological conditions leading to higher levels of ozone. Although surface temperatures are expected to increase in the Southeast region, ozone levels will not necessarily increase because ozone formation is also dependent on the relative amount of precursors available. The combination of higher temperatures, stagnant air masses, sunlight, and emissions of precursors may make it difficult to meet ozone NAAQS. States, however, must continue to comply with the CAA and ensure air quality standards are met. (NRC 2015c, Section 4.16.1.1) Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change in the region from other past, present, and future industrial and transportation sources would be SMALL.

4.12.3.1.2 Noise

Section 3.3 presents a summary of noise sources at WF3. The loudest noise generated at WF3 is the turbine generator. Periodic use of the gun range is another onsite activity that creates occasional noise. With the exception of emergency sirens, most of the noise sources are not audible at the property boundary and are intermittent and considered a minor nuisance (NRC 2015c, Section 4.16.1.2). As a major industrial facility, WF3 noise emissions can reach 65–75 dBA levels on site, which attenuates with distance (NRC 2015c, Section 4.16.1.2). Within the last 5 years, WF3 has not received any noise-related complaints from operation as discussed in Section 3.3. As discussed in Section 3.0.3, the residences nearest to WF3 are approximately 0.9 miles away, and as discussed in Section 3.0.4, the parks nearest to WF3 are located 1 mile away. Beyond any local ordinances, there are no federal regulations for public exposures to noise. As there are no planned license-renewal-related refurbishment activities, cumulative impacts to noise levels would be the result of continued operation sources from WF3 and around the site, as well as future projects and actions in the vicinity of WF3.

Section 3.0.5 provides a list of present and reasonably foreseeable projects that could contribute to cumulative noise impacts. Development and construction activities associated with regional growth of housing, business, and industry, as well as associated vehicular traffic, will result in additional noise generation. Construction equipment, for instance, can result in noise levels in the range of 85–95 dBA; however, noise levels attenuate rapidly with distance such that at half a mile distance from construction equipment, noise levels can drop to 51–61 dBA (NRC 2015c, Section 4.16.1.2). Therefore, contributions to noise levels from future actions are limited by projects in the vicinity of WF3. While the timing of these future activities is difficult to predict, noise emissions are expected to occur for short periods of time. Additionally, the residents or park visitors currently near WF3 are not anticipated to be affected because noise sources from WF3 are not audible at the property boundary.

<u>Conclusions</u>

Given that there is no planned site refurbishment associated with the WF3 license renewal and, therefore, no expected changes in air emissions or noise levels, cumulative air quality and noise impacts would be the result of changes to present-day and reasonably foreseeable projects and actions. As noted above, the timing and location of new projects, which are difficult to predict, affect cumulative impact on air quality and noise levels. However, various strategies and techniques are available to limit air quality impacts. Also, noise abatement and controls can be incorporated to reduce noise impacts. Therefore, Entergy concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions on air quality and noise levels during the WF3 license renewal term would be SMALL.

4.12.3.2 <u>Geology and Soils</u>

This section addresses the direct and indirect effects of license renewal on geology and soils when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. As noted in Section 2.3, Entergy has no plans to conduct license-renewal-related refurbishment or replacement activities. Ongoing operation and maintenance activities associated with WF3 are expected to be confined to previously disturbed areas. Any geologic materials, such as aggregates used to support operation and maintenance activities, would be procured from local and regional sources. These materials are abundant in the region. Geologic conditions are not expected to change during the license renewal term. Thus, activities associated with continued operations are not expected to affect the geologic environment. Considering ongoing activities and reasonably foreseeable actions, Entergy concludes that the cumulative impacts on geology and soils during the WF3 license renewal term would be SMALL.

4.12.3.3 Water Resources

4.12.3.3.1 Surface Water

The region of influence for surface water resources is concentrated in the Mississippi River with regard to the potential for consumptive water use to impact users. As discussed in Section 3.5.3.1, WF3 withdraws cooling water from the Mississippi River through a series of intake pipes at a design flow rate of 1,555.2 MGD. The average flow in the Mississippi River in the vicinity of the WF3 plant (River Mile 129.6) is estimated to be approximately 500,000 cfs. Based on this information, it is determined that WF3 withdraws a maximum of approximately 0.48 percent of the flow in the Mississippi River.

During the license renewal term, WF3 is expected to consume water from the Mississippi River at current rates. Because WF3 utilizes a once-through cooling system, the majority of the water withdrawn is returned back to the Mississippi River. As discussed in Section 3.5.1, the Mississippi River is the largest river in the United States, having an average discharge of 593,000 cfs; therefore, the contribution of cumulative impacts to surface water use as a result of WF3 operations during the license renewal term is anticipated to be SMALL.

A summary of surface water use in St. Charles, Jefferson, and St. John the Baptist parishes along the Mississippi River is presented in Table 3.5-3. In 2013, power generation accounted for approximately 81 percent of all withdrawals from the Mississippi River in these three parishes. As discussed above, the majority of the water withdrawn for once-through cooling systems is returned back to the Mississippi River. The cumulative surface water withdrawals from the Mississippi River for all surface water use categories identified in Table 3.5-3, was 3,670.89 MGD. Based on the mean flow of the Mississippi River in the vicinity of WF3 (approximately 500,000 cfs), this volume would be approximately 1.1 percent of the mean annual flow.

As discussed in Section 3.0.5, AM Agrigen Industries is exploring the potential of developing a plant to manufacture granulated urea, a widely used fertilizer, in St. Charles Parish, Louisiana. The company is currently conducting a feasibility study on the project and the prospective 650-acre site near Killona. If the project proceeds, then the source of water for plant use would most likely be the Mississippi River. However, even with the addition of this plant, surface water use is anticipated to be a small fraction of the mean flow of the Mississippi River.

Therefore, it is anticipated that cumulative impacts from current and future surface water use from the Mississippi River during the license renewal term would be SMALL.

Water Quality Considerations

As previously discussed in Section 3.5.4.1, segment 070301 of the Mississippi River that stretches from Monte Sano Bayou to Head of Passes is classified suitable for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply. In addition, based on LDEQ's *2014 Louisiana Water Quality Inventory: Integrated Report Fulfilling Requirements of the Federal Clean Water Act, Sections 305(b) and 303(d)*, which was finalized in 2015, the Mississippi River segment on which WF3 is located is not impaired. Therefore, water quality in this segment of the Mississippi River is considered good.

Point source and stormwater discharges at WF3 are monitored and controlled by LPDES permit LA0007374 (Attachment A). The current LPDES permit authorizes discharges from 13 outfalls (3 external and 10 internal). The outfalls (Figure 3.5-3) and their associated effluent limits are shown in Table 3.5-1. The LPDES permit ensures that discharges to the Mississippi River from WF3's operations comply with limitations established in the permit that would be protective of the water quality in the Mississippi River. Therefore, WF3's contribution to cumulative impacts on surface water quality during the license renewal term would be SMALL.

Due to location in an industrial area, residential development in the immediate area is not expected. Any offsite development outside the immediate area could lead to additional discharges to the Mississippi River that could impact water quality. However, any such discharges, including stormwater, would be subject to LPDES permit limits designed to be protective of surface water resources, minimizing cumulative impacts.

Upstream development could lead to discharges to the Mississippi River that could affect water quality. Development projects can result in water quality impacts if they increase sediment loading to nearby surface water bodies. The magnitude of cumulative impacts would depend on the nature and location of the actions relative to surface water bodies, the number of actions (facilities or projects), and whether facilities comply with regulating agency requirements (e.g., permitted discharge limits). New and modified industrial and large commercial facilities would be subject to regulation under the Federal Water Pollution Control Act. This would include LDEQ-administered LPDES permit limits on point source and stormwater discharges designed to be protective of surface water resources. Likewise, it is this regulatory framework that presently governs wastewater effluent and thermal discharges from WF3, and other major industrial facilities in the vicinity of WF3.

Therefore, it is anticipated that cumulative impacts on water quality in the Mississippi River from current and future surface water discharges during the license renewal term would be SMALL.

Climate Change Considerations

The potential cumulative effects of climate change on the Mississippi River, whether from natural cycles or related to anthropogenic activities, are speculative in nature, and hypothetically could result in a variety of environmental alterations that could affect the surface water resources. The environmental changes that could affect surface water include floods, prolonged drought, and temperature increases.

In general, climate models predict a gradual increase in the number of high heat days (greater than 90°F) for the southern and central United States. (USGCRP 2009, page 34) Potential increases in the Mississippi River water temperature resulting from climate change could increase the amount of cooling water needed for the operation of WF3 and other major users. Therefore, the operation of WF3 and other thermoelectric plants on the Mississippi River could be altered as a result of climate change. (USGCRP 2009, page 56)

Computer models of future Mississippi River flow rates are highly varied in the outcome, ranging from reduction in river flow rates due to drought (USGCRP 2009, page 34), to an overall increase in flow rates due to increased precipitation and runoff in the Upper Mississippi River basin and Midwest United States. (USGCRP 2009, page 30) If the discharge volume of the Mississippi River at WF3 (approximately 500,000 cfs) decreased by 2 percent as a result of climate change and WF3's current water usage (1,555.2 MGD) increased by one and a half times, then the annual water use by WF3 would still be negligible. Therefore, WF3's contribution to cumulative impacts on surface water resources as a result of climate change during the license term would continue to be SMALL.

The magnitude of impacts in the Mississippi River associated with climate change when combined with other past, present, and reasonably foreseeable actions remains speculative. However, long-term warming could potentially affect navigation, power production, and municipal and industrial users, although the magnitude of the impact is uncertain. Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to surface water resources would be SMALL. Therefore, it is concluded that the cumulative impacts as a result of climate change on surface water resources during the license renewal term could range from SMALL to MODERATE.

4.12.3.3.2 Groundwater

As discussed in Section 3.5.3.2, groundwater usage in St. Charles and adjoining parishes is substantially less than surface water usage. WF3 does not use groundwater as discussed in Section 3.5.3.2. Industrial and potable water is provided by St. Charles Parish Water System. The source of water for the St. Charles Parish Water System is the Mississippi River. Therefore, WF3 would have no impact on the quantity of groundwater resources available for use.

Groundwater quality in the vicinity of WF3 may be affected by point source pollution, such as industries or septic tanks, and non-point source pollution, such as agricultural chemical usage and lawn chemicals. Other operational or planned projects or industries could affect groundwater quality but likely would not result in significant, widespread groundwater impacts.

As discussed in Section 3.5.3.2, the shallow aquifers at WF3 are not commonly used because of poor quality. The potential for development of these aquifers is slight; their utility is restricted by their limited extent, poor water quality, and low permeability. Thus, offsite groundwater resources that are drinking water sources would be unaffected by WF3 operations.

WF3 has programs in place to protect the quality of groundwater resources from site industrial activities involving chemicals. As discussed in Section 3.5.4.2, these programs include spill prevention plans to prevent spills and implement immediate cleanup activities in the event of a spill to protect groundwater. Using these programs, no groundwater quality impacts are expected, and there would be no cumulative impacts to groundwater resources.

As discussed in Section 3.5.2.4, WF3 performs groundwater monitoring from 10 onsite locations to monitor for potential radioactive releases via groundwater pathways at the site in accordance with site procedures. Figure 3.5-6 shows locations of these groundwater monitoring wells with construction details presented in Table 3.5-2. As discussed in Section 4.5.2.4, there have been no tritium or plant-related gamma isotopes or hard-to-detect radionuclides detected since the groundwater monitoring program was initiated in 2007.

Considering ongoing activities and reasonably foreseeable actions, Entergy concludes that the cumulative impacts on groundwater use and quality during the WF3 license renewal term would be SMALL.

Climate Change Considerations

The magnitude of impacts of sea level rise associated with climate change when combined with other past, present, and reasonably foreseeable actions remains speculative. However, long-term sea level rises could potentially reduce the availability of fresh groundwater as a result of saltwater intrusion. Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to groundwater resources would be SMALL. Therefore, it is concluded that the cumulative impacts as a result of climate change on groundwater use and quality during the license renewal term could range from SMALL to MODERATE.

4.12.3.4 Aquatic Resources

The region of influence is concentrated in the Mississippi River, but also extends into the surrounding backwater areas with regard to the potential for consumptive water use to impact aquatic resources. Section 3.6 describes the existing environmental conditions for aquatic and riparian communities.

Many natural and human activities can influence the current and future aquatic life in the area surrounding WF3. Potential biological stressors include continued potential impingement, entrainment, and thermal stresses from WF3; modifications to the Mississippi River; runoff from industrial, agricultural, and urban areas; other water users and dischargers; and climate change.

Proposed Action

As discussed in Sections 4.6.1.1 and 4.6.1.2, Entergy determined that impingement and entrainment, and thermal impacts from renewal of the WF3 OL would be SMALL. The WF3 CWIS is located offshore in the main channel of the Mississippi River, which minimizes the fish and shellfish that enter the plant's cooling water system. In addition, most species cannot tolerate the harsh conditions of the Mississippi River main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source. The small thermal plume associated with the WF3 discharge, which is regulated under an LPDES permit, represents only a very small portion of the cross-sectional and vertical area of the Mississippi River. Because of the location of the discharge it does not block the movement of fish, either upstream or downstream at the WF3 plant. As a result, there is little, if any, thermal impact from the plant to the river and the associated aquatic life therein.

There are also three federally and/or state-listed fish species that may pass by the plant during various lifecycle migrations; however, WF3's activities do not interfere with such passages. It is unlikely that continued operation of the WF3 plant would cause any additional stresses to these federally and state-protected species than currently exist.

Modifications to the Mississippi River

The relative abundance of hard substrate, deep channel, and river bank habitat has been largely influenced by human activities to decrease flooding events and increase navigability. The USACE and Mississippi River Commission continue to oversee a comprehensive river management program that includes the following (NRC 2014b, Section 4.12.3.1):

- Levees for containing flood flows.
- Floodways for the passage of excess flows past critical reaches of the Mississippi River.
- Channel improvement and stabilization to provide an efficient and reliable navigation channel, increase the flood-carrying capacity of the river, and protect the levee system.
- Tributary basin improvements for major drainage basins to include dams and reservoirs, pumping plants, auxiliary channels, and pumping stations.

Implementing this management program will continue to affect the relative availability of aquatic habitats, resulting in, for example, a decrease in the amount of soft sediment river bank habitat and an increase in the amount of hard substrates (e.g., riprap or other materials used to line the river bank). Consequently, invertebrates that depend on a hard surface for attachment and can colonize manmade materials such as tires, concrete, or riprap used to line river banks, likely will continue to increase in relative abundance as compared to species that require soft sediments along the river bank. (NRC 2014b, Section 4.12.3.1)

The Mississippi River Commission also implements various programs to support the sustainability of aquatic life within the Mississippi River. For example, the Davis Pond and

Caernarvon freshwater diversion structures divert more than 18,000 cfs of fresh water to coastal marshlands. The input of fresh water helps to preserve the marsh habitat and reduce coastal land loss. In addition, the Mississippi River Commission conducted research and determined that using grooved articulated concrete mattresses to line river banks can help support benthic invertebrate and fish populations. For example, using grooved articulated concrete mattresses increases larval insect production, which is an important source of prey for many fish. (NRC 2014b, Section 4.12.3.1)

Runoff from Industrial, Agricultural, and Urban Areas

Nearly 40 percent of the land within the contiguous United States drains into the Mississippi River. Land use changes and industrial activities within this area have had a substantial impact on aquatic habitat and water quality within the Mississippi River. For example, historically, the Mississippi River has experienced decreased water quality as a result of industrial discharges, agricultural runoff, municipal sewage discharges, surface runoff from mining activity, and surface runoff from municipalities. However, over the past few decades, water quality within the Mississippi River has improved because of the implementation of the Clean Water Act and other environmental regulations. For example, most of the older, first-generation chlorinated insecticides have been banned since the late 1970s. Similarly, the addition and upgrading of numerous municipal sewage treatment facilities, rural septic systems, and animal waste management systems have helped to significantly decrease the concentration of median fecal coliform bacteria in the Mississippi River. Despite the trend of improving water quality within the Mississippi River, trace levels of some contaminants and increased nutrients from agricultural lands remain a source of concern for aquatic life. (NRC 2014b, Section 4.12.3.2)

Other Water Users and Discharges

Entergy currently owns and operates 10 electricity-generating facilities that withdraw water from the Mississippi River as a cooling water source. Three of these facilities are located outside the state of Louisiana and two are located on the Mississippi River estuary; five are located along the mainstem of the river: Waterford 1 and 2 (River Mile 129.9), WF3 (River Mile 129.6), Little Gypsy (River Mile 129.3), and Ninemile (River Mile 104).

Several other existing facilities also withdraw water from the Mississippi River. Climate patterns and increased water demands upstream of WF3 may increase the number of water users and rate of withdrawal from the Mississippi River. Aquatic life, especially threatened and endangered species, rely on sufficient flow within streams and rivers to survive. Also, fish and other aquatic life could be impinged and entrained within other facility water intake systems. Continued regulation of the flow by the USACE is expected to preserve the course and flow of the Mississippi River. Therefore, existing water withdrawals and other activities beyond WF3 would not be expected to noticeably alter aquatic resources within the Mississippi River. (NRC 2014b, Section 4.12.3.3)

Existing and other water users along the Mississippi River would also discharge cooling water and other effluents into the Mississippi River. Entergy considered the impacts to aquatic resources from discharge of heated effluent (e.g., water temperature, dissolved oxygen, thermal stratification, and impacts to fauna), cold shock, and chemical treatment of the cooling water, and determined that the effluent would not noticeably alter aquatic resources. Additionally, Entergy and other water dischargers would be required to comply with LPDES permits that must be renewed every 5 years, allowing LDEQ to ensure the permit limits provide the appropriate level of environmental protection. (NRC 2014b, Section 4.12.3.3) It is anticipated that foreseeable projects such as those listed in Section 3.0.5, which could withdraw and discharge to the Mississippi River, would not noticeably alter aquatic resources.

Climate Change

Climate change could noticeably alter aquatic resources near WF3. In the southeastern United States, precipitation during the fall season has increased and the overall amount of heavy downpours also has increased. Heavy downpours can increase the rate of runoff and pollutants reaching the Mississippi River because the heavier precipitation and the pollutants washed away in the runoff have less time to be absorbed in the soil before reaching the river and other surface waterbodies. Higher amounts of nitrogen have been noted in the Mississippi Basin and have been linked to increases in rainfall. High nitrogen levels can result in low oxygen levels that impact aquatic life. (NRC 2014b, Section 4.12.3.4)

Climate change models predict continued increases in heavy downpours in the southeastern United States accompanied with a decrease in water quality and ecosystem health. Climate models also predict increasing temperatures in the southeast, especially during summer. Increased temperatures and nutrients in runoff could lead to a decline in oxygen within small streams, lakes, and shallow aquatic habitats. During periods of low oxygen, many fish and other aquatic life may not be able to survive. Increased temperatures also may increase the frequency of shellfish-borne illness, alter the distribution of native fish, increase the local loss of threatened and endangered species, and increase the displacement of native species by non-native species. (NRC 2014b, Section 4.12.3.4)

Since the 1970s, there has been an increase in the amount of moderate to severe drought, especially during spring and summer. Climate models predict a continued increase in the amount and severity of droughts, which can lead to water use conflicts. Regulatory programs will be required to ensure sufficient water and flow is available within surface water bodies to provide habitat for aquatic life, especially threatened and endangered species. (NRC 2014b, Section 4.12.3.4) Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to aquatic resources would be SMALL.

Conclusion

The impact from the renewal of the WF3 OL by itself would not noticeably alter the aquatic environment, and thus, would be SMALL.

However, the direct and indirect impacts to aquatic resources from historical Mississippi River modifications and pollutants and sediments introduced into the river have had a substantial effect on aquatic life and their habitat. The cumulative stress from the activities described above, spread across the geographic area of interest, depends on many factors that cannot be quantified. This stress may noticeably alter some aquatic resources. For example, climate change may increase the temperature of the Mississippi River and rate of runoff into the river. This may noticeably alter the habitat for species most sensitive to nutrient loading, high levels of contaminants, and higher temperatures. (NRC 2014b, Section 4.12.3.5) Therefore, Entergy concludes that the cumulative impacts from the proposed license renewal and other past, present, and reasonably foreseeable projects could potentially be MODERATE.

4.12.3.5 Terrestrial Resources

This section addresses past, present, and future actions that could result in cumulative impacts on the terrestrial species and habitats, including protected terrestrial species described in Section 3.6.7. For purposes of this analysis, the geographic area considered in the evaluation includes WF3 and surrounding region.

Historic Conditions

WF3 is located in the Southern Holocene Meander Belts ecoregion. As discussed in Section 3.6.4, this ecoregion was once dominated by swamps, marshes, and bottomland forests, primarily oak-hickory-pine forests. Today, the ecoregion is heavily converted, with just under half of the ecoregion covered by forest. One-third has been converted to agriculture and the remaining areas are composed of water, wetlands, urban, and barren areas. This region is also a major bird migration corridor used in fall and spring migrations. Degradation and destruction of forest and wetland habitats and the construction of navigation and flood control systems have had detrimental effects on many of these bird populations. Development is likely to continue in the reasonably foreseeable future as a result of new residential and commercial activities.

Wildlife Preserves

Several wildlife refuges that are located within the region (Figure 3.0-6) would provide valuable habitat to native wildlife and migratory birds during the proposed license renewal period. As development and urbanization increase habitat conversion and fragmentation, these protected areas will become ecologically more important as they provide large, continuous areas of minimally disturbed habitat.

Development, Urbanization, and Habitat Fragmentation

As the region surrounding WF3 becomes more developed, habitat fragmentation will increase and the amount of forested and wetland areas are likely to decline. Increased development will likely decrease the overall availability and quality of forested, scrub-shrub, and wetland habitats. Species that require larger ranges, especially predators, will likely suffer reductions in their populations. Similarly, species with threatened, endangered, or declining populations are likely to be more sensitive to declines in habitat availability and quality.

Climate Change

Since 1970, the average annual temperature in the southeastern United States has risen by about 2°F and the number of freezing days has declined by 5 to 9 days per year. Over the next several decades, average temperatures in the region will rise by an additional 1.5 to 3.5°F. The Gulf Coast states, including Louisiana, will have less rainfall in winter and spring, and higher temperatures will increase the frequency, duration, and intensity of drought. Future hurricane intensity is uncertain; however, model projections agree that hurricane precipitation will increase by 20 percent. Changes in the climate will shift many wildlife population ranges and alter migratory patterns. Such changes could favor non-native invasive species and promote population increases of insect pests and plant pathogens. Climate change will likely alter the severity or frequency of precipitation, flooding, and fire. Climate change may also exacerbate the effects of existing stresses in the natural environment, such as those caused by habitat fragmentation, invasive species, industrial and agricultural runoff, and air emissions. (NRC 2014b, Section 4.12.4.5) Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to terrestrial resources would be SMALL.

Proposed Action

No refurbishment or other license-renewal-related construction activities have been identified; therefore, no terrestrial habitat areas would be impacted by renewal of the WF3 OL. In addition, any land disturbance activities are reviewed to ensure that the BMPs appropriate for the environment are used to protect terrestrial habitat and wildlife, threatened and endangered species, wetland areas, and water quality. Currently, no known populations of plants or animals that have been identified as endangered, threatened, or potentially listed have been found on the Entergy Louisiana, LLC property. While there is some limited habitat for state-listed plants, no listed plants were found on Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey. (Entergy 2014e) Similarly, bald eagles are seen from the site and overfly the site; however, they are not known to nest on the Entergy Louisiana, LLC property. It is unlikely that continued operation of the WF3 plant would cause any additional stresses to these federally and state-protected species than currently exist.

Conclusion

Section 4.6.2 of this ER concludes that the impact from the renewal of the WF3 OL by itself would not noticeably alter the terrestrial environment and, thus, would be SMALL.

However, as environmental stressors, such as industrial and agricultural runoff and climate change, continue over the proposed license renewal term, certain attributes of the terrestrial environment (e.g., species diversity and distribution) are likely to noticeably change. It is not expected that these impacts would destabilize any important attributes of the terrestrial environment because such impacts will cause gradual change, which should allow the terrestrial environment to appropriately adapt. (NRC 2014b, Section 4.12.4.6) Therefore, Entergy concludes that the cumulative impacts of the proposed license renewal of WF3 plus other past, present, and reasonably foreseeable future projects or actions could potentially result in MODERATE impacts to terrestrial resources.

4.12.3.6 Historic and Cultural Resources

No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, no license-renewal-related construction activities have been identified. However, as previously discussed in Section 3.7.5, Entergy has a fleet procedure in place for management of cultural resources ahead of any future ground-disturbing activities at the plant, in addition to the site's cultural resource protection plan. This fleet procedure and the cultural resource protection plan, both of which require reviews, investigations, and consultations as needed, ensure that existing or potentially existing cultural resources are adequately protected, and assist WF3 in meeting state and federal expectations.

As discussed in Section 4.7, it was determined that the renewal of the WF3 OL would not adversely affect historic aboveground properties or archaeological sites. Any future offsite developments from other than WF3, such as those projects listed in Section 3.0.5, would be required to comply with applicable federal and state laws regarding protection of cultural and archaeological resources, and any impacts would be mitigated accordingly.

Based on this information, Entergy concludes that the continued operation of WF3 during the license renewal term would not incrementally contribute to cumulative impacts on historic and cultural resources on the Entergy Louisiana, LLC property and in the surrounding area. Therefore, Entergy determined that historic and cultural resources during the license renewal term would not be adversely affected from a cumulative impact perspective.

4.12.3.7 Socioeconomics

WF3 employees reside in 21 different Louisiana parishes and four other states as shown in Table 2.5-1. Therefore, the primary geographic area of interest considered in this cumulative analysis was St. Charles and Jefferson parishes where approximately 44 percent of WF3 employees reside. This area is where the economy, tax base, and infrastructure would most likely be affected given that a large number of WF3 employees and their families reside, spend their income, and use their benefits within these parishes.

Socioeconomic conditions of St. Charles and Jefferson parishes are presented in Section 3.8, and evaluated for new and significant information in Section 4.8 to determine if the generic analysis in the GEIS bounds existing conditions. Section 3.10.2 presents minority and low-income population information within a 50-mile radius of WF3, and was evaluated in Section 4.10 for disproportionately adverse effects on minority and low-income populations as a result of license renewal.

As discussed in Section 4.8, no new and significant information was identified, and the generic analysis in the GEIS bounds existing conditions. Therefore, continued operation of WF3 during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already experienced. Because Entergy has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at WF3 would remain relatively constant with no additional demand for permanent housing and public services. In addition, because employment levels and tax payments would not change, there would be no population or tax revenue-related land use impacts. In addition, as discussed in Section 4.10, Entergy determined that there would be no disproportionately high and adverse health or environmental impacts from the renewal of the WF3 OL to minority or low-income populations in the region.

Therefore, the only contributory effects would come from other reasonably foreseeable, planned offsite activities such as those listed in Section 3.0.5. For example, industrial and residential development may increase in the WF3 area, but not to the point that overall socioeconomic conditions would noticeably change.

Therefore, based on this and the information presented in Sections 3.8 and 3.10.2, the additional contributory effect on socioeconomic conditions in the future from the continued operation of WF3 when combined with other past, present, and reasonably foreseeable future activities during the license renewal term beyond what is currently being experienced would be SMALL.

4.12.3.8 Human Health

4.12.3.8.1 Radiological Health

The NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials. As discussed in Section 3.9.1.1, the doses resulting from the operation of WF3 are below regulatory limits, and the impacts of these exposures would be SMALL.

The EPA regulations in 40 CFR Part 190 limit the annual cumulative radiation dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.9.1.1, radioactive releases from WF3 show that the annual radiation dose to the public has been less than 1.0 mrem (0.01 mSv), which is well within the NRC's and EPA's radiation protection standards.

In addition, as discussed in Section 3.9.1.2, WF3 conducts a REMP around its site. The program measures radiation and radioactive materials in the environment from WF3 and all other sources (i.e., area hospitals, industrial facilities). Therefore, the REMP would monitor any cumulative impacts. As discussed in Section 3.9.1.2 radiological environmental monitoring results for WF3 shows no significant environmental impact associated with the operation of the plant.

There are no other nuclear power generating stations within a 50-mile radius of WF3. However, Entergy plans to operate the onsite ISFSI at WF3, and there are likely to be medical, industrial, and research facilities that use radioactive materials within a 50-mile radius of WF3. These facilities could contribute to the cumulative radiological impacts in the vicinity of WF3. However, as discussed above, the NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials which would minimize the effect.

Based on WF3's radioactive effluent and environmental monitoring data, and the expected continued compliance with federal radiation protection standards, the cumulative radiological impacts from the operation of WF3 and its ISFSI would be SMALL. The NRC will regulate any future nuclear power facility construction and operation near WF3 that could contribute to cumulative radiological impacts. In addition, the state of Louisiana will regulate facilities using radioactive material licensed by the State. Therefore, the cumulative radiological impacts to human health from the continued operation of WF3, including other licensed users of radioactive material, during the license renewal term would be SMALL.

4.12.3.8.2 Microbiological Organisms

The geographic area considered in this analysis is the Mississippi River. The potential for exposure to microbiological agents was considered in Section 4.9.1. WF3 discharges heated effluent from the reactor cooling system to the Mississippi River. Section 4.9.1 concluded that impacts from microbiological agents resulting from the presence of elevated water temperatures would be SMALL because (1) the design of the discharge structure promotes rapid mixing of thermal discharges with the Mississippi River, thereby limiting the area of conditions necessary for optimal growth of thermophilic microorganisms; (2) the average heated discharge flow is small compared to the volume of river water flowing by the plant (approximately 500,000 cfs), thereby creating limited opportunity for rapid growth and population increases of thermophilic microorganisms; (3) infection by thermophilic microorganisms in the vicinity of the WF3 discharge area has a low-probability of occurring because access by the public is restricted, thus, eliminating the nasal exposure pathway; and (4) the Louisiana Department of Health and Hospitals has stated that from 2004 to 2013 there has never been a case of *Naegleria* infection attributable to the Mississippi River.

For existing and planned offsite facilities that would discharge into the Mississippi River, the magnitude of cumulative impacts would depend on the nature and location of the actions, the number of actions (facilities or projects), the level of the public's exposure, and whether facilities comply with regulating agency requirements (e.g., permitted discharge limits). However, as previously stated above, cases of *Naegleria* infection attributable to the Mississippi River have been very rare. Therefore, cumulative impacts on human health due to microbiological organisms are anticipated to be SMALL.

4.12.3.8.3 Electric Shock Hazards

Acute effects of electric shock from induced current under transmission lines could potentially be cumulative. As discussed in Section 4.9.2, Entergy's analysis showed that the calculated induced short-circuit current for the in-scope transmission lines at WF3 was approximately 3.9 mA, which is within the NESC 5-mA standard. In addition, as discussed in Section 4.9.2, all in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned property. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

For existing and planned offsite transmission facilities, the magnitude of cumulative impacts would depend on the nature and location of the actions, the number of actions (facilities or projects), and the level of the public's exposure. However, it is anticipated that any newly constructed transmission lines would comply with the NESC 5-mA standard. Therefore, cumulative impacts on human health due to electric shock hazards would be SMALL.

4.12.3.9 Waste Management

As with any major industrial facility, WF3 generates waste as a consequence of normal operations. The expected waste generation rates during the license renewal term would be the same as during current operations, and radioactive waste (low-level, high-level, and spent nuclear fuel) and nonradioactive waste will continue to be generated. Hazardous waste would continue to be packaged and shipped to offsite RCRA-permitted treatment and disposal facilities. Typically, hazardous waste is not held in long-term storage at WF3 because they are shipped to an approved licensed facility for disposition on a quarterly basis.

As discussed in Chapter 2 of this ER, Entergy maintains waste management programs for all radioactive and nonradioactive waste generated at WF3 and is required to comply with federal and state permits and other regulatory requirements for the management of waste material. Current waste management activities at WF3 would likely remain unchanged during the license renewal term. Nonradioactive and nonhazardous waste generated during the license renewal term would continue to be shipped off site by commercial haulers to licensed treatment and disposal facilities.

Because current waste management activities at WF3 would continue during the license renewal term, there would be no new or increased contributory effect beyond what is currently being experienced. Therefore, the only new contributory effects would come from reasonably foreseeable future planned activities at WF3, unrelated to the proposed action (license renewal), and other reasonably foreseeable planned offsite activities. All radioactive and nonradioactive waste treatment and disposal facilities within a 50-mile radius of WF3 would also be required to comply with federal and state permits and other regulatory requirements. In addition, the waste management activities at other industrial facilities generating radioactive and nonradioactive waste would also have to meet the same or similar requirements. Based on this information, the cumulative effect from continued waste management activities at WF3 during the license renewal term would be SMALL.

4.12.3.10 Cumulative Impacts Summary

Entergy considered the potential impacts from continued operation of WF3 during the license renewal term and other past, present, and future actions for cumulative impacts. Based on the various impacts discussed above, Entergy's conclusion is the potential cumulative impacts resulting from WF3 operation during the license renewal term (2024 to 2044) would be SMALL for air quality and noise, geology and soils, socioeconomics, human health, and waste management; SMALL to MODERATE for surface water and groundwater resources due to climate change; MODERATE for aquatic and terrestrial resources due to climate change; and no effect on historic and cultural resources.

4.13 Impacts Common to All Alternatives: Uranium Fuel Cycle

4.13.1 Offsite Radiological Impacts—Individual Impacts from other than the Disposal of Spent Fuel and High-Level Waste

4.13.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The impacts to the public from radiological exposures have been considered by the Commission in Table S-3 of this part. Based on information in the GEIS, impacts to individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, would remain at or below the NRC's regulatory limits.

4.13.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.13.1.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). No changes in WF3 fueling practices have been identified for the license renewal term.

In the GEIS, the NRC determined that offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste—from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste—and further analysis is not required.

4.13.2 Offsite Radiological Impacts—Collective Impacts from other than the Disposal of Spent Fuel and High-Level Waste

4.13.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

There are no regulatory limits applicable to collective doses to the general public from fuel-cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel-cycle facilities are designed and operated to meet the applicable regulatory limits and standards. The Commission concludes that the collective impacts are acceptable.

The Commission concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective impacts of the uranium fuel cycle, this issue is considered Category 1.

4.13.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.13.2.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and on an analysis of the radiological impact from radon releases (NRC 1981, Section 5.9.3). No changes in WF3 fueling practices have been identified for the license renewal term.

In the GEIS, it was concluded that offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste—are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. The GEIS did not assign a single level of significance for the collective effects of the fuel cycle; however, it is considered a Category 1 issue. (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste—and further analysis is not required.

4.13.3 Nonradiological Impacts of the Uranium Fuel Cycle

4.13.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant would be small.

4.13.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.13.3.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and on an analysis of the radiological impact from radon releases (NRC 1981, Section 5.9.3). No changes in WF3 fueling practices have been identified for the license renewal term.

In the GEIS, the NRC determined that nonradioactive impacts from the uranium fuel cycle from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to nonradiological impacts of the uranium fuel cycle, and further analysis is not required.

4.13.4 Transportation

4.13.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The impacts of transporting materials to and from uranium-fuel-cycle facilities on workers, the public, and the environment are expected to be small.

4.13.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.13.4.3 Analysis

As discussed in Section 2.2.1.1 of this ER, fuel enrichment is less than 5 percent, and average rod burn-up conditions are no more than 45,000 MWd/MTU. Utilizing Table S-4 of 10 CFR Part 51, Subpart A to form the basis of transportation impacts, the NRC determined in the GEIS that impacts to and from the uranium fuel cycle from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to transportation of materials to and from uranium-fuel-cycle facilities, and further analysis is not required.

4.14 Termination of Nuclear Power Plant Operations and Decommissioning

4.14.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. License renewal is expected to have a negligible effect on the impacts of terminating operations and decommissioning on all resources.

4.14.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.14.3 Analysis

The only impacts of license termination and decommissioning attributable to operation during an extended license period are the effects of an additional 20 years of operations on the impacts of decommissioning.

In the GEIS, the NRC determined that termination of nuclear power plant operations and decommissioning from continued plant operations during the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Table 2.1-1). Based on Entergy's review, no new and significant information was identified as it relates to termination of nuclear power plant operations and decommissioning, and further analysis is not required.

4.15 Postulated Accidents

4.15.1 Severe Accidents

4.15.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

4.15.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(L)]

If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided.

4.15.1.3 Background

The staff concluded that the generic analysis summarized in the GEIS applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts of severe accidents are of small significance for all plants. However, not all plants have performed a site-specific analysis of measures that could mitigate severe accidents. Consequently, severe accidents are a Category 2 issue for plants that have not performed a site-specific consideration of severe accident mitigation and submitted that analysis for Commission review (NRC 1996, Section 5.5.2.5).

4.15.1.4 Analysis of Environmental Impact

The method used to perform the Severe Accident Mitigation Alternatives (SAMA) analysis was based on the *Regulatory Analysis Technical Evaluation Handbook* used by the NRC to analyze benefits and costs of its regulatory activities (NRC 1997).

Environmental impact statements and ERs are prepared using a sliding scale in which impacts of greater concern and mitigation measures of greater potential value receive more detailed analysis than impacts of less concern and mitigation measures of less potential value. Accordingly, Entergy used less detailed feasibility investigation and cost estimation techniques for SAMA candidates having disproportionately high costs and low benefits, and more detailed evaluations for the most viable candidates.

The following is a brief outline of the approach taken in the SAMA analysis.

(1) Establish the Baseline Consequences of a Severe Accident

Severe accident consequences were evaluated in four areas.

- Offsite exposure costs: Monetary value of consequences (dose) to offsite population.

  The Probabilistic Safety Assessment (PSA) model was used to determine total accident frequency (core damage frequency [CDF] and containment release frequency). The Windows Melcor Accident Consequences Code System (WinMACCS) was used to convert release input to public dose. Dose was converted to present worth dollars (based on a valuation of $2,000 per person-rem and a present worth discount rate of 7 percent).

- Offsite economic costs: Monetary value of damage to offsite property.

  The PSA model was used to determine total accident frequency (CDF and containment release frequency). WinMACCS was used to convert release input to offsite property damage. Offsite property damage was converted to present worth dollars based on a discount rate of 7 percent.

- Onsite exposure costs: Monetary value of dose to workers.

  Best-estimate occupational dose values were used for immediate and long-term dose. Dose was converted to present worth dollars (based on a valuation of $2,000 per person-rem and a present worth discount rate of 7 percent).

- Onsite economic costs: Monetary value of damage to onsite property.

  Best-estimate cleanup and decontamination costs were used. Onsite property damage estimates were converted to present worth dollars based on a discount rate of 7 percent. It was assumed that, subsequent to a severe accident, the plant would be decommissioned rather than restored. Therefore replacement/refurbishment costs were not included in onsite costs. Replacement power costs were considered.

(2) Identify SAMA Candidates

Potential SAMA candidates were identified from the following sources (see Attachment D for reference details):

- SAMA analyses for other PWR plants.
- NRC and industry documentation discussing potential plant improvements.
- WF3 Individual Plant Examination (IPE) of internal and external events reports and their updates.
- WF3 updated PSA model lists of risk-significant contributors.

(3) Phase I—Preliminary Screening

Potential SAMA candidates were screened out if they modified features not applicable to WF3, if they had already been implemented at WF3, or if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate.

(4) Phase II—Final Screening and Cost Benefit Evaluation

The remaining SAMA candidates were evaluated individually to determine the benefits and costs of implementation, as follows:

- The total benefit of implementing a SAMA candidate was estimated in terms of averted consequences (benefits estimate).
    - The baseline PSA model was modified to reflect the maximum benefit of the improvement. Generally, the maximum benefit of a SAMA candidate was determined with a bounding modeling assumption. For example, if the objective of the SAMA candidate was to reduce the likelihood of a certain failure mode, then eliminating the failure mode from the PSA would bound the benefit, even though the SAMA candidate would not be expected to be 100 percent effective in eliminating the failure. The modified model was then used to produce a revised accident frequency.

- Using the revised accident frequency, the method described for the four baseline severe accident impact areas was used to estimate the cost associated with each impact area following implementation of the SAMA candidate.

- The benefit in terms of averted consequences for each SAMA candidate was then estimated by calculating the arithmetic difference between the total estimated cost associated with all four impact areas for the existing plant design and the revised plant design following implementation of the SAMA candidate.

• The cost of implementing a SAMA was estimated by one of the following methods (cost estimate).

  - An estimate for a similar modification considered in a previously performed SAMA analysis was used. These estimates were developed in the past and no credit was taken for inflation when applying them to WF3.

  - Engineering judgment on the cost associated with procedural changes, engineering analysis, testing, training, and hardware modification was applied to formulate a conclusion regarding the economic viability of the SAMA candidate.

The detail of the cost estimate was commensurate with the benefit. If the benefit was low, it was not necessary to perform a detailed cost estimate to determine if the SAMA was cost beneficial.

(5) Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. One sensitivity analysis was to investigate the sensitivity of assuming a 29-year period for remaining plant life (i.e., 9 years on the original plant license plus the 20-year license renewal period). The other sensitivity analysis was to investigate the sensitivity of each analysis case to a more conservative discount rate of 3 percent.

The SAMA analysis for WF3 is presented in the following sections. Sections D.1 and D.2 of Attachment D provide a more detailed discussion of the process presented above.

4.15.1.4.1 Establish the Baseline Consequences of a Severe Accident

A baseline was established to enable estimation of the risk reductions attributable to implementation of potential SAMA candidates. The baseline severe accident risk was estimated using the WF3 PSA model and the WinMACCS consequence analysis software code. The PSA model used for the SAMA analysis is an internal events risk model.

4.15.1.4.1.1 The PSA Internal Events Model—Level 1 and Level 2 Analysis

The PSA model (Level 1 and Level 2) used for the SAMA analysis was the most recent internal events risk model for WF3. This model is an updated version of the model used in the IPE. There have been no major plant hardware changes or procedural modifications since the release of the internal events model that would have a significant impact on the results of the SAMA analysis. Thus, the WF3 model used for the SAMA analysis is appropriate. The WF3 model adopts the small event tree / large fault tree approach and uses the Computer Aided Fault Tree Analysis (CAFTA) code for quantifying risk.

The WF3 Level 2 analysis uses a Containment Event Tree (CET) to analyze all core damage sequences identified in the Level 1 analysis. The CET evaluates systems, operator actions, and severe accident phenomena to characterize the magnitude and timing of radionuclide release. The result of the Level 2 analysis is a list of sequences involving radionuclide release, along with the frequency, magnitude, and timing of release for each sequence.

4.15.1.4.1.2 The PSA External Events Model—Individual Plant Examination of External Events (IPEEE) Model

The WF3 IPEEE determined that the plant is adequately designed to protect against the effects of seismic, high wind, and external flooding events. The seismic portion of the IPEEE was completed using a seismic margin method following the guidance of NUREG-1407*, Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities*, June 1991. Three plant improvements were identified as described in NUREG-1742, *Perspectives Gained from the IPEEE Program, Final Report*, April 2002. These improvements were implemented.

The WF3 fire analysis was performed using the EPRI Fire Induced Vulnerability Evaluation (FIVE) method for qualitative and quantitative screening of fire areas. Unscreened fire zones were then analyzed in more detail using a fire Probabilistic Risk Assessment (PRA) approach. The FIVE method is primarily a screening approach used to identify plant vulnerabilities due to fire initiating events. The end result of WF3 IPEEE fire analysis identified the CDF for significant fire areas.

The IPEEE fire analysis has been superseded by the WF3 fire PRA created for National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (NFPA 805), which utilizes guidance in NUREG/CR-6850. The WF3 fire PRA model is not fully integrated with the most recent Level 2 and 3 analyses and is based on NFPA 805 modifications that have not yet been implemented.

4.15.1.4.1.3 WinMACCS Model—Level 3 Analysis

A Level 3 model was developed using the WinMACCS consequence analysis software code (Version 3.10.0) to estimate the hypothetical impacts of severe accidents on the surrounding environment and members of the public. The principal phenomena analyzed were atmospheric transport of radionuclides; mitigation actions (i.e., evacuation, condemnation of contaminated crops and milk) based on dose projection; dose accumulation by a number of pathways, including food and water ingestion; and economic costs. Input for the Level 3 analysis included the core radionuclide inventory, source terms from the WF3 PSA model, site meteorological data, projected population distribution (within a 50-mile radius) for the year 2045, emergency response evacuation modeling, and economic data. The WinMACCS input data are described in Section D.1.5 of Attachment D.

4.15.1.4.1.4 Evaluation of Baseline Severe Accident Consequences Using the Regulatory Analysis Technical Evaluation Handbook Method

This section describes the method used to estimate the cost associated with each of the four impact areas for the baseline case (i.e., without SAMA implementation). This analysis was used to establish the maximum benefit that a SAMA could achieve if it eliminated all risk due to WF3 at-power internal events.

Offsite Exposure Costs

The Level 3 baseline analysis resulted in an annual offsite exposure risk of 15.9 person-rem. This value was converted to its monetary equivalent (dollars) via application of the $2,000 per person-rem conversion factor from the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997). This monetary equivalent was then discounted to present value using the formula from the same source:

$$APE = (F_S D_{P_S} - F_A D_{P_A}) R \frac{1 - e^{-rt_f}}{r}$$

where

APE = monetary value of accident risk avoided from population doses, after discounting.

R = monetary equivalent of unit dose, ($/person-rem).

F = accident frequency (events/year).

D_P = population dose factor (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using a 20-year period, a 7-percent discount rate, assuming F_A is zero, and the baseline release frequency of 1.05E-05/yr resulted in the monetary equivalent value of $341,881. This value is presented in Table 4.15-1.

Offsite Economic Costs

The Level 3 baseline analysis resulted in an annual offsite economic risk monetary equivalent of $147,339. This value was discounted in the same manner as the public health risks in accordance with the following equation:

$$AOC = (F_S P_{D_S} - F_A P_{D_A})\mathrm{R}\frac{1 - e^{-rt_f}}{r}$$

where

AOC = monetary value of risk avoided from offsite property damage, after discounting.

P_D = offsite property loss factor ($/event).

F = accident frequency (events/year).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using previously defined values, the resulting monetary equivalent is $1,587,336. This value is presented in Table 4.15-1.

Onsite Exposure Costs

The values for occupational exposure associated with severe accidents were not derived from the PSA model but from information in the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997). The values for occupational exposure consist of "immediate dose" and "long-term dose." The best-estimate value provided for immediate occupational dose is 3,300 person-rem, and long-term occupational dose is 20,000 person-rem (over a 10-year cleanup period). The following equations were used to estimate monetary equivalents:

Immediate Dose

$$W_{IO} = (F_S D_{IO_S} - F_A D_{IO_A}) R \frac{1 - e^{-rt_f}}{r} \quad (1)$$

where

W_{IO} = monetary value of accident risk avoided from immediate doses, after discounting.

IO = immediate occupational dose.

R = monetary equivalent of unit dose ($/person-rem).

F = accident frequency (events/year).

D_{IO} = immediate occupational dose (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = $2,000/person-rem.

r = 0.07.

D_{IO} = 3,300 person-rem/accident.

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the immediate dose associated with WF3's accident risk is

$$W_{IO} = (F_S D_{IO_S}) R \frac{1 - e^{-rt_f}}{r}$$

$$W_{IO} = 3300 \times F_S \times \$2000 \times \frac{1 - e^{-(0.07 \times 20)}}{0.07}$$

$$W_{IO} = (\$7.10 \times 10^7) F_S$$

For the baseline release frequency, 1.05 x 10^{-5}/yr,

$$W_{IO} = \$745$$

Long-Term Dose

$$W_{LTO} = (F_S D_{LTO_S} - F_A D_{LTO_A}) R \times \frac{1 - e^{-rt_f}}{r} \times \frac{1 - e^{-rm}}{rm} \quad (2)$$

where

W_{LTO} = monetary value of accident risk avoided long-term doses, after discounting ($).

LTO = long-term occupational dose.

m = years over which long-term doses accrue.

R = monetary equivalent of unit dose ($/person-rem).

F = accident frequency (events/year).

D_{LTO} = long-term occupational dose (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = $2,000/person-rem.

r = 0.07.

D_{LTO} = 20,000 person-rem/accident.

m = 10 years.

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the long-term dose associated with WF3's accident risk is

$$W_{LTO} = (F_S D_{LTO_S}) R \times \frac{1 - e^{-rt_f}}{r} \times \frac{1 - e^{-rm}}{rm}$$

$$W_{LTO} = (F_S \times 20{,}000)\$2000 \times \frac{1 - e^{-0.07 \times 20}}{0.07} \times \frac{1 - e^{-0.07 \times 10}}{0.07 \times 10}$$

$$W_{LTO} = (\$3.10 \times 10^8) F_S$$

For the release frequency for the baseline, 1.05 x 10^{-5}/yr,

$$W_{LTO} = \$3{,}249$$

Total Occupational Exposures

Combining equations (1) and (2) above, using delta (Δ) to signify the difference in accident frequency resulting from the proposed actions, and using the above numerical values, the long-term accident-related onsite (occupational) exposure avoided is

$$AOE = \Delta W_{IO} + \Delta W_{LTO} \ (\$)$$

where

AOE = onsite exposure avoided.

The bounding value for occupational exposure (AOE_B) is

$$AOE_B = W_{IO} + W_{LTO} = \$745 + \$3{,}249 = \$3{,}994$$

The resulting monetary equivalent of $3,994 is presented in Table 4.15-1.

Onsite Economic Costs

Cleanup/Decontamination

The total cost of cleanup/decontamination of a power reactor facility subsequent to a severe accident is estimated in the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997) to be $\$1.5 \times 10^9$; this same value was adopted for these analyses. Considering a 10-year cleanup period, the present value of this cost is

$$PV_{CD} = \left(\frac{C_{CD}}{m}\right)\left(\frac{1 - e^{-rm}}{r}\right)$$

where

PV_{CD} = present value of the cost of cleanup/decontamination.

CD = cleanup/decontamination.

C_{CD} = total cost of the cleanup/decontamination effort ($).

m = cleanup period (years).

r = discount rate (%).

Based upon the values previously assumed,

$$PV_{CD} = \left(\frac{\$1.5 \times 10^9}{10}\right)\left(\frac{1 - e^{-0.07 \times 10}}{0.07}\right)$$

$$PV_{CD} = \$1.08 \times 10^9$$

This cost is integrated over the term of the proposed license extension as follows:

$$U_{CD} = PV_{CD}\left(\frac{1-e^{-rt_f}}{r}\right)$$

where

U_{CD} = total cost of cleanup/decontamination over the life of the plant.

Based upon the values previously assumed,

$$U_{CD} = \$1.16 \times 10^{10}$$

Replacement Power Costs

Replacement power costs were estimated in accordance with the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997). Because replacement power will be needed for the time period following a severe accident, for the remainder of the expected generating plant life, long-term power replacement calculations have been used. The present value of replacement power was estimated as follows:

$$PV_{RP} = \left(\frac{B}{r}\right)(1-e^{-rt_f})^2$$

where

PV_{RP} = present value of the cost of replacement power for a single event.

t_f = license renewal period (years).

r = discount rate (%).

B = a constant representing a string of replacement power costs that occur over the lifetime of a reactor after an event (for a 910-MWe "generic" reactor, NUREG/BR-0184 uses a value of $1.2E+8).

$$B = \left(\frac{1188}{910}\right) \times (1.20\times10^{8}) = \$1.57\times10^{8}$$

This cost was scaled to account for the plant-specific power after the EPU of 1,188 MWe.

Based upon the values previously assumed:

$$PV_{RP} = \left(\frac{B}{r}\right)(1 - e^{-rt_f})^2 = \left(\frac{\$1.57 \times 10^8}{0.07}\right)(1 - e^{-(0.07)20})^2$$

$$PV_{RP} = \$1.27 \times 10^9$$

To account for the entire lifetime of the facility, U_{RP} was then calculated from PV_{RP}, as follows:

$$U_{RP} = \left[\frac{PV_{RP}}{r}\right](1 - e^{-rt_f})^2$$

where

U_{RP} = present value of the cost of replacement power over the remaining life.

t_f = license renewal period (years).

r = discount rate (%).

Based upon the values previously assumed:

$$U_{RP} = \frac{PV_{RP}}{r}(1 - e^{-rt_f})^2 = \frac{\$1.27 \times 10^9}{0.07}(1 - e^{-(0.07)20})^2 = \$1.03 \times 10^{10}$$

Total Onsite Property Damage Costs

Combining the cleanup/decontamination and replacement power costs, using delta (ΔF) to signify the difference in accident frequency resulting from the proposed actions, and using the above numerical values, the best-estimate value of averted occupational exposure can be expressed as

$$AOSC = \Delta F(U_{CD} + U_{RP}) = \Delta F(\$1.16 \times 10^{10} + \$1.03 \times 10^{10})$$

$$AOSC = \Delta F(\$2.19 \times 10^{10})$$

where

ΔF = difference in annual accident frequency resulting from the proposed action.

For the baseline release frequency, 1.05 x 10^{-5}/yr,

$$AOSC = \$229{,}892$$

The resulting monetary equivalent of $229,892 is presented in Table 4.15-1.

4.15.1.4.2 Identify SAMA Candidates

Based on a review of industry documents, an initial list of SAMA candidates was identified. Because WF3 is a PWR, considerable attention was paid to the SAMA candidates from SAMA analyses for other PWR plants. Attachment D lists the specific documents from which SAMA candidates were initially gathered.

In addition to SAMA candidates from review of industry documents, additional SAMA candidates were obtained from plant-specific sources, such as the WF3 IPE and IPEEE. In the IPE and IPEEE, several enhancements related to severe accident insights were recommended. These enhancements were included in the comprehensive list of SAMA candidates and were verified to have been implemented during preliminary screening or were retained for evaluation (see Table D.2-1 of Attachment D).

In addition, the current WF3 PSA Levels 1 and 2 models were used to identify plant-specific modifications for inclusion in the comprehensive list of SAMA candidates. The risk-significant events from the PSA Level 1 and Level 2 models were reviewed for similar failure modes and effects that could be addressed through a potential enhancement to the plant. The correlation between candidate SAMAs and the risk-significant events are listed in Tables D.1-2, D.1-4, and D.1-5 of Attachment D. The comprehensive list contained a total of 201 SAMA candidates. The first step in the analysis of these candidates was to eliminate the non-viable SAMA candidates through preliminary screening.

4.15.1.4.3 Preliminary Screening (Phase I)

The purpose of the preliminary SAMA screening was to eliminate from further consideration enhancements that were not viable for implementation at WF3. Potential SAMA candidates were screened out if they modified features not applicable to WF3 or if they had already been implemented at WF3. In addition, where it was determined those SAMA candidates were potentially viable, but similar in nature, they were combined to develop a more comprehensive or plant-specific SAMA candidate.

During this process, 127 of the 201 initial SAMA candidates were eliminated, leaving 74 SAMA candidates for further analysis. The list of 201 original SAMA candidates and applicable screening criterion is available in onsite documentation.

4.15.1.4.4 Final Screening and Cost Benefit Evaluation (Phase II)

A cost/benefit analysis was performed on 71 of the remaining 74 SAMA candidates. Three of the Phase II SAMA candidates were retained without evaluation as they are already commitments in the NFPA 805 License Amendment Request (LAR). The method for determining if a SAMA candidate was cost beneficial consisted of determining whether the benefit provided by implementation of the SAMA candidate exceeded the expected cost of implementation. The benefit was defined as the sum of the reduction in dollar equivalents for each severe accident impact area (offsite exposure, offsite economic costs, occupational exposure, and onsite economic costs). If the expected implementation cost exceeded the estimated benefit, the SAMA was not considered cost beneficial.

The result of implementation of each SAMA candidate would be a change in the severe accident risk (i.e., a change in frequency or consequence of severe accidents). The method of calculating the magnitude of these changes is straightforward. First, the severe accident risk after implementation of each SAMA candidate was estimated using the same method as for the baseline. The results of the Level 2 model were combined with the Level 3 model to calculate these post-SAMA risks. The results of the benefit analyses for the SAMA candidates are presented in Table D.2-2 of Attachment D.

Each SAMA evaluation was performed in a bounding fashion. Bounding evaluations were performed to address the generic nature of the initial SAMA concepts. Such bounding calculations overestimate the benefit and thus are conservative calculations. For example, one SAMA dealt with adding redundant and diverse limit switches to each containment isolation valve; the bounding analysis estimated the benefit of this improvement by eliminating containment isolation failure (see analysis for Phase II SAMA 55 in Table D.2-2 of Attachment D). Such a calculation obviously overestimated the benefit, but if the inflated benefit indicated that the SAMA is not cost beneficial, then the purpose of the analysis was satisfied.

As described above for the baseline, values for avoided public and occupational health risk were converted to a monetary equivalent (dollars) via application of the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997) conversion factor of $2,000 per person-rem and discounted to present value. Values for avoided offsite economic costs were also discounted to present value. The formula for calculating net value for each SAMA was

Net value = (APE + AOC + AOE + AOSC) - COE

where

APE = value of averted public exposure ($).

AOC = value of averted offsite costs ($).

AOE = value of averted occupational exposure ($).

AOSC = value of averted onsite costs ($).

COE = cost of enhancement ($).

If the net value of a SAMA was negative, the cost of the enhancement was greater than the benefit and the SAMA was not cost beneficial.

The SAMA analysis considered that external events (including fires and seismic events) could lead to potentially significant risk contributions. Also, internal flooding events are not included in the internal events model and could lead to potentially significant risk contributions. To account for the risk contribution from external events and internal flooding, the cost of SAMA implementation was compared with a benefit value estimated by applying a multiplier of 3.02 to the internal events estimated benefit. This value is defined as an "Internal and External Benefit." To account for uncertainties associated with the internal events CDF calculations, the cost of SAMA implementation was also compared with a benefit value estimated by applying an uncertainty multiplier of 1.99 to the internal and external estimated benefit. This value is defined as the "Internal and External Benefit with Uncertainty." Development of the multipliers for WF3 is described in the following paragraphs.

The WF3 IPEEE concluded for high winds, floods, and other external events that no undue risks are present that might contribute to CDF with a predicted frequency in excess of 1E-06/yr. As these events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible in estimation of the external events multiplier.

A seismic margin assessment was performed for the seismic portion of the WF3 IPEEE. Thus, no CDF sequences were quantified as part of the IPEEE seismic risk analysis. Though the IPEEE did not calculate a CDF due to seismic events, an Integrated Leak Rate Test (ILRT) Interval Extension Report calculated a value of 6.87E-07 for the seismic CDF. This value was conservatively used to calculate the internal/external events benefit multiplier.

The EPRI Fire PRA Implementation Guide was followed for the WF3 IPEEE fire analysis. The EPRI FIVE method was used for the initial screening, for treatment of transient combustibles, and as the source of fire frequency data. The CDF was determined to be 7.0E-06/yr. As discussed in Attachment D, the WF3 fire PRA model documented calculated a fire CDF of 1.80E-05, and this value is used in calculating the SAMA internal/external events multiplier.

The fire, seismic, and internal flooding CDF value is approximately 2.02 times the internal events CDF. This justifies use of a multiplier of 3.02 on the averted cost estimates (for internal events) to represent the SAMA benefits from both internal and external events.

The internal and external benefit with uncertainty is intended to account for both the internal and external events impacts with uncertainty. CDF uncertainty estimates conservatively resulted in a ratio of the 95th percentile to the mean of 1.99. Therefore, "Internal and External Benefit" values were multiplied by a factor of 1.99 to provide the "Internal and External Benefit with Uncertainty."

Use of an internal and external benefit (with uncertainty) is considered appropriate because of the inherent conservatism in the external events modeling approach and conservative assumptions in benefit modeling of individual SAMA candidates. In addition, not all potential enhancements would be impacted by an external event. In some cases, an external event would only impose partial failure of systems or trains. Therefore, using 6.01 times the internal events estimated benefit to account for internal and external events with uncertainty is appropriate.

The expected cost of implementation of each SAMA (COE) was established from existing estimates of similar modifications combined with engineering judgment. Most of the cost estimates were developed from similar modifications considered in previous performed SAMA analyses. In particular, these cost estimates were derived from the following major sources.

- Davis-Besse
- South Texas project
- Callaway
- Seabrook Station
- Sequoyah
- ANO-2
- Indian Point (IP2)

Estimates based on modifications that were implemented or estimated in the past were presented in terms of dollar values at the time of implementation and were not adjusted to present-day dollars.

Detailed cost estimates were often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit. The implementation costs for several of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis case. Nonetheless, the cost of SAMA candidates was conceptually estimated to the point where conclusions regarding the economic viability of the proposed modification could be adequately gauged. The cost benefit comparison and disposition of each of the 74 Phase II SAMA candidates is presented in Table D.2-2 of Attachment D.

4.15.1.4.5 Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. The main factors affecting present worth are the extended plant life and the discount rate. A description of each follows.

Sensitivity Case 1: Years Remaining Until End of Plant Life

The purpose of this sensitivity case was to investigate the sensitivity of assuming a 29-year period for remaining plant life (i.e., 9 years on the original plant license plus the 20-year license renewal period), rather than the 20-year license renewal period used in the base case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

Sensitivity Case 2: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. The discount rate of 7 percent used in the base case analyses is conservative relative to corporate practices. Nonetheless, a lower discount rate of 3 percent was assumed in this case to investigate the impact on each analysis case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

The benefits estimated for each of these sensitivities are presented in Table D.2-3 of Attachment D.

4.15.1.5 Conclusion

This analysis addressed 201 SAMA candidates for mitigating severe accident impacts. Phase I screening eliminated 127 SAMA candidates from further consideration, based on either inapplicability to WF3's design or features that had already been incorporated into WF3's current design, procedures and/or programs. During the Phase II cost-benefit evaluation of the remaining 74 SAMA candidates, an additional 62 SAMA candidates were eliminated because their cost was expected to exceed their benefit.

Twelve Phase II SAMA candidates presented in Table 4.15-2 were found to be potentially cost-beneficial for mitigating the consequences of a severe accident at WF3.

SAMA 1 Provide additional DC battery capacity.

The WF3 direct current (DC) batteries are designed to provide an adequate amount of energy for all required emergency loads following the loss of AC power for 4 hours. This SAMA recommends replacing the current DC batteries with batteries that can provide power to emergency loads for longer than 4 hours following the loss of AC power.

SAMA 3 Provide DC bus cross-ties.

DC bus cross-tie capability is not currently possible at WF3. This SAMA recommends installing DC bus cross-ties, which would allow aligning of emergency loads to an alternate train if their normal DC power source is failed.

SAMA 5 Improve 4.16-kV bus cross-tie ability.

There are three 4.16-kV Class 1E busses at WF3: 3A, 3B, and swing bus 3AB. Cross-ties exist between 3A and 3AB and between 3B and 3AB, but not between 3A and 3B. This SAMA recommends installing a cross-tie between 4.16-kV busses 3A and 3B, which would allow aligning of emergency loads to an alternate train if their normal power source is failed.

SAMA 7 Install a gas turbine generator.

Following the loss of offsite alternating current (AC) power, two emergency diesel generators power the safety-related loads. This SAMA recommends installing a gas turbine generator to enhance redundancy and diversity of onsite AC power sources.

SAMA 11 Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.

The WF3 emergency diesel generator (EDG) day tanks hold about 60 minutes of fuel oil, which is refilled from the fuel oil storage tank by fuel transfer pump. It is assumed the fuel oil transfer pump would need to cycle 6 times in a 24-hour period. This SAMA recommends gravity feeding fuel oil from the fuel oil storage tank to the day tanks, which would reduce the impact of the fuel oil transfer pump failing.

SAMA 26 Install improved reactor coolant pump seals.

The reactor coolant pump (RCP) seals are cooled by the CCWS. A failure of the CCWS will lead to a failure of the RCP seals and a LOCA event. This SAMA recommends replacing the current RCP seals with seals that can sustain for a longer time without cooling, which would allow for more time to trip the pumps during an accident.

SAMA 34 Use fire water system as a backup for steam generator inventory.

During emergency situations, the emergency feedwater (EFW) system, consisting of two motor-driven pumps and one turbine-driven pump, provides cooling water to the steam generators. Failure of the EFW system to cool the steam generators can lead to core damage. This SAMA recommends a modification to allow the fire water system to supply the steam generators as a backup to the EFW system.

SAMA 36 Implement procedures for temporary HVAC.

Following a loss of heating, ventilation, and air conditioning (HVAC), equipment failures and habitability issues may occur due to the increased heat. In order to mitigate these issues, actions can be taken to increase ventilation by setting up temporary fans and portable coolers or by opening doors. This SAMA recommends implementing procedures for temporary HVAC to mitigate the effects of a loss of HVAC for the battery, EDG, and main control rooms.

SAMA 40 Use the fire water system as a backup source for the containment spray system.

The purpose of the containment spray system is to remove heat during and following an accident which involves either a LOCA or a main steam line break (MSLB) inside containment, as well as reduce containment pressure. Failure of the containment spray system can lead to increased fission product leakage and containment failure. This

SAMA recommends upgrading the fire water system and adding a hard pipe connection to the containment spray system, thereby increasing redundancy.

SAMA 74 In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.

Per the NFPA 805 LAR, a radiant heat barrier will be installed in Fire Area RAB 2 to separate the A and B chilled water pump trains. This modification protects each train's chiller pump (and associated nearby equipment) from a fire in the opposite train. This SAMA was retained as potentially cost-beneficial without evaluation.

SAMA 75 In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.

Per the NFPA 805 LAR, a radiant heat shield will be installed in Fire Area RAB 8C, Switchgear Room A/B. This modification protects certain raceways from potential High Energy Arcing Fault (HEAF) effects. This SAMA was retained as potentially cost-beneficial without evaluation.

SAMA 76 In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.

Per the NFPA 805 LAR, Electric Raceway Fire Barrier System (ERFBS) will be installed in Fire Area RAB 6 to provide a qualified 1-hour fire resistance rating in accordance with requirements of NRC Generic Letter 86-10 and Generic Letter 86-10, Supplement 1. This SAMA was retained as potentially cost-beneficial without evaluation.

Although the above SAMA candidates do not relate to adequately managing the effects of aging during the period of extended operation, they have been submitted for detailed engineering project cost-benefit analysis to further evaluate implementation of these potentially cost-beneficial SAMAs. The sensitivity studies indicated that the results of the analysis would not change for the conditions analyzed.

Table 4.15-1
Estimated Present Dollar Value Equivalent of Internal Events CDF at WF3

Parameter	Present Dollar Value ($)
Offsite population dose	$341,881
Offsite economic costs	$1,587,336
Onsite dose	$3,994
Onsite economic costs	$229,892
Total	**$2,163,103**

Table 4.15-2
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
1	Provide additional DC battery capacity.	Reduces risk of core damage during station blackouts.	34.4%	42.5%	44.5%	$2,812,956	$5,597,783	$3,172,695
	Basis for Conclusion: Eliminated station blackout risk contribution. The implementation cost is a WF3 plant-specific estimate.							
3	Provide DC bus cross-ties.	Increases the availability of DC power.	20.8%	31.0%	31.3%	$1,966,036	$3,912,412	$1,449,686
	Basis for Conclusion: Required failure of three DC power busses to fail a single DC power train. The implementation cost is a WF3 plant-specific estimate.							
5	Improve 4.16-kV bus cross-tie ability.	Increases the availability of AC power.	22.2%	32.0%	32.3%	$2,033,811	$4,047,285	$1,554,988
	Basis for Conclusion: Required failure of both A and B busses to fail single AC power train. The implementation cost is a WF3 plant-specific estimate.							
7	Install a gas turbine generator.	Reduces risk of core damage during station blackouts.	34.4%	42.5%	44.5%	$2,812,956	$5,597,783	$2,000,000
	Basis for Conclusion: Eliminated station blackout risk contribution. The implementation cost is a Davis-Besse modification cost estimate.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
11	Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.	Eliminates the failure of the EDGs due to failures of the fuel oil transfer pump.	17.1%	20.8%	21.5%	$1,367,894	$2,722,110	$150,000
	Basis for Conclusion: Eliminated failure of fuel oil transfer pumps. The implementation cost is a Callaway modification cost estimate.							
26	Install improved reactor coolant pump seals.	Provides additional time to trip the RCPs in order to mitigate an RCP seal LOCA.	16.0%	31.6%	32.4%	$1,994,880	$3,969,811	$2,000,000
	Basis for Conclusion: Eliminated risk of RCP seal LOCA. The implementation cost is a Seabrook modification cost estimate.							
34	Use fire water system as a backup for steam generator inventory.	Reduces core damage due to failure of the steam generators from lack of cooling	67.3%	61.8%	62.9%	$4,126,742	$8,212,217	$3,073,130
	Basis for Conclusion: Reduced the frequency of the turbine-driven AFW pump failure during an SBO. The implementation cost is an Indian Point Unit 2 modification cost estimate.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
36	Implement procedures for temporary HVAC.	Reduces equipment and operator action failures following a loss of HVAC.	9.4%	11.9%	12.3%	$779,088	$1,550,385	$100,000
	Basis for Conclusion: Eliminated the failure of EDG room 3A room cooling. The implementation cost is a Callaway procedure change cost estimate.							
40	Use the fire water system as a backup source for the containment spray system.	Increases availability of the core spray system.	5.8%	17.2%	35.9%	$1,942,124	$3,864,827	$2,455,808
	Basis for Conclusion: Reduced failure of containment spray system. The implementation cost is a WF3 plant-specific estimate.							
74	In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.	Provides separation between A and B chilled water pump trains.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
75	In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.	Reduced risk of core damage due to high energy arcing faults.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							
76	In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.	Reduced risk of core damage due to fires in this area.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							

5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

> The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware. [10 CFR 51.53(c)(3)(iv)]

The NRC has resolved most license renewal environmental issues generically and requires an applicant to analyze only those issues the NRC has not resolved generically. While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those Category 1 environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware. [10 CFR 51.53(c)(3)(iv)]

5.1 New and Significant Information

The NRC provides guidance on new and significant information in Regulatory Guide 4.2, Supplement 1, Revision 1 (NRC 2013a, pages 7 and 8). In this guidance, new and significant information is defined as follows:

(1) Information that identifies a significant environmental impact issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Plants," in Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," of 10 CFR Part 51, or

(2) Information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1.

Further, a significant environmental issue includes, but is not limited to, any new activity or aspect associated with the nuclear power plant that can act upon the environment in a manner or an intensity and/or scope (context) not previously recognized (NRC 2013a, page 8).

The NRC does not specifically define the term "significant." Accordingly, for the purposes of this review, Entergy relied on Council on Environmental Quality regulations, which include a lengthy definition of "significant" that requires consideration of the context of the action and the intensity or severity of the impact(s) [40 CFR 1508.27]. Entergy considered that MODERATE or LARGE impacts, as defined by the NRC, would be seriously different than previously envisioned impacts. Therefore, only new information that would suggest a change from SMALL impacts to either MODERATE or LARGE impacts for an issue considered in the GEIS or an issue not considered in the GEIS with MODERATE or LARGE impacts would be considered "significant." Section 4.0.2 of this ER presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

5.2 New and Significant Information Review Process

During preparation of the WF3 ER, Entergy reviewed the analyses of the Category 1 issues discussed in the GEIS that were applicable to WF3, and the permits and reference materials listed in Table 9.1-1 and Chapter 10, respectively. Entergy also conducted meetings and consultations with those state and federal agencies having regulatory oversight of WF3, requesting their input on issues that should be considered in the ER.

Entergy also utilized its existing in-house process for reviewing and evaluating environmental issues which could potentially be new and significant information. This process provided an additional means for Entergy to ensure that any potential new and significant environmental information related to renewal of the WF3 OL was identified, reviewed, and addressed as appropriate.

This process is collectively conducted by departments within Entergy Nuclear's corporate group and members composed of technical personnel from all Entergy nuclear sites involved in environmental compliance, environmental monitoring, environmental planning, natural resource management, and health and safety issues.

This process identifies issues relevant to environmental matters through several avenues as follows:

- Participation in industry utility groups such as Edison Electric Institute, Electric Power Research Institute, NEI, and Utility Solid Waste Activities Group.
- Participation in non-utility groups such as the Institute of Hazardous Materials Management and National Registry of Environmental Professionals.
- Routine interface with regulatory agencies having oversight of the facility.
- Routine interface with non-nuclear Entergy business units such as Fossil, Transmission, and Corporate.
- Periodic reviews of proposed regulatory and legislative changes.
- Review of plant and site activities that are evaluated by Entergy fleet procedure EN-EV-115 (Environmental Reviews and Evaluations).

Additional actions conducted by Entergy during the development of the WF3 ER included the following:

- Interviews with site subject matter experts.
- Review of current site activities relating to the resource areas identified in the GEIS.

- Review of state and federal regulatory agency inspections and associated inspection results.

As a result of this review, Entergy is aware of no new and significant information regarding the environmental impacts of license renewal associated with WF3.

6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 License Renewal Impacts

Chapter 4 incorporates by reference NRC findings for the 51 Category 1 issues that apply to WF3 (plus the one uncategorized issue for which the NRC came to no generic conclusion), all of which have environmental impacts that are SMALL. The remainder of Chapter 4 analyzes the 17 Category 2 issues. Table 6.1-1 identifies the environmental impacts that renewal of the WF3 OL would have on resources associated with the Category 2 issues.

In summary, Entergy has reviewed the environmental impacts of renewing the WF3 OL and has concluded that further mitigation measures beyond those discussed in Section 6.2 and listed in Table 6.1-1 of this ER to avoid, reduce the severity of, or eliminate adverse impacts are not warranted. This ER documents the basis for Entergy's conclusion.

Table 6.1-1
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
Surface 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)]	4.5.1.1	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
Groundwater Resources		
Groundwater use conflicts (plants that withdraw more than 100 gpm) [10 CFR 51.53(c)(3)(ii)(C)]	4.5.2.1	No impact. Issue is not applicable because WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Waterworks and cooling water is supplied by the Mississippi River.
Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river) [10 CFR 51.53(c)(3)(ii)(A)]	4.5.2.2	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and cooling water is supplied by the Mississippi River.
Groundwater quality degradation (plants with cooling ponds at inland sites) [10 CFR 51.53(c)(3)(ii)(D)]	4.5.2.3	No impact. Issue is not applicable because WF3 does not utilize cooling ponds for condenser cooling purposes.
Radionuclides released to groundwater [10 CFR 51.53(c)(3)(ii)(P)]	4.5.2.4	SMALL impact. No tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected since the groundwater program was initiated in 2007.
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) [10 CFR 51.53(c)(3)(ii)(B)]	4.6.1.1	SMALL impact. CWIS is located offshore in main channel of river; most species cannot tolerate harsh conditions of river main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source; impingement and entrainment numbers are low; intake structure has been previously approved as BTA by the EPA (1991) and LDEQ (2010).

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds) [10 CFR 51.53(c)(3)(ii)(B)]	4.6.1.2	SMALL impact. Design of discharge structure promotes rapid mixing with the river; thermal plume represents a very small portion of the cross-sectional and vertical area of the river; thermal discharges do not block upstream or downstream movement of fish; thermal discharges continue to meet Louisiana water quality criteria for temperature.
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)]	4.6.1.3	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
Terrestrial Resources		
Effects on terrestrial resources (non-cooling system impacts) [10 CFR 51.53(c)(3)(ii)(E)]	4.6.2.1	SMALL impact. No refurbishment or other license-renewal-related construction activities have been identified; adequate management programs and regulatory controls in place to protect onsite important terrestrial ecosystems.
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)]	4.6.2.2	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat [10 CFR 51.53(c)(3)(ii)(E)]	4.6.3	No adverse effects on threatened and endangered species or essential fish habitat. No refurbishment or other license-renewal-related construction activities have been identified; management programs in place to protect threatened and endangered species; no essential fish habitat designated in the Mississippi River in the vicinity of WF3.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
Historic and Cultural Resources		
Historic and cultural resources [10 CFR 51.53(c)(3)(ii)(K)]	4.7	No adverse effects on historic properties. No refurbishment or other license-renewal-related construction activities have been identified; administrative procedure ensures protection of these type resources in the event of excavation activities.
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	SMALL impact. Design of discharge structure promotes rapid mixing of thermal discharges with the Mississippi River; average heated discharge flow is small compared to the volume of river water flowing by the plant; no cases of *Naegleria* infection attributable to the Mississippi River from 2004 to 2013.
Electric shock hazard [10 CFR 51.53(c)(3)(ii)(H)]	4.9.2	SMALL impact. Transmission lines meet applicable shock prevention provisions of the NESC; transmission lines located totally within Entergy Louisiana, LLC owned property; occupational safety and health measures for plant workers in place to address shock hazards from overhead lines.
Environmental Justice		
Minority and low-income populations [10 CFR 51.53(c)(3)(ii)(N)]	4.10	No disproportionately high and adverse impacts or effects on minority and low-income populations identified.
Cumulative Impacts		
Cumulative impacts [10 CFR 51.53(c)(3)(ii)(O)]	4.12	SMALL to MODERATE impacts. SMALL for air quality and noise, geology and soils, socioeconomics, human health, and waste management; SMALL to MODERATE for surface water and groundwater resources due to climate change; MODERATE for aquatic and terrestrial resources due to climate change; and no effect on historic and cultural resources.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
Postulated Accidents		
Severe accidents [10 CFR 51.53(c)(3)(ii)(L)]	4.15.1	SMALL impact. Potentially cost-effective SAMAs are not related to adequately managing the effects of aging during the period of extended operation.

6.2 Mitigation

> The environmental report must include an analysis that considers and balances . . . alternatives available for reducing or avoiding adverse environmental effects. [10 CFR 51.45(c)]

> The report must contain a consideration of alternatives for reducing adverse impacts . . . for all Category 2 license renewal issues . . . . [10 CFR 51.53(c)(3)(iii)]

NRC Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications*, specifies that the applicant should identify any ongoing mitigation and should discuss the potential need for additional mitigation. However, applicants are only required to consider mitigation alternatives in proportion to the significance of the impact. (NRC 2013a, page 8)

As discussed in Section 6.1, impacts associated with WF3 license renewal do not require the implementation of additional mitigation measures. The permits and programs discussed in Chapter 9 (i.e., LPDES permit; stormwater program; air permit; spill prevention, control, and countermeasure [SPCC] program; hazardous waste management program; cultural resource protection plan; and environmental review programs) that currently mitigate the operational environmental impacts of WF3 are adequate. Therefore, additional mitigation measures are not sufficiently beneficial as to be warranted.

6.3 Unavoidable Adverse Impacts

> The environmental report shall . . . discuss . . . any adverse environmental effects which cannot be avoided should the proposal be implemented . . . . [10 CFR 51.45(b)(2)]

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit, because the facility is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. As previously discussed in Chapter 4 of this ER, no license-renewal-related refurbishment or construction activities have been identified. Therefore, the environmental impacts to be evaluated for license renewal are those associated with continued operation during the renewal term.

Entergy adopts by reference NRC findings for the 51 Category 1 issues (NRC 2013b) applicable to WF3, including discussions of any unavoidable adverse impacts. In addition, Entergy identified the following site-specific unavoidable adverse impacts associated with license renewal:

- The majority of the land use at WF3 would continue to be designated as industrial until the plant is shut down and decommissioned (decommissioning can take up to 60 years after permanent shutdown of WF3). Uranium mining associated with the nuclear fuel cycle also has offsite land use implications.

- Aquatic organisms would continue to be impinged and entrained at the intake structure but, as discussed in Section 4.6.1.1, these impacts were determined to be SMALL.

- Normal plant operations result in industrial wastewater discharges containing small amounts of water treatment chemical additives to the Mississippi River at or below LDEQ-approved concentrations. Compliance with the LPDES permit would ensure that impacts remain SMALL.

- Operation of WF3 results in consumptive use of Mississippi River water as a result of plant operations. However, this consumptive use is negligible, amounting to only 0.01 percent of the water withdrawn from the Mississippi River (NRC 1981, Section 5.3.1.1).

- Operation of WF3 results in the generation of spent nuclear fuel and waste material, including LLRW, hazardous waste, and nonhazardous waste. However, specific plant design features in conjunction with a waste minimization program; employee safety training programs and work procedures; and strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste ensure that the impact is SMALL.

- Operation of WF3 results in a very small increase in radioactivity in the air. The incremental radiation dose to the local population resulting from WF3 operations is typically less than the magnitude of the fluctuations that occur in natural background radiation. Doses to the members of the public from WF3's gaseous releases would be well within the allowable limits of 10 CFR Part 20 and 10 CFR Part 50, Appendix I. Operation of WF3 also creates a very low probability of accidental radiation exposure to inhabitants of the area.

6.4 Irreversible or Irretrievable Resource Commitments

> The environmental report shall . . . discuss . . . any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. [10 CFR 51.45(b)(5)]

The term "irreversible" applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term "irretrievable" applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

The continued operation of WF3 for the period of extended operation will result in irreversible and irretrievable resource commitments, including the following:

- Uranium in the nuclear fuel consumed in the reactor that becomes high-level radioactive waste if the used fuel is not recycled through reprocessing.

- Land required for permanent storage or disposal of spent nuclear fuel, low-level radioactive wastes generated as a result of plant operations, and sanitary wastes generated from normal industrial operations.

- Elemental materials that will become radioactive.

- Materials used for the normal industrial operations of WF3 that cannot be recovered or recycled, or that are consumed or reduced to unrecoverable forms.

Other than the above, no license-renewal-related refurbishment activities have been identified that would irreversibly or irretrievably commit significant environmental components of land, water, and air.

However, if WF3 ceases operations on or before the expiration of the current OL, the likely power generation alternatives would require a commitment of resources for construction of the replacement plant as well as for fuel to run the plant. Significant resource commitments would also be required if transmission lines are needed to connect the plant to the electrical grid.

6.5 Short-Term Use Versus Long-Term Productivity of the Environment

> The environmental report shall . . . discuss . . . the 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)]

The current balance between short-term use and long-term productivity of the environment at the site has remained relatively constant since WF3 began operations in 1985. The WF3 FES evaluated the relationship between the short-term uses of the environment and the maintenance and enhancement of the long-term productivity associated with the construction and operation of WF3 (NRC 1981, Section 6.5). The period of extended operation will not alter the short-term uses of the environment from the uses previously evaluated in the WF3 FES. The period of extended operation will postpone the availability of the site resources (land, air, water) for other uses. Denial of the application to renew the WF3 OL would lead to the shutdown of the plant and would alter the balance in a manner that depends on the subsequent uses of the site. For example, the environmental consequences of turning the site area occupied by WF3 into a park or an industrial facility after decommissioning are quite different. However, extending WF3 operations would not alter, but only postpone, the potential long-term uses of the site that are currently possible.

In summary, no license-renewal-related refurbishment activities have been identified that would alter the evaluation of the WF3 FES for the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity of these resources.

7.0 ALTERNATIVES TO THE PROPOSED ACTION

> The environmental report shall . . . discuss . . . alternatives to the proposed action . . . . [10 CFR 51.45(b)(3)]
>
> The applicant shall discuss in this report the environmental impacts of alternatives and any other matters . . . . The report is not required to include discussion of need for power or economic costs and benefits of . . . alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation . . . . [10 CFR 51.53(c)(2)]
>
> A reasonable alternative must be commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license, or expected to become commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license . . . . The amount of replacement power generated must equal the base-load capacity previously supplied by the nuclear plant and reliably operate at or near the nuclear plant's demonstrated capacity factor. (NRC 2013b, Section 2.3)

Each energy alternative should meet the purpose of the proposed action (i.e., renewal of a commercial nuclear power plant OL), which is to provide the option to continue plant operations beyond the current OL term. If the WF3 OL were not renewed, the 1,188 MWe of reliable base-load power produced by WF3 would not be available to continue to meet Entergy's system generating needs during the WF3 license renewal period, December 2024 to December 2044. Therefore, because Entergy, a regulated utility, is required to furnish the Louisiana Public Service Commission its plan for meeting customers' long-term power needs and because WF3's power generation is included in this long-term plan, an alternative approach to meeting the electric power requirements of its customers would be needed.

7.1 Replacement Power Alternatives

As discussed in Section 2.6.2, Entergy considered a full range of alternatives for replacement power in the event that the WF3 OL is not renewed. Entergy considered each of the replacement power alternatives reviewed in the NRC's GEIS for license renewal (NRC 2013b, Section 2.3) for their reasonableness as an alternative to continued operation of WF3 to meet power demands of Entergy customers with regard to several criteria. As noted above, the NRC has defined a "reasonable alternative" as one that is 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). In evaluating reasonable alternatives to the renewal of the WF3 OL, Entergy reviewed both discrete power generation sources for replacement of the base-load generating capacity of WF3 and a combination of sources. If the WF3 OL is not renewed, the 1,188 MWe of reliable base-load power produced by WF3 would not be available to continue to meet Entergy's system generating needs during the license renewal period, 2024–2044. Any alternative that did not include replacing the base-load generating capacity of WF3 would be unreasonable.

7.1.1 Energy Alternatives Considered As Reasonable

Entergy's review determined that the alternatives listed below met the NRC's criteria for reasonableness for the replacement of WF3's generating capacity during the license renewal period. Each of the following hypothetical alternatives is discussed further in the following subsections.

- NGCC plant at the Entergy Louisiana, LLC property.
- SCPC plant at an alternate site.
- New nuclear plant at the Entergy Louisiana, LLC property.
- Combination of hypothetical alternatives consisting of an NGCC plant and biomass plants at the Entergy Louisiana, LLC property, plus energy savings from DSM programs.

As explained in Section 2.6.2, Entergy determined that the most likely alternative to replace WF3 is an NGCC plant due to economic reasons, and the relatively short development and construction time (approximately 3 years).

7.1.1.1 Natural Gas-Fired Generation

The NGCC plant alternative would be located on previously disturbed land on the Entergy Louisiana, LLC property, and would consist of multiple combustion turbines, heat recovery steam generator, and a steam turbine generator assembled in appropriate power-train configurations. Based on a capacity factor of 87 percent (EIA 2013a), the replacement NGCC plant would approximately be a 1,366-MWe plant, resulting in the equivalent to WF3's generating capacity of 1,188 MWe. Entergy assumes (1) the NGCC plant would utilize closed-cycle cooling with mechanical draft cooling towers, (2) source of cooling water would be the Mississippi River, (3) existing transmission line infrastructure is adequate, and (4) existing intake and discharge structures can be utilized with some modifications.

7.1.1.2 Coal-Fired Generation

As discussed in Section 2.6.2, Entergy's IRP selected SCPC with carbon capture as a technology for further consideration. Therefore, for purposes of assessing the impacts of energy replacement alternatives, the coal-fired plant alternative uses SCPC technology with carbon capture at an alternate site. Based on an 85-percent capacity factor (EIA 2013a), the SCPC plant would be a 1,398-MWe plant, resulting in the approximate equivalent to WF3's generating capacity of 1,188 MWe. Entergy assumes (1) the SCPC plant would be located in close proximity to an existing power plant in Louisiana within the Southeast Electric Reliability Corporation (SERC) region, adjacent to a rail line or waterway capable of supporting delivery of coal, and near a geological formation capable of storing carbon emissions to meet new power plant standards, as proposed (79 FR 1430); (2) existing transmission infrastructure would be sufficient; and (3) closed-cycle cooling with mechanical draft cooling towers would be utilized.

7.1.1.3 Nuclear Generation

The new nuclear plant alternative would be located on the Entergy Louisiana, LLC property on previously disturbed land. Based on a capacity factor of 90 percent (EIA 2013a), the new nuclear unit would be sized to approximately 1,320 MWe, resulting in the equivalent to WF3's generating capacity of 1,188 MWe. Entergy assumes (1) the new nuclear plant would utilize closed-cycle cooling with mechanical draft cooling towers, (2) source of cooling water would be the Mississippi River, (3) existing transmission infrastructure is adequate, and (4) existing intake and discharge structures can be utilized with some modifications.

7.1.1.4 Combination of Alternatives

A combination of hypothetical alternatives for replacing the generating capacity of WF3 consists of the following:

- A 668-MWe NGCC plant operating at an 87-percent capacity factor (EIA 2013a) for a total of 581 MWe.
- Four 50-MWe biomass plants operating at an 83-percent capacity factor (EIA 2013a) for a total of 166 MWe.
- DSM programs providing 441 MWe.

The NGCC plant and biomass plants would be located on the Entergy Louisiana, LLC property on previously disturbed land. For the NGCC plant and biomass plants, Entergy assumes (1) closed-cycle cooling with mechanical draft cooling towers would be utilized; (2) source of cooling water would be the Mississippi River; (3) existing transmission line infrastructure is adequate; (4) existing intake and discharge structures can be utilized with some modifications; and (5) the biomass-fired units would be capable of using a variety of biomass fuels such as wood waste, crop residues, energy crops, and municipal solid waste (MSW) to take advantage of the feedstock options available in the area, as well as for greater assurance of reliable feedstock.

7.1.2 Energy Alternatives Not Considered Reasonable

The NRC reviewed a full range of energy alternatives in the GEIS, including alternatives that require new generating capacity and those that do not (NRC 2013b, Section 2.3). Entergy considered alternatives, as presented in the GEIS, for its analysis as discussed in Section 2.6.2. The following sections discuss the energy alternatives not considered reasonable.

7.1.2.1 Alternatives Not Requiring New Generating Capacity

7.1.2.1.1 Purchased Power

Power to replace the capacity of a nuclear unit would have to be purchased from sources within the United States, Mexico, and/or Canada. The power purchased would likely be generated from coal, natural gas, nuclear, or some amount of intermittent renewables such as wind or solar, or a combination of these. Thus, the environmental impacts of purchased power would still occur, but would be located elsewhere within the region, nation, or another country. The description of environmental impacts of generating technologies presented in Chapter 8 of the 1996 GEIS is representative of the purchased power alternative. In addition, purchased power is generally economically adverse in that the cost of generated power has historically been less than the cost of the same power provided by a third party (NRC 2013c, Section 9.2.1).

Purchased power could require new transmission lines to import the amount of energy needed to replace WF3. WF3 electricity is distributed through the Entergy Louisiana, LLC grid, a part of the Entergy Electric System which interconnects Entergy's operating companies. In addition, Entergy Louisiana, LLC's grid is interconnected with three other companies which are not part of the Entergy Electric System: Central Louisiana Electric Company, Southwestern Electric Power Company, and Mississippi Power Company. (WF3 2014a, Section 8.1.1) Entergy Louisiana, LLC is also a member of the Midcontinent Independent System Operator, Inc. (MISO), and WF3 is located within the Delta sub-region of MISO's transmission grid. A recent study of the transmission constraints in Louisiana, Arkansas, and western Mississippi identified much of southeastern Louisiana and southwestern Louisiana as chronically constrained areas with regard to electricity transmission and the ability to import electricity (Patton 2013). Currently, there is no existing merchant generating facility within southeastern Louisiana that could provide replacement power (Lanning 2014).

The construction of transmission lines could have both environmental and aesthetic consequences, particularly if new transmission line ROWs have to be acquired. It is not possible to accurately predict the number of acres of land required for transmission system expansion to accommodate replacement of WF3's base-load generating capacity without knowing the location and grid access for generating facilities with reserve capacity available for purchase. If a ROW width of 150 feet or greater were needed for the extremely high voltage portions (345 kV or greater), this committed and disturbed land could amount to more than 1,800 acres per 100 miles of transmission line ROW. Therefore, the local environmental impacts from purchased power would be SMALL where existing transmission line ROWs are used, and could range from SMALL to LARGE if development of new ROWs is required.

Purchasing power from other utilities or power generators is not considered a reasonable or environmentally preferred alternative for replacement of WF3's base-load generation due to transmission constraints and potential land impacts from transmission line expansion.

7.1.2.1.2 Plant Reactivation or Extended Service Life

Entergy's integrated resource planning process involves looking at sustaining existing units as well as adding generating capacity and implementing DSM programs to meet projected electricity demand. The process reviews the entire Entergy Louisiana, LLC fleet and its viability and maintenance needs, and makes informed assumptions with regard to plant life and continued operations. The IRP assumes the deactivation of approximately 5,950 MWe of older gas-fired generating units within the aging Entergy Louisiana, LLC fleet (Entergy 2015g, Part 5). Even if investments in maintenance would be economically sound to allow for delayed retirement/ refurbishment of some of the units in the aging Entergy Louisiana, LLC generating fleet, given expected demand, Entergy projects that it will be necessary to add additional generating capacity.

Thus, even if substantial capacity scheduled for retirement could be delayed, the delayed retirement would be needed just to meet load growth. Thus, delayed retirement of other Entergy generating units would not provide a replacement for WF3's base-load generation. Therefore, delayed retirement is not considered a reasonable alternative.

7.1.2.1.3 Conservation or Demand-Side Management

DSM includes energy efficiency programs, energy conservation, and demand response initiatives to reduce energy usage during peak demand periods. To be considered a reasonable alternative, a DSM alternative would need to reduce the base-load demand within Entergy Louisiana, LLC's service territory by 1,188 MWe, which is equivalent to the amount generated by WF3.

To develop its IRP, Entergy reviewed deployment of a full range of existing and potentially deployable DSM programs across the residential, commercial, and industrial sectors served by Entergy. Entergy's DSM program scenarios assumed that WF3 would continue to operate, so the DSM projection component was a means of meeting demand in addition to WF3, not as a replacement. DSM projections were based on a “DSM Potential Study” that estimated the peak load, annual energy reduction, and program costs that result from a low, reference, and high level of spending on program incentives. (Entergy 2015g, Part 2 and Table 19) The DSM Potential Study projected a high of cumulative DSM savings in 2025 of approximately 4 million megawatt hours (MWh) (ICF 2015, Slide 16) or 457 MWe.

The DSM potential within the Entergy Louisiana, LLC service area is not adequate for replacement of WF3's generating capacity. The energy savings for 2025 was projected for three levels of implementation and funding with all the projections falling short of that needed for replacement of WF3's base-load generating capacity (ICF 2015, Slide 16). Therefore, DSM is not considered a reasonable alternative by itself. However, DSM is a component of the combination of alternatives included as a reasonable alternative for replacing WF3's base-load generation.

7.1.2.2 Alternatives Requiring New Generating Capacity

7.1.2.2.1 Wind

Based on the National Renewal Energy Laboratory's (NREL's) wind energy potential estimates, Louisiana's onshore potential is relatively low, with the potential installed capacity reported as 409.8 MW (NREL 2011a), which is less than the amount required for replacement of WF3's base-load generation. Importation of energy from onshore wind would pose the same transmission limitation and the need to develop new transmission lines as discussed in Section 7.1.2.1.1. The construction of roads and turbine tower supports would result in short-term impacts, such as increases in noise, erosion, and sedimentation, and decreases in air quality from fugitive dust and equipment emissions. Installation in undeveloped areas would also have the potential to disturb and impact cultural resources, wetlands, or habitat for sensitive species both during construction and operations. The environmental impacts of a large-scale wind farm are described in the GEIS (NRC 1996, Section 8.3.1; updated in NRC 2013b, Chapter 4). Impacts on aesthetics, land use, and terrestrial ecology from large-scale, land-based wind power facilities could range from SMALL to LARGE.

NREL also reviewed the offshore wind energy potential for the United States and reported Louisiana's offshore wind potential to be 38,798 MW within 3 nautical miles of shoreline at wind speeds of 7.0 to 7.5 meters/second at a turbine height of 90 meters, with the potential increasing at distances of 3 to 12 and 12 to 50 nautical miles from shore (NREL 2010, Table B.1.3). Using NREL data from 2011, the NRC determined Louisiana's offshore areas to have the lowest classification (Fair) for potential for wind energy development (NRC 2013b, Figure D.10-17). Potential impacts of offshore wind energy deployment may be similar to those associated with onshore wind power. A portion of the transmission system would be constructed offshore and would likely consist of buried or submerged cable. Environmental concerns include impacts on marine life, coastal terrestrial communities, avian communities, aesthetics, fishing impacts, and boating and yachting safety, due to the impacts from construction and maintenance (USDOI 2009, Table E-1).

Therefore, given the offshore wind energy potential for Louisiana and the potential impacts that could result as discussed above, offshore wind as a replacement for WF3's base-load generation is not considered a reasonable alternative.

7.1.2.2.2 Solar Technologies: Photovoltaic Cells and Solar Thermal Power

Generation from solar power is available in two different technologies: concentrating solar power (CSP) and photovoltaic (PV). CSP requires direct solar radiation, but PV can make use of both direct solar radiation and diffuse horizontal radiation.

NREL estimates direct solar radiation for the majority of Louisiana is 4.0 to 4.5 kilowatt hours per square meter per day (kWh/m^2/day), and for the coastline and New Orleans area, 4.5 to 5.0 kWh/m^2/day (NREL 2012a). For CSP generating facilities, the minimum viable level is 6.75 kWh/m^2/day (Blair et al. 2006). Such a level of direct solar radiation is not found in the Entergy Louisiana, LLC service territory (NREL 2012a). The PV solar resource for Louisiana and much of the Entergy territory is estimated by NREL to be higher, 5.0 to 5.5 kWh/m^2/day (NREL 2012b).

Due to the amount of solar generating capacity needed to replace WF3's base-load generation, the modest levels of solar radiation in Louisiana and the lower efficiencies in producing electricity from solar power versus nuclear power substantially increase land requirements beyond those of other alternatives considered. A recent NREL study for the United States indicated current estimates of the amount of land required for utility-scale solar generation. Direct land use requirements for PV installations range from 1.6 to 5.8 acres/gigawatt hours per year (GWh/yr), with a generation-weighted average of 3.1 acres/GWh/yr (NREL 2013). Direct land use intensity requirements for CSP installations range from 1.5 to 5.3 acres/GWh/yr, with a generation-weighted average of 2.7 acres/GWh/yr (NREL 2013). Based on these estimates, land use for replacement of WF3's 1,188 MWe (10,407 GWh/yr) could be between 16,700 and 60,400 acres of new land disturbance for PV generation, and between 15,600 and 55,200 acres of new land disturbance for CSP power generation. Depending on the location of the solar generation, this amount of land disturbance could result in MODERATE to LARGE impacts on affected resources (terrestrial habitat, land use, and aesthetic impacts).

Because CSP is a thermoelectric technology, like a fossil fuel-fired or nuclear power plant, a cooling system would be required. A CSP plant uses 760 to 920 gallons/MWh (AWR 2008), comparable with a nuclear plant with wet cooling towers which uses 720 gallons/MWh (NEI 2013). More recently, dry cooling technology using air cooling has been deployed (NREL 2014). Thus, water consumption for cooling as well as other water requirements for the CSP facility would result in SMALL water use impacts.

Solar power is an intermittent power source because direct or indirect solar radiation is not available throughout each day. Therefore, a solar facility would need to be coupled with energy storage to overcome its inherent intermittency. The storage facility would further increase land requirements and other environmental impacts.

Given the relatively modest solar radiation in Louisiana, increased land requirements for a utility-scale facility to provide replacement power, intermittency of the power source, and need for energy storage, solar is not considered a reasonable alternative for replacement of WF3's base-load generation.

7.1.2.2.3 Hydropower

Recent studies funded by the DOE reviewed the potential for new hydropower resources in the United States (ORNL 2012; ORNL 2014). The first study reviewed existing unpowered dams in the United States for their potential as hydropower sources. Louisiana was determined to have the potential for approximately 847 MW (ORNL 2012). Therefore, powering all the identified dams would not provide replacement generating capacity for WF3.

The second study reviewed the hydropower potential of undeveloped stream reaches. The median generating capacity of the undeveloped stream reaches in the LMR region is 3 MW in Louisiana, and southwest Mississippi had potential resources only up to the 10-MW range

(ORNL 2014, Section 11.3). The downstream area of the LMR tends to be larger in flow but lower in hydraulic head, requiring low-head technology that is generally more expensive and less efficient. For development of these streams, land would have to be inundated to provide water storage capacity with the median inundation being 2,000 acres per stream. Replacement of WF3's base-load generating capacity would therefore require flooding a substantial amount of land. Also, instream navigation is a more important function than hydropower in this region. (ORNL 2014, Section 11.1) In addition, protected species are found in many of these streams (ORNL 2014, Section 11.4).

Due to the large land use requirements of undeveloped stream reaches to provide water storage capacity as well as the development of transmission corridors for both unpowered existing dams and newly developed stream reaches, and related environmental and ecological resource impacts associated with siting hydroelectric facilities with cumulative capacity to replace WF3, it can be concluded that local hydropower alone is not a reasonable alternative to the renewal of the WF3 OL. Any attempts to site hydroelectric facilities with cumulative capacity to replace WF3 would result in LARGE environmental impacts.

7.1.2.2.4 Geothermal

Geothermal energy facilities have demonstrated capacity factors of 90 to 98 percent, making geothermal energy clearly eligible as a source of base-load electric power (NRC 2013b, Section 2.3.3.2). However, as with other renewable energy technologies, the ultimate feasibility of geothermal energy serving as a base-load power replacement for WF3 depends on the quality and accessibility of geothermal resources within or proximate to the region of interest—in this case, the Entergy Louisiana, LLC or SERC region. Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (NRC 2013b, Section 2.3.3.2; NREL 2011b, Figure 22). Therefore, geothermal resources are not considered a reasonable alternative for the replacement of WF3's base-load generation.

7.1.2.2.5 Wood Waste

Use of wood waste as a fuel for generating electricity depends on supply volume and proximity to the site of the proposed project. The volume of the supply of fuel would be dependent on the volume of wood waste from lumber or other wood product production to avoid harvesting timber just for fuel. NREL profiled the supply of forest residue in the United States using 2007 data collected by the U.S. Forest Service. Specifically, NREL reported that some parishes within a 50-mile radius of WF3 have an annual supply of 50,000 to 100,000 dry tonnes of forest residue (NREL 2009a). This amount of forest residue would supply an estimated 30 to 60 MW based on 8,570 British thermal units per pound (Btu/lb) (dry) (ENERCON 2015b). It would require the total supply from many parishes within a 50-mile radius of WF3 to provide the feedstock for replacement power for WF3. The feedstock would also have to be sustained for 20 years to serve as a replacement alternative for WF3, which would result in ecological impacts due to large-scale timber harvesting. Like coal-fired plants, wood-waste plants also require large land areas for fuel storage and processing, and they involve the same type of combustion equipment.

To replace the base-load generating capacity of WF3, several wood waste plants would be required. Therefore, development of wood waste-fired plants is not considered a reasonable alternative as a replacement for WF3's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing WF3's base-load generation.

7.1.2.2.6 Municipal Solid Waste

As with wood waste, MSW as a fuel is dependent on supply. The proximity of Louisiana's large cities of New Orleans and Baton Rouge provide the potential for a steady and sustainable supply of MSW. Louisiana does not have any active MSW-fired generating plants (ERC 2014). As of 2014, there are 84 waste-to-energy plants in the United States, 80 of which are currently operating and 4 that are currently inactive but may return to active service at a future date. These waste-to-energy plants have an aggregate generating capacity of 2,769 MWe, with the largest plant having a gross generating capacity of 93 MWe. In addition, a new plant with the capacity of 96 MWe is scheduled to open in 2015. (ERC 2014) More than 13 of the largest-sized plants would be necessary to provide the same level of output as WF3.

The average air emission rates in the United States from MSW-fired generation are 1.2 lbs/MWh of SO_2 and 6.7 lbs/MWh of nitrogen oxides (NO_x) (EPA 2013). MSW combustion results in approximately 1,016 pounds of carbon dioxide (CO_2) per MWh. The toxics generated by MSW combustion facilities are tightly regulated by the maximum achievable control technology (MACT) standards under the CAA, and a variety of air pollution control technologies are used to reduce toxic air pollutants from MSW-fired power plants. (EPA 2014c)

The overall level of impact from construction of a waste-fired plant would be approximately the same as that for a coal-fired power plant. In addition, waste-fired plants have the same or greater operational impacts as coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal). (NRC 2013c, Section 9.2.3.7)

Given limitations in generating capacity due to supply, land use impacts, and operational air emission impacts, Entergy does not consider an MSW-fired plant as a reasonable replacement alternative for WF3's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing WF3's base-load generation.

7.1.2.2.7 Other Biomass-Derived Fuels

Biomass fuels other than wood and MSW include waste sources such as crop residue, methane from animal facilities and wastewater treatment facilities, as well as energy crops such as switchgrass cultivated and harvested for use as a biofuel. These energy sources have comparable or less energy content than wood waste (EPA 2007), as discussed above. Availability of crop residue in the parishes near WF3 was reported by NREL (2009b) as predominantly 100,000 to 200,000 dry tonnes per year, which while more plentiful than wood waste, would still require use of all the feedstock in multiple parishes. The feedstock would also have to be sustained for 20 years to serve as a replacement for WF3's base-load generation.

Generally, biomass-fueled facilities are small-scale facilities, and co-firing with other fuels such as coal is common. As with wood waste, many multiple biomass-fueled plants would be required to replace the generating capacity of WF3 resulting in impacts on land use and air quality as a result of hazardous air pollutant (HAP) emissions. Therefore, development of biomass-derived fuel-fired plants is not considered a reasonable replacement alternative for WF3's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing WF3's base-load generation.

7.1.2.2.8 Fuel Cells

Fuel cells as an alternative source for generating base-load electricity are not presently economically or technologically competitive with other alternatives. This non-competitiveness is due to various challenges including the cost for commercial applications and technology challenges for reliability and durability of fuel cells, along with improvements in fuel processing systems to convert fuel such as natural gas to hydrogen (DOE 2013; DOE 2014). The EIA projects that fuel cells may cost $7,108 per installed kW (total overnight capital costs, 2012 dollars), which is higher than most other technologies analyzed, and fuel cell units are generally small in scale (EIA's analysis was based on a 10-MWe model) (EIA 2013b, page 6). The world's largest fuel cell plant, a 59-MWe plant located in South Korea, began operations in 2014 (National Geographic 2014). Using the world's largest plant as a model, WF3 replacement generating capacity would require approximately 21 plants. It would be extremely costly to replace the base-load generation provided by WF3. Given the immature status of fuel cell technology and high cost, fuel cells are not considered a reasonable alternative for replacing WF3's base-load generating capacity.

7.1.2.2.9 Oil

The variable costs of oil-fired generation tend to be greater than those of the nuclear or coal-fired operations, and oil-fired generation tends to have greater environmental impacts than natural gas-fired generation. For example, in addition to carbon dioxide emissions, oil-fired generation would also emit HAPs. Based on existing and pending air emission regulations for HAPs (77 FR 9304), and carbon dioxide, including carbon capture requirements (79 FR 1430), and the fact that oil-fired generation is one of the largest energy-related contributors to CO_2 emissions in the world, Entergy considers oil an unreasonable alternative to replace WF3's base-load generation, nor is it an environmentally preferred alternative.

7.1.2.2.10 Ocean Wave and Current Energy

The Electric Power Research Institute assessed the potential for wave energy along the continental shelf of the United States and estimated the available wave energy resource for Louisiana to be 29 terrawatt hours per year along the outer shelf, and 19 terrawatt hours per year along the inner shelf (EPRI 2011, Table 4-6). There are modest wave energy resources available off the Gulf Coast. However, wave energy technology is still in the early stages of development. The potential for wave and ocean energy is limited because the Gulf of Mexico is shallow and semi-enclosed (TCPA 2008, Chapter 20). Because most technologies are relatively undeveloped (and none are developed on the scale of WF3), and because the Gulf of Mexico has limited potential for wave and ocean energy, Entergy does not consider wave and ocean energy as a reasonable alternative to the renewal of the WF3 OL.

7.1.2.2.11 Coal-Fired Integrated Gasification Combined-Cycle

IGCC is a technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. Gasifiers, similar to those used in oil refineries, use heat pressure and steam to pyrolyze (thermally reform complex organic molecules without oxidation) coal to produce synthesis gases (generically referred to as syngas) typically composed of CO, hydrogen, and other flammable constituents. After processing to remove contaminants and produce various liquid chemicals, the syngas is combusted in a combustion turbine to produce electric power. Separating the CO_2 from the syngas before combustion is also possible. Latent heat is recovered both from the syngas as it exits the gasifier and from the combustion gases exiting the combustion turbine and directed to a heat recovery steam generator feeding a conventional Rankine cycle steam turbine generator to produce additional amounts of electricity. Emissions of criteria pollutants would likely be slightly higher than those from the NGCC plant alternative, but significantly lower than those from the SCPC plant alternative. Depending on the gasification technology employed, an IGCC plant would use less water than a SCPC plant but slightly more than an NGCC plant. Long-term maintenance costs of this relatively complex technology would likely be greater than those for a similarly sized SCPC or NGCC plant. (NRC 2014d, Section 8.6.13)

Operating at higher thermal efficiencies than SCPC-fired boilers, IGCC plants can produce electrical power with fewer air pollutants and solid wastes than SCPC-fired boilers. Currently, there is an operating IGCC plant at Edwardsport, Indiana, and another one being constructed in Mississippi. IGCC technology may become more commonplace in the future due to potential environmental regulations mandating carbon capture and storage (CCS) system as the best method of emission reduction. CCS is less expensive to operate with IGCC than SCPC primarily because the CO_2 is separated from the syngas before combustion, whereas with SCPC, the CO_2 is separated after combustion (NRC 2014d, Section 8.6.13).

To date, however, IGCC technologies have had limited application and have been plagued with operational problems such that their effective, long-term capacity factors are often not high enough for them to reliably serve as base-load units. Although IGCC technology may become more commonplace in the future, current operational problems that compromise reliability result in the dismissal of this technology as a reasonable alternative (NRC 2015c, Section 2.3.11) to the renewal of the WF3 OL.

7.1.3 Environmental Impacts of Alternatives

Each of the alternatives considered as reasonable (Section 7.1.1) are discussed below. The generation alternatives are sized to provide replacement of the approximately 1,188 net MWe base-load power generated by WF3 in order to compare the environmental impacts of the alternatives to the proposed action, which is renewal of the WF3 OL.

7.1.3.1 Natural Gas-Fired Generation

As discussed in Section 7.1.1.1, the natural gas-fired alternative would be an NGCC plant, consisting of multiple combustion turbines, heat recovery steam generator, and a steam turbine generator assembled in appropriate power-train configurations to produce net electrical power virtually equivalent to the 1,188 net MWe generated by WF3. Based on a capacity factor of 87 percent (EIA 2013a), the alternative is scoped as a 1,366-MWe plant to provide equivalent generating capacity to replace WF3's base-load generation. The NGCC plant alternative would be located on the Entergy Louisiana, LLC property on previously disturbed land. As previously discussed in Section 3.0, WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC owned land. Waterford 1 and 2 (oil/gas-fired generating plants) and Waterford 4 (oil-fired peaking plant) are also located on this same Entergy Louisiana, LLC property. The environmental impacts associated with constructing and operating the NGCC plant alternative assumes (1) closed-cycle cooling with mechanical draft cooling towers would be utilized, (2) source of cooling water would be the Mississippi River, (3) existing transmission line infrastructure is adequate, and (4) existing intake and discharge structures can be utilized with some modifications.

7.1.3.1.1 Land Use and Visual Resources

Land Use

Approximately 59 acres of land would be required to construct the NGCC plant alternative (ENERCON 2015b), based on 4.94E-06 acres per MWh (adapted from NETL 2010a, Figure 3-23). Due to the acreage available on the Entergy Louisiana, LLC property, encroachment into wetlands from construction activities is not anticipated; therefore, there would be no associated impacts on wetlands. The natural gas pipeline closest to the Entergy Louisiana, LLC property that has adequate supply to operate the hypothetical NGCC plant alternative is the TETCO pipeline, approximately 6–7 miles south of WF3 on the same side of the Mississippi River (Entergy 2015o). Therefore, a new pipeline segment with an associated 100-foot-wide ROW connecting the site to the existing natural gas distribution infrastructure would be needed. However, collocating a new pipeline within an existing ROW would minimize land use impacts. Because the NGCC plant alternative would be built at an existing power plant site on previously disturbed land and the potential exists that the new pipeline could be collocated within an existing ROW, construction-related impacts on land use under the NGCC plant alternative are assumed to be SMALL.

In addition to onsite land requirements, offsite land is typically required for natural gas wells and collection stations during operations. The 1996 GEIS estimated that approximately 3,600 acres would be needed for a natural gas well field of sufficient size to support a 1000-MWe gas-fired plant (NRC 1996, Section 8.3.10). Therefore, for a 1,366-MWe NGCC plant alternative, approximately 4,920 acres could be needed for the natural gas well field. However, no new gas wells or collection wells would be needed, because there is an abundance of gas supply being transported from the northeast United States through the TETCO pipeline to the Gulf area (Entergy 2015o). Therefore, Entergy assumes that existing gas supply can support operations of the NGCC plant alternative on the Entergy Louisiana, LLC property, and no additional offsite land would be required. Overall, operations-related land use impacts under the NGCC plant alternative are anticipated to be SMALL.

Visual Resources

During construction, all clearing and excavation would occur on the Entergy Louisiana, LLC property, which already hosts four power plants and would be visible off site. Because the existing site already appears industrial, construction of the NGCC plant alternative would appear similar to other ongoing onsite activities. Therefore, construction-related aesthetic impacts under the NGCC plant alternative would be SMALL.

During operations, the tallest structures at the NGCC plant alternative would include the exhaust stacks and mechanical draft cooling towers. The facility would be visible off site during daylight hours. The addition of mechanical draft cooling towers and associated condensate plumes could add to the visual impact. The power block of the NGCC plant alternative would look similar to the Waterford 1, 2, and 4 power plants already existing on the Entergy Louisiana, LLC property. Because the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants and other nearby industrial facilities, the new NGCC plant alternative would blend in with the industrial surroundings. Therefore, operations-related aesthetic impacts under the NGCC plant alternative would be SMALL.

7.1.3.1.2 Air Quality

Construction of the NGCC plant alternative would result in the release of various criteria pollutants such as CO, NO_x, sulfur oxide (SO_x), particulate matter, and volatile organic compounds (VOCs), as well as various GHGs from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce. VOC releases will also result from the onsite storage and dispensing of vehicle and equipment fuels. Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction BMPs, such as development and execution of a fugitive dust control plan, would mitigate such impacts. Air emissions would be intermittent and vary based on the level and duration of a specific activity throughout the construction phase. Gas-fired power plants are constructed relatively quickly. Therefore, construction-related impacts on air quality under the NGCC plant alternative would be of relatively short duration and SMALL.

During operations, the NGCC plant alternative would be equipped with air pollution controls to ensure compliance with air quality regulations, minimizing emissions of criteria air pollutants. The facility would consume approximately 94 billion cubic feet of natural gas annually. Emission estimates for the NGCC, based on EPA emission factors, are shown in Table 7.1-1.

A new NGCC plant would qualify as a new major source of criteria pollutants and would be subjected to Prevention of Significant Deterioration (PSD) of Air Quality review under CAA requirements and Louisiana state regulations. As such, it would need to comply with the New Source Performance Standard for NGCC plants set forth in 40 CFR Part 60 Subpart Da:

particulate matter and opacity [40 CFR 60.42Da]; SO_2 [40 CFR 60.43Da];and NO_x [40 CFR 60.44Da]. A new NGCC plant would also qualify as a major source because its potential to emit is greater than 100 tons/year of criteria pollutants and its CO_2 is greater than 75,000 tons/year, and would be required to secure a Title V operating permit. (NRC 2013c, Section 9.2.2.2)

In addition, an NGCC plant would be subject to the EPA's National Emission Standards for Hazardous Air Pollutants (HAPs) for Stationary Combustion Turbines [40 CFR 63, Subpart YYYY], if the NGCC plant was a major source of HAPs (having the potential to emit 10 tons/year or more of any single HAP or 25 tons/year or more of any combination of HAPs [40 CFR 63.6085(b)]. (NRC 2013c, Section 9.2.2.2)

A new NGCC plant would also have to comply with Title IV of the CAA [42 U.S.C. 7651] reduction requirements for SO_2 and NO_x, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum SO_2 and NO_x emission rates from the existing plants and a system of SO_2 emission allowances that can be used, sold, or saved for future use by new plants. (NRC 2014d, Section 8.1.1)

More recently, the EPA has promulgated additional rules and requirements that apply to certain fossil fuel-based power plants, such as NGCC plant generation. The Cross-State Air Pollution Rule and the PSD and Title V Greenhouse Gas Tailoring Rule impose several additional standards to limit ozone, particulate, and GHG emissions from fossil fuel-based power plants. A new NGCC plant would be subject to these additional rules and regulations. (NRC 2014d, Section 8.1.1)

As noted above, a new NGCC plant would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, a new NGCC plant would be a major source of criteria pollutants and GHGs. Therefore, the overall operations-related impacts on air quality under the NGCC plant alternative would be MODERATE.

7.1.3.1.3 Noise

During construction, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, and other stationary equipment (such as pumps and compressors), and the increase of human activity. The site on which the NGCC plant alternative would be constructed has been zoned as an M-2 Heavy Manufacturing Zoning District. This zoning designation requires a minimum 2,000-foot buffer from the nearest residential and commercial district, or located a lesser distance if clearly dictated safe by industry standards and approved by the local Board of Adjustments. Therefore, any site plan for an NGCC plant alternative would comply with this buffer requirement. As discussed in Sections 3.0.3 and 3.0.4, the closest sensitive receptors to WF3 are residences located approximately 0.9 miles to the northeast, east-northeast, northwest, and west-northwest, and two parks (Killona and Montz) approximately 1 mile northwest and 1 mile east-northeast, respectively, of WF3. Because noise activities associated with construction are intermittent and last only through the duration of construction (approximately 3 years), construction-related noise impacts under the NGCC plant alternative are anticipated to be effectively managed and kept SMALL.

Noise impacts from operations would include cooling towers (water pumps, cascading water, or fans), transformers, turbines, pumps, compressors, exhaust stack, the combustion inlet filter house, condenser fans, high-pressure steam piping, and vehicles. Entergy does not expect noise impacts from the operation of an NGCC plant alternative to be any greater than those currently associated with WF3. Therefore, operations-related noise impacts under the NGCC plant alternative are anticipated to be SMALL.

7.1.3.1.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone and sand and gravel, would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces, and a new natural gas pipeline would expose soils to erosion and alter surface drainage. However, any ground disturbance of one or more acres would require that a construction stormwater permit be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants the stormwater may contact. Removed soils and any excavated materials would be stored onsite for redistribution such as for backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts under the NGCC plant alternative on geology and soils would be minimized and SMALL.

Land disturbance during operations would also be conducted in accordance with applicable permits and site procedures and plans. The NGCC plant alternative would also have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils under the NGCC plant alternative would also be SMALL.

7.1.3.1.5 Hydrology (Surface Water and Groundwater)

<u>Surface Water</u>

The NGCC plant alternative would occupy a much smaller footprint (i.e., about 59 acres) than the existing WF3 plant and infrastructure, which would result in less extensive excavation and earthwork. Dewatering of excavations, if necessary, is unlikely to consume enough water to affect surface water bodies.

For the NGCC plant alternative, Entergy assumes that WF3's existing intake and discharge infrastructure would be modified to maximize use of existing facilities. This would reduce construction-related impacts on surface water quality. Dredge-and-fill operations would be conducted under a USACE permit and State-equivalent permits requiring the implementation of BMPs to minimize impacts. Construction activities associated with this alternative will alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas, from excavation, and dredge-and-fill activities. Stormwater runoff from construction areas, as well as spills and leaks from construction equipment, could potentially affect downstream surface water quality. Nevertheless, for this alternative, appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, water discharge, SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality under the NGCC plant alternative are anticipated to be SMALL.

Depending on the path of any required new gas pipelines to service the NGCC plant alternative, some stream crossings could be necessary. However, because of the short-term nature of any required dredge-and-fill and stream-crossing activities, the hydrologic alterations and sedimentation would be localized, and water-quality impacts would be temporary. In addition, modern pipeline construction techniques, such as horizontal directional drilling, would further minimize the potential for water-quality impacts on the affected streams. Such activities, including any dredge-and-fill operations, would be conducted under a USACE permit and State-equivalent permits for dredge-and-fill and stream encroachment, requiring the implementation of BMPs to minimize impacts. Therefore, construction-related impacts on surface water use and quality are anticipated to be SMALL.

During operations, the NGCC plant alternative would use mechanical draft cooling towers with makeup water supplied by the Mississippi River. Water withdrawals would be a fraction of that required by WF3's once-through cooling system, and water consumption as a result of cooling tower evaporative losses would be insignificant compared to the volume of water flowing in the Mississippi River. Cooling water treatment additives would essentially be the same as those for WF3. While the discharge water quality would be chemically similar, the discharge volume from the closed-cycle NGCC plant alternative would be a small fraction of the cooling water discharge and related effluents discharged from WF3's once-through cooling system. However, like WF3, cooling water discharges would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality under the NGCC plant alternative would be SMALL.

Groundwater

Entergy assumes that construction water would be obtained from the St. Charles Parish water system whose source of water is the Mississippi River, and who currently supplies water to WF3. Construction water would be required for uses such as potable and sanitary use by the construction workforce and for concrete production, equipment washdown, dust suppression, and soil compaction.

Foundation excavations may intrude on groundwater zones and require dewatering during construction. Discharge of water removed by dewatering activities would require an LPDES permit and compliance with any conditions, minimizing impacts on receiving waters and soils. The potential impacts on groundwater from dewatering activities could stem from reductions in quantity and quality. However, as discussed in Section 3.5.2, shallow and deeper aquifers underlie the site, but groundwater usage is limited and is mainly for industrial purposes. Groundwater could also be affected by runoff that could contain contaminants; however, compliance with appropriate waste management practices, construction stormwater permit and pollution prevention requirements, and spill prevention practices, would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality under the NGCC plant alternative would be SMALL.

During operations, it is assumed that the St. Charles Parish water system would continue to supply potable water. Continuing dewatering activities, if necessary, would be regulated under an LPDES permit. In addition, appropriate waste management, SWPPP, and spill prevention practices, would prevent or minimize groundwater quality impacts. Therefore, operations-related impacts on groundwater use and quality under the NGCC plant alternative would be SMALL.

7.1.3.1.6 Ecological Resources (Terrestrial and Aquatic)

Terrestrial

Terrestrial ecology impacts from construction of the NGCC plant alternative would primarily occur from land disturbance. As discussed in Section 7.1.3.1.1, the NGCC plant alternative would require approximately 59 acres of land on site. The site has available acreage that is already disturbed and would not encroach on the wetlands of the site, which are primarily found south of LA-3127. Furthermore, the site is an industrial site with existing industry onsite (Waterford 1, 2, and 4), and industrial and transportation corridors are adjacent. Also as discussed in Section 7.1.3.1.1, siting any new gas pipeline along existing utility corridors would minimize impacts, and existing gas supply from the TETCO pipeline is assumed to be adequate for supporting operations of the NGCC plant alternative.

Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site and gas pipeline, and wildlife would relocate by their own means. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. Because WF3 is located in a heavily industrialized area, wildlife species have most likely acclimated to noise associated with activities in this area. Therefore, construction-related impacts on terrestrial resources under the NGCC plant alternative are anticipated to be SMALL.

The impacts on terrestrial resources from operation of the NGCC plant alternative would be similar to the continued operation of WF3 with the exception of impacts due to the operation of the mechanical draft cooling towers. Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Other impacts such as fogging and shadowing, etc. would also occur. Cooling tower operational noise could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). Therefore, overall operations-related impacts on terrestrial resources under the NGCC plant alternative are anticipated to be SMALL.

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion. Therefore, construction-related impacts on aquatic ecological resources under the NGCC plant alternative are anticipated to be SMALL.

During operations, the NGCC plant alternative would require less cooling water to be withdrawn from the Mississippi River than is required for WF3. Because of the lower withdrawal rates, the number of fish and other aquatic resources affected by cooling-water intake and discharge operations, such as entrainment, impingement, and thermal stress, would be less for the NGCC plant alternative than for those associated with license renewal. The cooling system for the NGCC plant alternative would have similar chemical discharges as WF3 which would be regulated by an LPDES permit, but the air emissions from the NGCC plant alternative would contain pollutants that could settle onto the river surface and introduce a new source of pollutants. However, the flow of the Mississippi River would likely dissipate and dilute the concentration of pollutants, resulting in minimal exposure to aquatic biota. Therefore, operations-related impacts on aquatic ecological resources under the NGCC plant alternative are anticipated to be SMALL.

Special Status Species

Unlike the proposed action, no-action alternative, and new nuclear alternative, the NRC does not license NGCC facilities, and the NRC would not be responsible for initiating Section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids the taking of a listed species.

However, as discussed in Section 3.6.11, no suitable habitat was identified on the Entergy Louisiana, LLC property for any of the federally listed species in St. Charles Parish during an October 2014 threatened and endangered species habitat survey, and no federally listed species were identified as being present on site. Although suitable habitat for three state-listed species was identified in undisturbed portions of the Entergy Louisiana, LLC property, the survey did not identify any state-listed species as being present on the Entergy Louisiana, LLC property. Because the site has available acreage that is already disturbed, as discussed in Section 7.1.3.1.6, construction- and operations-related impacts on special status species under the NGCC plant alternative are anticipated to have no effect. Based on consultation with the NMFS, no EFH has been designated in the Mississippi River in the vicinity of WF3 (Attachment B). Construction activities associated with the new gas pipeline would be subject to LDEQ construction stormwater permitting requirements, which would consider protection of special status species and associated designated habitats. Therefore, construction- and operations-related impacts on special status species under the NGCC plant alternative would have no effect.

7.1.3.1.7 Historic and Cultural Resources

As discussed in Section 7.1.3.1.1, the NGCC plant alternative would require approximately 59 acres of land on the Entergy Louisiana, LLC property and, as discussed in Section 7.1.3.1.6, the site has available acreage that is already disturbed. The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, the Waterford Plantation is the only cultural resources site on the Entergy Louisiana, LLC property eligible for listing on the NRHP. The Killona Plantation and possibly a portion of the Providence Plantation are also located on the Entergy Louisiana, NRHP eligibility. Therefore, any construction activities would either need to avoid these areas, or in the case of the Killona and Providence plantations, surveys would need to be conducted to determine their NRHP eligibility. However, because portions of the Entergy Louisiana, LLC property have already been previously identified as not containing significant historic and cultural resources, use of these areas for an NGCC plant alternative would have no effect on historic and cultural resources. As previously discussed in Section 7.1.3.1.1, a new gas pipeline would have to be installed to connect the hypothetical NGCC plant alternative to the gas infrastructure. However, this new pipeline could be collocated within an existing ROW, or if not located within an existing ROW, the area could be surveyed to identify and record historic and cultural resources. No offsite land would be needed for gas wells and collection wells, because the TETCO gas pipeline is assumed to be adequate for supporting operations of the NGCC plant alternative.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction and operational impacts on historic and cultural resources under the NGCC plant alternative is projected to have no adverse effect.

7.1.3.1.8 Socioeconomics

Socioeconomic Issues Other than Transportation

Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the NGCC plant alternative were evaluated to measure their possible effects on current socioeconomic conditions.

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.1) estimate of 1,200 workers needed to construct a 1,000-MWe natural gas plant, the NGCC plant alternative would have a peak construction workforce of approximately 1,640. Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region (50-mile radius of WF3). It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current WF3 workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Therefore, construction-related socioeconomics impacts under the NGCC plant alternative are anticipated to be SMALL.

Scaling from the 1996 GEIS (NRC 1996, Table 8.2) estimate of 150 workers needed for operations, the operations workforce under the NGCC plant alternative would be approximately 205, significantly smaller than the WF3 operations workforce of 641. The NGCC plant alternative workforce would continue to contribute beneficial socioeconomic impacts on the area albeit on a smaller scale as compared to WF3's current contribution and, as a smaller workforce, would have less of a demand for community services.

This alternative would also result in the loss of jobs at WF3 and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. However, the reduction in jobs at WF3 would most likely occur gradually as Entergy transitions from reactor operations to decommissioning. Socioeconomic impacts may not be noticeable in local communities, because this transition may occur over a long period of time. Although the NGCC plant alternative would be located in an area with other existing industries, it is uncertain what the loss of jobs at WF3 and potentially lower property tax payments would mean to the local community. Therefore, socioeconomic impacts during the operations period under the NGCC plant alternative could range from SMALL to MODERATE.

Transportation

A network of interstate highways surrounds the Entergy Louisiana, LLC property, with LA-18 providing access to WF3. This transportation network would be used by the commuting workforce and for delivery of needed construction materials. Larger components for the NGCC plant would likely arrive by barge or rail, which would avoid potential traffic congestion and stoppages for transport of large components. The traffic capacity of these roads and the ability to stagger workforce shifts, if needed, would minimize traffic congestion; however, the construction-related impacts under the NGCC plant alternative could still be MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the NGCC plant alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. The operations workforce of approximately 210 likely would not be noticeable relative to total traffic volumes on local roadways. Because fuel is transported by pipeline, the transportation infrastructure would experience little to no increased traffic from plant operations. Overall, given the relatively small operations workforce, operations-related transportation impacts under the NGCC plant alternative would be SMALL.

7.1.3.1.9 Human Health

Impacts on human health from construction of the NGCC plant alternative, including the construction of a new gas pipeline, would be similar to effects associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. The radiological human health impact on construction workers due to the proximity of WF3 still operating at that time would also be SMALL due to compliance with the NRC regulations and adherence to ALARA principles. The NRC reviewed radiation exposures to plant workers in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1). Impacts from construction on the general public would be minimal because crews would limit access to active construction areas to authorized individuals. Therefore, construction-related impacts on human health under the NGCC plant alternative would be SMALL.

During the operations period, the NGCC plant alternative would emit criteria air pollutants (Table 7.1-1). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risk. Regulatory agencies, including the EPA and State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and State agencies, human health impacts from criteria air pollutant emissions under the NGCC plant alternative would be SMALL. Operations would also be conducted in accordance with OSHA worker protection rules and NRC regulations, minimizing exposures and hazards. Based on the above, operations-related impacts on human health under the NGCC plant alternative would be SMALL.

7.1.3.1.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the NGCC plant alternative would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short-term and managed to limit offsite impacts. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse and would be contained to a limited time period during certain hours of the day. Increased demand for rental housing during construction could cause rental costs to rise disproportionately, affecting low-income populations residing in the vicinity of WF3 who rely on inexpensive housing. However, given the proximity of the New Orleans and Baton Rouge metropolitan areas, the majority of workers would be expected to commute to the construction site, thereby reducing the need for rental housing.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.1 of this ER, the construction and operation of an NGCC plant alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of WF3.

7.1.3.1.11 Waste Management

Sanitary wastes resulting from both the support of the construction crew and industrial wastes (some hazardous) would be generated during construction. Construction-related wastes are expected to be properly characterized and initially managed on site, and eventually removed to properly permitted offsite treatment or disposal facilities. Waste impacts from construction are expected to be SMALL.

During operation of the NGCC plant alternative, spent selective catalytic reduction (SCR) catalysts used to control nitrous oxide emissions would make up the majority of the waste, and this waste stream could exhibit hazardous characteristics (NRC 2013c, Section 9.2.2.2). Wastes generated during operations would be properly managed and disposed of as hazardous or nonhazardous waste in permitted offsite facilities. Recycling and waste minimization programs such as those at WF3 would also be implemented as appropriate. Therefore, waste management impacts during operations under the NGCC plant alternative are anticipated to be SMALL.

7.1.3.2 Coal-Fired Generation

As discussed in Section 7.1.1.2, the coal-fired alternative would be an SCPC plant, configured to produce net electrical power virtually equivalent to the 1,188 net MWe generated by WF3. Based on a capacity factor of 85 percent (EIA 2013a), the alternative is scoped as a 1,398-MWe plant to provide replacement power for WF3. Entergy assumes that the SCPC plant alternative would utilize closed-cycle cooling with mechanical draft cooling towers, and be equipped with carbon capture and storage technology. Due to site requirements as discussed below, the plant could potentially be sited on the Entergy Louisiana, LLC property. Entergy Louisiana, LLC property along with much of Louisiana is underlain with saline or coal geological formations with the potential for storing carbon (NETL 2012). However, the siting of the SCPC plant would require proven carbon storage capacity. In addition, the Entergy Louisiana, LLC property includes wetlands whose avoidance is highly desirable to minimize impacts. Furthermore, the permitting of a new major air criteria pollutant would be dependent on NAAQS attainment status within the ACQR where it is to be located. Therefore, the SCPC plant is assessed for a hypothetical site rather than identifying the Entergy Louisiana, LLC property as the specific site as is done for the other alternatives. For this analysis, impacts are based on the following assumptions:

- The plant would be located in Louisiana within the SERC transmission region in close proximity to an existing power plant.
- The plant would use closed-cycle cooling with mechanical draft cooling towers.
- The existing transmission line infrastructure would be sufficient to support the plant.
- The usable land at the site would be sufficient to avoid impacts on wetlands.
- The usable, previously disturbed land would be sufficient for the plant and infrastructure.
- The site would be located adjacent to a rail line or waterway capable of supporting delivery of coal in sufficient quantities for the plant's operation.
- The site would be at or near a geological formation capable of storing carbon emissions.

7.1.3.2.1 Land Use and Visual Resources

Land Use

Approximately 115 acres of land would be required for the SCPC plant alternative (ENERCON 2015b), based on a land use factor of 9.39E-06 acres per MWh (adapted from NETL 2010b, Figure 3-13). As previously discussed, the hypothetical site would be served by a rail line, requiring only the development of a rail spur on site, or would be served by a waterway capable of barge traffic that would deliver the needed coal supplies.

If the SCPC plant alternative is sited at a smaller previous plant site, then additional non-industrialized areas of the site may be needed. For example, an NGCC plant is typically one-half to one-third the size of an SCPC plant. If an SCPC plant is built on an existing NGCC plant site, the footprint of the SCPC plant would likely exceed the existing footprint of the NGCC site. Impacts could range from minimal, if the newly disturbed land surrounding the NGCC site was previously used for industrial purposes, to noticeable, if land that exceeded the original footprint of the NGCC plant site was previously used for non-industrial land uses. Therefore, the land use impacts from construction under the SCPC plant alternative could range from SMALL to MODERATE depending on the amount of land adjacent to the site that is converted to an industrial land use.

In its 1996 GEIS, the NRC estimated that approximately 22,000 acres would be needed for coal mining and waste disposal to support a 1,000-MWe plant during its operational life (NRC 1996, Section 8.3.9). Therefore, for a 1,398-MWe SCPC plant alternative, approximately 30,700 acres could be needed to support the plant for its lifetime. However, more recent impacts analysis for coal mining, based on limited case studies, indicates much less land would be transformed to support mining. NETL (2010b) study of the life-cycle cost of coal mining found the required feedstock of coal would result in land use impacts of approximately 1,350 acres (ENERCON 2015b). Much of this land is assumed to already experience some level of disturbance, because the land use would likely occur in existing coal mining areas. The elimination of 1,188 acres of uranium mining to supply fuel for WF3, estimated at approximately 1 acre per MWe (NRC 1996, Section 8.3.12) would offset some of these offsite land requirements. However, because the amount of land required for coal mining and processing could range from 1,350 to 30,700 acres, land use impacts during operations under the SCPC plant alternative are anticipated to range from SMALL to MODERATE.

Visual Resources

During construction, all of the clearing and excavation could potentially be visible off site. The SCPC plant alternative could be approximately 100 feet tall, with two to four exhaust stacks several hundred feet tall, and mechanical draft cooling towers. The facility would most likely be visible off site during daylight hours, and some structures may require aircraft warning lights. The condensate plumes from the cooling towers could also add to the visual impact.

In general, given that the SCPC plant alternative would be located near an existing power plant site, the new SCPC plant alternative could blend in with the surroundings. The power block of the SCPC plant alternative would look very similar to the existing power plant, and construction would appear similar to other ongoing onsite activities. However, if cooling towers did not previously exist at the site, the impact could be noticeable. Aesthetic impacts could range from SMALL to MODERATE under the SCPC plant alternative, depending on whether aesthetic changes are limited to the immediate vicinity of the existing power plant site, or whether the new cooling towers result in a noticeable change within the viewshed of the plant.

7.1.3.2.2 Air Quality

Construction of a coal-fired power plant would result in the release of various criteria pollutants and GHGs from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce. VOC releases would also result from the onsite storage and dispensing of vehicle and equipment fuels. Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction BMPs (e.g., development and execution of an appropriate fugitive dust control plan) would mitigate such impacts. Given that construction-related impacts on air quality from a coal-fired alternative would be of relatively short duration, impacts on air quality under the SCPC plant alternative are anticipated to be SMALL.

Air quality impacts associated with the operation of coal-fired generation are considerably different from those of nuclear power. SCPC plants emit SO_x, NO_x, particulate matter, and CO, all of which are regulated pollutants. Table 7.1-2 provides emission estimates for the SCPC plant alternative. Emission control technology and percent control assumptions were based on alternatives the EPA has identified as being available for minimizing emissions. A new coal-fired electricity-generating plant would qualify as a new major source of criteria pollutants and would be subject to PSD of air quality review under CAA requirements and Louisiana state regulations. A new coal-fired electricity-generating plant would also need to comply with the New Source Performance Standard for coal-fired plants set forth in 40 CFR Part 60, Subpart Da: particulate matter and opacity [40 CFR 60.42Da]; SO_2 [40 CFR 60.43Da]; and NO_x [40 CFR 60.44Da]. In addition, the new coal-fired electricity-generating plant would qualify as a major source because of its potential to emit greater than 100 tons/year of criteria pollutants and would be required to secure a Title V operating permit. (NRC 2013c, Section 9.2.2.1)

Section 169A of the CAA [42 USC 7401] establishes a national goal of preventing future, and remedying existing, impairment of visibility in mandatory Class I federal areas when impairment results from manmade air pollution. As discussed in Section 3.2.4, Breton Wilderness Area on Breton Island is the only Class I area located within Louisiana; no other Class I areas within the neighboring states exist near the Louisiana border (EPA 2015a).

CO_2 emissions are a major contributor to anthropogenic GHG emissions, which have been suggested to contribute to climate change. These emissions result from the efficiency of the technologies utilized to produce and deliver the energy and carbon content of the fuel being utilized. Coal-fired electricity generation has the highest emissions rate of CO_2 of the fossil-fuel sources, and significantly higher emissions compared to nuclear power electricity generation. As mentioned above, the SCPC plant alternative provides for carbon sequestration as proposed by EPA regulations (79 FR 1430). The proposed regulations require partial carbon capture sequestration technology operating to a level of 1,100 lb CO_2/MWh.

A new SCPC plant would also have to comply with CAA [42 U.S.C. 7651] Title IV reduction requirements for SO_2 and NO_x, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum SO_2 and NO_x emission rates from existing plants and a system of SO_2 emission allowances that can be used, sold, or saved for future use by new plants. (NRC 2014d, Section 8.2.1)

More recently, the EPA has promulgated additional rules and requirements that apply to certain fossil fuel-based power plants, such as SCPC plant generation. The Cross-State Air Pollution Rule, the PSD and Title V Greenhouse Gas Tailoring Rule, and the Mercury and Air Toxics Standards for Power Plants impose several additional standards to limit ozone, particulate, mercury, and GHG emissions from fossil fuel-based power plants. A new SCPC plant would be subject to these additional rules and regulations. (NRC 2014d, Section 8.2.1)

As noted above, a new SCPC plant would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, a new SCPC plant would be a major source of criteria pollutants and GHGs, and the overall operational air quality impacts under the SCPC plant alternative would be MODERATE.

7.1.3.2.3 Noise

Noise activities associated with construction are temporary and given the required acreage for the site, there is much potential for the distance to the nearest sensitive receptors to be great enough that construction noise is attenuated to levels close to levels associated with community or commercial activity. Construction activities would be conducted in compliance with any applicable local noise ordinances. Therefore, construction-related noise impacts under the SCPC plant alternative are anticipated to be effectively managed and kept SMALL.

During operations, the SCPC plant alternative would introduce mechanical sources of noise that could be audible off site. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal and ash handling which, although intermittent, occur daily both during daylight and night time hours; transportation related to coal and lime/limestone delivery; use of outside loudspeakers; and the commuting of plant employees. In the case of rail delivery of supplies, noise impacts would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains, if applicable, significantly increases noise levels near the rail corridor, the short duration of the noise reduces the impacts. Therefore, operations-related noise impacts under the SCPC alternative could range from SMALL to MODERATE depending on the site location and proximity to residences.

7.1.3.2.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone and sand and gravel, would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces would expose soils to erosion and alter surface drainage. However, any ground disturbance of one or more acres would require that a construction stormwater permit be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Removed soils and any excavated materials would be stored on site for redistribution, such as for backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts under the SCPC plant alternative on geology and soils would be minimized and SMALL.

Land disturbance during operations would also be conducted in accordance with applicable permits and site procedures and plans. The SCPC plant alternative would also have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils under the SCPC plant alternative would also be SMALL.

7.1.3.2.5 Hydrology (Surface Water and Groundwater)

Surface Water

Entergy assumes that there would be no direct use of surface water during construction. In addition, any dewatering of excavations is unlikely to consume enough water to affect surface water bodies. For the SCPC plant alternative, it is assumed that an intake and discharge infrastructure would be required. Dredge-and-fill operations would be conducted under a permit from the USACE and State-equivalent permits requiring the implementation of BMPs to minimize impacts. Construction activities associated with this alternative will alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas, from excavation, and dredge-and-fill activities. Stormwater runoff from construction areas and spills and leaks from construction equipment could potentially affect downstream surface water quality. Nevertheless for this alternative, it is anticipated that appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, water discharge, SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts under the SCPC plant alternative on surface water use and quality are anticipated to be SMALL.

During operations, the SCPC plant alternative would use mechanical draft cooling towers with the source of makeup water most likely supplied from a river. Cooling water treatment additives would essentially be the same as those for WF3. While the discharge water quality would be chemically similar, the discharge volume from the closed-cycle SCPC plant alternative would be a small fraction of the cooling water discharge and related effluents discharged from WF3's once-through cooling system. However, like WF3, cooling water discharges would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality under the SCPC plant alternative would be SMALL.

Groundwater

Entergy assumes that construction water would be obtained from a local water supply system. Construction water would be required for uses such as potable and sanitary use by the construction workforce and for concrete production, equipment washdown, dust suppression, and soil compaction.

Foundation excavations may intrude on groundwater zones and require dewatering during construction. Discharge of water removed by dewatering activities would require an LPDES permit and compliance with any conditions, minimizing environmental impacts on receiving waters and soils. The potential impacts on groundwater from dewatering activities could stem from reductions in quantity and quality. Groundwater could also be affected by runoff that could contain contaminants, but compliance with appropriate waste management practices, a required construction stormwater permit and pollution prevention requirements, and spill prevention practices, would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality under the SCPC plant alternative would be SMALL.

During the operations period, it is assumed that a local water supply system would continue to provide potable water. Continuing dewatering activities, if necessary, would be regulated under an LPDES permit. In addition, appropriate waste management, SWPPP, and spill prevention practices, would prevent or minimize groundwater quality impacts. Therefore, operations-related impacts on groundwater use and quality under the SCPC plant alternative would be SMALL.

7.1.3.2.6 Ecological Resources (Terrestrial and Aquatic)

Terrestrial

As discussed in Section 7.1.3.2.1, the SCPC plant alternative requires approximately 115 acres of land, and it is assumed that the hypothetical site would not impact wetlands. During construction, terrestrial ecology impacts would primarily occur from land disturbance and destruction of habitat. Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would be displaced. The level of direct impacts would vary substantially based on the amount and ecological importance of directly affected habitats. Erosion and sedimentation, fugitive dust, and construction debris impacts would likely be minor with the implementation of appropriate BMPs. Therefore, construction-related impacts on terrestrial resources under the SCPC plant alternative could range from SMALL to MODERATE.

During operations, onsite temporary storage of coal, coal combustion residue (CCR), spent catalysts, and scrubber sludge, as well as any offsite waste disposal by landfilling of CCR, would also affect the terrestrial ecology by requiring conversion of existing habitat. Deposition of acid rain resulting from NO_x or SO_x emissions, and deposition of other pollutants could also affect terrestrial ecology. In addition, operation of the mechanical draft cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Cooling tower operational noise could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). However, because it is assumed that the SCPC plant alternative would be located on previously disturbed land as discussed in Section 7.1.3.2, these impacts are anticipated to be SMALL.

As discussed in Section 7.1.3.2.1, the amount of land required for coal mining could range from 1,350 to 30,700 acres to support a coal-fired plant during its operational life. Offsetting a small portion of this offsite land use would be the elimination of the need for uranium mining and processing to supply fuel for WF3. It was estimated that approximately 1 acre per MWe would be affected for mining and processing the uranium during the operating life of a nuclear power plant (NRC 1996, Section 8.3.12). Because of the potentially large area of undisturbed habitat that could be affected by mining activities, the operations-related impacts on terrestrial resources under the SCPC plant alternative could range from SMALL to MODERATE.

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features, while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion. Therefore, construction-related impacts on aquatic resources under the SCPC plant alternative are anticipated to be SMALL.

Impacts on aquatic ecosystems during operation could take the form of impingement and entrainment due to the closed-cycle cooling system's water withdrawals, and thermal and chemical discharges associated with blowdown. Impingement and entrainment effects would be dependent on the quality of the source water and organisms residing within the local habitat, but use of closed-cycle cooling would minimize impacts. However, all impacts associated with impingement, entrainment, and thermal and chemical discharges would be controlled by an LPDES permit. The air emissions from the SCPC plant alternative would emit pollutants that could settle onto the source waterbody and introduce a new source of pollutants. However, the source waterbody would most likely dissipate and dilute the concentration of pollutants, resulting in minimal exposure to aquatic biota. Therefore, operations-related impacts on aquatic resources under the SCPC alternative are anticipated to be SMALL.

Special Status Species

The types and magnitudes of adverse impacts on ESA-listed species and EFH would depend on the proposed site, plant design, operation, and listed species and habitats present when the alternative is implemented. Therefore, Entergy cannot forecast a particular level of impact on special status species for this alternative.

7.1.3.2.7 Historic and Cultural Resources

Land areas affected by the construction of the SCPC plant alternative would be surveyed to identify and record historic and cultural resources. Any resources found would be recorded and evaluated for eligibility for listing on the NRHP. Mitigation of adverse effects would be considered if eligible properties were encountered. Areas with the most significant cultural resources would be avoided. Visual impacts, such as historic property viewsheds near the proposed power plant site, would also be evaluated.

The potential impacts on historic and cultural resources would vary depending on the site selected for the proposed SCPC plant alternative. The cooling towers could impact the viewshed of historic properties. However, siting the SCPC plant alternative near an existing power plant site could reduce the potential impacts on historic and cultural resources, if effectively managed under current laws and regulations. Therefore, the construction- and operations-related impacts on historic and cultural resources under the SCPC plant alternative are projected to have no adverse effect.

7.1.3.2.8 Socioeconomics

Socioeconomic Issues Other than Transportation

Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the SCPC plant alternative were evaluated to measure their possible effects on current socioeconomic conditions.

In the GEIS, the NRC estimated the peak workforce required to construct a 1,000-MWe coal-fired plant at 1,200 to 2,500 (NRC 1996, Table 8.1). Therefore for the hypothetical 1,398-MWe SCPC plant, the peak workforce could range from approximately 1,680 to 3,500. The socioeconomic impact would be dependent on the setting for the plant (rural or urban), and cannot be projected without the selection of a site. However, the relative economic effect of this many workers on the local economy and tax base would vary with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short-term economic "boom" from increased tax revenue and income generated by construction expenditures, and the increased demand for temporary (rental) housing and public services, as well as commercial services.

After construction, local communities could experience a return to pre-construction economic conditions. Based on this information and given the number of workers required for the SCPC plant alternative, socioeconomic impacts during construction in communities near the site could range from MODERATE to LARGE.

In the GEIS, the NRC estimated the operations workforce for a 1,000-MWe coal-fired plant at 250 (NRC 1996, Table 8.2). Therefore, the operations workforce for the SCPC plant alternative would be approximately 350. Local communities would experience the economic benefits from increased tax revenue and income generated by operations expenditures, and demand for housing and public and commercial services. The amount of property tax payments under the SCPC plant alternative may also increase if additional land is required to support this alternative. The socioeconomic operations impacts under the SCPC plant alternative on local communities could range from SMALL to MODERATE.

The coal-fired alternative would also result in the loss of jobs at WF3 and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. However, the reduction in jobs at WF3 could occur gradually as Entergy transitions from reactor operations to decommissioning. As discussed in Section 3.8.5, for property tax purposes, Louisiana calculates a total entity or unit value for regulated utilities in the state, including Entergy Louisiana, LLC, and does not value WF3 on a standalone basis. Therefore, Entergy Louisiana, LLC does not receive separate tax invoices for power plants. Because it is uncertain what portion of the tax payments made to St. Charles Parish is attributable to WF3, socioeconomic impacts in communities local to WF3 could range from SMALL to MODERATE.

<u>Transportation</u>

As discussed above, the SCPC plant alternative would have a peak construction workforce of approximately 1,680 to 3,500 workers. Larger components for the SCPC plant would most likely arrive by barge or rail, which would avoid potential traffic congestion and stoppages for transport of large components. Traffic congestion associated with the workforce could potentially be minimized by staggering workforce shifts. However, due to the uncertainty of where the SCPC plant alternative would be located (rural or urban setting), construction-related transportation impacts under the SCPC plant alternative could range from SMALL to MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the SCPC plant alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. The operations workforce of approximately 360 would be divided over shifts, and likely would not be noticeable relative to total traffic volumes on local roadways. Because coal would be transported by rail or waterway, the transportation infrastructure would experience little to no increased traffic from plant operations. Overall, given the relatively small operations workforce, operations-related transportation impacts under the SCPC plant alternative would be SMALL.

7.1.3.2.9 Human Health

Impacts on workers are expected to be similar to those experienced during construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. Construction would increase traffic on local roads, which could affect the health of the general public. Human health impacts would be the same for all facilities whether located on greenfield sites, brownfield sites, or at an existing nuclear power plant. Personal protective equipment, training, and engineered barriers would protect the workforce. Therefore, the impacts on human health from the construction of the SCPC plant alternative would be SMALL.

Coal-fired power plants introduce worker risks from coal and limestone mining, coal and limestone transportation, industrial operations at the plant, and waste disposal operations. In addition, there are stack emissions and secondary effects of deposition of eating foods grown in areas subject to pollutants emitted from power plant stacks. However, many of the byproducts of coal combustion responsible for health effects are largely controlled, captured, or converted in modern power plants. (NRC 2013c, Section 9.2.2.1)

Regulations restricting emissions have reduced potential health effects. Permitting agencies also impose site-specific emissions limits, as needed, to protect human health. Even if the SCPC plant alternative were located in a nonattainment area, emission controls and trading or offset mechanisms could prevent further regional degradation; however, local effects could be visible. (NRC 2013c, Section 9.2.2.1) Therefore, operations-related impacts on human health under the SCPC plant alternative would be SMALL.

7.1.3.2.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction and operation of the SCPC plant alternative near an existing power plant site would consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short-term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle traffic during shift changes and truck traffic. However, these effects would be temporary during certain hours of the day and would not likely be high and adverse. Increased demand for rental housing during construction could affect low-income populations. However, given the proximity of some existing power plant sites to metropolitan areas, many construction workers could commute to the site, thereby reducing the potential demand for rental housing.

Emissions from the operation of the SCPC plant alternative could affect minority and low-income populations living in the vicinity of the new power plant. However, permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.2 of this ER, the construction and operation of the SCPC plant alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations. However, a definitive determination of the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations would depend on the SCPC plant alternative's location, plant design, and expected operations characteristics. Therefore, the effects on minority and low-income populations for this alternative cannot be definitively forecasted.

7.1.3.2.11 Waste Management

Sanitary wastes resulting from both the support of the construction crew and industrial wastes (some hazardous) would be generated during construction, such as clearing the construction site of vegetation, excavating and preparing the site surface before other crews begin actual construction of the plant, modifying existing infrastructure, and constructing any additional required infrastructure. Minor amounts of industrial wastes will result from the onsite maintenance of construction vehicles and equipment, the use of cleaning solvents, and the application of corrosion control coatings. Construction-related wastes are expected to be properly characterized and initially managed on site, and eventually removed to properly permitted offsite treatment disposal or recycling facilities. Construction-related waste impacts under the SCPC plant alternative are expected to be SMALL.

Coal combustion generated during the operations period includes several waste streams, including ash (a dry solid recovered from both pollution control devices [fly ash] and from the bottom of the boiler [bottom ash]) and sludge (a semi-solid byproduct of emission control system operation; in this case, primarily calcium sulfate from the operation of the wet calcium carbonate SO_2 scrubber) (NRC 2013c, Section 9.2.2.1). The estimated annual volumes of these wastes are presented in Table 7.1-3. Recycling and waste minimization programs applicable to these waste streams and other plant waste streams would be implemented as appropriate.

The impacts from waste generated during operation of the SCPC plant alternative would be dependent on the ability to recycle the solid wastes and dispose of the wastes that could not be recycled in dry ash piles in compliance with regulatory requirements. Based on the waste quantities requiring disposal as presented in Table 7.1-3, 40 years of operation could require from 167 to 387 acres to hold the ash and dry sludge wastes if the wastes were piled 30 feet high. Therefore, based on the large volume of waste, as well as the toxicity of the waste generated by coal combustion, and the uncertainty of recycling percentages of the waste, it is concluded that operations-related waste impacts could range from SMALL to MODERATE.

7.1.3.3 New Nuclear Generation

As discussed in Section 7.1.1.3, the new nuclear generation plant alternative involves the construction and operation of a new nuclear reactor on the Entergy Louisiana, LLC property. For purposes of this evaluation, it is assumed that the alternative would involve one unit with a generating capacity to replace WF3's base-load generation capacity of 1,188 MWe, which as a 90-percent capacity factor (EIA 2013a) would be a 1,320-MWe plant. The environmental impacts associated with constructing and operating the new nuclear plant alternative assumes (1) closed-cycle cooling with mechanical draft cooling towers would be utilized, (2) source of cooling water would be the Mississippi River, (3) existing transmission infrastructure is adequate, and (4) existing intake and discharge structures can be utilized with some modifications.

7.1.3.3.1 Land Use and Visual Resources

Land Use

As shown in Figures 3.0-1 and 3.1-1, much of the Entergy Louisiana, LLC property north of LA-3127 is developed at a low intensity, (e.g., cleared, parking lot, agricultural). This analysis assumes that land on the Entergy Louisiana, LLC property could be developed for the new nuclear plant alternative, meeting levee setback restrictions and avoiding wetlands. The Entergy Louisiana, LLC property was previously the subject of a feasibility evaluation by the Idaho National Laboratory for locating a new nuclear plant. The evaluation determined four sites adjacent to WF3 to be feasible pending a more intensive investigation (INL 2011, Figure 5).

Based on previous acreage estimated for the Grand Gulf Nuclear Station Unit 3, Entergy is assuming that approximately 234 acres would be needed for this alternative (SERI 2008, Section 4.1.1). The new nuclear plant alternative would be located on property that is already zoned for heavy industry and constructed on previously disturbed land so that encroachment on wetlands can be avoided. In addition, the new nuclear plant alternative could make use of the existing infrastructure, which would reduce the amount of land needed to support the new unit. Therefore, construction-related impacts on land use under the new nuclear plant alternative would be SMALL.

During operations, there would be no net change in offsite land use impacts from the mining of uranium fuel, if supplies destined to be used during WF3 license renewal period were redirected for use at a new nuclear facility. Therefore, operations-related impacts on land use under the new nuclear plant alternative would be SMALL.

Visual Resources

During construction, all of the clearing and excavation would occur on site and may be visible off site. Because the existing power plant site already appears industrial and is situated in a heavily industrialized area, construction of the new nuclear power plant alternative would appear similar to other ongoing onsite activities. Therefore, construction-related impacts on visual resources under the new nuclear plant alternative would be SMALL.

The Entergy Louisiana, LLC property is already aesthetically altered by the presence of an existing nuclear power plant as well as Waterford 1, 2, and 4 fossil plants, and other industrial facilities nearby. Therefore, the new nuclear plant alternative would blend in with its surroundings. Aesthetic changes would therefore be limited to the immediate vicinity of the existing power plant site. Because cooling towers did not previously exist at the site, the impact could be noticeable. However, as previously discussed, the new nuclear plant alternative would be located in a heavily industrialized area where tall structures and visible plumes already exist. Therefore, operations-related impacts on visual resources under the new nuclear plant alternative are anticipated to be SMALL.

7.1.3.3.2 Air Quality

Construction of the new nuclear plant alternative would result in temporary impacts on local air quality. Ground-clearing, grading, and excavation activities would raise dust, as would the movement of materials and machinery. Fugitive dust may also arise from cleared areas during windy periods. In addition, emissions from these activities would contain various air pollutants, including CO, NO_x, SO_x, particulate matter, and VOCs, as well as various GHGs. Air emissions would be intermittent and vary based on the level and duration of a specific activity throughout the construction phase. Exhaust from the vehicles required to transport the construction workforce could also decrease air quality somewhat. Various mitigation techniques could be utilized to minimize air emissions and reduce fugitive dust. Because air emissions from construction activities would be limited, local, and temporary, construction-related impacts on air quality under the new nuclear plant alternative are anticipated to be SMALL.

Sources of air emissions during the operations phase include equipment such as emergency diesel generators and other minor emission sources that would be operated within federal and state air quality limits, some of which would only be operated intermittently. Similar to WF3, the new nuclear plant alternative would be considered a minor source of air emissions and subject to conditions established in an LDEQ-issued air permit that would be protective of Louisiana's ambient air quality standards to ensure that impacts are maintained at acceptable levels. As previously discussed in Section 7.1.1.3, the new nuclear plant alternative would utilize a closed-cycle cooling system with mechanical draft cooling towers. Particulate emissions from the cooling towers would be subject to conditions established in the LDEQ-issued air permit. The NRC evaluated the impacts from cooling tower particulate emissions in the GEIS and considered these impacts to be SMALL (NRC 2013b, Table 2.1-1). Therefore, the overall operations-related impacts on air quality under the new nuclear plant alternative would be SMALL.

In addition, as the NRC discussed in the GEIS, GHG emissions that would be associated with nuclear are lower than fossil fuel-based energy sources, and similar to the life-cycle GHG emissions from renewable energy sources (NRC 2013b, Tables 4.12-4, 4.12-5, 4.12-6). Therefore, air quality impacts associated with the new nuclear plant alternative would avoid millions of tons of GHGs that otherwise would be produced by fossil fuel-fired generation, thereby resulting in a beneficial air quality impact.

7.1.3.3.3 Noise

Sources of noise during construction would include bulldozers, draglines, scrapers, haulers to excavate earth and grade, cranes, front loaders, graders, forklifts, man lifts, compressors, backhoes, dump trucks, a pier driller, and portable welding machines. These impacts would be intermittent and last only through the duration of plant construction. As previously discussed in Section 7.1.3.1.3, the site is zoned heavy industrial and is located within an existing heavily industrialized area. The nearest residences are located approximately 0.9 miles to the northeast, east-northeast, northwest and west-northwest, and parks located approximately 1 mile northwest and 1 mile east-northeast, respectively, from the site. Therefore, construction-related noise impacts under the new nuclear plant alternative are anticipated to be SMALL.

Noise associated with the operation of a new nuclear plant would include sources such as cooling towers, switchyard, motors, generators, pumps, and trucks and cars typical of an operating industrial facility. The permanent workforce would also produce traffic noise during their commute to and from work. However, as previously discussed, the new nuclear plant alternative would be located in a heavily industrialized area, and noise levels are anticipated to be similar to those associated with WF3 operations. Therefore, operations-related noise impacts under the new nuclear plant alternative are expected to be SMALL.

7.1.3.3.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone and sand and gravel, would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces would expose soils to erosion and alter surface drainage. Any ground disturbance of one or more acres would require that a construction stormwater permit be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Removed soils and any excavated materials would be stored onsite for redistribution such as for backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts under the new nuclear plant alternative on geology and soils would be SMALL.

Land disturbance during operations would also be conducted in accordance with applicable permits and site procedures and plans. The new nuclear plant alternative would have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and would contain BMPs that would be used to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils under the new nuclear plant alternative would also be SMALL.

7.1.3.3.5 Hydrology (Surface Water and Groundwater)

<u>Surface Water</u>

Entergy assumes that there would be no direct use of surface water during construction, because water could be supplied by a local water utility. In addition, the dewatering of excavations is unlikely to consume enough water to affect surface water bodies at this location adjacent to the Mississippi River. For the new nuclear plant alternative, Entergy also assumes that WF3's existing intake and discharge infrastructure would be modified to maximize use of existing facilities. This would reduce construction-related impacts on surface water quality. Dredge-and-fill operations would be conducted under a permit from the USACE and State-equivalent permits requiring the implementation of BMPs to minimize impacts.

Construction activities associated with this alternative will alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas, excavation, and dredge-and-fill activities. Stormwater runoff from construction areas, and spills and leaks from construction equipment could potentially affect downstream surface water quality. Nevertheless, for this alternative, it is anticipated that appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, water discharge, SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality under the new nuclear plant alternative are anticipated to be SMALL.

During operations, the new nuclear plant would utilize mechanical draft cooling towers with the source of makeup water supplied by the Mississippi River. Water withdrawals would be a fraction of that required by WF3's once-through cooling system, and water consumption as a result of cooling tower evaporative losses would be insignificant compared to the volume of water flowing in the Mississippi River.

Cooling water treatment additives would essentially be the same as WF3. While the discharge water quality would be chemically similar, the water discharge volume from the new closed-cycle nuclear plant alternative would be a small fraction of that discharged from WF3's once-through cooling system. However, like WF3, water discharges would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality under the new nuclear plant alternative would be SMALL.

Groundwater

Entergy assumes that construction water would be obtained from the St. Charles Parish water system whose source of water is the Mississippi River, and who currently supplies water to WF3. Construction water would be required for uses such as potable and sanitary use by the construction workforce and for concrete production, equipment washdown, dust suppression, and soil compaction.

Foundation excavations may intrude on groundwater zones and require dewatering during construction. Discharge of water removed by dewatering activities would require an LPDES permit and compliance with any conditions, minimizing environmental impacts on receiving waters and soils. The potential impacts on groundwater from dewatering activities could stem from reductions in quantity and quality. However, as discussed in Section 3.5.2, shallow and deeper aquifers underlie the site, but groundwater usage is limited and is mainly for industrial purposes. Groundwater could also be affected by runoff that could contain contaminants, but compliance with appropriate waste management practices, a required construction stormwater permit and pollution prevention requirements, and spill prevention practices, would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality under the new nuclear plant alternative would be SMALL.

During the operations period, it is assumed that the St. Charles Parish water system would continue to supply potable water. Continuing dewatering activities, if necessary, would be regulated under an LPDES permit. In addition, appropriate waste management, SWPPP, and spill prevention practices, would prevent or minimize groundwater quality impacts. Therefore, operations-related impacts on groundwater use and quality under the new nuclear plant alternative would be SMALL.

7.1.3.3.6 Ecological Resources (Terrestrial and Aquatic)

Terrestrial

Terrestrial ecology impacts from construction of the new nuclear plant alternative would primarily occur from land disturbance. As discussed in Section 7.1.3.3.1, a new nuclear plant would require approximately 234 acres of land on the Entergy Louisiana, LLC property. The site has available acreage that is already disturbed and would not encroach on the wetlands of the site, which are primarily found south of LA-3127. Furthermore, the site is an industrial site with existing industry onsite (Waterford 1, 2, and 4), and industrial and transportation corridors are adjacent.

Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would relocate by their own means. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. Because WF3 is located in a heavily industrialized area, wildlife species have most likely acclimated to noise activities associated with this area. Therefore, construction-related impacts on terrestrial resources under the new nuclear plant alternative are anticipated to be SMALL.

The impacts on terrestrial resources from operation of the new nuclear plant alternative would be similar to continued operation of WF3, with the exception of impacts due to the operation of onsite mechanical draft cooling towers. Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Other impacts such as fogging and shadowing, etc. would also occur. Operational noise from the mechanical draft cooling towers could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to those at existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). Therefore, it is concluded that overall operations-related impacts on terrestrial resources under the new nuclear plant alternative would be SMALL.

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features, while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion.

Therefore, construction-related impacts on aquatic resources under the new nuclear plant alternative are anticipated to be SMALL.

During operations, the new nuclear plant alternative would require less cooling water to be withdrawn from the Mississippi River than required for WF3. Because of the lower withdrawal rates, the number of fish and other aquatic resources affected by cooling-water intake and discharge operations, such as entrainment, impingement, and thermal stress, would be less for the new nuclear plant alternative than for those associated with license renewal. The cooling system for the new nuclear plant alternative would have chemical discharges similar to those from WF3 which would be regulated by an LPDES permit, but the air emissions from the new nuclear plant alternative would emit pollutants that could settle onto the river surface and introduce a new source of pollutants. However, the flow of the Mississippi River would likely dissipate and dilute the concentration of pollutants, resulting in minimal exposure to aquatic biota. Therefore, operations-related impacts on aquatic resources under the new nuclear plant alternative are anticipated to be SMALL.

Special Status Species

The NRC would remain the licensing agency under this alternative, and thus, the ESA would require the NRC to initiate consultation with the USFWS and NMFS, as applicable, prior to construction to ensure that the construction and operation of the new nuclear plant would not adversely affect any federally listed species or adversely modify or destroy designated critical habitat.

As discussed in Section 3.6.11, no suitable habitat was identified on the Entergy Louisiana, LLC property for any of the federally listed species in St. Charles Parish during an October 2014 threatened and endangered species habitat survey, and no federally listed species were identified as being present on site. Although suitable habitat for three state-listed species was identified in undisturbed portions of the Entergy Louisiana, LLC property, the survey did not identify any of the state-listed species as being present on the Entergy Louisiana, LLC property. Because the site has available acreage that is already disturbed, as discussed in Section 7.1.3.1.6, construction- and operations-related impacts on special status species under the new nuclear plant alternative are anticipated to have no effect. Based on consultation with the NMFS, no EFH has been designated in the Mississippi River in the vicinity of WF3 (Attachment B).

7.1.3.3.7 Historic and Cultural Resources

As discussed in Section 7.1.3.3.1, a new nuclear plant would require approximately 234 acres of land on site, and already disturbed acreage is available. The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, the only area located on the Entergy Louisiana, LLC property eligible for listing on the NRHP is the Waterford Plantation. The Killona Plantation and possibly a portion of the Providence Plantation are also located on the Entergy Louisiana, LLC property, although neither of these sites has been surveyed to determine their NRHP eligibility. Therefore, any construction activities would either need to avoid these areas, or in the case of the Killona and Providence plantations, surveys would need to be conducted to determine their NRHP eligibility. However, as portions of the Entergy Louisiana, LLC property have been previously identified as not containing significant historic and cultural resources, use of these areas for a new nuclear plant alternative would have no effect on historic and cultural resources.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction and operation of the new nuclear plant alternative is projected to have no adverse effect on historic and cultural resources.

7.1.3.3.8 Socioeconomics

Socioeconomic Issues Other than Transportation

Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the new nuclear plant alternative were evaluated to measure their possible effects on current socioeconomic conditions.

New nuclear construction is currently underway at three existing plants in the United States: two involve the construction of two units, and one is constructing a single unit. The two-unit construction projects have projected peak workforces of 3,500 and 5,000, respectively (POWER 2013 and Augusta Chronicle 2014). Using actual workforce numbers for constructing the single unit, Watts Bar 2 (TVA 2012), a workforce size of approximately 2,100 was assumed for construction of the new nuclear plant alternative. Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region (50-mile radius of WF3). It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current WF3 workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Therefore, construction-related socioeconomic impacts under the new nuclear plant alternative are anticipated to be SMALL.

Entergy assumes that the number of operations workers at the new nuclear plant alternative would be similar to the number of operations workers at WF3, but there could be a temporary increase in employment at the site from decommissioning activities at WF3. Entergy also assumes that property taxes for the new nuclear alternative would be comparable to those of WF3. Therefore, operations-related socioeconomic impacts under the new nuclear plant alternative could range from SMALL to MODERATE.

Transportation

A network of interstate highways surrounds the Entergy Louisiana, LLC property, with LA-18 providing access to WF3. Larger components for the new nuclear plant would likely arrive by barge or rail, which would avoid potential traffic congestion and stoppages for transport of large components. The traffic capacity of these roads and the ability to stagger workforce shifts, if needed, would minimize traffic congestion; however, construction-related transportation impacts under the new nuclear plant alternative could still be MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the new nuclear plant alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. Therefore, operations-related transportation impacts under the new nuclear plant alternative are anticipated to be SMALL.

7.1.3.3.9 Human Health

Impacts on human health from construction of the new nuclear plant alternative would be similar to effects associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. The radiological human health impact on construction workers due to the proximity of WF3 still operating at that time would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. NRC reviewed the human health and environmental impacts from radiological emissions and waste in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1). Impacts from construction on the general public would be minimal, because crews would limit access to active construction area to authorized individuals. Based on the above, the construction-related impacts on human health under the new nuclear plant alternative would be SMALL.

The human health effects from the operation of the new nuclear plant alternative would be similar to those of the existing WF3 plant. As presented in Section 4.9, impacts on human health from the operation of WF3 would be SMALL. In addition, the NRC determined in the GEIS that impacts from radiological emissions and waste would be SMALL (NRC 2013b, Table 2.1-1). Therefore, overall operations-related impacts on human health under the new nuclear plant alternative would be SMALL.

7.1.3.3.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the new nuclear plant alternative on the Entergy Louisiana, LLC property would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short-term, though longer than for the NGCC or coal-fired plant alternatives, and primarily limited to onsite. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse and would be contained to a limited time period during certain hours of the day. Increased demand for rental housing during construction could cause rental costs to rise disproportionately, affecting low-income populations living near WF3 who rely on inexpensive housing. However, given the proximity of New Orleans and Baton Rouge metropolitan areas and their volume of temporary and permanent housing across the social economic spectrum, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.3 of this ER, the construction and operation of a new nuclear plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of WF3.

7.1.3.3.11 Waste Management

Sanitary wastes resulting from both the support of the construction crew and industrial wastes (some hazardous) would be generated during construction. Construction-related wastes are expected to be properly characterized and initially managed on site and eventually removed to properly permitted offsite treatment or disposal facilities. Waste impacts from construction under the new nuclear plant alternative are expected to be SMALL.

During operation, the new nuclear plant alternative would generate nonhazardous, hazardous, spent nuclear fuel, and radioactive waste. The nonhazardous and hazardous waste would be managed in compliance with state regulations and disposed of in permitted facilities. Entergy has internal recycling and waste minimization programs that would reduce waste volumes. Spent nuclear fuel would be managed on site per NRC regulations and the nuclear plant's NRC OL. Radioactive waste would be managed on site in accordance with NRC and state regulations and disposed of in permitted facilities. The NRC reviewed the impacts from nonradioactive and radioactive waste in the GEIS and determined the impacts to be SMALL (NRC 2013b, Table 2.1-1). Therefore, waste management impacts during operations under the new nuclear plant alternative would be SMALL.

7.1.3.4 Combination of Alternatives

As discussed in Section 7.1.1.4 and shown below, the combination of alternatives involves the construction and operation of NGCC and biomass plants at the Entergy Louisiana, LLC site and implementation of DSM programs for an annual reduction in demand. This combination of alternatives (NGCC plant, biomass plants, and DSM) was also selected by the NRC as a reasonable alternative to replace the base-load power generated by the Grand Gulf Nuclear Station, Unit 1 plant, which is also located in the southeastern United States (NRC 2014b, Section 8.4):

- A 668-MWe NGCC plant operating at an 87-percent capacity factor (EIA 2013a) for a total of 581 MWe.
- Four 50-MWe biomass plants operating at an 83-percent capacity factor (EIA 2013a) for a total of 166 MWe.
- DSM programs providing 441 MWe.

The biomass plants would be capable of using a variety of biomass fuels such as wood waste, crop residue, energy crops, and MSW to take advantage of the feedstock options available in the area, as well as for greater assurance of reliable feedstock.

Based on the projected supply for 2025 stemming from DSM programs as discussed in Section 7.1.2.1.3, it is assumed that the potential for an annual savings of 441 MW from implementation of a variety of energy efficiency and demand reduction programs can be achieved. The environmental impacts associated with the combination alternatives based on the assumptions described in Section 7.1.1.4 are described below.

7.1.3.4.1 Land Use and Visual Resources

Land Use

As previously discussed in Section 7.1.3.1.1, there is ample availability of disturbed land on the Entergy Louisiana, LLC property to avoid encroachment into wetlands as a result of construction activities. For the NGCC plant combination alternative, an estimated 29 acres would be needed, approximately 50 percent of that required for the discrete NGCC plant alternative discussed in Section 7.1.3.1.1. Also as discussed in Section 7.1.3.1.1, the natural gas pipeline closest to WF3 capable of supplying adequate gas supply to operate the NGCC plant alternative is the TETCO pipeline, approximately 6–7 miles south of WF3 on the same side of the Mississippi River. In addition, offsite land is typically required for natural gas wells and collection stations during operations. However, as previously discussed in Section 7.1.3.1.1, there is an abundance of gas supply being transported from the northeast United States through the TETCO pipeline to the Gulf area. Therefore, Entergy assumes that no additional offsite land would be required.

The biomass plants component of the combination alternative would require an estimated 60 acres based on the NRC's previous use of 15 acres per unit (NRC 2014b, Section 8.4.7). The biomass plants' fuel mix is assumed to include energy crops, but based on the NREL profile for energy crop supplies in the area, as discussed in Section 7.1.2.2.7, additional conversion of land to cultivate the energy crops is not anticipated. Forest residue and wood waste are byproducts of the timber industry, and thus activities associated with the production of this feedstock will occur regardless of whether a biomass-fired power plant is available to use the feedstock. Accordingly, the land use impacts associated with the production of this feedstock will be the same regardless whether the feedstock is used for electricity generation or not. However, additional land would be required for storing, loading, and transporting forest residue and wood waste power plant feedstock. Ultimately, land use impacts would depend on the characteristics of the affected forested lands and the effects of storing, loading, and transporting the biomass feedstock (NRC 2014b, Section 8.4.7).

DSM would have little to no direct land use impacts. However, quickly replacing old inefficient appliances and other equipment could generate waste material and potentially increase the size of landfills. However, given time for program development and implementation, the cost of replacements, and the average life of an appliance, the replacement process likely would be gradual. For example, older appliances would be replaced by more efficient appliances as they fail (especially in the case of frequently replaced items, such as light bulbs). In addition, many appliances and industrial equipment have substantial recycling value and would not be disposed of in landfills. (NRC 2014b, Section 8.4.7)

Overall land use impacts from the construction and operation of the combination alternative could range from SMALL to MODERATE.

Visual Resources

Aesthetic impacts from the NGCC plant component of the combination alternative would be essentially the same as those described for the discrete NGCC alternative in Section 7.1.3.1.1. Plant infrastructure generally would be smaller and less noticeable than the WF3 plant structures. As previously discussed in Section 7.1.3.1.1, the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants and other industrial facilities within the area. The biomass plants would look similar to other fossil-fuel power plants with a boiler stack and cooling towers. In addition, it would have feedstock storage, handling, and processing facilities. Combustion exhaust and cooling steam plumes may be visible in close proximity to the plant depending on atmospheric conditions. However as previously discussed, the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants and other industrial facilities within the area. No aesthetic impacts would be expected for the DSM component of this alternative.

Overall aesthetic impacts as a result of the construction and operation of the combination alternative would be SMALL.

7.1.3.4.2 Air Quality

Construction activities associated with the NGCC plant and biomass plants combination alternatives would generate fugitive dust. However, mitigation measures, including wetting of unpaved roads and construction areas, and seeding or mulching bare areas would minimize fugitive dust. Construction worker vehicles and motorized construction equipment would create exhaust emissions. However, these emissions would end upon completion of construction.

During operations, the air quality emissions from the NGCC plant combination alternative would be slightly more than 50 percent of the quantities for the discrete NGCC plant alternative as shown in Table 7.1-4. The biomass plants component of the combination alternative would also emit air pollutants that would be dependent on the feedstock, but nevertheless in compliance with the MACT standards as discussed in Section 7.1.2.2.6. The biomass plants' annual SO_2 and NO_x emissions based on a feedstock of MSW would be approximately 1,050 tons and 5,870 tons, respectively (ENERCON 2015b). The biomass plants' annual CO_2 generation, based on MSW, would be approximately 890,000 tons (ENERCON 2015b). As discussed in Section 7.1.3.1.2 and Section 7.1.2.2.6, an NGCC plant and biomass plants would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, a new NGCC plant and the four biomass plants would be a major source of criteria pollutants and GHGs. Air quality impacts from the DSM component of the combination alternative would be negligible.

Overall air quality impacts from the construction and operation of the combination alternative could range from SMALL to MODERATE.

7.1.3.4.3 Noise

The construction of the NGCC and biomass plants would have noise impacts similar to that of the discrete NGCC plant alternative discussed in Section 7.1.3.1.3.

Most noise generated during NGCC plant operations would be limited to industrial processes and communications. Pipelines delivering natural gas fuel could be audible off site near gas compressor stations. However, pipeline companies and the NGCC plant combination alternative on the Entergy Louisiana, LLC property would need to adhere to local ordinances regarding maximum noise levels during operations. The biomass plants would have feedstock storage, handling, and processing facilities. Noise may be detectable off site during the delivery and onsite handling operations of the feedstock, but given the industrial setting and setback requirements of the local ordinances, noise impacts would be minimized on adjacent properties. No noise impacts would be expected for the DSM component of this alternative.

Overall noise impacts as a result of the construction and operation of the combination alternative would be SMALL.

7.1.3.4.4 Geology and Soils

The impact on geology and soils due to constructing and operating the NGCC and associated gas pipeline, and biomass plants on the Entergy Louisiana, LLC property would be similar to that of the discrete NGCC plant alternative discussed in Section 7.1.3.1.4. Any ground disturbance of one or more acres would require a construction stormwater permit from the LDEQ, which specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Construction activities would be temporary and localized. During operations, the NGCC plant and biomass plant combination alternatives would have to comply with stormwater permitting requirements to develop and maintain a SWPPP that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges. No geology and soil impacts would be expected for the DSM component of this alternative.

Overall, construction and operational impacts on geology and soils of the combination alternative are anticipated to be SMALL.

7.1.3.4.5 Hydrology (Surface Water and Groundwater)

Surface Water

The impact on surface water use and quality due to constructing and operating the NGCC and biomass plants on the Entergy Louisiana, LLC property would be similar to that of the discrete

NGCC plant alternative as discussed in Section 7.1.3.1.5. However, no surface water use and quality impacts would be expected for the DSM component of this alternative.

WF3's existing intake and discharge infrastructure would be modified to maximize use of existing facilities, reducing construction-related impacts on surface water quality. Dredge-and-fill operations would be conducted under a permit from the USACE and State-equivalent permits requiring the implementation of BMPs. Stormwater runoff from construction areas and spills and leaks from construction equipment could potentially affect downstream surface water quality. However, application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, water discharge, SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality under the combination alternative would be SMALL.

Depending on the path of any required new gas pipelines to service the NGCC plant alternative, some stream crossings could be necessary. However, because of the short-term nature of any required dredge-and-fill and stream-crossing activities, the hydrologic alterations and sedimentation would be localized and water-quality impacts would be temporary. In addition, modern pipeline construction techniques, such as horizontal directional drilling, would further minimize the potential for water-quality impacts on the affected streams. Such activities, including any dredge-and-fill operations, would be conducted under a permit from the USACE or State-equivalent permits for dredge-and-fill and stream encroachment, requiring the implementation of BMPs to minimize impacts. Therefore, construction-related impacts on surface water use and quality are anticipated to be SMALL.

During operations, the NGCC plant and biomass plants components of the combination alternative would use mechanical draft cooling towers with the source of makeup water supplied by the Mississippi River. Water withdrawals would be a fraction of that required by WF3's once-through cooling system, and water consumption as a result of cooling tower evaporative losses would be insignificant compared to the volume of water flowing in the Mississippi River. Cooling water treatment additives would essentially be the same as WF3. While the discharge water quality would be chemically similar, the effluents discharge volume from the closed-cycle NGCC plant and biomass plants would be a small fraction of that discharged from WF3's once-through cooling system. However, like WF3, cooling water discharges would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality under the NGCC plant and biomass plants components of the combination alternative would be SMALL.

<u>Groundwater</u>

The impact on groundwater use and quality due to constructing and operating the NGCC plant and biomass plant components of the combination alternative on the Entergy Louisiana, LLC property would be similar to that of the discrete NGCC plant alternative as discussed in Section 7.1.3.1.5. No groundwater use and quality impacts would be expected for the DSM component of this alternative.

Entergy assumes that construction water for uses such as potable and sanitary use by the construction workforce and for concrete production, equipment washdown, dust suppression, and soil compaction, would be obtained from the St. Charles Parish water system whose source of water is the Mississippi River. Any discharge involving dewatering activities would require an LPDES permit. Dewatering activities, if needed, are not anticipated to affect groundwater quantity and quality, because groundwater usage within the vicinity of WF3 is limited and mainly for industrial purposes. Appropriate waste management practices, a required construction stormwater permit and pollution prevention requirements, and spill prevention practices, would prevent or minimize impacts on groundwater quality as a result of stormwater runoff.

During the operations period, Entergy assumes that the St. Charles Parish water system would continue to supply potable water. Continuing dewatering activities, if necessary, would be regulated under an LPDES permit. In addition, appropriate waste management, SWPPP, and spill prevention practices, would prevent or minimize groundwater quality impacts.

Therefore, the construction- and operations-related impacts on groundwater use and quality of the combination alternative would be SMALL.

7.1.3.4.6 Ecological Resources (Terrestrial and Aquatic)

<u>Terrestrial</u>

The impact on terrestrial resources due to constructing and operating the NGCC plant (and associated gas pipeline) and biomass plants on the Entergy Louisiana, LLC property would be similar to that of the discrete NGCC discussed in Section 7.1.3.1.6. The DSM component of the combination alternative would have no impact on terrestrial resources.

The NGCC and biomass plants components of the combination alternative would be located on the Entergy Louisiana, LLC property, and predominantly previously developed or previously disturbed land would be affected. The new NGCC plant alternative gas pipeline could potentially be collocated within an existing ROW. Plant communities in the proposed construction footprint would be cleared, and wildlife would relocate by their own means. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. As previously discussed in Section 7.1.3.1.6, the site is an industrial site with existing power plants on site (Waterford 1, 2, and 4), and industrial and transportation corridors are adjacent. Also as discussed in Section 7.1.3.1.1, minimal land would be required for new gas pipelines, and existing gas supply from the TETCO pipeline is assumed to be adequate for supporting operations of the NGCC plant component of the combination alternative

During operations, it is not anticipated that wildlife species will be displaced, because the site is located in a heavily industrialized setting, and they have most likely acclimated to noise associated with activities in this area. Operation of the mechanical draft cooling towers could cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Operational noise from the cooling towers could also impact terrestrial wildlife, and there is the potential for bird collisions with the cooling towers. However, these impacts would be similar to existing nuclear plants with cooling towers.

Overall, construction and operations impacts on terrestrial resources under the combination alternative are anticipated to be SMALL.

Aquatic

The impact on aquatic resources due to constructing and operating the NGCC and biomass plants on the Entergy Louisiana, LLC property would be similar to that of the discrete NGCC plant alternative, as discussed in Section 7.1.3.1.6. The DSM component of this alternative would have no impact on aquatic resources.

Impacts on aquatic resources during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a stormwater permit and USACE permit. Impingement and entrainment impacts from water withdrawals, and thermal and chemical impacts from blowdown discharges during operation would be less than projected impacts from continued operation of WF3 due to smaller heat rejection demand and less water withdrawals. All such impacts would be controlled by an LPDES permit issued by the LDEQ. The air emissions from the NGCC plant and biomass plant components of the combination alternative would emit particulates that would settle onto the river surface and introduce a new source of pollutants that would not exist if WF3 continued operating. However, the flow of the Mississippi River would dissipate pollutants, which would minimize the exposure of fish and other aquatic organisms to pollutants. Therefore, impacts on aquatic resources from the construction and operation under the combination alternative would be SMALL.

Special Status Species

As discussed in Section 3.6.11, no suitable habitat was identified on the Entergy Louisiana, LLC property for any of the federally listed species in St. Charles Parish during an October 2014 threatened and endangered species habitat survey, and no federally listed species were identified as being present on site. Although suitable habitat for three state-listed species was identified in undisturbed portions of the Entergy Louisiana, LLC property, the survey did not identify any state-listed species as being present on the Entergy Louisiana, LLC property. Construction activities associated with the new gas pipeline would be subject to LDEQ construction stormwater permitting requirements, which would consider protection of special status species and associated designated habitats. Because the site has available acreage that is already disturbed, as discussed in Section 7.1.3.1.6, construction- and operations-related impacts on special status species under the combination alternative are anticipated to have no effect. Based on consultation with the NMFS, no EFH has been designated in the Mississippi River in the vicinity of WF3 (Attachment B).

7.1.3.4.7 Historic and Cultural Resources

The impact on historic and cultural resources due to constructing and operating the NGCC and biomass plants components on the Entergy Louisiana, LLC property would be similar to that of the discrete NGCC plant alternative as discussed in Section 7.1.3.1.7. No direct impacts on historic and cultural resources are expected from DSM.

The historic and cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, the only area located on the WF3 property eligible for listing on the NRHP is the Waterford Plantation. The Killona Plantation and possibly a portion of the Providence Plantation are also located on the Entergy Louisiana, LLC property, although neither of these sites has been surveyed to determine their NRHP eligibility. Therefore, any construction activities would either need to avoid these areas, or in the case of the Killona and Providence plantations, surveys would need to be conducted to determine their NRHP eligibility. However, because portions of the Entergy Louisiana, LLC property have been previously identified as not containing significant historic and cultural resources, use of these areas for the NGCC plant and biomass plants components of the combination alternative would have no effect on historic and cultural resources.

As previously discussed in Section 7.1.3.1.1, a new gas pipeline would have to be installed to connect the hypothetical NGCC plant alternative to the gas infrastructure. However, this new pipeline could be collocated within an existing ROW, or if not located within an existing ROW, the area could be surveyed to identify and record historic and cultural resources. No offsite land would be needed for gas wells and collection wells, because the existing gas supply from the TETCO pipeline is assumed to be adequate for supporting operations of the NGCC plant component of the combination alternative.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction- and operations-related impacts under the combination alternative are projected to have no adverse effect on historic and cultural resources.

7.1.3.4.8 Socioeconomics

Socioeconomic Issues Other than Transportation

Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts.

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.1) estimate of 1,200 workers needed to construct a 1,000-MWe natural gas plant, the NGCC plant combination component would have a peak construction workforce of approximately 800. Fifty construction workers are required for each of the four biomass plants, totaling 200 construction workers if all four units are constructed at the same time (NRC 2014b, Section 8.4.8). Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region (50-mile radius of WF3). It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current WF3 workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary.

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.2) estimate of 150 workers needed to operate a 1,000-MWe natural gas plant, the NGCC plant combination component would have an operations workforce of 100. Each biomass unit is assumed to require 22 operations workers for a total of 88 operations workers for this component of the combination alternative (NRC 2014b, Section 8.4.8). Therefore, this combination alternative would result in the loss of approximately 450 relatively high-paying jobs at WF3. This reduction in employment at WF3 from operations to decommissioning and shutdown could affect property tax revenue and income in local communities and businesses. In addition, the permanent housing market could also experience increased vacancies and decreased prices if WF3 operations workers and their families move out of the region. In addition, the property taxes levied on the operating NGCC and biomass plants components of the combination alternative would likely be less than that of an operating nuclear plant. However, this may be offset some by the property taxes paid to local jurisdictions from the NGCC plant and biomass plants components of the combination alternative.

The DSM component could generate additional employment, depending on the nature of the conservation programs and the need for direct measure installations in homes and office buildings. Jobs would likely be few and scattered throughout the region, and would not have a noticeable effect on the local economy.

Overall, the socioeconomic impacts from the construction and operation of the combination alternative could range from SMALL to MODERATE.

Transportation

Transportation impacts during the construction and operation of the NGCC and biomass plants components of the combination alternative would be less than the impacts for any of the previous alternatives discussed, because the construction workforce for each component and the volume of materials and equipment to be transported to each respective construction site would be smaller than each of the other alternatives.

During construction, commuting workers and trucks transporting construction materials and equipment to the work site would increase the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Transporting heavy and oversized components on local roads could have a noticeable impact over a large area. Some components and materials also could be delivered by rail or barge. During operations, transportation impacts from the NGCC plant and biomass plants components of the combination alternative would be less noticeable than during construction. No incremental operations impacts would be expected for the DSM component of this alternative.

Overall, transportation impacts from the construction and operation of the combination alternative could range from SMALL to MODERATE.

7.1.3.4.9 Human Health

Impacts on human health from construction of the NGCC plant (including the construction of a new gas pipeline) and biomass plants components of the combination alternative would be similar to impacts associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the general public would be minimal, because crews would limit access to active construction areas to authorized individuals. The radiological human health impact on construction workers, operations workers, and the surrounding public would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. The NRC reviewed the human health and environmental impacts from radiological emissions and waste in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1).

Construction and operations impacts for the DSM component of the combination alternative would be minimal and localized to activities such as weatherization efficiency of an end-user's home or facility. The GEIS notes that the environmental impacts are likely to be centered on indoor air quality due to increased weatherization of the home in the form of extra insulation and reduced air turnover rates from the reduction in air leaks. However, the actual impact is highly site specific and not yet well established. (NRC 2014b, Section 8.4.6).

Human health effects of gas-fired generation are generally low, although in Table 8.2 of the GEIS (NRC 1996), the NRC identified cancer and emphysema as potential health risks from gas-fired plants. NO_x emissions contribute to ozone formation, which in turn contributes to human health risks. Emission controls on the NGCC plant component of the combination alternative can be expected to maintain NO_x emissions well below air quality standards established to protect human health, and emissions trading or offset requirements mean that overall NO_x releases in the region would not increase. Health risks for workers may also result from handling spent catalysts used for NO_x control that may contain heavy metals.

Using biomass for energy consists of the direct burning of MSW, crop residue, and/or forest residue/wood waste. Given this source of fuel for power generation, the health impacts would be similar to those found in a fossil fuel-fired electricity generating facility. As discussed in the discrete NGCC and the SCPC plant alternatives in Section 7.1.3.1.2 and Section 7.1.3.2.2, respectively, regulations restricting emissions enforced by either the EPA or delegated state agencies have reduced the potential health effects from plant emissions, but have not entirely eliminated them. These agencies also impose site-specific emission limits, as needed, to protect human health. Proper emissions controls would protect workers and the public from the harmful effects of burning the biomass fuel.

Overall, human health risks during construction and operations to occupational workers and members of the public from the combination alternative would be SMALL.

7.1.3.4.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the NGCC plant and biomass plants components of the combination alternative would consist mostly of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse. Increased demand for rental housing during construction could cause rental costs to rise disproportionately affecting low-income populations residing in the vicinity of WF3 who rely on inexpensive housing. However, given the proximity of New Orleans and Baton Rouge metropolitan areas and their volume of temporary and permanent housing across the social economic spectrum, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.4 of this ER, the construction and operation of the combination alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of WF3.

7.1.3.4.11 Waste Management

During the construction stage for the NGCC plant component of the combination alternative, land clearing and other construction activities would generate wastes that could be recycled, disposed of on site, or shipped to an offsite waste disposal facility. During the operations period, spent SCR catalysts, which control NO_x emissions from the NGCC plant, would make up the majority of waste generated by this alternative. These wastes would be properly managed and disposed of as hazardous or nonhazardous waste in permitted offsite facilities. Recycling and waste minimization programs such as those at WF3 would also be implemented as appropriate.

For DSM, there may be an increase in wastes generated during installation or implementation of energy conservation measures, such as appropriate disposal of old appliances, installation of control devices, and building modifications. New and existing recycling programs would help minimize the amount of generated waste.

During construction of the biomass plants component of the combination alternative, land clearing and other construction activities would generate waste that could be recycled, disposed of on site, or shipped to an offsite waste disposal facility. A biomass plant may use as fuel the residue from forest clear cut and thinning operations and timber mill operations, crop residue and MSW from nearby metropolitan areas. In addition to the gaseous emissions, ash would be generated. Waste would be handled in accordance with appropriate LDEQ regulations.

Overall, waste management impacts from the construction and operation of the combination alternative would be SMALL.

Table 7.1-1
Air Emissions from NGCC Plant Alternative

Emission	Annual Amount[a]
Gas consumption	94.0 billion ft^3
Sulfur dioxide[b]	164 tons
Nitrogen oxides[c]	625 tons
Carbon monoxide	1,440 tons
Particulate matter	317 tons
Nitrous oxide	144 tons
Volatile organic compounds	101 tons
Carbon dioxide	5.3 million tons

(ENERCON 2015b)

a. Based on emission factors from EPA 2000, Tables 3.1-1 and 3.1-2a.
b. Assumes sulfur content of 3.4 percent.
c. Assumes 90 percent conversion in SCR equipment.

Table 7.1-2
Air Emissions from SCPC Plant Alternative

Parameter	Tons/Year
Annual coal consumption	7.84 million
Sulfur oxides	2,670
Nitrogen oxides	1,410
Carbon monoxide	1,960
Filterable particulate matter	524
Particulates less than 10 microns in diameter	121
Carbon dioxide	13.7 million

(ENERCON 2015b)

Table 7.1-3
Solid Waste from SCPC Plant Alternative

Parameter	Amount
Annual SO_2 generated subject to removal by scrubbers	61,000 tons per year
Annual SO_2 captured	58,000 tons per year
Annual scrubber waste	158,000 tons per year
Annual scrubber waste disposed based on 90-percent recycling	15,800 tons per year
Annual ash generated	523,000 tons per year
Annual ash disposed based on 50-percent recycling	262,000 tons per year
Annual total waste disposed assuming no recycling	681,000 tons per year
Annual total waste disposed assuming recycling	277,000 tons per year
Waste pile area (40-year period) assuming no recycling	387 acres, 30 feet high
Waste pile area (40-year period) assuming recycling	167 acres, 30 feet high

(ENERCON 2015b)

Table 7.1-4
Air Emissions from NGCC Plant Combination Alternative

Emission	Annual Amount[a]
Gas consumption	46.0 billion ft^3
Sulfur dioxide	80 tons
Nitrogen oxides	306 tons
Carbon monoxide	705 tons
Particulate matter	155 tons
Nitrous oxide	71 tons
Volatile organic compounds	49 tons
Carbon dioxide	2.6 million tons

a. Adapted from Table 7.1-1 (668-MWe NGCC plant combination alternative ÷ 1,366-MWe discrete NGCC plant alternative × discrete NGCC plant alternative annual amount).

7.2 Alternatives for Reducing Adverse Impacts

7.2.1 Alternatives Considered

As noted in 10 CFR 51.53(c)(3)(iii), "The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues in Appendix B to Subpart A of this part." The review of the environmental impacts associated with the Category 2 issues 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 the Chapter 4 analysis, Entergy concludes that the impacts of renewal of the WF3 OL do not warrant additional consideration of alternatives for reducing adverse impacts, as specified in NRC Regulatory Guide 4.2, Revision 1 (NRC 2013a, Section 7.2), and existing mitigation measures discussed in Section 6.2 and listed in Table 6.1-1 to avoid, reduce the severity of, or eliminate adverse impacts are adequate for minimizing adverse impacts.

7.2.2 Environmental Impacts of Alternatives for Reducing Adverse Impacts

As discussed in Section 7.2.1 above, there were no alternatives identified by Entergy to further warrant additional consideration for reducing adverse impacts associated with the renewal of the WF3 OL.

7.3 No-Action Alternative

7.3.1 Proposed Action

The proposed action is to renew the WF3 OL, which would preserve the option for Entergy to continue to operate WF3 to provide reliable base-load power and meet future system generating needs throughout the 20-year license renewal period. The analysis of the environmental impacts required by 10 CFR 51.53(c)(3)(ii) and presented in Chapter 4 identified no significant adverse effects from the continued operation of WF3 during the license renewal period.

7.3.2 No-Action Alternative

The "no-action alternative" to the proposed action is not to renew the WF3 OL. In this alternative, it is expected that WF3 would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin (Section 7.3.3). The environmental impacts of the no-action alternative would be the impacts associated with the construction and operation of the type of replacement power utilized, such as those identified in Section 7.1.1 of this ER. In effect, the net environmental impacts would be transferred from the continued operation of WF3 to the environmental impacts associated with the construction and operation of a new generating facility or a combination of facilities. Therefore, the no-action alternative would have no net environmental benefits.

The environmental impacts associated with the proposed action (continued operation of WF3) were compared to the environmental impacts from the no-action alternative (decommissioning of

WF3) and the construction and operation of other reasonable sources of electricity generation. Entergy believes this comparison shows that the continued operation of WF3 would produce no significant environmental impacts while the no-action alternative would have greater impacts than the proposed action on certain environmental resources as described in Section 7.1.3.

In addition, CO_2 emissions are suspected to be a major contributor to anthropogenic GHG emissions, which some scientists believe contribute to climate change. The burning of fossil fuels (coal, natural gas, and petroleum) is the largest energy-related contributor to CO_2 emissions in the world. Table 7.3-1 shows the amount of CO_2 released by the consumption of various fuel sources to produce electricity. This table illustrates that all fossil fuel-based energy sources produce GHG emissions, whereas nuclear power produces none. In addition, as previously discussed in Section 7.1.3.3.2, GHG emissions associated with nuclear power are similar to the life-cycle GHG emissions from renewable energy sources. Therefore, under the proposed action, millions of tons of GHGs would be avoided, thereby resulting in a beneficial air quality impact.

7.3.3 Decommissioning Impacts

The NRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license, or (2) release of the property under restricted conditions and termination of the license [10 CFR 20.1003]. The NRC-evaluated decommissioning options include (1) immediate dismantling soon after the facility closes and prompt decontamination (DECON); (2) safe storage and monitoring of the facility for a period of time that allows the radioactivity to decay, followed by dismantling and additional decontamination (SAFSTOR); and (3) permanent entombment on site in structurally sound material, such as concrete, and appropriately maintained and monitored (ENTOMB). Regardless of the option chosen, decommissioning must be completed within the 60-year period following permanent cessation of operations and permanent removal of fuel.

Under the no-action alternative, Entergy would continue operating WF3 until the existing OL expires, and then initiate decommissioning activities in accordance with NRC requirements. As the GEIS notes, the NRC has evaluated environmental impacts from decommissioning. The NRC-evaluated impacts include those associated with land use, visual resources, air quality, noise, geology and soils, hydrology, ecology, historic and cultural resources, socioeconomics, human health, environmental justice, and waste management and pollution prevention. Entergy considers the NRC's evaluation of these impacts in the GEIS to be reasonably representative of actions that Entergy would perform for decommissioning of WF3. Therefore, Entergy relies on the NRC conclusions regarding environmental impacts of decommissioning WF3.

Entergy notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. WF3 will have to be decommissioned eventually, regardless of the NRC decision on license renewal; license renewal would only postpone decommissioning for another 20 years. The NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning.

Entergy relies on NRC findings [10 CFR Part 51, Subpart A, Appendix B, Table B-1] to the effect that delaying decommissioning until after the renewal term would have SMALL environmental impacts. The discriminators between the proposed action and the no-action alternative lie within the choice of power generation replacement options to be part of the no-action alternative. Section 7.1.3 analyzes the impacts from these options.

Entergy concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those following license renewal as identified in the GEIS and in the decommissioning generic environmental impact statement. Decommissioning impacts under the no-action alternative would be temporary and could overlap with operation of a WF3 replacement.

Table 7.3-1
Carbon Dioxide Emissions from Electricity Generation

Fuel	Pounds CO_2 per Million Btu
Bituminous coal[a]	205
Sub-bituminous coal[a]	213
Lignite coal[a]	215
Natural gas[a]	117
Distillate oil (No. 2)[a]	161
Residual oil (No. 6)[a]	174
Nuclear	0
Renewable sources	0

a. (EIA 2014)

8.0 COMPARISON OF THE ENVIRONMENTAL IMPACT OF LICENSE RENEWAL WITH THE ALTERNATIVES

> To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form . . . . [10 CFR 51.45(b)(3)]

The proposed action is renewal of the WF3 OL, which would preserve the option to continue to operate WF3 to provide reliable base-load power and meet Entergy's future system generating needs throughout the 20-year license renewal period. Chapter 4 analyzes environmental impacts of the proposed action, and Chapter 7 describes potential energy alternatives to the proposed action, and analyzes impacts from the alternatives deemed to be reasonable.

Table 8.0-1 summarizes the environmental impacts of the proposed action and the alternatives deemed reasonable, for comparison purposes. Table 8.0-2 provides a more detailed comparison. The environmental impacts compared in Tables 8.0-1 and 8.0-2 are either Category 2 issues that apply to the proposed action or issues that the GEIS identified as major considerations in an alternatives analysis.

As shown in Tables 8.0-1 and 8.0-2, there are no reasonable alternatives superior to that of the continued operation of WF3, providing approximately 1,188 MWe of reliable base-load power generation. The continued operation of WF3 would create significantly less environmental impact than the construction and operation of new alternative generating capacity. In addition, the continued operation of WF3 will have a significant positive economic impact on the communities surrounding the station, such as reduced local unemployment, economic support of surrounding communities, and lower energy costs.

Table 8.0-1
Environmental Impacts Comparison Summary

		No-Action Alternative				
Impact Area[a]	**Proposed Action**	**Decommissioning**	**NGCC Plant Alternative**	**SCPC Plant Alternative**	**New Nuclear Plant Alternative**	**Combination of Alternatives**
Land Use	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Visual Resources	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Noise	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Geology and Soils	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Surface Water	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Terrestrial	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Aquatic	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Special Status Species	NO EFFECT	NO EFFECT	NO EFFECT	(b)	NO EFFECT	NO EFFECT
Historic and Cultural	NO ADVERSE EFFECT	NO ADVERSE EFFECT	NO ADVERSE EFFECT	NO ADVERSE EFFECT	NO ADVERSE EFFECT	NO ADVERSE EFFECT
Socioeconomics	SMALL	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

Table 8.0-1 (Continued)
Environmental Impacts Comparison Summary

		No-Action Alternative				
Impact Area[a]	**Proposed Action**	**Decommissioning**	**NGCC Plant Alternative**	**SCPC Plant Alternative**	**New Nuclear Plant Alternative**	**Combination of Alternatives**
Environmental Justice	(c)	(c)	(c)	(d)	(c)	(c)
Waste Management	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL

a. As defined in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 3:
SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

b. The magnitude of impacts could vary widely based on site selection and the presence or absence of special status species and habitats when the alternative is implemented; thus, Entergy cannot forecast a level of impact for this alternative.

c. This alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations in the vicinity of WF3.

d. A definitive determination of the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations would depend on this alternative's location, plant design, and expected operations characteristics; thus, Entergy cannot forecast the effects on minority and low-income populations for this alternative.

Table 8.0-2 (Sheet 1 of 16)
Environmental Impacts Comparison Detail

Summary of Replacement Power Alternatives and Key Characteristics				
	NGCC Alternative	**SCPC Alternative**	**New Nuclear Alternative**	**Combination Alternative**
Summary of Alternative	Multiple combustion turbines assembled in appropriate power train configurations for a total of 1,188 net MWe.	SCPC plant with CCS for a total of 1,188 net MWe.	One unit nuclear plant for a total of 1,188 net MWe.	One NGCC plant for a total of 581 net MWe; four biomass plants for a total of 166 net MWe; and 441 MWe from DSM.
Location	At Entergy Louisiana, LLC property.	At or near an existing power plant site (other than WF3).	At Entergy Louisiana, LLC property.	At Entergy Louisiana, LLC property.
Cooling System	Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required.	Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required.	Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required.	NGCC and Biomass Plants: Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required.
Land Requirements	59 acres for the plant; potentially 4,920 acres for gas field.	115 acres for the plant; 1,350 to 30,700 acres for coal mining; 167 to 387 acres for waste disposal.	234 acres for the plant; 1,188 acres for uranium mining and processing.	29 acres for the NGCC plant; 60 acres for the biomass plants.
Workforce	1,640 during peak construction; 205 during operations.	1,680 to 3,500 during peak construction; 350 during operations.	2,100 during peak construction; 641 during operations.	800 during peak construction of NGCC plant and 100 during operations; 200 during peak construction of the biomass plants and 88 during operations.

Table 8.0-2 (Sheet 2 of 16)
Environmental Impacts Comparison Detail

Land Use	
Proposed action	**SMALL:** Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Onsite land use Offsite land use
Decommissioning	**SMALL:** Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL:** Plant to be constructed on previously disturbed land; no encroachment into wetlands; new gas pipeline may be collocated within existing ROW; existing gas supply assumed adequate to support NGCC plant operations.
SCPC plant alternative	**SMALL to MODERATE**: Impacts could range from minimal, if newly disturbed land surrounding the site was previously used for industrial purposes, to noticeable, if land exceeds original footprint of the site that was previously used for non-industrial purposes; land required for coal mining and processing to support SCPC plant operations could range from 1,350 to 30,700 acres.
New nuclear plant alternative	**SMALL:** Plant to be constructed on previously disturbed land; no encroachment into wetlands; during operations, there would be no net change in offsite land use impacts as a result of uranium mining.
Combination of alternatives	**SMALL to MODERATE**: NGCC and biomass plants to be constructed on previously disturbed land; no encroachment into wetlands; new gas pipeline may be collocated within existing ROW; DSM would have little to no direct land use impacts; existing gas supply assumed adequate to support NGCC plant operations; biomass plants impact depend on characteristics of affected forested lands and effects of storing, loading, and transporting biomass feedstock.

Table 8.0-2 (Sheet 3 of 16)
Environmental Impacts Comparison Detail

Visual Resources	
Proposed action	**SMALL:** Adopting by reference the Category 1 issue finding for aesthetic impacts in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
Decommissioning	**SMALL:** Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL:** Construction and operations activities would appear similar to other ongoing onsite activities because the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants.
SCPC plant alternative	**SMALL to MODERATE**: Construction activities would appear similar to other ongoing onsite activities if located near existing power plant site**;** cooling towers could result in a noticeable change within the viewshed of the plant if not previously present at the site.
New nuclear plant alternative	**SMALL:** Construction and operations activities would appear similar to other ongoing onsite activities because the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants.
Combination of alternatives	**SMALL:** Construction and operations activities would appear similar to other ongoing onsite activities because the Entergy Louisiana, LLC property is already aesthetically altered by the presence of existing power plants; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 4 of 16)
Environmental Impacts Comparison Detail

Air Quality	
Proposed action	**SMALL:** Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Air quality impacts (all plants) Air quality effects of transmission lines
Decommissioning	**SMALL:** Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows: Sulfur dioxide = 164 tons per year Nitrogen oxides = 625 tons per year Carbon monoxide = 1,440 tons per year Particulate matter = 317tons per year Nitrous oxide = 144 tons per year Volatile organic compounds = 101 tons per year Carbon dioxide = 5.3 million tons per year
SCPC plant alternative	**SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows: Sulfur dioxide = 2,670 tons per year Nitrogen oxides = 1,410 tons per year Carbon monoxide = 1,960 tons per year Filterable particulate matter = 524 tons per year Particulates less than 10 microns in diameter = 121 tons per year Carbon dioxide = 13.7 million tons per year
New nuclear plant alternative	**SMALL:** Construction impacts would be temporary; operations impacts would be minor with emission sources operating intermittently, and emissions being maintained within federal and state regulatory limits.
Combination of alternatives	**SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows: *NGCC Plant* Sulfur dioxide = 80 tons per year Nitrogen oxides = 306 tons per year Carbon monoxide = 705 tons per year Particulate matter = 155 tons per year Nitrous oxide = 71 tons per year Volatile organic compounds = 49 tons per year Carbon dioxide = 2.6 million tons per year *Biomass Plants* Sulfur dioxide = 1,050 tons Nitrogen oxide = 5,870 tons Carbon dioxide = 890,000 tons Air quality impacts associated with DSM would be negligible.

Table 8.0-2 (Sheet 5 of 16)
Environmental Impacts Comparison Detail

Noise	
Proposed action	**SMALL:** Adopting by reference the Category 1 issue finding for noise impacts in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
Decommissioning	**SMALL:** Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL:** Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with WF3.
SCPC plant alternative	**SMALL to MODERATE**: Noise impacts from construction activities would be temporary and managed in accordance with local noise ordinances; depending on site location, operations noise impacts associated with rail delivery of coal and lime/limestone could be significant for residents living in vicinity of the facility and along rail route.
New nuclear plant alternative	**SMALL:** Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with WF3.
Combination of alternatives	**SMALL:** Noise impacts from construction activities would be temporary; noise impacts during operations are not anticipated to be greater than those currently associated with WF3; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 6 of 16)
Environmental Impacts Comparison Detail

Geology and Soils	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue finding for geology and soils in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs.
SCPC plant alternative	**SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs.
New nuclear plant alternative	**SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs.
Combination of alternatives	**SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 7 of 16)
Environmental Impacts Comparison Detail

Surface Water	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Surface water use and quality (non-cooling system impacts) Altered current patterns at intake and discharge structures Scouring caused by discharged cooling water Discharge of metals in cooling system effluent Discharge of biocides, sanitary wastes, and minor chemical spills Surface water use conflicts (plants with once-through cooling systems) Effects of dredging on surface water quality Temperature effects on sediment transport capacity
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit.
SCPC plant alternative	**SMALL**: No direct use of surface water anticipated during construction; construction impacts would be minimized through implementation of BMPs; during operations, water consumption would be comparable to a similarly sized nuclear plant; cooling water discharges would be regulated under an LPDES permit.
New nuclear plant alternative	**SMALL**: Construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit.
Combination of alternatives	**SMALL**: Construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 8 of 16)
Environmental Impacts Comparison Detail

Groundwater	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue finding for groundwater contamination and use (non-cooling system impacts) in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. SMALL[a] (Radionuclides released to groundwater): No tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected since initiation of the groundwater monitoring program in 2007.
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: During construction and operations, potable water would be supplied by a local water supply; dewatering activities, if necessary, would be regulated by an LPDES permit; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation.
SCPC plant alternative	**SMALL**: During construction and operations, potable water would be supplied by a local water supply system; dewatering activities, if necessary, would be regulated by an LPDES permit; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation.
New nuclear plant alternative	**SMALL**: During construction and operations, potable water would be supplied by St. Charles Parish water system whose water source is the Mississippi River; dewatering activities, if necessary, would be regulated by an LPDES permit; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation.
Combination of alternatives	**SMALL**: During construction and operations, potable water would be supplied by St. Charles Parish water system whose water source is the Mississippi River; dewatering activities, if necessary, would be regulated by an LPDES permit; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation; no impacts would be expected from the DSM component.

a. Category 2 issue requiring site-specific evaluation.

Table 8.0-2 (Sheet 9 of 16)
Environmental Impacts Comparison Detail

Terrestrial	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Exposure of terrestrial organisms to radionuclides Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds) Bird collisions with plant structures and transmission lines Transmission line ROW management impacts on terrestrial resources Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock) **SMALL**[(a)] (Effects on terrestrial resources—non-cooling system impacts): No license-renewal-related refurbishment or construction activities identified; adequate management programs and regulatory controls in place to ensure that important plant and animal habitats are protected.
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; siting gas pipeline along existing ROWs would minimize impacts; existing gas supply assumed to be adequate; cooling tower impacts similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of WF3.
SCPC plant alternative	**SMALL to MODERATE**: Impacts would primarily occur from land disturbance and destruction of habitat; impacts would depend on the amount and ecological importance of directly affected habitats; land required for coal mining and processing to support plant operations could range from 1,350 to 30,700 acres; onsite temporary storage of coal, CCR, spent catalysts, and scrubber sludge would occur on previously disturbed land.
New nuclear plant alternative	**SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; cooling tower impacts would be similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of WF3.
Combination of alternatives	**SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; cooling tower impacts would be similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of WF3; no impacts would be expected from the DSM component.

a. Category 2 issue requiring site-specific evaluation.

Table 8.0-2 (Sheet 10 of 16)
Environmental Impacts Comparison Detail

Aquatic	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Entrainment of phytoplankton and zooplankton (all plants) Infrequently reported thermal impacts (all plants) Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication Effects of nonradiological contaminants on aquatic organisms Exposure of aquatic organisms to radionuclides Effects of dredging on aquatic organisms Effects on aquatic resources (non-cooling system impacts) Impacts of transmission line ROW management on aquatic resources Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses **SMALL**[a] (Impingement and entrainment of aquatic organisms—plants with once-through cooling systems or cooling ponds): No past or current impacts identified; offshore location of CWIS minimizes fish and shellfish from entering the system as the conditions of the Mississippi River (i.e., high velocity, increased debris, shifting river bed, lack of habitat/vegetation, and reduction of food source) at the CWIS location are not easily tolerated. **SMALL[a]** (Thermal impacts on aquatic organisms—plants with once-through cooling systems or cooling ponds): Thermal discharges meet the LDEQ's mixing zone water quality criteria of 5°F allowable rise of temperature above ambient; stretch of the Mississippi River at WF3 is not "unique" for any shellfish, fish, or wildlife; most of the cross-sectional area available for flow in the river unaffected by the thermal plume.
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, less cooling water would be withdrawn; discharges would be governed under an LPDES permit.
SCPC plant alternative	**SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, less cooling water would be withdrawn; discharges would be governed under an LPDES permit.
New nuclear plant alternative	**SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, less cooling water would be withdrawn; discharges would be governed under an LPDES permit.
Combination of alternatives	**SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, less cooling water would be withdrawn; discharges would be governed under an LPDES permit; no impacts would be expected from the DSM component.

a. Category 2 issue requiring site-specific evaluation.

Table 8.0-2 (Sheet 11 of 16)
Environmental Impacts Comparison Detail

Special Status Species	
Proposed action	**NO EFFECT**: No license-renewal-related refurbishment or construction activities identified; no suitable habitat identified on site for federally listed species; no species or habitats under NMFS's jurisdiction occur within the action area; management and regulatory programs in place to protect special status species.
Decommissioning	**NO EFFECT**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**NO EFFECT**: Construction activities to occur on already disturbed land; no suitable habitat identified on site for federally listed species; no species or habitats under NMFS's jurisdiction occur within the action area; construction of gas pipeline subject to LDEQ construction stormwater permitting requirements.
SCPC plant alternative	**UNDETERMINED**: Types and magnitudes of adverse impacts to ESA listed species and EFH would depend on the proposed site, plant design, operation, and listed species and habitats present when the alternative is implemented.
New nuclear plant alternative	**NO EFFECT**: Construction activities to occur on already disturbed land; no suitable habitat identified on site for federally listed species; no species or habitats under NMFS's jurisdiction occur within the action area.
Combination of alternatives	**NO EFFECT**: Construction activities to occur on already disturbed land; no suitable habitat identified on site for federally listed species; no species or habitats under NMFS's jurisdiction occur within the action area; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 12 of 16)
Environmental Impacts Comparison Detail

Historic and Cultural Resources	
Proposed action	**NO ADVERSE EFFECT**: No license-renewal-related refurbishment or construction activities identified; administrative controls ensure protection of cultural resources in the event of excavation activities.
Decommissioning	**NO ADVERSE EFFECT**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations.
SCPC plant alternative	**NO ADVERSE EFFECT**: Land areas would be surveyed prior to construction and mitigation considered if eligible properties encountered; siting of the plant and associated cooling towers can be effectively managed under current laws and regulations.
New nuclear plant alternative	**NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations.
Combination of alternatives	**NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations; no impacts would be expected from the DSM component.

Table 8.0-2 (Sheet 13 of 16)
Environmental Impacts Comparison Detail

Socioeconomics	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Employment and income, recreation and tourism Tax revenues Community services and education Population and housing Transportation
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL to MODERATE**: Majority of workers would reside within the region; in-migrating workers would be temporary; economic contributions locally and regionally would remain generally the same; traffic congestion during construction could be minimized but would still be noticeable; loss of jobs at WF3 and revenue contributions locally and regionally could be noticeable; traffic-related transportation impacts would be reduced after construction.
SCPC plant alternative	**SMALL to LARGE**: Local communities could experience a short-term economic "boom" from increased tax revenue and income; after construction, local communities could experience a return to pre-construction economic conditions; traffic-related impacts dependent on rural or urban setting; impacts could be noticeable to local communities due to the loss of tax payments to the parish's tax base; traffic-related transportation impacts would be reduced after construction.
New nuclear plant alternative	**SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; economic contributions locally and regionally would remain generally the same; traffic congestion during construction could be minimized but would still be noticeable; number of operations workforce would be similar to that of WF3; could be a temporary increase in employment from decommissioning activities; property taxes would be comparable to those of WF3; traffic-related transportation impacts would be reduced after construction.
Combination of alternatives	**SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; economic contributions locally and regionally would remain generally the same; traffic congestion during construction could be minimized but would still be noticeable; loss of jobs at WF3 and revenue contributions locally and regionally could be noticeable; traffic-related transportation impacts would be reduced after construction; DSM component would not have a noticeable effect on the local economy.

Table 8.0-2 (Sheet 14 of 16)
Environmental Impacts Comparison Detail

Human Health	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Radiation exposures to the public Radiation exposures to plant workers Human health impact from chemicals Microbiological hazards to plant workers Physical occupational hazards **SMALL**[(a)] (Public health—plants using lakes or canals, or cooling towers or cooling ponds that discharge to a river): Discharge structure design promotes rapid mixing of thermal discharges with the Mississippi River; average heated discharge flow is small compared to volume of river water flow; from 2004 to 2013, no cases of reported *Naegleria* infection attributable to Mississippi River; public restricted from discharge area. **SMALL[(a)]** (Electric shock hazards): Transmission lines located entirely within Entergy Louisiana, LLC property and meet NESC's 5 mA standard; occupational safety and health measures in place to address shock hazards from overhead lines. **SMALL[(a)]** (SAMA): Potentially cost-effective SAMAs are not related to adequately managing the effects of aging during the period of extended operation.
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health.
SCPC plant alternative	**SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health.
New nuclear plant alternative	**SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction; human health impacts during operation would be similar to WF3.
Combination of alternatives	**SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health; impacts from DSM component would be minimal and localized.

a. Category 2 issue requiring site-specific evaluation.

Table 8.0-2 (Sheet 15 of 16)
Environmental Impacts Comparison Detail

Environmental Justice	
Proposed action	There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the proposed action of renewing the WF3 OL.
Decommissioning	Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of an NGCC plant alternative.
SCPC plant alternative	Cannot forecast the effects on minority and low-income populations because the location, plant design, and expected operations characteristics are unknown.
New nuclear plant alternative	There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of a new nuclear plant alternative.
Combination of alternatives	There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of a combination of energy alternatives.

Table 8.0-2 (Sheet 16 of 16)
Environmental Impacts Comparison Detail

Waste Management	
Proposed action	**SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following: Low-level waste storage and disposal Onsite storage of spent nuclear fuel Offsite radiological impacts of spent nuclear fuel and high-level waste disposal Mixed-waste storage and disposal Nonradioactive waste storage and disposal
Decommissioning	**SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.
NGCC plant alternative	**SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; spent SCR catalysts would make up the majority of the waste during operations; operations-related wastes would be managed and recycled or disposed of at permitted offsite facilities.
SCPC plant alternative	**SMALL to MODERATE**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; scrubber and ash wastes disposed of annually would total 277,000 tons if recycling options are available; without recycling, scrubber and ash wastes disposed of annually would be 681,000 tons.
New nuclear plant alternative	**SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; during operations, nonhazardous, hazardous, and radioactive wastes would be managed in compliance with federal and state regulations and disposed of in permitted facilities.
Combination of alternatives	**SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; during operations, spent SCR catalysts would make up the majority of the NGCC plant waste, while ash would make up the majority of the biomass plants waste; operations-related wastes would be managed and recycled or disposed of at permitted offsite facilities; recycling programs would minimize DSM generated waste.

9.0 STATUS OF COMPLIANCE

> The environmental report shall list all Federal permits, licenses, approvals, and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection. [10 CFR 51.45(d)]

9.1 WF3 Authorizations

Table 9.1-1 provides a summary of authorizations held by WF3 for current plant operations. Authorizations in this context include any permits, licenses, approvals, or other entitlements that would continue to be in place, as appropriate, throughout the period of extended operation given their respective renewal schedules. Table 9.1-2 lists additional environmental authorizations and consultations related to the renewal of the WF3 OL.

Table 9.1-1
Environmental Authorizations for Current WF3 Operations

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
CILLRWC	Omnibus Low-Level Radioactive Waste Interstate Compact Consent Act (1980 and amended in 1985)	Authorization to Export Waste	None	Updated annually	Export of LLRW outside the region
DOT	49 CFR Part 107, Subpart G	Hazardous Materials Certificate of Registration	060115551059X	June 30, 2016	Radioactive and hazardous materials shipments
LDEQ	Federal Water Pollution Control Act Section 402	LPDES Permit	LA0007374	September 7, 2015[a]	Discharge of wastewaters to waters of the State
LDEQ	LAC 33:III.503	Air Permit	2520-00091-00	[b]	Operation of air emission sources (diesel generators, diesel pumps, portable auxiliary boiler, and portable gas/diesel generators)
LDEQ	LAC 33:V.1105	Hazardous Waste Generator Identification	LAD000757450	None	Hazardous waste generation
LDEQ	LAC 33:VII.501	Industrial Solid Waste Site Identification	G-089-3276	None	Industrial solid waste generation
MEMA	Chapter 432, Laws of 1982, Mississippi Radioactive Waste Transportation Act	Radioactive Waste Transport Permit	4537	Updated annually	Transportation of radioactive waste into, within, or through the state of Mississippi

Table 9.1-1 (Continued)
Environmental Authorizations for Current WF3 Operations

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
NRC	Atomic Energy Act, 10 CFR 50	WF3 License to Operate	NPF-38	December 18, 2024	Operation of WF3
TDEC	Tennessee Department of Environment and Conservation Rule 1200-2-10-32	Radioactive Waste License for Delivery	T-LA001-L15	Updated annually	Shipment of radioactive material into Tennessee to a disposal/ processing facility

CILLRWC: Central Interstate Low-Level Radioactive Waste Commission

DOT: U.S. Department of Transportation

LDEQ: Louisiana Department of Environmental Quality

MEMA: Mississippi Emergency Management Agency

NRC: U.S. Nuclear Regulatory Commission

TDEC: Tennessee Department of Environment and Conservation

a. Timely renewal application submitted 180 days prior to permit expiration (Entergy 2015p); therefore, permit has been administratively continued.

b. Current air permit does not contain an expiration date. However in 2015, LDEQ promulgated amendments to LAC 33:III.503 to establish a regulatory framework setting forth maximum terms and renewal procedures for minor source air permits of not more than 10 years. Based on LDEQ's established schedule, WF3's air permit renewal application is due to the LDEQ on October 1, 2017.

Table 9.1-2
Environmental Authorizations and Consultations for WF3 License Renewal

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act [42 USC 2011 et seq.]	License renewal	Applicant for federal license must submit an Environmental Report in support of license renewal application.
U.S. Fish and Wildlife Service	Endangered Species Act Section 7 [16 USC 1636]	Consultation	Requires federal agency issuing a license to consult with the USFWS, and NMFS if applicable, regarding federally protected species.
Louisiana Department of Culture, Recreation & Tourism	National Historic Preservation Act Section 106	Consultation	Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or tribal historic preservation officer.
Louisiana Department of Environmental Quality	Clean Water Act Section 401 [33 USC 1341]	Certification	Applicant seeking federal license for a project with discharge to state waters must obtain either State certification that proposed action would comply with applicable State water quality standards, or a waiver.
Louisiana Department of Natural Resources	Federal Coastal Zone Management Act [16 USC 1451 et seq.]	Consistency Determination	Requires an applicant to provide certification to the federal agency issuing the license that license renewal would be consistent with the federally approved state coastal zone management program.

9.2 Status of Compliance

WF3 has established control measures in place to ensure compliance with the authorizations listed in Table 9.1-1, including monitoring, reporting, and operating within specified limits. WF3 chemistry personnel are primarily responsible for monitoring and ensuring that the site complies with its environmental permits and applicable regulations. Monitoring and sampling results associated with environmental programs are submitted to appropriate agencies, as specified in the permits and/or governing regulations.

9.3 Notice of Violations

Based on review of records over the previous 5 years (2010–2014) of various environmental programs and permits that WF3 is subject to and complies with, there have been no federal (i.e., agencies other than the NRC), state, or local regulatory notices of violations issued to the facility.

9.4 Remediation Activities

There are no current or ongoing remediation activities or investigations occurring at WF3.

9.5 Federal, State, and Local Regulatory Standards: Discussion of Compliance

9.5.1 Clean Water Act

9.5.1.1 Water Quality (401) Certification

Federal CWA, Section 401, requires an applicant for a federal license to conduct an activity that might result in a discharge into navigable waters to provide the licensing agency a certification, or a waiver of certification, from the state where the discharge would originate that the discharge will not violate state water quality standards [33 USC 1341]. The Louisiana Stream Control Commission issued a Section 401 State Water Quality Certification (WQC) for WF3 on June 21, 1972 (Attachment A). Correspondence from the LDEQ in January 2015 (Attachment A) confirms the following:

- No new or additional 401 WQC is required for WF3 in support of its license renewal application.
- The 401 WQC issued by the Louisiana Stream Control Commission on June 21, 1972, remains valid for WF3.
- WF3 LPDES Permit No. LA0007374 constitutes 401 WQC.

The EPA has granted Louisiana the authority to issue NPDES permits under a fully delegated NPDES program. Attachment A contains the LPDES permit that authorizes plant discharges at WF3. WF3 is providing a copy of its LPDES permit as further demonstration of the existing state water quality (401) certification.

9.5.1.2 LPDES Permit

The release of pollutants in wastewaters at the WF3 facility is regulated and controlled through LPDES Permit No. LA0007374 issued by the LDEQ. As discussed in Section 3.5.1.1.1, there are 13 outfalls (3 external and 10 internal) identified in the LPDES permit. Monitoring results associated with these outfalls are submitted in discharge monitoring reports to the LDEQ at the frequency specified in the permit. WF3's compliance with the LPDES permit over the previous 5 years (2010–2014) has been excellent. For example, there has not been an exceedance relative to thermal discharge or non-related thermal discharge limits as identified in the station's LPDES permit.

9.5.1.3 Stormwater Permit

Stormwater discharges associated with WF3 industrial activities are regulated and controlled through LPDES Permit No. LA0007374 issued by the LDEQ. WF3 samples stormwater runoff at LPDES Outfall 004 (which receives runoff from the entire industrial area) on a quarterly basis and analyzes for pollutants as specified in the permit. WF3 is also required to develop, maintain, and implement a SWPPP for the facility that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater and identify the BMPs that will be used to prevent or reduce the pollutants in stormwater discharges (WF3 2007b). WF3 is in compliance with the terms and conditions of the LPDES permit as it relates to the stormwater program.

9.5.1.4 Sanitary Wastewaters

As previously discussed in Section 3.5.1.1.3, with the exception of the EEC, sanitary wastewater from all plant locations is transferred to the St. Charles Parish POTW where it is managed appropriately. Sanitary wastewater from the EEC, which is regulated by WF3's LPDES Permit No. LA0007374, flows to an onsite sewage treatment unit prior to discharging to 40 Arpent Canal via LPDES Outfall 005.

Because sanitary wastewaters at the EEC are treated in a sewage treatment unit and sanitary wastewaters are collected in sewage lift stations at the plant prior to discharge to the St. Charles Parish POTW, WF3 is required to have personnel certified in accordance with Louisiana Department of Health and Hospitals LAC 48:V.7303 (Certification Requirements). WF3 maintains onsite certified wastewater operators; therefore, the site is in compliance with this program.

9.5.1.5 Spill Prevention, Control, and Countermeasures

The EPA's Oil Pollution Prevention Rule became effective January 10, 1974, and was published under the authority of Section 311(j)(1)(C) of the Federal Water Pollution Control Act. The regulation has been published in 40 CFR Part 112 and facilities subject to the rule must prepare and implement an SPCC plan to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines. WF3 is subject to this rule and has a written SPCC plan that identifies and describes the procedures, materials, equipment, and facilities that are utilized at the station to minimize the frequency and severity of oil spills in order to meet the requirements of this rule (WF3 2015b).

Reportable Spills [40 CFR Part 110]

WF3 is subject to the reporting provisions of 40 CFR Part 110 as it relates to the discharge of oil in such quantities as may be harmful pursuant to Section 311(b)(4) of the Federal Water Pollution Control Act. Any discharges of oil in such quantities that may be harmful to the public health or welfare or the environment must be reported to the National Response Center. Based on a review of records over the previous 5 years (2010–2014), there have been no releases at WF3 that have triggered this notification requirement.

Reportable Spills [LAC 33.I Chapter 39]

WF3 is also subject to the reporting provisions of Louisiana Environmental Regulatory Code, LAC 33.I Chapter 39. This reporting provision requires that any release of oil in a quantity of 42 gallons (1 barrel) or greater to the environment be reported to the Louisiana Department of Public Safety and the LDEQ. Based on a review of records over the previous 5 years (2010–2014), there have been no releases at WF3 that have triggered this notification requirement.

9.5.1.6 Facility Response Plan

WF3 is not subject to the Facility Response Plan risk requirements described in 40 CFR 112.20 because the facility does not transfer oil over water to or from vessels and does not store oil in quantities greater than 1 million gallons.

9.5.1.7 Section 404 Permit

As discussed in Section 3.1.1, approximately 63 percent of the Entergy Louisiana, LLC property consists of wetlands. For these wetland areas, either a Section 404 Individual or Nationwide Permit would have to be obtained from the USACE prior to performing activities in these type areas. Although WF3's current operation does not require a Section 404 Permit, the Station would comply with regulatory requirements imposed by the USACE as it relates to performing activities in federal jurisdictional wetland areas when appropriate.

9.5.2 Safe Drinking Water Act

As discussed in Section 2.2.2.6, potable water for WF3 is supplied by the St. Charles Parish Water System. No further treatment for potable water usage is performed on site. In addition, WF3 does not engage in underground injections or other actions that could endanger drinking water sources. Therefore, WF3 is not subject to the Safe Drinking Water Act.

9.5.3 Clean Air Act

9.5.3.1 Air Permit

WF3 has a permit to operate emergency diesel generators, diesel fire water pumps, diesel dry cooling tower pumps, portable auxiliary boiler, and portable outage engines (WF3 2004a). Operation of these air emission sources is maintained within the emission, opacity, fuel sulfur content, and fuel usage (as applicable) limits established in the station air permit issued by the LDEQ. As required by the air permit, reports are submitted annually and semiannually to the LDEQ. For purposes of the CAA, WF3 is considered a minor air emission source. WF3 is in compliance with this permit.

9.5.3.2 Chemical Accident Prevention Provisions [40 CFR Part 68]

WF3 is not subject to the Risk Management Plan requirements described in 40 CFR Part 68 because the amount of regulated chemicals present on site do not exceed the threshold quantities specified in 40 CFR 68.130.

9.5.3.3 Stratospheric Ozone [40 CFR 82]

Under Title VI of the CAA, the EPA is responsible for several programs that protect the stratospheric ozone layer. Regulations promulgated by the EPA to protect the ozone layer are contained in 40 CFR Part 82. Refrigeration appliances and motor vehicle air conditioners are regulated under Sections 608 and 609 of the CAA, respectively. A number of service practices, refrigerant reclamation, technician certification, and other requirements are covered by these programs. WF3 is in compliance with Section 608 of the CAA as amended in 1990 and the implementing regulations codified in 40 CFR Part 82. The program to manage stationary refrigeration appliances at WF3 is described in Entergy's fleet procedure (Entergy 2014h). Because motor vehicle air conditioners are not serviced on site, Section 609 of the CAA is not applicable.

9.5.4 Atomic Energy Act

9.5.4.1 Radioactive Waste

As a generator of both LLRW and spent fuel, WF3 is subject to and complies with provisions and requirements of the Low-Level Radioactive Waste Policy Amendment Act of 1985 and the Nuclear Waste Policy Act of 1982, as subsequently amended.

WF3 also complies with permits issued by (1) the Central Interstate Low-Level Radioactive Waste Commission for exporting radioactive waste outside the region, (2) the Mississippi Emergency Management Agency for transportation of radioactive material into, within, or through the state of Mississippi, and (3) the Tennessee Department of Environment and Conservation for shipping radioactive material to a licensed disposal/processing facility within the state of Tennessee.

9.5.5 Resource Conservation and Recovery Act

9.5.5.1 Nonradioactive Wastes

As a generator of hazardous and nonhazardous wastes, WF3 is subject to and complies with the RCRA and specific LDEQ regulations contained in LAC 33: Part V (Hazardous Waste and Hazardous Materials) and LAC 33: Part VII (Solid Waste). As discussed in Section 2.2.4, WF3 is classified as a small quantity generator of hazardous wastes; therefore, hazardous wastes routinely make up only a small percentage of the total wastes generated. As a generator of hazardous wastes, WF3 also maintains a hazardous waste generator identification number (Table 9.1-1). Because WF3 is classified as a small quantity generator of hazardous waste, LDEQ regulations LAC 33:V.1111.E exempts the facility from annual hazardous waste reporting requirements.

Reportable Spills [40 CFR Part 262]

WF3 is subject to the reporting provisions of 40 CFR 262.34(d)(5)(iv)(C) as it relates to a fire, explosion, or other release of hazardous waste, which could threaten human health outside the facility boundary or when the facility has knowledge that a spill has reached surface water. Any such events must be reported to the National Response Center. Based on a review of records over the previous 5 years (2010–2014), there have been no releases at WF3 that have triggered this notification requirement.

9.5.5.2 Mixed Wastes

Radioactive materials are regulated by the NRC under the Atomic Energy Act of 1954, and hazardous wastes are regulated by the EPA under the RCRA of 1976. Although there are currently no mixed waste streams being generated or stored at WF3, the facility would comply with required NRC and EPA management practices when applicable.

9.5.5.3 Underground Storage Tanks [LAC 33:XI]

WF3 has one underground storage tank located on site at the EEC, a 550-gallon fiberglass diesel fuel oil underground storage tank. This 550-gallon tank is the fuel supply for the Emergency Operations Facility emergency generator. This tank is subject to the release response and corrective action requirements specified in LAC 33:XI.715. WF3 is in compliance with these requirements.

Reportable Spills [LAC 33:XI.715]

WF3 is subject to the reporting provisions of LAC 33:XI.715 as it relates to discovering a release of a regulated substance from an underground storage tank containing a petroleum product. Any such events must be reported to the LDEQ. There have been no releases at WF3 that have triggered this notification requirement over the previous 5 years (2010–2014).

9.5.6 Louisiana Public Health Sanitary Code

9.5.6.1 Medical Waste

Because WF3 generates small quantities of medical waste from the onsite medical clinic, the facility is subject to and complies with the requirements of Louisiana Sanitary Code, Chapter XXVII (Management of Refuse, Infectious Waste, Medical Waste, and Potentially Infectious Biomedical Waste).

9.5.7 Pollution Prevention Act

In accordance with RCRA Section 3002(b) and 40 CFR 262.27, a small or large quantity generator must certify that there is a waste minimization program in place to reduce the volume and toxicity of the waste generated to the degree determined to be economically practical. As previously discussed in Section 2.2.4, WF3 is meeting this requirement as procedural measures are in place to minimize hazardous waste generated to the maximum extent practical.

9.5.8 Federal Insecticide, Fungicide and Rodenticide Act

Commercially approved herbicides such as Pramitol® and Roundup® are applied by a licensed contractor on an as-needed basis to control vegetation. Pesticides are also applied inside buildings by a licensed contractor. Fertilizers or soil conditioners are not used at WF3. (Entergy 2009a, Section 4.3.1) Because only contractors who have obtained a license as specified in Louisiana Department of Agriculture and Animals LAC 7:XXIX.107 conduct pesticide/herbicide applications on site, WF3 is in compliance with the requirements of this act.

9.5.9 Toxic Substances Control Act

The Toxic Substances Control Act of 1976 regulates PCBs [40 CFR Part 761] and asbestos [40 CFR Part 763], both of which are present at WF3. PCBs are present in some lighting ballasts and large capacitors, while asbestos is present in specific types of insulation and gaskets. WF3 is in compliance with the PCB and asbestos regulations applicable to the facility.

9.5.10 Hazardous Materials Transportation Act

Because WF3 ships hazardous materials off site that are regulated by the U.S. Department of Transportation, the facility is subject to and complies with the applicable requirements of the Hazardous Materials Transportation Act described in 49 CFR, including the requirement to possess a current Hazardous Materials Certificate of Registration (Table 9.1-1).

9.5.11 Emergency Planning and Community Right-to-Know Act

9.5.11.1 Section 312 Reporting [40 CFR Part 370]

WF3 is subject to and complies with Section 312 of the Emergency Planning and Community Right-to-Know Act that requires the submittal of an emergency and hazardous chemical inventory report (Tier II) to the Local Emergency Planning Commission, the State Emergency

Response Commission, and the local fire department. This report which typically includes, but is not limited to, chemicals such as ammonium hydroxide, boric acid, carbon dioxide, diesel fuel, electrohydraulic fluid, ethylene glycol, gasoline, hydrazine, hydrogen, lube oils, Nalco products, nitrogen, sodium hydroxide, and sulfuric acid is submitted to these agencies annually.

9.5.11.2 Section 313 Reporting [40 CFR Part 372]

Because WF3 is located on the same Entergy Louisiana, LLC property as Waterford 1, 2, and 4 and the facilities are owned by the same entity, the facilities are designated as one "complex". By default, this subjects WF3 to the Section 313 Toxic Release Inventory reporting requirements. Although reporting under this requirement may not be applicable in certain calendar years given that the reporting trigger associated with this complex is either the quantity of Number 6 fuel oil combusted (5,140 gallons) at the Waterford 1, 2, and 4 facilities, or Number 2 fuel oil (1,410,000 gallons) combusted at WF3 and Waterford 4, WF3 is in compliance with the Section 313 Toxic Release Inventory reporting requirements.

9.5.12 Comprehensive Environmental Response, Compensation, and Liability Act

WF3 is subject to the hazardous substance release and reporting provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as subsequently amended. Any release of reportable quantities of listed hazardous substances to the environment requires a notification to the National Response Center, Louisiana Department of Public Safety, and LDEQ, and subsequent written follow-up. Based on a review of records over the previous 5 years (2010–2014), there have been no releases at WF3 that have triggered this notification requirement.

9.5.13 Migratory Bird Treaty Act

The Migratory Bird Treaty Act makes it unlawful to pursue, hunt, take, capture, kill, or sell birds listed and grants protection to any bird parts including feathers, eggs, and nests. There are currently no Migratory Bird Treaty Act permitting requirements associated with WF3 operations.

9.5.14 Endangered Species Act

Potential impacts on federally and state-listed species were considered in Entergy's review and analysis in Section 4.6.3, and it was concluded that none would likely be adversely affected as a result of license renewal.

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of species that are listed, or proposed for listing, as endangered or threatened. Depending on the action involved, the ESA requires consultation with the USFWS, and with the NMFS if marine or anadromous species could be affected. Although Entergy invited comment from the USFWS and NMFS (Attachment B) during the development of this ER, a more structured consultation process with these agencies may be initiated by the NRC per Section 7 of the ESA.

9.5.15 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits 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. There are currently no Bald and Golden Eagle Protection Act permitting requirements associated with WF3 operations.

9.5.16 Coastal Zone Management Act

The federal Coastal Zone Management Act [16 USC 1451 et seq.] imposes requirements on applicants for a federal license to conduct an activity that could affect a state's coastal zone. The act requires the applicant to certify to the licensing agency that the proposed activity would be consistent with the state's federally approved coastal zone management program [16 USC 1456(c)(3)(A)]. The National Oceanic and Atmospheric Administration has promulgated implementing regulations that indicate that the requirement is applicable to renewal of federal licenses for activities not previously reviewed by the state [15 CFR 930.51(b)(1)]. The regulation requires that the license applicant provide its certification to the federal licensing agency and a copy to the applicable state agency [15 CFR 930.57(a)].

The NRC's Office of Nuclear Reactor Regulation has issued guidance to its staff regarding compliance with the act. This guidance acknowledges that Louisiana has an approved coastal zone management program (NRC 2013d, page E-3). WF3, located in St. Charles Parish, is within the Louisiana coastal zone.

Based on correspondence from the Louisiana Department of Natural Resources, the agency determined that renewal of the WF3 OL is consistent with Louisiana's coastal zone policies (Attachment E). Therefore, WF3 has fulfilled the regulatory requirement to certify to the licensing agency that the proposed activity would be consistent with the state's federally approved coastal zone management program.

9.5.17 Magnuson-Stevens Fishery Conservation and Management Act

WF3 is not subject to the Magnuson-Stevens Fishery Conservation and Management Act because no essential fish habitat has been designated by the NMFS within the vicinity of WF3 (Attachment B).

9.5.18 Marine Mammal Protection Act

The Marine Mammal Protection Act prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. There are currently no Marine Mammal Protection Act permitting requirements associated with WF3 operations.

9.5.19 Farmland Protection Policy Act

The FPPA only applies to "federal programs." The term "federal program" under this act does not include federal permitting or licensing for activities on private or non-federal lands. Therefore, because license renewal is considered a federal licensing activity and WF3 is located on non-federal lands, the FPPA is not applicable.

9.5.20 National Historic Preservation Act

Potential impacts on historic properties were considered in Entergy's review and analysis in Section 4.7, and it was concluded that although one eligible historic property is present (Waterford Plantation), it will not be adversely affected as a result of license renewal. As previously discussed in Section 3.7.5, administrative controls are in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. These controls consist of a cultural resources protection plan fleet procedure that requires reviews, investigations, and consultations as needed (Entergy 2013c), and a site-specific cultural resource protection plan to protect those areas on the property determined to be eligible for the NRHP, specifically the Waterford Plantation (LP&L 1983). These controls ensure that existing or potentially existing cultural resources are adequately protected, and assist WF3 in meeting state and federal expectations.

Section 106 of the NHPA requires federal agencies having the authority to license any undertaking to take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking, prior to the agency issuing the license. Although Entergy invited comment from the SHPO (Attachment C) during development of this ER, a more structured consultation process with the SHPO may be initiated by the NRC per Section 106 of the NHPA.

9.5.21 State Water Use Program

In accordance with L.R.S. 38:3091-3097, the Louisiana Department of Transportation and Development requires that all major water users keep accurate records of water pumpage within their facilities and report such pumpage to the State on a quarterly basis. Entergy's New Orleans, Louisiana, fossil headquarters group reports quarterly water pumpage for several facilities, including WF3. Water pumpage is based on the monthly average flow reported in the facility's monthly discharge monitoring report. WF3 is in compliance with this reporting requirement.

9.5.22 Federal Aviation Act

Coordination with the Federal Aviation Administration (FAA) is required when it becomes necessary to ensure that the highest structures associated with the project do not impair the safety of aviation. Submission of a letter of notification (with accompanying maps and project description) to the FAA would result in a written response from the FAA certifying that no hazard exists or recommending project changes and/or the installation of warning devices such as lighting.

The site elevation is dominated by the 249.5-foot high reactor shield building (WF3 2014a, Section 3.8.4.1.1) and the 200-foot high primary and backup meteorological towers that are equipped with an FAA lighting system (Entergy 1999). No license-renewal-related construction activities have been identified; therefore, no new notifications to the FAA are required.

9.5.23 Occupational Safety and Health Act

The federal OSHA governs the occupational safety and health of the construction workers and the operations staffs. WF3 and its contractors comply with OSHA's substantive requirements, as these are incorporated in the sites occupational health and safety practices.

9.5.24 St. Charles Parish Zoning Requirements

9.5.24.1 Land Use

Section 11.5-36 of the St. Charles Parish zoning code designates the Entergy Louisiana, LLC property as an industrial area. The designated industrial area does not include the wetland areas south of LA-3127. Appendix A of the St. Charles Parish zoning code ordinance requires WF3 to maintain a buffer zone to ensure the protection and well-being of neighboring areas and that major operations must be located 2,000 feet from the nearest residential and commercial district, or located a lesser distance if clearly dictated safe by industry standards and approved by the local Board of Adjustments. (SCP 2014a) WF3 is in compliance with this zoning ordinance.

9.6 Environmental Reviews

Entergy has fleet procedural controls in place to ensure that environmentally sensitive areas at WF3, if present, are adequately protected during site operations and project planning (Entergy 2013g). These controls, which encompass nonradiological environmental resource areas such as land use, air quality, surface water and groundwater, terrestrial and aquatic ecology, historic and cultural resources, and waste management and pollution prevention consist of the following:

- Appropriate local, state, and/or federal permits are obtained or modified as necessary.
- BMPs are implemented to protect wetlands, natural heritage areas, and sensitive ecosystems.
- Appropriate agencies are consulted on matters involving federally and state-listed threatened, endangered, and protected species, and that BMPs are implemented to minimize impacts to these species.
- Appropriate agencies are consulted on matters involving cultural resources and to ensure BMPs are implemented to minimize impact to this resource.

In summary, Entergy's administrative controls ensure that appropriate local, state, and/or federal permits are obtained or modified as necessary, that cultural resources and threatened and endangered species are protected if present, and that other regulatory issues are adequately addressed as necessary.

9.7 Requirement [10 CFR 51.45(d)]

> The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements. [10 CFR 51.45(d)]

The coal, gas, new nuclear, and combination of alternatives discussed in Chapter 7 could probably be constructed and operated to comply with all applicable environmental quality standards and requirements. However, increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in certain regional locations.

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Attachment A

WF3 Clean Water Act Documentation

Attachment A

WF3 Clean Water Act Documentation

- Section 401 (Water Quality) Certification. June 21, 1972.
- Louisiana Pollutant Discharge Elimination System (LPDES) Permit No. LA0007374. September 7, 2010.
- Scott Guilliams, Louisiana Department of Environmental Quality, to Kelli M. Dowell, Entergy Services, Inc. January 30, 2015.

APPENDIX B

STATE OF LOUISIANA
STREAM CONTROL COMMISSION
P. O. DRAWER FC
UNIVERSITY STATION
BATON ROUGE, LOUISIANA 70803

June 21, 1972

Louisiana Power and Light Company
142 Delaronde Street
New Orleans, Louisiana 70114

Attention: Mr. Donald L. Aswell, Production Manager

Gentlemen:

This is to officially inform you that the discharge permit applications for Units 1, 2, and 3, Taft, Louisiana, to discharge condenser cooling water to the Mississippi River and demineralizer waste to the Forty Arpent Canal were approved by the Louisiana Stream Control Commission at its meeting on May 31, 1972. Any change in either the quality or quantity of the discharges will require submission of new proposals.

The Commission, in approving the discharges, is of the opinion that water quality standards of the State of Louisiana will not be violated. Therefore, in accordance with provisions of Louisiana Revised Statutes of 1950, Title 56, Section 1439(5) - Act 628 of the 1970 Louisiana Legislature - this is your letter of certification from the commission that the installations comply with Section 21(b) of the Federal Water Quality Improvement Act of 1970.

Enclosed is copy of a public notice to be run by you, one (1) time, in the official state journal, the BATON ROUGE STATE TIMES, at your expense.

Very truly yours,

Robert A. Lafleur
Executive Secretary

fbr
Enclosure

PERMIT NUMBER
LA0007374
AI No.: 35260

DEQ
LOUISIANA

OFFICE OF ENVIRONMENTAL SERVICES

Water Discharge Permit

Pursuant to the Clean Water Act, as amended (33 U.S.C. 1251 et seq.), and the Louisiana Environmental Quality Act, as amended (La. R. S. 30:2001 et seq.), rules and regulations effective or promulgated under the authority of said Acts, and in reliance on statements and representations heretofore made in the application, a Louisiana Pollutant Discharge Elimination System permit is issued authorizing

Entergy Operations, Inc.
Waterford 3 Steam Electric Station
17265 River Road
Killona, Louisiana 70057

Type Facility:	steam electric generating station
Location:	17265 River Road, Killona St. Charles Parish
Receiving Waters:	Outfall 001 - Mississippi River (070301) Outfalls 004 and 005 - 40 Arpent Canal thence to Lac Des Allemands (020202)

to discharge in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III attached hereto.

This permit shall become effective on 01 October 2010

This permit and the authorization to discharge shall expire five (5) years from the effective date of the permit.

Issued on 07 September 2010

Cheryl Sonnier Nolan
Assistant Secretary

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 001, the continuous discharge of once through non-contact cooling water combined with previously monitored intermittent discharges including but not limited to: steam generator blowdown, cooling tower blowdown, metal cleaning wastewaters, low volume wastewater, and stormwater from Outfalls 101, 201, 301, 401, 501, 601, 701, 801, 901, and 1001 (estimated flow is 994 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow-MGD (*1)	50050	Report	Report	---	---	Continuous	Recorder
Temperature(°F)	00011	Report(*2)	118(*3)	---	---	Continuous	Recorder
Heat	00015	---	(*4)	---	---	Continuous	Recorder
Total Residual Chlorine	50060	---	211	---	---	1/week(*5)	Grab

WHOLE EFFLUENT (ACUTE) TOXICITY TESTING		(Percent %, UNLESS STATED)					
	STORET Code			Monthly Avg Minimum	48-Hour Minimum	Measurement Frequency(*5)	Sample Type
NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas	TEM6C	---	---	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas	TOM6C	---	---	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, Pimephales promelas	TQM6C	---	---	Report	Report	1/quarter	24-hr. Composite
NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Daphnia pulex	TEM3D	---	---	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, Daphnia pulex	TOM3D	---	---	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, Daphnia pulex	TQM3D	---	---	Report	Report	1/quarter	24-hr. Composite

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 001, at the point of discharge from the circulating water system discharge structure prior to mixing with other waters.

FOOTNOTE(S):

(*1) Discharge flow is to be determined from calibrated pumping curves or calculated using appropriate heat balance methodology.

(*2) See Part II, Q.

(*3) Instantaneous maximum.

(*4) Daily maximum limitation of 9.5×10^3 MBTU/hour.

(*5) Sample shall be representative of any periodic episodes of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 101, the intermittent discharge from the liquid waste management system. The liquid waste management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423 (estimated flow is 0.0129 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/batch	Totalized
TSS	00530	---	---	---	100	1/month	Grab
Oil & Grease	03582	---	---	---	20	1/month	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*2) (Min)	9.0 (*2) (Max)	1/batch	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 101, at the point of discharge from the liquid waste management system prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 201, the intermittent discharge from the boron management system. The boron management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423 (estimated flow is 0.0128 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/batch	Totalized
TSS	00530	---	---	---	100	1/month	Grab
Oil & Grease	03582	---	---	---	20	1/month	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*2) (Min)	9.0 (*2) (Max)	1/batch	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 201, at the point of discharge from the boron management system prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 301, the intermittent discharge of filter flush water from the primary water treatment system. The primary water treatment system filters riverwater for various plant uses. The filters of this system are flushed periodically with untreated river water to remove solids trapped in the filter beds (estimated flow is 0.0001 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
				Other Units			
		(lbs/day, UNLESS STATED)		(mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	Weekly	Totalized
Clarifying Agents (*2)							

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 301, at the point of discharge from the primary water treatment system prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The quantity and types of clarifying agents (coagulants) used in the primary water treatment system during the sampling month shall be recorded. Records of the quantity and type of clarifying agents used shall be retained for three (3) years following Part III.C.3. No DMR reporting shall be required.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 401, the intermittent discharge of steam generator blowdown and other low volume wastewaters as defined in 40 CFR 423 (estimated flow is 0.042 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD(*2)	50050	---	Report	---	---	Daily	Totalized
TSS	00530	---	---	---	100	1/week	Grab
Oil & Grease	03582	---	---	---	20	1/week	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/week	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 401, at the point of discharge from the secondary steam plant system prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) When low volume wastewaters are discharged, the flow must be estimated.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 501, the intermittent discharge from Auxiliary Component Cooling Water Basin A. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, Mississippi River water used for flow testing, and stormwater (estimated flow is 0.26 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/week	Estimate
TOC	00680	---	---	---	50	1/week	Grab
TSS (*2)	00530	---	---	---	100	1/week	Grab
Oil & Grease	03582	---	---	---	20	1/week	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/week	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 501, at the point of discharge from Auxiliary Component Cooling Water Basin A prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) During circulating water flow testing, sampling for TSS is not required (when Mississippi River water is used for the flow test).

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 601, the intermittent discharge from Auxiliary Component Cooling Water Basin B. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, secondary plant water system wastewater, Mississippi River water used for flow testing, and stormwater (estimated flow is 0.26 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/week	Estimate
TOC	00680	---	---	---	50	1/week	Grab
TSS (*2)	00530	---	---	---	100	1/week	Grab
Oil & Grease	03582	---	---	---	20	1/week	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/week	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 601, at the point of discharge from the Auxiliary Component Cooling Water Basin B prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) During circulating water flow testing, sampling for TSS is not required (when Mississippi River water is used for the flow test).

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 701, the intermittent discharge of cooling tower blowdown and low volume wastewaters from the Cooling Tower Sump #1. Low volume wastewaters include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.) (estimated flow is 0.0185 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency(*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/month	Estimate
TOC	00680	---	---	---	50	1/quarter	Grab
TSS	00530	---	---	---	100	1/month	Grab
Oil & Grease	03582	---	---	---	20	1/month	Grab
FAC (*2)	50064	---	---	---	0.5	1/month	Grab
Total Chromium (*2)	01034	---	---	---	0.2	1/year	Grab
Total Zinc (*2)	01092	---	---	---	1.0	1/month	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/month	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 701, at the point of discharge from the Dry Cooling Tower Sump #1 prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) Sample shall be representative of periods during cooling tower blowdown discharge.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 801, the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #2. Low volume wastewater sources as defined in 40 CFR 423 include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.) (estimated flow is 0.068 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency (*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/month	Estimate
TOC	00680	---	---	---	50	1/quarter	Grab
TSS	00530	---	---	---	100	1/month	Grab
Oil & Grease	03582	---	---	---	20	1/month	Grab
FAC (*2)	50064	---	---	---	0.5	1/month	Grab
Total Chromium(*2)	01034	---	---	---	0.2	1/year	Grab
Total Zinc (*2)	01092	---	---	---	1.0	1/month	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/month	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 801, at the point of discharge from the Dry Cooling Tower Sump #2 prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) Sample shall be representative of periods during cooling tower blowdown discharge.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 901, the mobile intermittent discharge of metal cleaning wastewaters (both chemical and non-chemical) from various plant equipment components including, but not limited to: the steam generator, cooling water heat exchangers, and piping (estimated flow is 0.0201 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency (*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/week	Estimate
TSS	00530	---	---	---	100	1/week	Grab
Oil & Grease	03582	---	---	---	20	1/week	Grab
Total Copper	01042	---	---	---	1.0	1/week	Grab
Total Iron	01045	---	---	---	1.0	1/week	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*2) (Min)	9.0 (*2) (Max)	1/week	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 901, at the point of discharge from the mobile cleaning process unit(s) prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 1001, the intermittent discharge from the yard oil separator system. Wastewater includes auxiliary boiler blowdown, stormwater, and low volume wastewaters from various sources, including plant floor drains and discharge from the industrial waste system as defined in 40 CFR 423. Low volume wastewater sources include, but are not limited to: secondary water system drains, system leakage, auxiliary boiler sumps, turbine building equipment and floor drains, turbine building floor wash downs, and laboratory drains. (NOTE: Optional discharge to Final Outfall 004 may occur during maintenance periods and during rain events that compromise the capacity of the discharge pumps.) (estimated flow is 0.0553 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency (*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/month	Estimate
TSS	00530	---	---	---	100	1/month	Grab
Oil & Grease	03582	---	---	---	20	1/month	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*2) (Min)	9.0 (*2) (Max)	1/month	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 1001, at the point of discharge from the yard oil separator system prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 004, the intermittent discharge from the plant drainage ditch system consisting of stormwater, potable water from the fire water system, maintenance wastewaters including, but not limited to hydrostatic test water, air conditioning condensate, low volume wastewaters including, but not limited to reverse osmosis reject water and demineralized water. The plant drainage ditch system receives discharges during maintenance from the Dry Cooling Tower Sump #1 (Internal Outfall 701), Dry Cooling Tower Sump #2 (Internal Outfall 801), and treated discharge from the yard oil separator system, including, but not limited to: plant floor drains and discharge from the industrial waste system (Internal Outfall 1001).(estimated flow is 10.3 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency (*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/3 months	Estimate
TOC	00680	---	---	---	50	1/3 months	Grab
TSS (*2)	00530	---	---	---	100	1/3 months	Grab
Oil & Grease	03582	---	---	---	15	1/3 months	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*3) (Min)	9.0 (*3) (Max)	1/3 months	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 004, at the point of discharge from the stormwater drainage ditch south of the plant laydown area and prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) Samples shall be representative of periods during discharge of low volume wastewaters as defined in 40 CFR 423 (excludes Mississippi River water that accumulates in the condenser water boxes).

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 005, the intermittent discharge of treated sanitary wastewater and a *de minimis* discharge from the HVAC unit from the Entergy Energy Education Center (estimated flow is 0.061 MGD).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic		Discharge Limitations				Monitoring Requirements	
		(lbs/day, UNLESS STATED)		Other Units (mg/L, UNLESS STATED)			
	STORET Code	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Measurement Frequency (*1)	Sample Type
Flow-MGD	50050	---	Report	---	---	1/6 months	Estimate
BOD_5	00310	---	---	30	45	1/6 months	Grab
TSS	00530	---	---	30	45	1/6 months	Grab
Fecal Coliform colonies/100 mL	74055	---	---	200	400	1/6 months	Grab
pH Minimum/Maximum Values (Standard Units)	00400	---	---	6.0 (*2) (Min)	9.0 (*2) (Max)	1/6 months	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 005, at the point of discharge from the sewage treatment plant prior to mixing with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

PART II

OTHER REQUIREMENTS

In addition to the standard conditions required in all permits and listed in Part III, the Office has established the following additional requirements in accordance with the Louisiana Water Quality Regulations.

A. This permit does not in any way authorize the permittee to discharge a pollutant not listed or quantified in the application or limited or monitored for in the permit.

B. Authorization to discharge pursuant to the conditions of this permit does not relieve the permittee of any liability for damages to state waters or private property. For discharges to private land, this permit does not relieve the permittee from obtaining proper approval from the landowner for appropriate easements and rights of way.

C. For definitions of monitoring and sampling terminology see STANDARD CONDITIONS FOR LPDES PERMITS, Section F.

D. 24-HOUR ORAL REPORTING: DAILY MAXIMUM LIMITATION VIOLATIONS

Under the provisions of Part III.D.6.e.(3) of this permit, violations of daily maximum limitations for the following pollutants shall be reported orally to the Office of Environmental Compliance within 24 hours from the time the permittee became aware of the violation followed by a written report in five days.

Pollutant(s): Total Copper, Total Chromium, Total Zinc

E. COMPOSITE SAMPLING (24-HOUR)

Unless otherwise specified in this permit, the term "24-hour composite sample" means a sample consisting of a minimum of four (4) aliquots of effluent collected at regular intervals over a normal 24-hour operating day and combined in proportion to flow or a sample continuously collected in proportion to flow over a normal 24-hour operating period.

F. 40 CFR PART 136 (See LAC 33:IX.4901) ANALYTICAL REQUIREMENTS

Unless otherwise specified in this permit, monitoring shall be conducted according to analytical, apparatus and materials, sample collection, preservation, handling, etc., procedures listed at 40 CFR Part 136, and in particular, Appendices A, B, and C (See LAC 33:IX.4901).

G. FLOW MEASUREMENT "ESTIMATE" SAMPLE TYPE

If the flow measurement sample type in Part I is specified as "estimate", flow measurements shall not be subject to the accuracy provisions established at Part III.C.6 of this permit. The daily flow value may be estimated using best engineering judgement.

OTHER REQUIREMENTS (continued)

H. MINIMUM QUANTIFICATION LEVEL (MQL)

If any individual analytical test result is less than the minimum quantification level listed below, a value of zero (0) may be used for that individual result for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

NONCONVENTIONAL	MQL (µg/L)
Phenolics, Total Recoverable (4AAP)	5
Chlorine (Total Residual)	100
3-Chlorophenol	10
4-Chlorophenol	10
2,3-Dichlorophenol	10
2,5-Dichlorophenol	10
2,6-Dichlorophenol	10
3,4-Dichlorophenol	10
2,4-D	10
2,4,5-TP (Silvex)	4

METALS AND CYANIDE	MQL (µg/L)
Antimony (Total)	60
Arsenic (Total)	10
Beryllium (Total)	5
Cadmium (Total)	1
Chromium (Total)	10
Chromium (3+)	10
Chromium (6+)	10
Copper (Total)	10
Lead (Total)	5
Mercury (Total)	0.2
Molybdenum (Total)	30
Nickel (Total) Freshwater	40
Nickel (Total) Marine	5
Selenium (Total)	5
Silver (Total)	2
Thallium (Total)	10
Zinc (Total)	20
Cyanide (Total)	20

DIOXIN	MQL (µg/L)
2,3,7,8-TCDD	0.00001

VOLATILE COMPOUNDS	MQL (µg/L)
Acrolein	50
Acrylonitrile	50
Benzene	10
Bromoform	10
Carbon Tetrachloride	10
Chlorobenzene	10
Chlorodibromomethane	10
Chloroethane	50
2-Chloroethylvinylether	10
Chloroform	10

OTHER REQUIREMENTS (continued)

Dichlorobromomethane	10
1,1-Dichloroethane	10
1,2-Dichloroethane	10
1,1-Dichloroethylene	10
1,2-Dichloropropane	10
1,3-Dichloropropylene	10
Ethylbenzene	10
Methyl Bromide [Bromomethane]	50
Methyl Chloride [Chloromethane]	50
Methylene Chloride	20
1,1,2,2-Tetrachloroethane	10
Tetrachloroethylene	10
Toluene	10
1,2-trans-Dichloroethylene	10
1,1,1-Trichloroethane	10
1,1,2-Trichloroethane	10
Trichloroethylene	10
Vinyl Chloride	10

ACID COMPOUNDS	MQL (µg/L)
2-Chlorophenol	10
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
4,6-Dinitro-o-Cresol [2-Methyl-4,6-Dinitrophenol]	50
2,4-Dinitrophenol	50
2-Nitrophenol	20
4-Nitrophenol	50
p-Chloro-m-Cresol [4-Chloro-3-Methylphenol]	10
Pentachlorophenol	50
Phenol	10
2,4,6-Trichlorophenol	10

BASE/NEUTRAL COMPOUNDS	MQL (µg/L)
Acenaphthene	10
Acenaphthylene	10
Anthracene	10
Benzidine	50
Benzo(a)anthracene	10
Benzo(a)pyrene	10
3,4-Benzofluoranthene	10
Benzo(ghi)perylene	20
Benzo(k)fluoranthene	10
Bis(2-chloroethoxy) Methane	10
Bis(2-chloroethyl) Ether	10
Bis(2-chloroisopropyl) Ether	10
Bis(2-ethylhexyl) Phthalate	10
4-Bromophenyl Phenyl Ether	10
Butylbenzyl Phthalate	10
2-Chloronapthalene	10
4-Chlorophenyl Phenyl Ether	10
Chrysene	10
Dibenzo(a,h)anthracene	20
1,2-Dichlorobenzene	10

OTHER REQUIREMENTS (continued)

1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
3,3'-Dichlorobenzidine	50
Diethyl Phthalate	10
Dimethyl Phthalate	10
Di-n-Butyl Phthalate	10
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
Di-n-octyl Phthalate	10
1,2-Diphenylhydrazine	20
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	10
Hexachloroethane	20
Indeno(1,2,3-cd)pyrene [2,3-o-Phenylene Pyrene]	20
Isophorone	10
Naphthalene	10
Nitrobenzene	10
n-Nitrosodimethylamine	50
n-Nitrosodi-n-Propylamine	20
n-Nitrosodiphenylamine	20
Phenanthrene	10
Pyrene	10
1,2,4-Trichlorobenzene	10

PESTICIDES	MQL (μg/L)
Aldrin	0.05
Alpha-BHC	0.05
Beta-BHC	0.05
Gamma-BHC [Lindane]	0.05
Delta-BHC	0.05
Chlordane	0.2
4,4'-DDT	0.1
4,4'-DDE [p,p-DDX]	0.1
4,4'-DDD [p,p-TDE]	0.1
Dieldrin	0.1
Alpha-Endosulfan	0.1
Beta-Endosulfan	0.1
Endosulfan Sulfate	0.1
Endrin	0.1
Endrin Aldehyde	0.1
Heptachlor	0.05
Heptachlor Epoxide [BHC-Hexachlorocyclohexane]	0.05
PCB-1242	1.0
PCB-1254	1.0
PCB-1221	1.0
PCB-1232	1.0
PCB-1248	1.0
PCB-1260	1.0
PCB-1016	1.0
Toxaphene	5.0

OTHER REQUIREMENTS (continued)

The permittee may develop an effluent specific method detection limit (MDL) in accordance with Appendix B to 40 CFR Part 136 (See LAC 33:IX.4901). For any pollutant for which the permittee determines an effluent specific MDL, the permittee shall send to this Office a report containing QA/QC documentation, analytical results, and calculations necessary to demonstrate that the effluent specific MDL was correctly calculated. An effluent specific minimum quantification level (MQL) shall be determined in accordance with the following calculation:

$$MQL = 3.3 \times MDL$$

Upon written approval by this Office, the effluent specific MQL may be utilized by the permittee for all future Discharge Monitoring Report (DMR) calculations and reporting requirements.

I. The permittee shall achieve compliance with the effluent limitations and monitoring requirements specified for discharges in accordance with the following schedule:

Effective date of the permit

J. PROHIBITION OF PCB DISCHARGES

There shall be no discharge of polychlorinated biphenyls (PCB's). The minimum quantification level for PCB's is 1.0 µg/L. If any individual analytical test result for PCB's is less than the minimum quantification level, then a value of zero(0) shall be used for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

K. PROHIBITION OF 126 PRIORITY POLLUTANTS

There shall be no discharge of any 126 priority pollutants (40 CFR 423 Appendix A) associated with the chemicals added for cooling tower maintenance, except total chromium and total zinc. The minimum quantification levels for the 126 priority pollutants are found in Part II, Paragraph I.

L. CHEMICAL METAL CLEANING WASTE

The term *chemical metal cleaning waste* means any wastewater resulting from cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning.

M. METAL CLEANING WASTE

The term *metal cleaning waste* means any wastewater resulting from cleaning (with or without chemical cleaning compounds) any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

OTHER REQUIREMENTS (continued)

N. LOW VOLUME WASTE SOURCES

The term "low volume waste sources" means, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established. Low volume waste sources include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastewaters are not included.

O. TOTAL RESIDUAL CHLORINE

The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in 40 CFR Part 136.

Total residual chlorine may not be discharged from any unit for more than two hours per day.

Simultaneous multi-unit chlorination is permitted.

P. FREE AVAILABLE CHLORINE

The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in the latest edition of Standard Methods for the Examination of Water and Wastewater.

Free available chlorine may not be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available chlorine at any one time.

Q. TEMPERATURE

Daily temperature discharge is defined as the flow-weighted average (FWAT) and, on a daily basis, shall be monitored and recorded in accordance with Part I of this permit. FWAT shall be calculated at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$FWAT = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

"Daily average temperature" (also known as average monthly or maximum 30 day value) shall be the arithmetic average of all FWATs calculated during the calendar month.

"Daily maximum temperature" (also known as the maximum daily value) shall be the highest FWAT calculated during the calendar month.

OTHER REQUIREMENTS (continued)

R. HEAT

Discharge of heat shall be continuously calculated and recorded as:

[Instantaneous ▲T (circulating water temperature rise through the plant in °F)] X [Instantaneous flow rate in MGD] X [$3.48X10^5$]

OR AS

[Heat transferred to the turbine generator cycle (BTU/hour)] - [Gross electrical output (BTU/hour)].

S. NON-RADIOACTIVE WASTEWATERS

Certain low volume and chemical wastewaters from this facility with no detectable radioactivity, as defined by the Nuclear Regulatory Commission plant effluent release limits may be commingled and treated with similar wastewaters from Waterford 1 & 2 and controlled under terms of LPDES Permit Number LA0007439.

T. WATER TREATMENT CLARIFIER SLUDGE WASTES

Water treatment clarifier sludge wastes may be returned to the stream without treatment if not previously combined with any other untreated waste source, including demineralizer and softener wastes.

U. ZEBRA MUSSEL TREATMENT

The terms and conditions of the zebra mussel treatment program submitted by Entergy Operations, Inc., Waterford 3 and approved by this Office on June 23, 1998, shall be enforceable as if part of this permit.

According to section 3.d., "Samples and Composites", of the biomonitoring requirements paragraph of this permit, the permittee must collect composite samples that "are representative of any periodic episodes of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis". Anytime the treatment method involves an increase in the concentration of a treatment chemical, a change in type of treatment chemical used, or if any event occurs that creates the potential for an effluent with a higher toxic nature, additional biomonitoring according to the terms and conditions of the biomonitoring section of Part II of this permit shall be required.

The permittee must notify this Office if changes occur in the zebra mussel control plan and obtain approval prior to initiating the new treatment. If chlorine is applied to control zebra mussels, the permittee must comply with a daily maximum Total Residual Chlorine (TRC) concentration limit of 0.2 mg/L. Monitoring shall be performed at a frequency of 1/day, by grab sample, during periods of chlorine application.

OTHER REQUIREMENTS (continued)

V. PERMIT REOPENER CLAUSE

This permit may be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitations issued or approved under sections 301(b)(2)(C) and (D); 304(b)(2); and 307(a)(2) of the Clean Water Act, or more stringent discharge limitations and/or additional restrictions in the future to maintain the water quality integrity and the designated uses of the receiving water bodies based upon additional water quality studies and/or TMDL's, if the effluent standard, limitations, water quality studies or TMDL's so issued or approved:

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or

2. Controls any pollutant not limited in the permit; or

3. Require reassessment due to change in 303(d) status of waterbody; or

4. Incorporates the results of any total maximum daily load allocation, which may be approved for the receiving water body.

The Louisiana Department of Environmental Quality (LDEQ) reserves the right to modify or revoke and reissue this permit based upon any changes to established TMDL's for this discharge, or to accommodate for pollutant trading provisions in approved TMDL watersheds as necessary to achieve compliance with water quality standards. Therefore, prior to upgrading or expanding this facility, the permittee should contact the Department to determine the status of the work being done to establish future effluent limitations and additional permit conditions.

W. STORMWATER DISCHARGES

1. This section applies to all stormwater discharges from the facility, either through permitted outfalls or through outfalls which are not listed in the permit or as sheet flow. The purpose of the pollution prevention plan is to identify potential sources of pollution that would reasonably be expected to affect the quality of stormwater and identify the practices that will be used to prevent or reduce the pollutants in stormwater discharges.

2. Any runoff leaving the developed areas of the facility, other than the permitted outfall(s), exceeding 50 mg/L TOC, 15 mg/L Oil and Grease, or having a pH less than 6.0 or greater than 9.0 standard units shall be a violation of this permit. Any discharge in excess of these limitations, which is attributable to offsite contamination shall not be considered a violation of this permit. A visual inspection of the facility shall be conducted and a report made annually as described in Paragraph 4 below.

3. **For first time permit issuance,** the permittee shall prepare, implement, and maintain a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. **For renewal permit issuance,** the permittee shall review and update, if necessary,

OTHER REQUIREMENTS (continued)

a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. The terms and conditions of the SWP3 shall be an enforceable Part of the permit. If the permittee maintains other plans that contain duplicative information, those plans could be incorporated by reference into the SWP3. Examples of these type plans include, but are not limited to: Spill Prevention Control and Countermeasure Plan (SPCC), Best Management Plan (BMP), Response Plans, etc. EPA document 832-R-92-006 (Storm Water Management for Industrial Activities) may be used as a guidance and may be obtained by writing to the Water Resource Center (RC-4100T), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington D.C. 20460 or by calling (202) 566-1729 or via the Wetlands Helpline (800) 832-7828.

4. The following conditions are applicable to all facilities and shall be included in the SWP3 for the facility.

   a. The permittee shall conduct an annual inspection of the facility site to identify areas contributing to the storm water discharge from developed areas of the facility and evaluate whether measures to reduce pollutant loadings identified in the SWP3 are adequate and have been properly implemented in accordance with the terms of the permit or whether additional control measures are needed.

   b. The permittee shall develop a site map which includes all areas where stormwater may contact potential pollutants or substances which can cause pollution. Any location where reportable quantities leaks or spills have previously occurred are to be documented in the SWP3. The SWP3 shall contain a description of the potential pollutant sources, including, the type and quantity of material present and what action has been taken to assure stormwater precipitation will not directly contact the substances and result in contaminated runoff.

   c. Where experience indicates a reasonable potential for equipment failure (e.g. a tank overflow or leakage), natural condition of (e.g. precipitation), or other circumstances which result in significant amounts of pollutants reaching surface waters, the SWP3 should include a prediction of the direction, rate of flow and total quantity of pollutants which could be discharged from the facility as a result of each condition or circumstance.

   d. The permittee shall maintain for a period of three years a record summarizing the results of the inspection and a certification that the facility is in compliance with the SWP3, and identifying any incidents of noncompliance. The summary report should contain, at a minimum, the date and time of inspection, name of inspector(s), conditions found, and changes to be made to the SWP3.

   e. The summary report and the following certification shall be signed in accordance with LAC 33:IX.2503. The summary report is to be attached to the SWP3 and provided to the Department upon request.

OTHER REQUIREMENTS (continued)

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signatory requirements for the certification may be found in Part III, Section D.10 of this permit.

f. The permittee shall make available to the Department, upon request, a copy of the SWP3 and any supporting documentation.

5. The following shall be included in the SWP3, if applicable.

a. The permittee shall utilize all reasonable methods to minimize any adverse impact on the drainage system including but not limited to:

i. maintaining adequate roads and driveway surfaces;
ii. removing debris and accumulated solids from the drainage system; and
iii. cleaning up immediately any spill by sweeping, absorbent pads, or other appropriate methods.

b. All spilled product and other spilled wastes shall be immediately cleaned up and disposed of according to all applicable regulations, Spill Prevention and Control (SPC) plans or Spill Prevention Control and Countermeasures (SPCC) plans. Use of detergents, emulsifiers, or dispersants to clean up spilled product is prohibited except where necessary to comply with State or Federal safety regulations (i.e., requirement for non-slippery work surface) except where the cleanup practice does not result in a discharge and does not leave residues exposed to future storm events. In all such cases, initial cleanup shall be done by physical removal and chemical usage shall be minimized.

c. All equipment, parts, dumpsters, trash bins, petroleum products, chemical solvents, detergents, or other materials exposed to stormwater shall be maintained in a manner which prevents contamination of stormwater by pollutants.

d. All waste fuel, lubricants, coolants, solvents, or other fluids used in the repair or maintenance of vehicles or equipment shall be recycled or contained for proper disposal. Spills of these materials are to be cleaned up by dry means whenever possible.

e. If applicable, all storage tank installations (with a capacity greater than 660 gallons for an individual container, or 1,320 gallons for two or more containers in aggregate within a common

OTHER REQUIREMENTS (continued)

storage area) shall be constructed so that a secondary means of containment is provided for the entire contents of the largest tank plus sufficient freeboard to allow for precipitation. Diked areas should be sufficiently impervious to contain spills.

f. All diked areas surrounding storage tanks or stormwater collection basins shall be free of residual oil or other contaminants so as to prevent the accidental discharge of these materials in the event of flooding, dike failure, or improper draining of the diked area. All drains from diked areas shall be equipped with valves which shall be kept in the closed condition except during periods of supervised discharge.

g. All check valves, tanks, drains, or other potential sources of pollutant releases shall be inspected and maintained on a regular basis to assure their proper operation and to prevent the discharge of pollutants.

h. The permittee shall assure compliance with all applicable regulations promulgated under the Louisiana Solid Waste and Resource Recovery Law and the Hazardous Waste Management Law (L.R.S. 30:2151, etc.). Management practices required under above regulations shall be referenced in the SWP3.

i. The permittee shall amend the SWP3 whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant amounts of pollutants.

j. If the SWP3 proves to be ineffective in achieving the general objectives of preventing the release of significant amounts of pollutants to water of the state, then the specific objectives and requirements of the SWP3 shall be subject to modification to incorporate revised SWP3 requirements.

6. Facility Specific SWP3 Conditions:

None

X. DISCHARGE MONITORING REPORTS

Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1 or an approved substitute). All monitoring reports must be retained for a period of at least three (3) years from the date of the sample measurement. The permittee shall make available to this Department, upon request, copies of all monitoring data required by this permit.

If there is no discharge during the reporting period, place an "X" in the NO DISCHARGE box located in the upper right corner of the Discharge Monitoring Report for that outfall.

Monitoring results for each reporting period shall be summarized on a Discharge Monitoring Report (DMR) Form (one DMR form per monitoring period

OTHER REQUIREMENTS (continued)

per outfall) and submitted to the Office of Environmental Compliance either hand delivered, postmarked, or electronically submitted no later than the 15th day of the month following each reporting period.

1. For parameter(s) with monitoring frequencies of 1/month or more frequent (i.e. continuous, 1/batch, 1/discharge event, 1/day, 3/week, 2/week, 1/week, 2/month, etc.), DMRs shall be submitted in accordance with the following schedule:

   Submit DMR postmarked by the 15th day of the following month.

2. For parameter(s) that require a monitoring frequency of 1/2 months, DMRs shall be submitted in accordance with the following schedule:

Monitoring Period	DMR Postmark Date
January 1 - February 28(29)	March 15th
March 1 - April 30	May 15th
May 1 - June 30	July 15th
July 1 - August 31	September 15th
September 1 - October 31	November 15th
November 1 -December 31	January 15th

3. For parameter(s) that require a monitoring frequency of quarterly, DMRs shall be submitted in accordance with the following schedule:

Monitoring Period	DMR Postmark Date
January, February, March	April 15th
April, May, June	July 15th
July, August, September	October 15th
October, November, December	January 15th

4. For parameter(s) that require a semiannual monitoring frequency, DMRs shall be submitted in accordance with the following schedule:

Monitoring Period	DMR Postmark Date
January - June	July 15th
July - December	January 15th

5. For parameter(s) that require an annual monitoring frequency, DMRs shall be submitted in accordance with the following schedule:

Monitoring Period	DMR Postmark Date
January-December	January 15th

If not electronically submitting, duplicate copies of DMR's (one set of originals and one set of copies) signed and certified as required by LAC 33:IX.2503, and all other reports (one set of originals) required by this permit shall be submitted to the Permit Compliance Unit at the following address:

OTHER REQUIREMENTS (continued)

Department of Environmental Quality
Office of Environmental Compliance
Permit Compliance Unit
Post Office Box 4312
Baton Rouge, Louisiana 70821-4312

Y. <u>316(b) PHASE II RULE REQUIREMENTS</u>

1. On July 6, 2004, EPA promulgated Phase II regulations in accordance with section 316(b) of the Clean Water Act (CWA). In February 2005, LDEQ promulgated Phase II regulations found at LAC 33:IX.Chapter 47.Subchapter B. On January 25, 2007, the Second U.S._Circuit Court of Appeals remanded several provisions of the Phase II rule. On March 20, 2007, EPA issued a memo saying, "the rule should be considered suspended". On July 9, 2007, EPA published a Federal Register notice suspending all parts of the Phase II regulations except 40 CFR 125.90(b) [LAC 33:IX.4731.B]. In October 2007, LDEQ suspended LAC 33:IX.Chapter 47, Subchapter B, with the exception of LAC 33:IX.4731.B.

   According to EPA, 316(b) Phase II regulations are under complete reconsideration at this time. LAC 33:IX.4731.B provides for regulating cooling water intake structures for existing facilities on a case-by-case basis using best professional judgment.

   EPA's repromulgation of the Phase II Rule may require procedures or timelines different from those included in this permit. If necessary for compliance with the Phase II Rule, this permit may be reopened.

   In order to reduce the adverse environmental impact, if any, caused by the cooling water intake structure (CWIS), the permittee shall comply with effective regulations promulgated in accordance with section 316(b) of the CWA for cooling water intake structures. The permittee shall at all times operate and maintain the existing CWIS as described in the assessment document received on July 10, 2008, entitled *Impingement Mortality and Entrainment Characterization Study (IMECS)*. The permittee has submitted information to DEQ characterizing the fish/shellfish in the vicinity of the CWIS, assessing impingement mortality and entrainment (IM&E), and assessing the cooling water system. DEQ may request an update of this information, or additional information, if necessary, to comply with the repromulgated Phase II Rule.

2. The following special definitions apply to this subpart:

   a. Baseline conditions means the impingement mortality and entrainment that would occur at your site assuming that (1) the cooling water system has been designed as a once-through system, (2) the opening of the CWIS is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source water body.

OTHER REQUIREMENTS (continued)

b. Closed-cycle recirculating system means a system designed, using minimized makeup and blow down flows, to withdraw water from a natural or other water source to support contact and/or non-contact cooling uses within a facility. The water is usually sent to a cooling canal or channel, lake, pond, or tower to allow waste heat to be dissipated to the atmosphere and then is returned to the system. (Some facilities divert the waste heat to other process operations.) New source water (make-up water) is added to the system to replenish losses that have occurred due to blow down, drift, and evaporation

c. Cooling water means water used for contact or non-contact cooling, including water used for equipment cooling, evaporative cooling tower makeup, and dilution of effluent heat content. The intended use of the cooling water is to absorb waste heat rejected from the process or processes used, or from auxiliary operations on the facility's premises.

d. Cooling water intake structure means the total physical structure and any associated constructed waterways used to withdraw cooling water from waters of the U.S. The cooling water intake structure extends from the point at which water is withdrawn from the surface water source up to, and including, the intake pumps.

e. Intake flow means the value of the total volume of water withdrawn from a source water body over a specific time period.

f. Intake velocity means the value of the average speed at which intake water passes through the open area of the intake screen (or other device) against which organisms might be impinged or through which they might be entrained.

g. Entrainment means the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a cooling water system.

h. Hydraulic zone of influence means that portion of the source water body hydraulically affected by the cooling water intake structure withdrawal of water.

i. Impingement means the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal.

j. Maximize means to increase to the greatest amount, extent, or degree reasonably possible.

k. Minimize means to reduce to the smallest amount, extent, or degree reasonably possible.

OTHER REQUIREMENTS (continued)

Z. 48 HR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

It is unlawful and a violation of this permit for a permittee or the designated agent to manipulate test samples in any manner, to delay shipment, or to terminate a toxicity test. Once initiated, all toxicity tests must be completed unless specific authority has been granted by the Louisiana Department of Environmental Quality.

1. SCOPE AND METHODOLOGY

a. The permittee shall test the effluent for toxicity in accordance with the provisions in this section.

APPLICABLE TO OUTFALL(S):	001
CRITICAL DILUTION:	31%
EFFLUENT DILUTION SERIES:	13%, 18%, 24%, 31%, and 42%
COMPOSITE SAMPLE TYPE:	Defined at PART I
TEST SPECIES/METHODS:	40 CFR Part 136 (See LAC 33:IX.4901)

Daphnia pulex acute static renewal 48-hour definitive toxicity test using EPA 821-R-02-012, or the latest update thereof. A minimum of five (5) replicates with ten (10) organisms per replicate must be used in the control and in each effluent dilution of this test.

Pimephales promelas (Fathead minnow) acute static renewal 48-hour definitive toxicity test using EPA 821-R-02-012, or the latest update thereof. A minimum of five (5) replicates with ten (10) organisms per replicate must be used in the control and in each effluent dilution of this test.

b. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution at and below which lethality that is statistically different from the control (0% effluent) at the 95% confidence level does not occur.

c. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

d. Test failure is defined as a demonstration of statistically significant sub-lethal or lethal effects to a test species at or below the effluent critical dilution.

2. PERSISTENT LETHALITY

The requirements of this subsection apply only when a toxicity test demonstrates significant lethal effects at or below the critical

OTHER REQUIREMENTS (continued)

dilution. Significant lethal effects are herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

If any valid test demonstrates significant lethal effects to a test species at or below the critical dilution, the frequency of testing for that species is automatically increased to once per quarter for the term of the permit.

a. The permittee shall conduct a total of three (3) additional tests for any species that demonstrates statistically significant lethal toxic effects at the critical dilution or lower effluent dilutions. The additional tests shall be conducted monthly during the next three consecutive months in which a discharge occurs to determine if toxicity is persistent or occurs on a periodic basis. The purpose of this testing is to determine whether toxicity is present at a level and frequency that will provide toxic sample results to use in performing a Toxicity Reduction Evaluation (TRE). If no additional test failures occur during the retest monitoring period, the testing frequency will be once per quarter for the term of the permit or until another test failure occurs. The permittee may substitute one of the additional tests in lieu of one routine toxicity test. A full report shall be prepared for each test required by this section in accordance with procedures outlined in Item 4 of this section and submitted with the period discharge monitoring report (DMR) to the permitting authority for review.

b. If any of the valid additional tests demonstrates significant lethal effects at or below the critical dilution, the permittee shall initiate Toxicity Reduction Evaluation (TRE) requirements as specified in Item 6 of this section. The permittee shall notify the Department of Environmental Quality, Office of Environmental Compliance - Permit Compliance Unit in writing within 5 days of the failure in any retest, and the TRE initiation date will be the test completion date of the first failed retest. A TRE may also be required due to a demonstration of intermittent lethal effects at or below the critical dilution, or for failure to perform the required retests.

c. The provisions of Item 2.a are suspended upon submittal of the TRE Action Plan.

3. <u>REQUIRED TOXICITY TESTING CONDITIONS</u>

a. <u>Test Acceptance</u>

The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied, including the following additional criteria:

OTHER REQUIREMENTS (continued)

i. Each toxicity test control (0% effluent) must have a survival equal to or greater than 90%.

ii. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: Daphnia pulex survival test; and Fathead minnow survival test.

iii. The percent coefficient of variation between replicates shall be 40% or less in the critical dilution, unless significant lethal effects are exhibited for: Daphnia pulex survival test; and Fathead minnow survival test.

Test failure may not be construed or reported as invalid due to a coefficient of variation value of greater than 40%. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

b. Statistical Interpretation

For the Daphnia pulex survival test and the Fathead minnow survival test, the statistical analyses used to determine if there is a statistically significant difference between the control and the critical dilution shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in EPA 821-R-02-012, or the most recent update thereof.

If the conditions of Test Acceptability are met in Item 3.a above and the percent survival of the test organism is equal to or greater than 90% in the critical dilution concentration and all lower dilution concentrations, the test shall be considered to be a passing test regardless of the NOEC, and the permittee shall report a NOEC of not less than the critical dilution for the DMR reporting requirements found in Item 4 below.

c. Dilution Water

i. Dilution water used in the toxicity tests will be receiving water collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness and alkalinity to the closest downstream perennial water for;

(A) toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

(B) toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of instream toxicity (fails to fulfill the test acceptance criteria of Item 3.a), the permittee may substitute synthetic

OTHER REQUIREMENTS (continued)

dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

(A) a synthetic dilution water control which fulfills the test acceptance requirements of Item 3.a was run concurrently with the receiving water control;

(B) the test indicating receiving water toxicity has been carried out to completion (i.e., 48 hours);

(C) the permittee includes all test results indicating receiving water toxicity with the full report and information required by Item 4 below; and

(D) the synthetic dilution water shall have a pH, hardness and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. Samples and Composites

i. The permittee shall collect two 24-hour flow-weighted composite samples from the outfall(s) listed at Item 1.a above. A 24-hour composite sample consists of a minimum of 4 effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

ii. The permittee shall collect a second 24-hour composite sample for use during the 24-hour renewal of each dilution concentration for both tests. The permittee must collect the 24-hour composite samples so that the maximum holding time for any effluent sample shall not exceed 36 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first 24-hour composite sample. Samples shall be chilled to 0-6 degrees Centigrade during collection, shipping and/or storage.

iii. The permittee must collect the 24-hour composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge

OTHER REQUIREMENTS (continued)

that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Item 4. of this section.

v. MULTIPLE OUTFALLS: If the provisions of this section are applicable to multiple outfalls, the permittee shall combine the composite effluent samples in proportion to the average flow from the outfalls listed in Item 1.a above for the day the sample was collected. The permittee shall perform the toxicity test on the flow-weighted composite of the outfall samples.

4. REPORTING

a. A valid test must be completed and test results must be submitted for each species during each Monitoring Period. The permittee shall prepare a full report of the results of all tests conducted pursuant to this Part in accordance with the Report Preparation Section of EPA 821-R-02-012, for every valid or invalid toxicity test initiated, whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of Part III.C.3 of this permit. For any test which fails, is considered invalid or which is terminated early for any reason, the full report must be submitted for agency review. The permittee shall submit the first full report to the following address:

Department of Environmental Quality
Office of Environmental Compliance
Enforcement Division
P.O. Box 4312
Baton Rouge, Louisiana 70821-4312
Attn: Permit Compliance Unit

In addition, if enforcement authority has been retained by EPA, a copy of the report must also be submitted to the following address:

U.S. Environmental Protection Agency, Region 6
Water Enforcement Branch, 6 EN-WC
1445 Ross Ave.
Dallas, Texas 75202

b. The permittee shall submit the results of each valid toxicity test on the DMR for that Monitoring Period in accordance with Part III.D.4 of this permit. Submit retest information clearly marked as such on the DMR for the Monitoring Period in which the retest occurred. Only results of valid tests are to be reported on the DMR. The permittee shall submit the Table 1 Summary Sheet with each valid test.

OTHER REQUIREMENTS (continued)

i. Pimephales promelas (Fathead minnow)

(A) If the No Observed Effect Concentration (NOEC) for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TEM6C.

(B) Report the NOEC value for survival, Parameter No. TOM6C.

(C) Report the highest (critical dilution or control) Coefficient of Variation, Parameter No. TQM6C.

ii. Daphnia pulex

(A) If the NOEC for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TEM3D.

(B) Report the NOEC value for survival, Parameter No. TOM3D.

(C) Report the highest (critical dilution or control) Coefficient of Variation, Parameter No. TQM3D.

iii. The permittee shall report the following results for all VALID toxicity retests on the DMR for that Monitoring Period.

(A) Retest #1 (STORET 22415): If the first monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

(B) Retest #2 (STORET 22416): If the second monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

(C) Retest #3 (STORET 51443): If the third monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

If, for any reason, a retest cannot be performed during the Monitoring Period in which the triggering routine test failure is experienced, the permittee shall report it on the following Monitoring Period's DMR, and the comments section of the DMRs shall be annotated to that effect. If retesting is not required during a given Monitoring Period, the permittee shall leave these DMR fields blank.

OTHER REQUIREMENTS (continued)

The permittee shall submit the toxicity testing information contained in Table 1 of this permit with the DMR subsequent to each and every toxicity test Monitoring Period. The DMR and the summary tables should be sent to the address indicated in 4.a.

5. MONITORING FREQUENCY REDUCTION

a. Upon successfully passing the first four quarters of WET testing after permit issuance/reissuance and in the absence of subsequent lethal toxicity for one or both test species at or below the critical dilution, the permittee may apply for a testing frequency reduction. If granted, the monitoring frequency for that test species may be reduced to not less than once per year for the less sensitive species (usually the Fathead minnow) and not less than once per six months for the more sensitive test species (usually the Daphnia pulex). Monitoring frequency reduction shall not apply to monitoring frequencies of once per year.

b. CERTIFICATION - The permittee must certify in writing that no test failures have occurred and that all tests meet all test acceptability criteria in Item 3.a. above. In addition, the permittee must provide a list with each test performed including test initiation date, species, NOEC's for lethal and sub-lethal effects and the maximum coefficient of variation for the controls. Upon review and acceptance of this information the agency will issue a letter of confirmation of the monitoring frequency reduction. A copy of the letter will be forwarded to the agency's Permit Compliance Unit to update the permit reporting requirements.

c. This monitoring frequency reduction applies only until the expiration date of this permit, at which time the Monitoring Frequency/Monitoring Period for both test species reverts to once per quarter until the permit is re-issued.

d. SURVIVAL FAILURES - If any test fails the survival endpoint at any time during the term of this permit, three monthly retests are required and the monitoring frequency for the affected test species shall be increased to once per quarter until the permit is reissued. Monthly retesting is not required if the permittee is performing a TRE.

6. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent requirements/and or chemical-specific limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity

OTHER REQUIREMENTS (continued)

testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the critical dilution and include the following:

i. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the document "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081), as appropriate.

   The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

   U.S. Department of Commerce
   National Technical Information Service
   5285 Port Royal Road
   Springfield, Va. 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.). The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified;

   Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 24 hours of test initiation, each composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample,

OTHER REQUIREMENTS (continued)

comprised of equal portions of the individual composite samples, for the chemical specific analysis;

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report, with the Discharge Monitoring Report in the months of January, April, July and October, containing information on toxicity reduction evaluation activities including:

i. any data and/or substantiating documentation which identify the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

iii. any data which identify effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to achieve compliance with permit biomonitoring requirements and/or chemical-specific limits.

The TRE Activities Report shall be submitted to the following addresses:

Department of Environmental Quality
Office of Environmental Compliance
Enforcement Division
P.O. Box 4312
Baton Rouge, Louisiana 70821-4312
Attn: Permit Compliance Unit

U.S. Environmental Protection Agency, Region 6
Water Enforcement Branch, 6 EN-WC
1445 Ross Avenue
Dallas, Texas 75202

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in the permittee achieving compliance with permit biomonitoring requirements and/or chemical-specific limits. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

OTHER REQUIREMENTS (continued)

A copy of the Final Report on Toxicity Reduction Evaluation Activities shall also be submitted to the above addresses.

e. Quarterly testing during the TRE is a minimum monitoring requirement. LDEQ recommends that permittees required to perform a TRE not rely on quarterly testing alone to ensure success in the TRE, and that additional screening tests be performed to capture toxic samples for identification of toxicants. At the end of the TRE, LDEQ will consider all information submitted and establish appropriate controls to prevent future toxic discharges, including WET and/or chemical-specific limits per state regulations at LAC 33:IX.2707.D.1.e.

TABLE 1

SUMMARY SHEET

Daphnia pulex ACUTE SURVIVAL TEST RESULTS

PERMITTEE: Entergy Operations, Inc. ____

FACILITY SITE: Waterford 3 Steam Electric Station ____

LPDES PERMIT NUMBER: LA0007374, 35260

OUTFALL IDENTIFICATION: 001 ____

OUTFALL SAMPLE IS FROM ____ SINGLE ____ MULTIPLE DISCHARGES

BIOMONITORING LABORATORY: ____

DILUTION WATER USED: ____ RECEIVING WATER ____ LAB WATER

CRITICAL DILUTION 31% DATE TEST INITIATED ____

1. LOW-FLOW LETHALITY:
   Is the mean survival at 48 hours significantly less (p=0.05) than the control survival for the low flow or critical dilution?
   ____yes ____no

DILUTION SERIES RESULTS-DAPHNIA

TIME OF READING	REP	0%	13%	18%	24%	31%	42%
24-HOUR	A						
	B						
	C						
	D						
	E						
48-HOUR	A						
	B						
	C						
	D						
	E						
MEAN							

2. Are the test results to be considered valid? ____yes ____no
   If X no (test invalid), what are the reasons for invalidity?

3. Is this a retest of a previous invalid test? ____ yes____no
   Is this a retest of a previous test failure? ____ yes____no

4. Enter percent effluent corresponding to each NOEC (No Observed Effect Concentration) for Daphnia pulex:
   NOEC = ____% effluent
   $LC_{50}48$ = ____% effluent

TABLE 1

SUMMARY SHEET

Pimephales promelas ACUTE SURVIVAL TEST RESULTS

PERMITTEE: Entergy Operations, Inc.
FACILITY SITE: Waterford 3 Steam Electric Station
LPDES PERMIT NUMBER: LA0007374, 35260
OUTFALL IDENTIFICATION: 001
OUTFALL SAMPLE IS FROM _______ SINGLE ______ MULTIPLE DISCHARGES
BIOMONITORING LABORATORY:________________________
DILUTION WATER USED: _________ RECEIVING WATER ______LAB WATER
CRITICAL DILUTION 31% DATE TEST INITIATED______________

1. LOW-FLOW LETHALITY:
   Is the mean survival at 48 hours significantly less (p=0.05) than the control survival for the low flow or critical dilution?
   _______yes _______no

DILUTION SERIES RESULTS-PIMEPHALES

TIME OF READING	REP	0%	13%	18%	24%	31%	42%
24-HOUR	A						
	B						
	C						
	D						
	E						
48-HOUR	A						
	B						
	C						
	D						
	E						
MEAN							

2. Are the test results to be considered valid? ____yes ____no
   If __X__no (test invalid), what are the reasons for invalidity?

3. Is this a retest of a previous invalid test? ____ yes____no
   Is this a retest of a previous test failure? ____ yes____no

4. Enter percent effluent corresponding to each NOEC (No Observed Effect Concentration) for Pimephales:
   NOEC = ____% effluent
   $LC_{50}48$ = ____% effluent

PART III
STANDARD CONDITIONS FOR LPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Introduction
   In accordance with the provisions of LAC 33:IX.2701, et seq., this permit incorporates either expressly or by reference ALL conditions and requirements applicable to the Louisiana Pollutant Discharge Elimination System Permits (LPDES) set forth in the Louisiana Environmental Quality Act (LEQA), as amended, as well as ALL applicable regulations.

2. Duty to Comply
   The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Louisiana Environmental Quality Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

3. Penalties for Violation of Permit Conditions
   a. La. R. S. 30:2025 provides for civil penalties for violations of these regulations and the Louisiana Environmental Quality Act. La. R. S. 30:2076.2 provides for criminal penalties for violation of any provisions of the LPDES or any order or any permit condition or limitation issued under or implementing any provisions of the LPDES program. (See Section E. Penalties for Violation of Permit Conditions for additional details).

   b. Any person may be assessed an administrative penalty by the State Administrative Authority under La. R. S. 30:2025 for violating a permit condition or limitation implementing any of the requirements of the LPDES program in a permit issued under the regulations or the Louisiana Environmental Quality Act.

4. Toxic Pollutants
   a. Other effluent limitations and standards under Sections 301, 302, 303, 307, 318, and 405 of the Clean Water Act. If any applicable toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, the state administrative authority shall institute proceedings under these regulations to modify or revoke and reissue the permit to conform to the toxic effluent standard or prohibition.

   b. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions, or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

5. Duty to Reapply
   a. Individual Permits. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The new application shall be submitted at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the state administrative authority. (The state administrative authority shall not grant permission for applications to be submitted later than the expiration date of the existing permit.) Continuation of expiring permits shall be governed by regulations promulgated at LAC 33:IX.2321 and any subsequent amendments.

b. General Permits. General permits expire five years after the effective date. The 180-day reapplication period as defined above is not applicable to general permit authorizations. Reissued general permits may provide automatic coverage for permittees authorized under the previous version of the permit, and no new application is required. Requirements for obtaining authorization under the reissued general permit will be outlined in Part I of the new permit. Permittees authorized to discharge under an expiring general permit should follow the requirements for obtaining coverage under the new general permit to maintain discharge authorization.

6. Permit Action
This permit may be modified, revoked and reissued, or terminated for cause in accordance with LAC 33:IX.2903, 2905, 2907, 3105 and 6509. The causes may include, but are not limited to, the following:

a. Noncompliance by the permittee with any condition of the permit;

b. The permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the permittee's misrepresentation of any relevant facts at any time; or

c. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination;

d. A change in any condition that requires either a temporary or a permanent reduction or elimination of any discharge;

e. Failure to pay applicable fees under the provisions of LAC 33: IX. Chapter 13;

f. Change of ownership or operational control.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

7. Property Rights
This permit does not convey any property rights of any sort, or any exclusive privilege.

8. Duty to Provide Information
The permittee shall furnish to the state administrative authority, within a reasonable time, any information which the state administrative authority may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the state administrative authority, upon request, copies of records required to be kept by this permit.

9. Criminal and Civil Liability
Except as provided in permit conditions on "Bypassing" and "Upsets", nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the Permit may subject the Permittee to criminal enforcement pursuant to La. R.S. 30:2025.

10. Oil and Hazardous Substance Liability
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

11. State Laws
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

12. Severability
If any provision of these rules and regulations, or the application thereof, is held to be invalid, the remaining provisions of these rules and regulations shall not be affected, so long as they can be given effect without the invalid provision. To this end, the provisions of these rules and regulations are declared to be severable.

13. Dilution
A permittee shall not achieve any effluent concentration by dilution unless specifically authorized in the permit. A permittee shall not increase the use of process water or cooling water or otherwise attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve permit limitations or water quality.

14. Facilities Requiring Approval from Other State Agencies
In accordance with La. R.S.40.4(A)(6) the plans and specifications of all sanitary sewerage treatment systems, both public and private, must be approved by the Department of Health and Hospitals state health officer or his designee. It is unlawful for any person, firm, or corporation, both municipal and private to operate a sanitary sewage treatment facility without proper authorization from the state health officer.

In accordance with La. R.S.40.1149, it is unlawful for any person, firm or corporation, both municipal and private, operating a sewerage system to operate that system unless the competency of the operator is duly certified by the Department of Health and Hospitals state health officer. Furthermore, it is unlawful for any person to perform the duties of an operator without being duly certified.

In accordance with La. R.S.48.385, it is unlawful for any industrial wastes, sewage, septic tanks effluent, or any noxious or harmful matter, solid, liquid or gaseous to be discharged into the side or cross ditches or placed upon the rights-of-ways of state highways without the prior written consent of the Department of Transportation and Development chief engineer or his duly authorized representative and of the secretary of the Department of Health and Hospitals.

SECTION B. PROPER OPERATION AND MAINTENANCE

1. Need to Halt or Reduce not a Defense
It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Duty to Mitigate
The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. The permittee shall also take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with the permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

3. Proper Operation and Maintenance
   a. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

   b. The permittee shall provide an adequate operating staff which is duly qualified to carry out operation, maintenance and other functions necessary to ensure compliance with the conditions of this permit.

4. Bypass of Treatment Facilities
   a. ***Bypass***. The intentional diversion of waste streams from any portion of a treatment facility.

   b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Section B.4.c. and 4.d of these standard conditions.

   c. Notice
      (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Office of Environmental Services, Water Permits Division, if possible at least ten days before the date of the bypass.

      (2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in LAC 33:IX.2701.L.6 (24-hour notice) and Section D.6.e. of these standard conditions.

   d. Prohibition of bypass
      (1) Bypass is prohibited, and the state administrative authority may take enforcement action against a permittee for bypass, unless:

         (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

         (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

         (c) The permittee submitted notices as required by Section B.4.c of these standard conditions.

      (2) The state administrative authority may approve an anticipated bypass after considering its adverse effects, if the state administrative authority determines that it will meet the three conditions listed in Section B.4.d(1) of these standard conditions.

5. Upset Conditions
   a. Upset. An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

   b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Section B.5.c. are met. No determination made during administrative review of claims that noncompliance was caused by an upset, and before an action for noncompliance, is final administrative action subject to judicial review.

   c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
      (1) An upset occurred and that the permittee can identify the cause(s) of the upset;

      (2) The permitted facility was at the time being properly operated; and

      (3) The permittee submitted notice of the upset as required by LAC 33:IX.2701.L.6.b.ii. and Section D.6.e.(2) of these standard conditions; and

(4) The permittee complied with any remedial measures required by Section B.2 of these standard conditions.

d. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances
Solids, sewage sludges, filter backwash, or other pollutants removed in the course of treatment or wastewater control shall be properly disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the state and in accordance with environmental regulations.

7. Percent Removal
For publicly owned treatment works, the 30-day average percent removal for Biochemical Oxygen Demand and Total Suspended Solids shall not be less than 85 percent in accordance with LAC 33:IX.5905.A.3. and B.3. Publicly owned treatment works utilizing waste stabilization ponds/oxidation ponds are not subject to the 85 percent removal rate for Total Suspended Solids.

SECTION C. MONITORING AND RECORDS

1. Inspection and Entry
The permittee shall allow the state administrative authority or an authorized representative (including an authorized contractor acting as a representative of the Administrator), upon the presentation of credentials and other documents as may be required by the law to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

   Enter upon the permittee's premises where a discharge source is or might be located or in which monitoring equipment or records required by a permit are kept for inspection or sampling purposes. Most inspections will be unannounced and should be allowed to begin immediately, but in no case shall begin more than thirty (30) minutes after the time the inspector presents his/her credentials and announces the purpose(s) of the inspection. Delay in excess of thirty (30) minutes shall constitute a violation of this permit. However, additional time can be granted if the inspector or the Administrative Authority determines that the circumstances warrant such action; and

b. Have access to and copy, at reasonable times, any records that the department or its authorized representative determines are necessary for the enforcement of this permit. For records maintained in either a central or private office that is open only during normal office hours and is closed at the time of inspection, the records shall be made available as soon as the office is open, but in no case later than the close of business the next working day;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act or the Louisiana Environmental Quality Act, any substances or parameters at any location.

e. Sample Collection
   (1) When the inspector announces that samples will be collected, the permittee will be given an additional thirty (30) minutes to prepare containers in order to collect duplicates. If the permittee cannot obtain and prepare sample containers within this time, he is considered to have waived his right to collect duplicate samples and the sampling will proceed immediately. Further delay on the part of the permittee in allowing initiation of the sampling will constitute a violation of this permit.
   (2) At the discretion of the administrative authority, sample collection shall proceed immediately (without the additional 30 minutes described in Section C.1.a. above) and the inspector shall supply the permittee with a duplicate sample.

f. It shall be the responsibility of the permittee to ensure that a facility representative familiar with provisions of its wastewater discharge permit, including any other conditions or limitations, be available either by phone or in person at the facility during all hours of operation. The absence of such personnel on-site who are familiar with the permit shall not be grounds for delaying the initiation of an inspection except in situations as described in Section C.1.b. of these standard conditions. The permittee shall be responsible for providing witnesses/escorts during inspections. Inspectors shall abide by all company safety rules and shall be equipped with standard safety equipment (hard hat, safety shoes, safety glasses) normally required by industrial facilities.

g. Upon written request copies of field notes, drawings, etc., taken by department personnel during an inspection shall be provided to the permittee after the final inspection report has been completed.

2. Representative Sampling
Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. All samples shall be taken at the outfall location(s) indicated in the permit. The state administrative authority shall be notified prior to any changes in the outfall location(s). Any changes in the outfall location(s) may be subject to modification, revocation and reissuance in accordance with LAC 33:IX.2903.

3. Retention of Records
Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the state administrative authority at any time.

4. Record Contents
Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The time(s) analyses were begun;
e. The individual(s) who performed the analyses;
f. The analytical techniques or methods used;
g. The results of such analyses; and
h. The results of all quality control procedures.

5. Monitoring Procedures
a. Monitoring results must be conducted according to test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal, approved under 40 CFR Part 136 unless otherwise specified in 40 CFR Part 503, unless other test procedures have been specified in this permit.

b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to insure accuracy of measurements and shall maintain appropriate records of such activities.

c. The permittee or designated laboratory shall have an adequate analytical quality assurance/quality control program to produce defensible data of known precision and accuracy. All quality control measures shall be assessed and evaluated on an on-going basis and quality control acceptance criteria shall be used to determine the validity of the data. All method specific quality control as prescribed in the method shall be followed. If quality control requirements are not included in the method, the permittee or designated laboratory shall follow the quality control requirements as prescribed in the Approved Edition (40 CFR Part 136) Standard Methods for the Examination of Water and Wastes, Sections 1020A and 1020B. General sampling protocol shall follow guidelines established in the "Handbook for Sampling and Sample Preservation of Water and Wastewater, 1982 "U.S. Environmental Protection Agency. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-83-124503.

6. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration and operation of acceptable flow measurement devices can be obtained from the following references:
   a. "A Guide to Methods and Standards for the Measurement of Water Flow, 1975," U.S. Department of Commerce, National Bureau of Standards. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number COM-75-10683.

   b. "Flow Measurement in Open Channels and Closed Conduits, Volumes 1 and 2," U.S. Department of Commerce, National Bureau of Standards. This publication is available from the National Technical Service (NTIS), Springfield, VA, 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-273 535.

   c. "NPDES Compliance Flow Measurement Manual," U.S. Environmental Protection Agency, Office of Water Enforcement. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-82-131178.

7. Prohibition for Tampering: Penalties
   a. La. R.S. 30:2025 provides for punishment of any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit.

   b. La. R.S. 30:2076.2 provides for penalties for any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance.

8. Additional Monitoring by the Permittee
If the Permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136 (See LAC 33:IX.4901) or, in the case of sludge use and disposal, approved under 40 CFR Part 136 (See LAC 33:IX.4901) unless otherwise specified in 40 CFR Part 503, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the state administrative authority.

9. Averaging of Measurements
Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the state administrative authority in the permit.

10. Laboratory Accreditation
   a. LAC 33:I.Subpart 3, Chapters 45-59 provide requirements for an accreditation program specifically applicable to commercial laboratories, wherever located, that provide chemical analyses, analytical results, or other test data to the department, by contract or by agreement, and the data is:
      (1) Submitted on behalf of any facility, as defined in La. R.S.30:2004;
      (2) Required as part of any permit application;
      (3) Required by order of the department;
      (4) Required to be included on any monitoring reports submitted to the department;

(5) Required to be submitted by contractor
(6) Otherwise required by department regulations.

b. The department laboratory accreditation program, Louisiana Environmental Laboratory Accreditation Program (LELAP) is designed to ensure the accuracy, precision, and reliability of the data generated, as well as the use of department-approved methodologies in generation of that data. Laboratory data generated by commercial environmental laboratories that are not (LELAP) accredited will not be accepted by the department. Retesting of analysis will be required by an accredited commercial laboratory.

Where retesting of effluent is not possible (i.e. data reported on DMRs for prior month's sampling), the data generated will be considered invalid and in violation of the LPDES permit.

c. Regulations on the Louisiana Environmental Laboratory Accreditation Program and a list of labs that have applied for accreditation are available on the department website located under DIVISIONS → PERMIT SUPPORT SERVICES → LABORATORY ACCREDITATION at the following link:

http://www.deq.louisiana.gov

Questions concerning the program may be directed to (225) 219-9800.

SECTION D. REPORTING REQUIREMENTS

1. Facility Changes
The permittee shall give notice to the state administrative authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:
   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b); or

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under LAC 33:IX.2703.A.1.

   c. For Municipal Permits. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to Section 301, or 306 of the CWA if it were directly discharging those pollutants; and any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. Anticipated Noncompliance
The permittee shall give advance notice to the state administrative authority of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers
This permit is not transferable to any person except after notice to the state administrative authority. The state administrative authority may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act or the Louisiana Environmental Quality Act. (See LAC 33:IX.2901; in some cases, modification or revocation and reissuance is mandatory.)

A permit may be transferred by the permittee to a new owner or operator only if: (1)the permit has been modified or revoked and reissued (under LAC 33:IX.2903.A.2.b) by the permittee and new owner submitting a Name/Ownership/Operator Change Form (NOC-1 Form) and approved by LDEQ (LAC 33:I.Chapter 19); or (2) a minor modification made (under LAC 33:IX.2905) to identify the new permittee and incorporate such other requirements as may be necessary under the Clean Water Act and the Louisiana Environmental Quality Act.

The NOC-1 form can be found at the following link: http://www.deq.louisiana.gov/portal/Portals/0/assistance/NOC-1%20FORM%20Jan%2025,%202006.pdf

4. Monitoring Reports
Monitoring results shall be reported at the intervals and in the form specified in Part I or Part II of this permit.

The permittee shall submit properly completed Discharge Monitoring Reports (DMRs) on the form specified in the permit. Preprinted DMRs are provided to majors/92-500s and other designated facilities. Please contact the Permit Compliance Unit concerning preprints. Self-generated DMRs must be pre-approved by the Permit Compliance Unit prior to submittal. Self-generated DMRs are approved on an individual basis. Requests for approval of self-generated DMRs should be submitted to:

Supervisor, Permit Compliance Unit
Office of Environmental Compliance
Post Office Box 4312
Baton Rouge, LA 70821-4312

Copies of blank DMR templates, plus instructions for completing them, and EPA's LPDES Reporting Handbook are available at the department website located at:

http://www.deq.louisiana.gov/portal/Default.aspx?tabid=2276

5. Compliance Schedules
Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

6. Requirements for Notification

a. Emergency Notification
As required by LAC 33.I.3915, in the event of an unauthorized discharge that does cause an emergency condition, the discharger shall notify the hotline (DPS 24-hour Louisiana Emergency Hazardous Materials Hotline) by telephone at (225) 925-6595 (collect calls accepted 24 hours a day) immediately (a reasonable period of time after taking prompt measures to determine the nature, quantity, and potential off-site impact of a release, considering the exigency of the circumstances), but in no case later than one hour after learning of the discharge. (An emergency condition is any condition which could reasonably be expected to endanger the health and safety of the public, cause significant adverse impact to the land, water, or air environment, or cause severe damage to property.) Notification required by this section will be made regardless of the amount of discharge. Prompt Notification Procedures are listed in Section D.6.c. of these standard conditions.

A written report shall be provided within seven calendar days after the notification. The report shall contain the information listed in Section D.6.d. of these standard conditions and any additional information in LAC 33:I.3925.B.

b. Prompt Notification
As required by LAC 33:I.3917, in the event of an unauthorized discharge that exceeds a reportable quantity specified in LAC 33:I.Subchapter E, but does not cause an emergency condition, the discharger shall promptly notify the department within 24 hours after learning of the discharge. Notification should be made to the Office of Environmental Compliance, Surveillance Division Single Point of Contact (SPOC) in accordance with LAC 33:I.3923.

In accordance with LAC 33:I.3923, prompt notification shall be provided within a time frame not to exceed 24 hours and shall be given to the Office of Environmental Compliance, Surveillance Division (SPOC) as follows:

(1) by the Online Incident Reporting screens found at http://www.deq.louisiana.gov/portal/tabid/66/Default.aspx ;or
(2) by e-mail utilizing the Incident Report Form and instructions found at http://www.deq.louisiana.gov/portal/tabid/66/Default.aspx;or
(3) by telephone at (225) 219-3640 during office hours, or (225) 342-1234 after hours and on weekends and holidays.

c. Content of Prompt Notifications. The following guidelines will be utilized as appropriate, based on the conditions and circumstances surrounding any unauthorized discharge, to provide relevant information regarding the nature of the discharge:
(1) the name of the person making the notification and the telephone number where any return calls from response agencies can be placed;
(2) the name and location of the facility or site where the unauthorized discharge is imminent or has occurred, using common landmarks. In the event of an incident involving transport, include the name and address of the transporter and generator;
(3) the date and time the incident began and ended, or the estimated time of continuation if the discharge is continuing;
(4) the extent of any injuries and identification of any known personnel hazards that response agencies may face;
(5) the common or scientific chemical name, the U.S. Department of Transportation hazard classification, and the best estimate of amounts of any and all discharged pollutants;
(6) a brief description of the incident sufficient to allow response agencies to formulate their level and extent of response activity.

d. Written Notification Procedures. Written reports for any unauthorized discharge that requires notification under Section D.6.a. or 6.b., or shall be submitted by the discharger to the Office of Environmental Compliance, Surveillance Division SPOC in accordance with LAC 33:I.3925 within seven calendar days after the notification required by D.6.a. or 6.b., unless otherwise provided for in a valid permit or other department regulation. Written notification reports shall include, but not be limited to, the following information:
(1) the name, address, telephone number, Agency Interest (AI) number (number assigned by the department) if applicable, and any other applicable identification numbers of the person, company, or other party who is filing the written report, and specific identification that the report is the written follow-up report required by this section;
(2) the time and date of prompt notification, the state official contacted when reporting, the name of person making that notification, and identification of the site or facility, vessel, transport vehicle, or storage area from which the unauthorized discharge occurred;
(3) date(s), time(s), and duration of the unauthorized discharge and, if not corrected, the anticipated time it is expected to continue;
(4) details of the circumstances (unauthorized discharge description and root cause) and events leading to any unauthorized discharge, including incidents of loss of sources of radiation, and if the release point is subject to a permit:
    (a) the current permitted limit for the pollutant(s) released;and
    (b) the permitted release point/outfall ID.

(5) the common or scientific chemical name of each specific pollutant that was released as the result of an unauthorized discharge, including the CAS number and U.S. Department of Transportation hazard classification, and the best estimate of amounts of any and all released pollutants (total amount of each compound expressed in pounds, including calculations);
(6) a statement of the actual or probable fate or disposition of the pollutant or source of radiation and what off-site impact resulted;

(7) remedial actions taken, or to be taken, to stop unauthorized discharges or to recover pollutants or sources of radiation.

(8) Written notification reports shall be submitted to the Office of Environmental Compliance, Surveillance Division SPOC by mail or fax. The transmittal envelope and report or fax cover page and report should be clearly marked "**UNAUTHORIZED DISCHARGE NOTIFICATION REPORT**."

Written reports (LAC 33:I.3925) should be mailed to:

Louisiana Department of Environmental Quality
Post Office Box 4312
Baton Rouge, LA 70821-4312
ATTENTION: EMERGENCY AND RADIOLOGICAL SERVICES DIVISION – SPOC
"UNAUTHORIZED DISCHARGE NOTIFICATION REPORT"

The Written Notification Report may also be faxed to the Louisiana Department of Environmental Quality, Office of Environmental Compliance, Emergency and Radiological Services Division at: (225)-219-4044.

Please see LAC 33:I.3925.B for additional written notification procedures.

e. Twenty-four Hour Reporting. The permittee shall report any noncompliance which may endanger human health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. The following shall be included as information which must be reported within 24hours:
   (1) Any unanticipated bypass which exceeds any effluent limitation in the permit (see LAC 33:IX.2701.M.3.b.);
   (2) Any upset which exceeds any effluent limitation in the permit;
   (3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the state administrative authority in Part II of the permit to be reported within 24 hours (LAC 33:IX.2707.G.).

7. Other Noncompliance
The permittee shall report all instances of noncompliance not reported under Section D.4., 5., and 6., at the time monitoring reports are submitted. The reports shall contain the information listed in Section D.6.e.

8. Other Information
Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the state administrative authority, it shall promptly submit such facts or information.

9. Discharges of Toxic Substances
In addition to the reporting requirements under Section D.1-8, all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Office of Environmental Services, Water Permits Division as soon as they know or have reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant:
   i. listed at LAC 33:IX.7107, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:
      (1) One hundred micrograms per liter (100 μg/L);
      (2) Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4 -dinitro-phenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with LAC33:IX.2501.G.7; or
(4) The level established by the state administrative authority in accordance with LAC 33:IX.2707.F; or

ii. which exceeds the reportable quantity levels for pollutants at LAC 33:I. Subchapter E.

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant:
i. listed at LAC 33:IX.7107, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 μg/L);
(2) One milligram per liter (1 mg/L) for antimony;
(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with LAC 33:IX.2501.G.7; or
(4) The level established by the state administrative authority in accordance with LAC 33:IX.2707.F; or

ii. which exceeds the reportable quantity levels for pollutants at LAC 33:I. Subchapter E.

10. Signatory Requirements
All applications, reports, or information submitted to the state administrative authority shall be signed and certified.
a. All permit applications shall be signed as follows:
(1) For a corporation - by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:
(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation; or,
(b) The manager of one or more manufacturing, production, or operating facilities, provided: the manager is authorized to make management decisions that govern the operation of the regulated facility, including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to ensure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and the authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

NOTE: DEQ does not require specific assignments or delegations of authority to responsible corporate officers identified in Section D.10.a(1)(a). The agency will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the state administrative authority to the contrary. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions under Section D.10.a(1)(b) rather than to specific individuals.

(2) For a partnership or sole proprietorship - by a general partner or the proprietor, respectively; or
(3) For a municipality, state, federal, or other public agency - by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a federal agency includes:
(a) The chief executive officer of the agency, or
(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

b. All reports required by permits and other information requested by the state administrative authority shall be signed by a person described in Section D.10.a., or by a duly authorized representative of that person. A person is a duly authorized representative only if:
   (1) The authorization is made in writing by a person described in Section D.10.a. of these standard conditions;
   (2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company, (a duly authorized representative may thus be either a named individual or an individual occupying a named position; and,
   (3) The written authorization is submitted to the state administrative authority.

c. Changes to authorization. If an authorization under Section D.10.b. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Section D.10.b. must be submitted to the state administrative authority prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under Section D.10. a. or b. above, shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Availability of Reports
All recorded information (completed permit application forms, fact sheets, draft permits, or any public document) not classified as confidential information under La. R.S. 30:2030(A) and 30:2074(D) and designated as such in accordance with these regulations (LAC 33:IX.2323 and LAC 33:IX.6503) shall be made available to the public for inspection and copying during normal working hours in accordance with the Public Records Act, La. R.S. 44:1 et seq.

Claims of confidentiality for the following will be denied:
a. The name and address of any permit applicant or permittee;
b. Permit applications, permits, and effluent data.
c. Information required by LPDES application forms provided by the state administrative authority under LAC 33:IX.2501 may not be claimed confidential. This includes information submitted on the forms themselves and any attachments used to supply information required by the forms.

SECTION E. PENALTIES FOR VIOLATIONS OF PERMIT CONDITION

1. Criminal
   a. Negligent Violations
   The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who negligently violates any provision of the LPDES, or any order issued by the secretary under the LPDES, or any permit condition or limitation implementing any such provision in a permit issued under the LPDES by the secretary, or any requirement imposed in a pretreatment program approved under the LPDES is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both. If a conviction of a person is for a violation committed after a first conviction of such person, he shall be subject to a fine of not more than $50,000 per day of violation, or imprisonment of not more than two years, or both.

b. Knowing Violations
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly violates any provision of the LPDES, or any permit condition or limitation implementing any such provisions in a permit issued under the LPDES, or any requirement imposed in a pretreatment program approved under the LPDES is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or imprisonment for not more than 3 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, he shall be subject to a fine of not more than $100,000 per day of violation, or imprisonment of not more than six years, or both.

c. Knowing Endangerment
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly violates any provision of the LPDES, or any order issued by the secretary under the LPDES, or any permit condition or limitation implementing any of such provisions in a permit issued under the LPDES by the secretary, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both. A person which is an organization shall, upon conviction of violating this Paragraph, be subject to a fine of not more than one million dollars. If a conviction of a person is for a violation committed after a first conviction of such person under this Paragraph, the maximum punishment shall be doubled with respect to both fine and imprisonment.

d. False Statements
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the LPDES or who knowingly falsifies, tampers with, or renders inaccurate~~,~~ any monitoring device or method required to be maintained under the LPDES, shall, upon conviction, be subject to a fine of not more than $10,000, or imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this Subsection, he shall be subject to a fine of not more than $20,000 per day of violation, or imprisonment of not more than 4 years, or both.

2. Civil Penalties
The Louisiana Revised Statutes La. R. S. 30:2025 provides that any person found to be in violation of any requirement of this Subtitle may be liable for a civil penalty, to be assessed by the secretary, an assistant secretary, or the court, of not more than the cost to the state of any response action made necessary by such violation which is not voluntarily paid by the violator, and a penalty of not more than $32,500 for each day of violation. However, when any such violation is done intentionally, willfully, or knowingly, or results in a discharge or disposal which causes irreparable or severe damage to the environment or if the substance discharged is one which endangers human life or health, such person may be liable for an additional penalty of not more than one million dollars.

(**PLEASE NOTE**: These penalties are listed in their entirety in Subtitle II of Title 30 of the Louisiana Revised Statutes.)

SECTION F. DEFINITIONS

All definitions contained in Section 502 of the Clean Water Act shall apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. Clean Water Act (CWA) means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or the Federal Water Pollution Control Act Amendments of 1972) Pub.L.92-500, as amended by Pub.L. 95-217, Pub.L. 95-576, Pub.L. 96-483 and Pub.L. 97-117, 33 U.S.C. 1251 et. seq.).

2. Accreditation means the formal recognition by the department of a laboratory's competence wherein specific tests or types of tests can be accurately and successfully performed in compliance with all minimum requirements set forth in the regulations regarding laboratory accreditation.

3. Administrator means the Administrator of the U.S. Environmental Protection Agency, or an authorized representative.

4. Applicable Standards and Limitations means all state, interstate and federal standards and limitations to which a discharge is subject under the Clean Water Act, including, effluent limitations, water quality standards of performance, toxic effluent standards or prohibitions, best management practices, and pretreatment standards under Sections 301, 302, 303, 304, 306, 307, 308 and 403.

5. Applicable water quality standards means all water quality standards to which a discharge is subject under the Clean Water Act.

6. Commercial Laboratory means any laboratory, wherever located, that performs analyses or tests for third parties for a fee or other compensation and provides chemical analyses, analytical results, or other test data to the department. The term commercial laboratory does not include laboratories accredited by the Louisiana Department of Health and Hospitals in accordance with La. R.S.49:1001 et seq.

7. Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the sampling day. Daily discharge determination of concentration made using a composite sample shall be the concentration of the composite sample.

8. Daily Maximum discharge limitation means the highest allowable "daily discharge".

9. Director means the U.S. Environmental Protection Agency Regional Administrator, or the state administrative authority, or an authorized representative.

10. Domestic septage means either liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives only domestic sewage. Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar treatment works that receives either commercial wastewater or industrial wastewater and does not include grease removed from grease trap at a restaurant.

11. Domestic sewage means waste and wastewater from humans, or household operations that is discharged to or otherwise enters a treatment works.

12. Environmental Protection Agency or (EPA) means the U.S. Environmental Protection Agency.

13. Grab sample means an individual sample collected over a period of time not exceeding 15 minutes, unless more time is needed to collect an adequate sample, and is representative of the discharge.

14. Industrial user means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly owned treatment works.

15. LEQA means the Louisiana Environmental Quality Act.

16. Louisiana Pollutant Discharge Elimination System (LPDES) means those portions of the Louisiana Environmental Quality Act and the Louisiana Water Control Law and all regulations promulgated under their authority which are deemed equivalent to the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act in accordance with Section 402 of the Clean Water Act and all applicable federal regulations.

17. Monthly Average, other than for fecal coliform bacteria, discharge limitations are calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes monthly average concentration effluent limitations or conditions, and flow is measured as continuous record or with a totalizer, the monthly average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily discharge concentration, F = daily flow and n = number of daily samples; monthly average discharge =

$$\frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

When the permit establishes monthly average concentration effluent limitations or conditions, and the flow is not measured as a continuous record, then the monthly average concentration means the arithmetic average of all "daily discharge(s)" of concentration determined during the calendar month.

The monthly average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.

18. National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the Clean Water Act.

19. Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

20. Sewage sludge means any solid, semi-solid, or liquid residue removed during the treatment of municipal wastewater or domestic sewage. *Sewage sludge* includes, but is not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings (33 CFR Part 159), and sewage sludge products. *Sewage sludge* does not include grit or screenings, or ash generated during the incineration of sewage sludge.

21. Stormwater Runoff—aqueous surface runoff including any soluble or suspended material mobilized by naturally occurring precipitation events.

22. Surface Water: all lakes, bays, rivers, streams, springs, ponds, impounding reservoirs, wetlands, swamps, marshes, water sources, drainage systems and other surface water, natural or artificial, public or private within the state or under its jurisdiction that are not part of a treatment system allowed by state law, regulation, or permit.

23. Treatment works means any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage and industrial wastes of a liquid nature to implement Section 201 of the Clean Water Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and their appurtenances, extension, improvement, remodeling, additions, and alterations thereof. (See Part 212 of the Clean Water Act)

24. For fecal coliform bacteria, a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.

25. The term MGD shall mean million gallons per day.

26. The term GPD shall mean gallons per day.

27. The term mg/L shall mean milligrams per liter or parts per million (ppm).

28. The term SPC shall mean Spill Prevention and Control. Plan covering the release of pollutants as defined by the Louisiana Administrative Code (LAC 33:IX.Chapter 9).

29. The term SPCC shall mean Spill Prevention Control and Countermeasures Plan. Plan covering the release of pollutants as defined in 40 CFR Part 112.

30. The term µg/L shall mean micrograms per liter or parts per billion (ppb).

31. The term ng/L shall mean nanograms per liter or parts per trillion (ppt).

32. Visible Sheen: a silvery or metallic sheen, gloss, or increased reflectivity; visual color; or iridescence on the water surface.

33. Wastewater—liquid waste resulting from commercial, municipal, private, or industrial processes. Wastewater includes, but is not limited to, cooling and condensing waters, sanitary sewage, industrial waste, and contaminated rainwater runoff.

34. Waters of the State: for the purposes of the Louisiana Pollutant Discharge Elimination system, all surface waters within the state of Louisiana and, on the coastline of Louisiana and the Gulf of Mexico, all surface waters extending there from three miles into the Gulf of Mexico. For purposes of the Louisiana Pollutant Discharge Elimination System, this includes all surface waters which are subject to the ebb and flow of the tide, lakes, rivers, streams, (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, natural ponds, impoundments of waters within the state of Louisiana otherwise defined as "waters of the United States" in 40 CFR 122.2, and tributaries of all such waters. "Waters of the state" does not include waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act, 33 U.S.C. 1251 et seq.

35. Weekly average, other than for fecal coliform bacteria, is the highest allowable arithmetic mean of the daily discharges over a calendar week, calculated as the sum of all "daily discharge(s)" measured during a calendar week divided by the number of "daily discharge(s)" measured during that week. When the permit establishes weekly average concentration effluent limitations or conditions, and flow is measured as continuous record or with a totalizer, the weekly average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar week where C = daily discharge concentration, F = daily flow and n = number of daily samples; weekly average discharge

$$= \frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

When the permit establishes weekly average concentration effluent limitations or conditions, and the flow is not measured as a continuous record, then the weekly average concentration means the arithmetic average of all "daily discharge(s)" of concentration determined during the calendar week.

The weekly average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

36. Sanitary Wastewater Term(s):

a. 3-hour composite sample consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) over the 3-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 3-hour period.

b. 6-hour composite sample consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) over the 6-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 6-hour period.

c. 12-hour composite sample consists of 12 effluent portions collected no closer together than one hour over the 12-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 12-hour period. The daily sampling intervals shall include the highest flow periods.

d. 24-hour composite sample consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample continuously collected in proportion to flow over the 24-hour period.

LPDES PERMIT NO. LA0007374, AI No. 35260

LPDES FACT SHEET and RATIONALE
ADDENDUM
FOR THE DRAFT LOUISIANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (LPDES) PERMIT TO DISCHARGE TO WATERS OF LOUISIANA

1. **Company/Facility Name:** Entergy Operations, Inc.
   Waterford 3 Steam Electric Station
   17265 River Road
   Killona, Louisiana 70057

2. **Issuing Office:** Louisiana Department of Environmental Quality (LDEQ)
   Office of Environmental Services
   Post Office Box 4313
   Baton Rouge, Louisiana 70821-4313

3. **Prepared By:** Michelle Bickham
   Industrial Permits Section
   Water Permits Division
   Phone #: 225-219-3082

   Date Prepared: August 24, 2010

4. **Permit Action/Status:**

   A. Reason For Permit Action:

   A meeting was held on August 10, 2010, to discuss the 316(b) requirements in the permit. This addendum addresses only those changes made to the 316(b) language in the fact sheet. **All other information stated in the original fact sheet remains the same.**

   B. LPDES permit - (LA0007374)
   LPDES permit effective date: February 1, 2005
   LPDES permit expiration date: January 31, 2010
   LPDES permit modification date: January 10, 2008

   C. LPDES Draft issued - June 28, 2010. The public notice was published in the Office of Environmental Services Public Notice Mailing List on July 12, 2010, and the ST. CHARLES HERALD-GUIDE of Boutte on July 15, 2010. The comment period ended on August 16, 2010. A request for a meeting was received on August 2, 2010. The meeting was held on August 10, 2010, with Entergy Operations, Inc. and the Water Permits Division. The permit language was changed to reflect the following: (1) the requirement to submit information on the assessment of the cooling water system has been removed as this information was submitted on July 10, 2008, as part of the *Impingement Mortality and Entrainment Characterization Study*; and replaced with a requirement stating that Office may request an update of this information or additional information of the cooling water system if necessary; and (2) the statement that the repromulgated regulation will supersede any requirements contained in the permit has been removed and replaced with the provision that if EPA repromulgates the Phase II Rule, this permit may be reopened to comply with the repromulgated rule. The fact sheet language from the draft permit has been changed to the following:

316(b) PHASE II RULE REQUIREMENTS

- July 6, 2004, EPA promulgated 'Phase II' regulations in accordance with section 316(b) of the Clean Water Act (CWA). February 2005, LDEQ promulgated 'Phase II' regulations found at LAC 33:IX.Chapter 47.Subchapter B.
- January 25, 2007, the Second U.S. Circuit Court of Appeals remanded several provisions of the Phase II rule.
- March 20, 2007, EPA issued a memo saying, "the rule should be considered suspended".
- July 9, 2007, Federal Register notice suspending all parts of the Phase II regulations except 40 CFR 125.90(b) [LAC 33:IX.4731.B]. October 2007, LDEQ suspended LAC 33:IX.Chapter 47.Subchapter B, with the exception of LAC 33:IX.4731.B.

According to EPA, 316(b) 'Phase II' regulations are under complete reconsideration at this time. LAC 33:IX.4731.B provides for regulating the cooling water intake structure (CWIS) for existing facilities on a case-by-case basis using best professional judgment.

This facility was issued a number of previous NPDES and/or LPDES permits and has been withdrawing once-through, non-contact cooling water without any identified problems. Based on information evaluated, there have been no past or current impacts identified associated with the withdrawal of the applicable cooling water. The facility is located in the main channel of the Mississippi River at River Mile 129.5 on the west descending bank. The intake structure extends out 162 feet from the bank and is equipped with a skimmer wall as to prevent debris and surface swimming organisms from entering the CWIS. The offshore location of the CWIS minimizes fish and shellfish from entering the system as the conditions of the Mississippi River (i.e., high velocity, increased debris, shifting river bed, lack of habitat/vegetation, and reduction of food source) at the location of the intake structure are not easily tolerated. LDEQ has made the determination that this CWIS represents the best technology available.

A permit modification, effective January 10, 2008, required Entergy Operations, Inc. to characterize the fish/shellfish in the vicinity of the CWIS, assess impingement mortality and entrainment (IM&E), and assess the cooling water system. The assessment results were received by LDEQ on July 10, 2008 (EDMS document 37109798).

The permittee shall comply with effective regulations promulgated in accordance with section 316(b) of the CWA for cooling water intake structures. Based on any additional evaluation of the assessment results received by LDEQ on July 10, 2008, any new information required to be submitted to LDEQ, or a revision to the regulations, the permit may be reopened to incorporate limitations and/or requirements for the CWIS.

ADDITIONAL INFORMATION

As stated in Section 9 of the original Fact Sheet, the flow requirement for Outfall 001 was changed from a daily maximum limitation of 1518 MGD to a reporting requirement only in the draft permit. This is consistent with similar outfalls for similar permits. Because flow is not a pollutant as defined by LAC33:IX.2313, anti-backsliding regulations at LAC33:IX.2707.L do not apply.

LPDES PERMIT NO. LA0007374, AI No. 35260

LPDES FACT SHEET and RATIONALE
FOR THE DRAFT LOUISIANA POLLUTANT DISCHARGE ELIMINATION SYSTEM
(LPDES) PERMIT TO DISCHARGE TO WATERS OF LOUISIANA

1. **Company/Facility Name:** Entergy Operations, Inc.
Waterford 3 Steam Electric Station
17265 River Road
Killona, Louisiana 70057

2. **Issuing Office:** Louisiana Department of Environmental Quality (LDEQ)
Office of Environmental Services
Post Office Box 4313
Baton Rouge, Louisiana 70821-4313

3. **Prepared By:** Michelle Bickham
Industrial Permits Section
Water Permits Division
Phone #: 225-219-3082

Date Prepared: April 14, 2010

4. **Permit Action/Status:**

A. Reason For Permit Action:

Proposed reissuance of an expired Louisiana Pollutant Discharge Elimination System (LPDES) permit for a 5-year term following regulations promulgated at LAC 33:IX.2711/40 CFR 122.46.

<u>LAC 33:IX Citations:</u> Unless otherwise stated, citations to LAC 33:IX refer to promulgated regulations listed at Louisiana Administrative Code, Title 33, Part IX.

B. LPDES permit - LPDES permit effective date: February 1, 2005
LPDES permit expiration date: January 31, 2010
LPDES permit modification date: January 10, 2008

C. Application received on July 30, 2009

5. **Facility Information:**

A. Location - 17265 River Road, Killona, St. Charles Parish

B. Applicant Activity - According to the application, Entergy Operations, Inc., Waterford 3 Steam Electric Station is a steam electric generating station that has a maximum electrical generating capacity of 1,104 megawatts (MWe). The primary fuel source for the unit is enriched Uranium 235.

C. Technology Basis - LAC33:IX.4903

Guideline	Reference
Steam Electric Power Generating Point Source Category	40 CFR 423

Other sources of technology based limits:
LDEQ Stormwater Guidance, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)
LDEQ Sanitary General Permits
LDEQ Multi-Sector General Permit for Storm Water Discharges LAR050000
Best Professional Judgement

D. Fee Rate -
1. Fee Rating Facility Type: major
2. Complexity Type: V
3. Wastewater Type: I
4. SIC code: 4911

E. Continuous Facility Effluent Flow (30-Day Average) - 1005 MGD

6. Receiving Waters:

Mississippi River

1. TSS (15%), mg/L: 32
2. Average Hardness, mg/L $CaCO_3$: 153.4
3. Critical Flow, cfs: 141,955
4. Mixing Zone Fraction: 0.333
5. Harmonic Mean Flow, cfs: 366,758
6. River Basin: Mississippi River, Segment No. 070301
7. Designated Uses:
   The designated uses are primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply.

Information based on the following: LAC 33:IX Chapter 11;/Recommendation(s) from the Engineering Section. Hardness and 15% TSS data comes from monitoring station #0319 on the Mississippi River east of Plaquemine at the Plaquemine ferry landing, midstream. (email from Ronnie Bean dated 4/28/10)

40 Arpent Canal

1. River Basin: Barataria Basin, Segment No. 020202
2. Designated Uses:
   The designated uses are primary contact recreation, secondary contact recreation, and fish and wildlife propagation.

7. **Outfall Information:**

Outfall 001

A. Type of wastewater - the continuous discharge of once through non-contact cooling water combined with previously monitored intermittent discharges including but not limited to: steam generator blowdown, cooling tower blowdown, metal cleaning wastewaters, low volume wastewater, and stormwater from Outfalls 101, 201, 301, 401, 501, 601, 701, 801, 901, and 1001

B. Location - at the point of discharge from the circulating water system discharge structure prior to entering the Mississippi River (Latitude 29°59'49", Longitude 90°28'01"). (NOTE: During high river stages when the structure is inaccessible, representative effluent samples are collected at an alternate location between the main condenser and the discharge structure.)

C. Treatment - intake screening, chlorination (when required), LDEQ approved mussel treatment (when required), and addition of dispersant/polymer (when required)

D. Flow - 994 MGD (average)

E. Receiving waters - Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 101

A. Type of wastewater - the intermittent discharge from the liquid waste management system. The liquid waste management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423.

B. Location - at the point of discharge from the liquid waste management system prior to combining with the waters of Outfall 001 (Latitude 29°59'40", Longitude 90°28'16")

C. Treatment - filtering/screening, cationic and anionic polymer injection, ion exchange, neuralization/pH adjustmnet (when required), and distillation (when required)

D. Flow - 0.0129 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 201

A. Type of wastewater - the intermittent discharge from the boron management system. The boron management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423

B. Location - at the point of discharge from the boron management system prior to combining with the waters of Outfall 001 (Latitude 29°59'40", Longitude 90°28'16")

C. Treatment - filtering/screening, ion exchange, neutralization/pH adjustment (when required), distillation (when required)

D. Flow - 0.0128 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 301

A. Type of wastewater - the intermittent discharge of filter flush water from the primary water treatment system. The primary water treatment system filters riverwater for various plant uses. The filters of this system are flushed periodically with untreated river water to remove solids trapped in the filter beds.

B. Location - at the point of discharge from the primary water treatment system prior to combining with the waters of Outfall 001 (Latitude 29°59'41", Longitude 90°28'20")

C. Treatment - filter/screening, separation, polymer injection (when required)

D. Flow - 0.0001 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 401

A. Type of wastewater - the intermittent discharge of steam generator blowdown and other low volume wastewaters as defined in 40 CFR 423

B. Location - at the point of discharge from the secondary stream plant system prior to combining with the waters of Outfall 001 (Latitude 29°59'41", Longitude 90°28'15")

C. Treatment - filtration, ion exchange, neutralization/pH adjustment (when required)

D. Flow - 0.042 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 501

A. Type of wastewater - the intermittent discharge from Auxiliary Component Cooling Water Basin A. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, Mississippi River water used for flow testing, and stormwater.

B. Location - at the point of discharge from Auxiliary Component Cooling Water Basin A prior to combining with the waters of Outfall 001 (Latitude 29°59'44", Longitude 90°28'13")

C. Treatment - sedimentation, neutralization/pH adjustment (when required), side stream ionization (when required), and filtration (when required)

D. Flow - 0.26 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 601

A. Type of wastewater - the intermittent discharge from Auxiliary Component Cooling Water Basin B. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, secondary plant water system wastewater, Mississippi River water used for flow testing, and stormwater.

B. Location - at the point of discharge from Auxiliary Component Cooling Water Basin B prior to combining with the waters of Outfall 001 (Latitude 29°59'44", Longitude 90°28'13")

C. Treatment - sedimentation, neutralization/pH adjustment (when required), side stream ionization (when required), and filtration (when required)

D. Flow - 0.26 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 701

A. Type of wastewater - the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #1. Low volume wastewaters include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.)

B. Location - at the point of discharge from the Dry Cooling Tower Sump #1 prior to combining with the waters of Outfall 001 (or Outfall 004)(Latitude 29°59'44", Longitude 90°28'13")

C. Treatment - sedimentation, neutralization/pH adjustment (when required), side stream ionization (when required), filtration (when required)

D. Flow - 0.0185 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River OR through Outfall 004 thence to 40 Arpent Canal

F. Basin and segment - Mississippi River Basin, Segment 070301 OR Barataria Basin, Segment 020202

Outfall 801

A. Type of wastewater - the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #2. Low volume wastewater sources as defined in 40 CFR 423 include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.)

B. Location - at the point of discharge from the Dry Cooling Tower Sump #2 prior to combining with the waters of Outfall 001 (or Outfall 004) (Latitude 29°59'44", Longitude 90°28'13")

C. Treatment - sedimentation, neutralization/pH adjustment (when required), side stream ionization (when required), filtration (when required)

D. Flow - 0.068 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River OR through Outfall 004 thence to 40 Arpent Canal

F. Basin and segment - Mississippi River Basin, Segment 070301 OR Barataria Basin, Segment 020202

Outfall 901

A. Type of wastewater - the mobile intermittent discharge of metal cleaning wastewaters (both chemical and non-chemical) from various plant equipment components including, but not limited to: the steam generator, cooling water heat exchangers, and piping

B. Location - at the point of discharge from the mobile cleaning process unit(s) prior to combining with the waters of Outfall 001

C. Treatment - chemical precipitation, neutralization, sedimentation, pre-aeration (when required), flocculation (when required), ion exchange (when required)

D. Flow - 0.0201 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Segment 070301

Outfall 1001

A. Type of wastewater - the intermittent discharge from the yard oil separator system. Wastewater includes auxiliary boiler blowdown, stormwater, and low volume wastewaters from various sources, including plant floor drains and discharge from the industrial waste system as defined in 40 CFR 423. Low volume wastewater sources include, but are not limited to: secondary water system drains, system leakage, auxiliary boiler sumps, turbine building equipment and floor drains, turbine building floor wash downs, and laboratory drains. (NOTE: Optional discharge to Outfall 004 may occur during maintenance periods and during rain events that compromise the capacity of the discharge pumps.)

B. Location - at the point of discharge from the yard oil separator system prior to combining with the waters of Outfall 001 (or Outfall 004) (Latitude 29°59'38", Longitude 90°28'17")

C. Treatment - sedimentation, flotation, oil/water separation, polymer injection (when required), neutralization/pH adjustment, (when required), flocculation (when required), filtration (when required)

D. Flow - 0.0553 MGD (average)

E. Receiving waters - through Outfall 001 thence to the Mississippi River OR through Outfall 004 thence to 40 Arpent Canal

F. Basin and segment - Mississippi River Basin, Segment 070301 OR Barataria Basin, Segment 020202

Outfall 004

A. Type of wastewater - the intermittent discharge from the plant drainage ditch system consisting of stormwater, potable water from the fire water system, maintenance wastewaters including, but not limited to: hydrostatic test water, air conditioning condensate, low volume wastewaters including, but not limited to: reverse osmosis reject water and demineralized water. The plant drainage ditch system receives discharges during maintenance from the Dry Cooling Tower Sump #1 (Internal Outfall 701), Dry Cooling Tower Sump #2 (Internal Outfall 801), and treated discharge from the yard oil separator system, including, but not limited to: plant floor drains and discharge from the industrial waste system (Internal Outfall 1001).

B. Location - at the point of discharge from the stormwater drainage ditch south of the plant laydown area and prior to combining with the waters of the 40 Arpent Canal (Latitude 29°59'19", Longitude 90°28'24")

C. Treatment - none

D. Flow - 10.3 MGD (average)

E. Receiving waters - 40 Arpent Canal thence to Lac Des Allemands

F. Basin and segment - Barataria Basin, Segment 020202

Outfall 005

A. Type of wastewater - the intermittent discharge of treated sanitary wastewater and a *de minimis* discharge from the HVAC unit from the Entergy Energy Education Center

B. Location - at the point of discharge from the sewage treatment plant prior to combining with the waters of the 40 Arpent Canal (Latitude 29°58'53", Longitude 90°28'35")

C. Treatment - sewage treatment plant with chlorination

D. Flow - 0.061 MGD (average)

E. Receiving waters - 40 Arpent Canal thence to Lac Des Allemands

F. Basin and segment - Barataria Basin, Segment 020202

8. Previous Effluent Limitations

Outfall 001 - the continuous discharge of once through non-contact cooling water, and previously monitored intermittent discharges including but not limited to: steam generator blowdown, cooling tower blowdown, metal cleaning wastewaters, low volume wastewaters, and stormwater

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	Report Continuous Recorder	1518 Continuous Recorder
Temperature	Report Continuous Recorder	118° F Continuous Recorder

Heat (BTU)	---	9.5 X 10^3 MBTU/hour Continuous Recorder
Total Residual Chlorine*	---	211 lbs/day 1/week Grab

*Samples shall be representative of any periodic episodes of chlornation, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

WHOLE EFFLUENT TOXICITY TESTING (ACUTE)	**PERCENT %, UNLESS STATED**		**MONITORING REQUIREMENTS**	
	MONTHLY AVERAGE MINIMUM	**48-HOUR MINIMUM**	**MEASUREMENT FREQUENCY**	**SAMPLE TYPE**
NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, *Pimephales promelas*	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, *Pimephales promelas*	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, *Pimephales promelas*	Report	Report	1/quarter	24-hr. Composite
NOEC, Pass/Fail [0,1], Lethality , Static Renewal, 48-Hour Acute, *Daphnia pulex*	Report	Report	1/quarter	24-hr. Composite
NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, *Daphnia pulex*	Report	Report	1/quarter	24-hr. Composite

NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, *Daphnia pulex*	Report	Report	1/quarter	24-hr. Composite

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 001, at the point of discharge from the circulating water system discharge structure

Outfall 101 - the intermittent discharge from the liquid waste management system to Final Outfall 001 via the turbine condenser cooling system. The liquid waste management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/batch Totalized
TSS	---	100 mg/L 1/month Grab
Oil & Grease		20 mg/L 1/month Grab
pH	6.0 s.u. 1/batch Grab	9.0 s.u. 1/batch Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 101, at the point of discharge from the liquid waste management system

Outfall 201 - the intermittent discharge from the boron management system to Final Outfall 001 via the turbine condenser cooling system. The boron management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/batch Totalized
TSS	---	100 mg/L 1/month Grab
Oil & Grease		20 mg/L 1/month Grab
pH	6.0 s.u. 1/batch Grab	9.0 s.u. 1/batch Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 201, at the point of discharge from the boron management system

Outfall 301 - the intermittent discharge of filter flush water from the primary water treatment system

Parameter	LPDES	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report Weekly Totalized

Clarifying Agents - The quantity and types of all clarifying agents (coagulants) used in the primary water treatment system during the sampling month shall be recorded.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 301, at the point of discharge from the primary water treatment system

Outfall 401 - the intermittent discharge of steam generator blowdown and other low volume wastewaters as defined in 40 CFR 423

Parameter	LPDES	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report Daily Totalized*
TSS	---	100 mg/L 1/week Grab
Oil & Grease	---	20 mg/L 1/week Grab
pH	6.0 s.u. 1/week Grab	9.0 s.u. 1/week Grab

*When low volume wastewaters are discharged, the flow must be estimated.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 401, at the point of discharge from the secondary steam plant system

Outfall 501 - the intermittent discharge from Auxiliary Component Cooling Water Basin A. Low volume wastewater include, but not limited to: auxiliary component cooling water, component cooling water, Mississippi River water used for flow testing, and stormwater

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/week Estimate
TOC	---	50 mg/L 1/week Grab
TSS*	---	100 mg/L 1/week Grab
Oil & Grease	---	20 mg/L 1/week Grab
pH	6.0 s.u. 1/week Grab	9.0 s.u. 1/week Grab

*During circulating water flow testing, sampling for TSS is not required (when Mississippi River water is used for the flow test).

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 501, at the point of discharge from Auxiliary Component Cooling Water Basin A

Outfall 601 - the intermittent discharge from Auxiliary Component Cooling Water Basin B. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, secondary plant water system wastewater, Mississippi River water used for flow testing, and stormwater

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/week Estimate
TOC	---	50 mg/L 1/week Grab
TSS*	---	100 mg/L 1/week Grab
Oil & Grease	---	20 mg/L 1/week Grab
pH	6.0 s.u. 1/week Grab	9.0 s.u. 1/week Grab

*During circulating water flow testing, sampling for TSS is not required (when Mississippi River water is used for the flow test).

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 601, at the point of discharge from Auxiliary Component Cooling Water Basin B

Outfall 701 - the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #1. Low volume wastewater as defined in 40 CFR 423 include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. Optional discharge to Final Outfall 004 via the plant drainage ditches may occur during periods when the circulating water system is unavailable

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/month Estimate
TOC	---	50 mg/L 1/quarter Grab
TSS	---	100 mg/L 1/month Grab
Oil & Grease	---	20 mg/L 1/month Grab
FAC*	---	0.5 mg/L 1/month Grab
Total Chromium*	---	0.2 mg/L 1/year Grab
Total Zinc*	---	1.0 mg/L 1/month Grab
pH	6.0 s.u. 1/month Grab	9.0 s.u. 1/month Grab

* Sample shall be representative of periods during cooling tower blowdown discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 701, at the point of discharge from Dry Cooling Tower Sump #1

Outfall 801 - the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #2. Low volume wastewater sources as defined in 40 CFR 423 include, but not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. Optional discharge to Final Outfall 004 via the plant drainage ditches may occur during periods when the circulating water system is unavailable

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/month Estimate
TOC	---	50 mg/L 1/quarter Grab
TSS	---	100 mg/L 1/month Grab
Oil & Grease	---	20 mg/L 1/month Grab
FAC*	---	0.5 mg/L 1/month Grab
Total Chromium*	---	0.2 mg/L 1/year Grab
Total Zinc*	---	1.0 mg/L 1/month Grab
pH	6.0 s.u. 1/month Grab	9.0 s.u. 1/month Grab

* Sample shall be representative of periods during cooling tower blowdown discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 801, at the point of discharge from Dry Cooling Tower Sump #2

Outfall 901 - the mobile intermittent discharge of metal cleaning wastewaters (both chemical and non-chemical) from various plant equipment components including, but not limited to: the steam generator, cooling water heat exchangers, and piping

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/week Estimate
TSS	---	100 mg/L 1/week Grab
Oil & Grease	---	20 mg/L 1/week Grab
Total Copper	---	1.0 mg/L 1/week Grab
Total Iron	---	1.0 mg/L 1/week Grab
pH	6.0 s.u. 1/week Grab	9.0 s.u. 1/week Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 901, at the point of discharge from the mobile cleaning process unit(s)

Outfall 1001 - the intermittent discharge from the yard oil separator system. Wastewater includes auxiliary boiler blowdown, stormwater, and low volume wastewaters from various sources, including plant floor drains and discharge from the industrial waste system as defined in 40 CFR 423. Low volume wastewater sources include, but are not limited to: secondary water system drains, system leakage, auxiliary boiler sumps, turbine building equipment and floor drains, turbine building floor wash downs, and laboratory drains. Optional discharge to Final Outfall 004 may occur during maintenance periods and rain events that compromise the capacity of the discharge pumps.

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/month Estimate
TSS	---	100 mg/L 1/month Grab
Oil & Grease		20 mg/L 1/month Grab
pH	6.0 s.u. 1/month Grab	9.0 s.u. 1/month Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 1001, at the point of discharge from the yard oil separator system

Outfall 004 - the intermittent discharge from the plant drainage ditch system consisting of stormwater, potable water from the fire water system, maintenance wastewaters including, but not limited to: hydrostatic test water, air conditioning condensate, low volume wastewaters including, but not limited to: reverse osmosis reject water and demineralized water. The plant drainage ditch system receives treated carwash wastewater (Internal Outfall 204), and during maintenance activities discharges from Dry Cooling Tower Sump #1 (Internal Outfall 701), Dry Cooling Tower Sump #2 (Internal Outfall 801), and treated discharge from the yard oil separator system, including, but not limited to: plant floor drains and discharge from the industrial waste system (Internal Outfall 1001).

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/3 months Estimate
TOC	---	50 mg/L 1/3 months Grab
TSS*	---	100 mg/L 1/3 months Grab
Oil & Grease		15 mg/L 1/3 months Grab
pH	6.0 s.u. 1/3 months Grab	9.0 s.u. 1/3 months Grab

*Samples shall be representative of periods during discharge of low volume wastewaters as defined in 40 CFR 423 (excludes Mississippi River water that accumulates in the condenser water boxes.)

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 004, at the point of discharge from the stormwater drainage ditch south of the plant laydown area

Outfall 204 - the intermittent internal discharge of treated carwash wastewater

Parameter	**LPDES**	
	Monthly Average	**Daily Maximum**
Flow - mgd	---	Report 1/3 months Estimate
COD	200 mg/L 1/3 months Grab	300 mg/L 1/3 months Grab
TSS	---	45 mg/L 1/3 months Grab
Oil & Grease		15 mg/L 1/3 months Grab
pH	6.0 s.u. 1/3 months Grab	9.0 s.u. 1/3 months Grab
Soaps & Detergents*	Report 1/3 months Grab	---

*The quantity and types of all Soaps and/or Detergents used during the sampling month shall be recorded.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 204, at the point of discharge from the carwash treatment system

Outfall 005 - the intermittent discharge of treated sanitary wastewater and a *de minimis* discharge from the HVAC unit from the Entergy Energy Education Center

Parameter	**LPDES**	
	Monthly Average	**Weekly Average**
Flow - mgd	---	Report 1/6 months Estimate
BOD_5	---	45 mg/L 1/6 months Grab
TSS	---	45 mg/L 1/6 months Grab
Oil & Grease	---	400 mg/L 1/6 months Grab
pH	6.0 s.u. 1/6 months Grab	9.0 s.u. 1/6 months Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations:

Outfall 005, at the point of discharge from the sewage treatment plant

9. Summary of Proposed Changes From the Current LPDES permit:

- The outfall descriptions have been updated based on an email from Rodney LeBlanc dated March 2, 2010.
- The flow limitation for Outfall 001 has been removed.
- Outfall 204 (car washwater) has been removed from the permit and the outfall description for Outfall 004 has been modified to reflect this change.

- The limits for Outfall 005 have been updated in accordance with the reissuance of the Class I Sanitary Discharge General Permit, and the limitations have been changed from weekly average to daily maximum.

10. Proposed Permit Limits:

The specific effluent limitations and/or conditions will be found in the draft permit. Development and calculation of permit limits are detailed in the Permit Limit Rationale section below.

11. Permit Limit Rationale:

The following section sets forth the principal facts and the significant factual, legal, methodological, and policy questions considered in preparing the draft permit. Also set forth are any calculations or other explanations of the derivation of specific effluent limitations and conditions, including a citation to the applicable effluent limitation guideline or performance standard provisions as required under LAC 33:IX.2707 and reasons why they are applicable or an explanation of how the alternate effluent limitations were developed.

A. TECHNOLOGY-BASED VERSUS WATER QUALITY STANDARDS-BASED EFFLUENT LIMITATIONS AND CONDITIONS

Following regulations promulgated at LAC 33:IX.2707.L.2.b, the draft permit limits are based on either technology-based effluent limits pursuant to LAC 33:IX.2707.A or on State water quality standards and requirements pursuant to LAC 33:IX.2707.D, whichever are more stringent.

B. TECHNOLOGY-BASED EFFLUENT LIMITATIONS AND CONDITIONS

Regulations promulgated at LAC 33:IX.2707.A require technology-based effluent limitations to be placed in LPDES permits based on effluent limitations guidelines where applicable, on BPJ (best professional judgement) in the absence of guidelines, or on a combination of the two. The following is a rationale for types of wastewaters. See outfall information descriptions for associated outfall(s) in Section 7. Regulations also require permits to establish monitoring requirements to yield data representative of the monitored activity [LAC 33:IX.2715] and to assure compliance with permit limitations [LAC 33:IX.2707.I.].

Manufacturing Operation	Guideline
Steam Electric Power Generating Point Source Category	40 CFR 423

Regulations require permits establish monitoring requirements to yield data representative of the monitored activity [LAC33:IX.2715] and to assure compliance with permit limitations [LAC33:IX.2707.I].

C. WATER QUALITY-BASED EFFLUENT LIMITATIONS

Technology-based effluent limitations and/or specific analytical results from the permittee's application were screened against state water quality numerical standard based limits by following guidance procedures established in the Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, LDEQ, October 7, 2009. Calculations, results, and documentation are given in Appendix B.

The following pollutants received water quality based effluent limits:

POLLUTANT(S)
None

D. MONITORING FREQUENCIES

Regulations require permits to establish monitoring requirements to yield data representative of the monitored activity (LAC33:IX.2715) and to assure compliance with permit limitations (LAC33:IX.2707.I). Specific monitoring frequencies per outfall are listed in Section E.

E. OUTFALL SPECIFIC RATIONALE

Outfall 001

1. General Comments

This outfall is the continuous discharge of once through non-contact cooling water combined with previously monitored intermittent discharges including but not limited to: steam generator blowdown, cooling tower blowdown, metal cleaning wastewaters, low volume wastewater, and stormwater from Outfalls 101, 201, 301, 401, 501, 601, 701, 801, 901, and 1001.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow-mgd	Report	Report	Continuous	Recorder
Temperature	Report	118°F	Continuous	Recorder
Heat	---	9.5×10^3 MBTU/hour	Continuous	Recorder
Total Residual Chlorine	---	211 lbs/day	1/week	Grab

Flow - The current LPDES permit established a reporting requirement for monthly average. This requirement is being retained. The daily maximum limitation of 1518 in the current permit is being changed to a reporting requirement as per current guidance. Both requirements will have a measurement frequency of continuous and a sample type of recorder. These requirements are consistent with LAC33:IX.2707.I.1.b.

Temperature - The current LPDES permit established a reporting requirement for monthly average and daily maximum limitation of 118° F. These limitations are being retained with a monitoring frequency of continuous. Temperature is measured by a recorder with analysis required immediately.

Heat - The current LPDES permit established a daily maximum limitation of 9.5×10^3 MBTU/hour. This limitation is being retained with a monitoring frequency of continuous and a sample type of recorder.

Total Residual Chlorine - The current LPDES permit established a daily maximum limitation of 211 lbs/day. This limitation is being retained with the same monitoring frequency of once per week by grab sample during periods of chlorination.

TOXICITY TESTS	FREQUENCY
Acute static renewal 48-hour definitive toxicity test using fathead minnow (*Pimephales promelas*)	once per quarter
Acute static renewal 48-hour definitive toxicity test using water flea (*Daphnia pulex*)	Once per quarter

Toxicity tests shall be performed in accordance with protocols described in the latest revision of the "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms." The stipulated test species are appropriate to measure the toxicity of the effluent consistent with the requirements of the State water quality standards. The biomonitoring frequency has been established to reflect the likelihood of ambient toxicity and to provide data representative of the toxic potential of the facility's discharge in accordance with regulations promulgated at LAC 33:IX.2715.

Results of all dilutions as well as the associated chemical monitoring of pH, temperature, hardness, dissolved oxygen, conductivity, and salinity shall be documented in a full report according to the test method publication mentioned in the previous paragraph. The permittee shall submit a copy of the first full report to the Office of Environmental Compliance. However, the full report and subsequent reports are to be retained for three (3) years following the provisions of Part III.C.3 of this permit. The permit requires the submission of certain toxicity testing information as an attachment to the Discharge Monitoring Report.

This permit may be reopened to require effluent limits, additional testing, and/or other appropriate actions to address toxicity if biomonitoring data shows actual or potential ambient toxicity to be the result of the permittee's discharge to the receiving stream or water body. Modification or revocation of the permit is subject to the provisions of LAC 33:IX.3105. Accelerated or intensified toxicity testing may be required in accordance with Section 308 of the Clean Water Act.

Dilution Series - The permit requires five (5) dilutions in addition to the control (0% effluent) to be used in the toxicity tests. These additional effluent concentrations shall be 13%, 18%, 24%, 31%, and 42%. The biomonitoring critical dilution is defined as 31% effluent.

Internal Outfalls

In accordance with LAC33:IX.3305, the following is an explanation for the establishment of Internal Outfalls 101, 201, 301, 401, 501, 601, 701, 801, 901, and 1001. Certain permit effluent limitations at the point of discharge are impractical because at the final discharge point, the wastewater is diluted as to make monitoring impracticable. Therefore, in accordance with LAC33:IX.2709, the internal outfalls described below will remain in the permit.

Outfall 101

1. General Comments

This outfall is the intermittent discharge from the liquid waste management system. The boron management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow-mgd	---	Report	1/batch	Totalized
TSS	---	100 mg/L	1/month	Grab
Oil and Grease	---	20 mg/L	1/month	Grab
pH	6.0 s.u.	9.0 s.u.	1/batch	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per batch and a sample type of totalized. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per month by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with monitoring frequency of once per month by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and maximum discharge limit of 9.0 standard units for pH in accordance with 40 CFR 423.12(b)(1). These limitations are being retained with a monitoring frequency of once per batch by grab sample.

Outfall 201

1. General Comments

This outfall is the intermittent discharge from the boron management system. The boron management system receives low volume wastewater from the following sources, including but not limited to: the turbine and reactor building equipment and floor drains, primary plant water makeup, laboratory drains, and other low volume wastewater sources as defined in 40 CFR 423.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow-mgd	---	Report	1/batch	Totalized
TSS	---	100 mg/L	1/month	Grab
Oil and Grease	---	20 mg/L	1/month	Grab
pH	6.0 s.u.	9.0 s.u.	1/batch	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per batch and a sample type of totalized. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per month by grab sample.

Oil & Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per month by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and maximum discharge limit of 9.0 standard units for pH in accordance with 40 CFR 423.12(b)(1). These limitations are being retained with a monitoring frequency of once per batch by grab sample.

Outfall 301

1. General Comments

This outfall is the intermittent discharge of filter flush water from the primary water treatment system. The primary water treatment system filters riverwater for various plant uses. The filters of this system are flushed periodically with untreated river water to remove solids trapped in the filter beds.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow-mgd	---	Report	Weekly	Totalized

NOTE: The quantity and types of all clarifying agents (coagulants) used in the primary water treatment system during the sampling month shall be recorded. Records of the quantity and type of clarifying agents used shall be retained for three (3) years following Part III.C.3 of the LPDES permit. No DMR reporting shall be required.

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of weekly and a sample type of totalized. This requirement is consistent with LAC33:IX.2707.I.1.b.

Outfall 401

1. General Comments

This outfall is the intermittent discharge of steam generator blowdown and other low volume wastewaters as defined in 40 CFR 423.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow-mgd	---	Report	Daily	Totalized
TSS	---	100 mg/L	1/week	Grab
Oil and Grease	---	20 mg/L	1/week	Grab
pH	6.0 s.u.	9.0 s.u.	1/week	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a daily measurement frequency and a sample type of totalized. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

Oil & Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance withi 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and maximum discharge limit of 9.0 standard units for pH in accordance with 40 CFR 423(b)(1). These limitations are being retained with a monitoring frequency of once per week by grab sample.

Outfall 501

1. General Comments

This outfall is the intermittent discharge from Auxiliary Component Cooling Water Basin A. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, Mississippi River water used for flow testing, and stormwater.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	**LIMITATION**		**MONITORING REQUIREMENTS**	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow-mgd	---	Report	1/week	Estimate
TOC	---	50 mg/L	1/week	Grab
TSS	---	100 mg/L	1/week	Grab
Oil and Grease	---	20 mg/L	1/week	Grab
pH	6.0 s.u.	9.0 s.u.	1/week	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per week and a sample type of estimate. These requirements are consistent with LAC33:IX.2707.I.1.b.

Total Organic Carbon - The current LPDES permit established a daily maximum limitation of 50 mg/L. The limitation is based on BPJ in accordance with this

Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with a monitoring frequency of once per week by grab sample.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

Oil & Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and maximum discharge limit of 9.0 standard units for pH in accordance with 40 CFR 423.12(b)(1). These limitations are being retained with a monitoring frequency of once per week by grab sample.

<u>Outfall 601</u>

1. General Comments

   This outfall is the intermittent discharge from Auxiliary Component Cooling Water Basin B. Low volume wastewaters include, but are not limited to: auxiliary component cooling water, component cooling water, secondary plant water system wastewater, Mississippi River water used for flow testing, and stormwater.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	**LIMITATION**		**MONITORING REQUIREMENTS**	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow-mgd	---	Report	1/week	Estimate
TOC	---	50 mg/L	1/week	Grab
TSS	---	100 mg/L	1/week	Grab
Oil and Grease	---	20 mg/L	1/week	Grab
pH	6.0 s.u.	9.0 s.u.	1/week	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per week and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Organic Carbon - The current LPDES permit established a daily maximum limitation of 50 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with a monitoring frequency of once per week by grab sample.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

Oil & Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with a monitoring frequency of once per week by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and maximum discharge limit of 9.0 standard units for pH in accordance with 40 CFR 423.12 (b)(1). These limitations are being retained with a monitoring frequency of once per week by grab sample.

<u>Outfall 701</u>

1. General Comments

   This outfall is the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #1. Low volume wastewaters include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.)

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow	---	Report	1/month	Estimate
TOC	---	50 mg/L	1/quarter	Grab
TSS	---	100 mg/L	1/month	Grab
Oil and Grease	---	20 mg/L	1/month	Grab
Free Available Chlorine	---	0.5 mg/L	1/month	Grab
Total Chromium	---	0.2 mg/L	1/year	Grab
Total Zinc	---	1.0 mg/L	1/month	Grab
pH	6.0 s.u.	9.0 s.u.	1/month	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per month and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Organic Carbon - The current LPDES permit established a daily maximum limitation of 50 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with the same monitoring frequency of once per quarter by grab sample.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Free Available Chlorine - The current LPDES permit established a daily maximum limitation of 0.5 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Total Chromium - The current LPDES permit established a daily maximum of 0.2 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per year by grab sample.

Total Zinc - The current LPDES permit established a daily maximum of 1.0 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. These limits are based on 40 CFR 423.12(b)(1). These limitations are being retained with the same monitoring frequency of once per month by grab sample.

<u>Outfall 801</u>

1. General Comments

   This outfall is the intermittent discharge of cooling tower blowdown and low volume wastewaters from Dry Cooling Tower Sump #2. Low volume wastewater sources as defined in 40 CFR 423 include, but are not limited to: wet cooling tower leakage, auxiliary component cooling water, component cooling water, secondary plant water system wastewater, and stormwater. (NOTE: Optional discharge to plant drainage ditches thence to Outfall 004 may occur during periods when the circulating water system is unavailable.)

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow	---	Report	1/month	Estimate
TOC	---	50 mg/L	1/quarter	Grab
TSS	---	100 mg/L	1/month	Grab
Oil and Grease	---	20 mg/L	1/month	Grab
Free Available Chlorine	---	0.5 mg/L	1/month	Grab
Total Chromium	---	0.2 mg/L	1/year	Grab
Total Zinc	---	1.0 mg/L	1/month	Grab
pH	6.0 s.u.	9.0 s.u.	1/month	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per month and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Organic Carbon - The current LPDES permit established a daily maximum limitation of 50 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with the same monitoring frequency of once per quarter by grab sample.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Free Available Chlorine - The current LPDES permit established a daily maximum limitation of 0.5 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Total Chromium - The current LPDES permit established a monthly average of 0.2 mg/L and a daily maximum of 0.2 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per year by grab sample.

Total Zinc - The current LPDES permit established a daily maximum of 1.0 mg/L in accordance with 40 CFR 423.13(d)(1). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. These limits are based on 40 CFR 423.12(b)(1). These limitations are being retained with the same monitoring frequency of once per month by grab sample.

Outfall 901

1. General Comments

This outfall is the intermittent discharge of metal cleaning wastewaters (both chemical and non-chemical) from various plant equipment components including, but not limited to: the steam generator, cooling water heat exchangers, and piping.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow	---	Report	1/week	Estimate
TSS	---	100 mg/L	1/week	Grab
Oil and Grease	---	20 mg/L	1/week	Grab
Total Copper	---	1.0 mg/L	1/week	Grab
Total Iron	---	1.0 mg/L	1/week	Grab
pH	6.0 s.u.	9.0 s.u.	1/week	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per week and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per week by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per week by grab sample.

Total Copper- The current LPDES permit established a daily maximum limitation of 1.0 mg/L in accordance with 40 CFR 423.13(b)(5). This limitation is being retained with the same monitoring frequency of once per week by grab sample.

Total Iron - The current LPDES permit established a daily maximum of 1.0 mg/L in accordance with 40 CFR 423.13(b)(5). This limitation is being retained with the same monitoring frequency of once per week by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. These limits are based on 40 CFR 423.12(b)(1). These limitations are being retained with the same monitoring frequency of once per week by grab sample.

Outfall 1001

1. General Comments

This outfall is the intermittent discharge from the yard oil separator system. Wastewater includes auxiliary boiler blowdown, stormwater, and low volume wastewaters from various sources, including plant floor drains and discharge from the industrial waste system as defined in 40 CFR 423. Low volume wastewater sources include, but are not limited to: secondary water system drains, system leakage, auxiliary boiler sumps, turbine building equipment and floor drains, turbine building floor wash downs, and laboratory drains. (NOTE: Optional discharge to Final Outfall 004 may occur during maintenance periods and during rain events that compromise the capacity of the discharge pumps.)

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	**LIMITATION**		**MONITORING REQUIREMENTS**	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow	---	Report	1/month	Estimate
TSS	---	100 mg/L	1/month	Grab
Oil and Grease	---	20 mg/L	1/month	Grab
pH	6.0 s.u.	9.0 s.u.	1/month	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per month and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 20 mg/L in accordance with 40 CFR 423.12(b)(3). This limitation is being retained with the same monitoring frequency of once per month by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. These limits are based on 40 CFR 423.12(b)(1). These limitations are being retained with the same monitoring frequency of once per month by grab sample.

Outfall 004

1. General Comments

This outfall is the intermittent discharge from the plant drainage ditch system consisting of stormwater, potable water from the fire water system, maintenance wastewaters including, but not limited to: hydrostatic test water, air conditioning condensate, low volume wastewaters including, but not limited to: reverse osmosis reject water and demineralized water. The plant drainage ditch system receives discharges during maintenance from the Dry Cooling Tower Sump #1 (Internal Outfall 701), Dry Cooling Tower Sump #2 (Internal Outfall 801), and treated discharge from the yard oil separator system, including, but not limited to: plant floor drains and discharge from the industrial waste system (Internal Outfall 1001)

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	**LIMITATION**		**MONITORING REQUIREMENTS**	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow	---	Report	1/3 months	Estimate
TOC	---	50 mg/L	1/3 months	Grab
TSS	---	100 mg/L	1/3 months	Grab
Oil and Grease	---	15 mg/L	1/3 months	Grab
pH	6.0 s.u.	9.0 s.u.	1/3 months	Grab

Flow - The current LPDES permit established a reporting requirement for daily maximum flow. This requirement is being retained with a measurement frequency of once per three months and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Total Organic Carbon - The current LPDES permit established a daily maximum limitation of 50 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with the same monitoring frequency of once per three months by grab sample.

Total Suspended Solids - The current LPDES permit established a daily maximum limitation of 100 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with the same monitoring frequency of once per three months by grab sample.

Oil and Grease - The current LPDES permit established a daily maximum limitation of 15 mg/L. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. This limitation is being retained with the same monitoring frequency of once per three months by grab sample.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. The limitation is based on BPJ in accordance with this Office's guidance on stormwater, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6)and the LPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities, LAR050000, effective on May 1, 2006. These limitations are being retained with the same monitoring frequency of once per three months by grab sample.

Outfall 005

1. General Comments

This outfall is the intermittent discharge of treated sanitary wastewater and a *de minimis* discharge from the HVAC unit from the Entergy Energy Education Center.

2. Effluent Limitation, Monitoring Frequencies, and Sample Types

EFFLUENT CHARACTERISTIC	LIMITATION		MONITORING REQUIREMENTS	
	Monthly Average	**Daily Maximum**	**Measurement Frequency**	**Sample Type**
Flow	---	Report	1/6 months	Estimate
BOD_5	30 mg/L	45 mg/L	1/6 months	Grab
TSS	30 mg/L	45 mg/L	1/6 months	Grab
Fecal Coliform	200 col/100 mL	400 col/100 mL	1/6 months	Grab
pH	6.0 s.u.	9.0 s.u.	1/6 months	Grab

Flow - The current LPDES permit established a reporting requirement for weekly average flow. This requirement is being retained with a measurement frequency of once per six months and a sample type of estimate. This requirement is consistent with LAC33:IX.2707.I.1.b.

Biological Oxygen Demand - The current LPDES permit established a weekly average limitation of 45 mg/L. This limitation is changed to a daily maximum limitation. The same monitoring frequency of once per six months by grab sample is being retained. In addition, a monthly average limitation of 30 mg/L with a monitoring frequency of once per six months by grab sample is being proposed. These limitations are based on the Class I Sanitary General Discharge Permit, LAG530000.

Total Suspended Solids - The current LPDES permit established a weekly average limitation of 45 mg/L. This limitation is changed to a daily maximum limitation. The same monitoring frequency of once per six months by grab sample is being retained. In addition, a monthly average limitation of 30 mg/L with a monitoring frequency of once per six months by grab sample is being proposed. These limitations are based on the Class I Sanitary General Discharge Permit, LAG530000.

Fecal Coliform - The current LPDES permit established a daily weekly average limitation of 400 colonies per 100 mL. This limitation is changed to a daily maximum limitation. The same monitoring frequency of once per six months by grab sample is being retained. In addition, a monthly average limitation of 200 colonies per mL with a monitoring frequency of once per six months by grab sample is being proposed. These limitations are based on the Class I Sanitary General Discharge Permit, LAG530000.

pH - The current LPDES permit established a minimum discharge limit of 6.0 standard units and a maximum discharge limit of 9.0 standard units for pH. These limitations are based on the Class I Sanitary General Discharge Permit, LAG530000.These limitations are being retained with the same monitoring frequency of once per three months by grab sample.

Part II Specific Conditions

PROHIBITION OF PCB DISCHARGES

There shall be no discharge of polychlorinated biphenyls (PCB's). The minimum quantification level for PCB's is 1.0 μg/L. If any individual analytical test result for PCB's is less than the minimum quantification level, then a value of zero(0) shall be used for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

PROHIBITION OF 126 PRIORITY POLLUTANTS

There shall be no discharge of any 126 priority pollutants (40 CFR 423 Appendix A) associated with the chemicals added for cooling tower maintenance, except total chromium and total zinc. The minimum quantification levels for the 126 priority pollutants are found in Part II, Paragraph I.

CHEMICAL METAL CLEANING WASTE

The term chemical metal cleaning waste means any wastewater resulting from cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning.

METAL CLEANING WASTE

The term metal cleaning waste means any wastewater resulting from cleaning (with or without chemical cleaning compounds) any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

LOW VOLUME WASTE SOURCES

The term "low volume waste sources" means, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established. Low volume waste sources include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastewaters are not included.

TOTAL RESIDUAL CHLORINE

The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in 40 CFR Part 136.

Total residual chlorine may not be discharged from any unit for more than two hours per day.

Simultaneous multi-unit chlorination is permitted.

FREE AVAILABLE CHLORINE

The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in the latest edition of Standard Methods for the Examination of Water and Wastewater.

Free available chlorine may not be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available chlorine at any one time.

TEMPERATURE

Daily temperature discharge is defined as the flow-weighted average (FWAT) and, on a daily basis, shall be monitored and recorded in accordance with Part I of this permit. FWAT shall be calculated at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

FWAT = SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)
SUMMATION (INSTANTANEOUS FLOW)

"Daily average temperature" (also known as average monthly or maximum 30 day value) shall be the arithmetic average of all FWATs calculated during the calendar month.

"Daily maximum temperature" (also known as the maximum daily value) shall be the highest FWAT calculated during the calendar month.

HEAT

Discharge of heat shall be continuously calculated and recorded as:

[Instantaneous T (circulating water temperature rise through the plant in F)] X [Instantaneous flow rate in MGD] X [3.48X105]

OR AS

[Heat transferred to the turbine generator cycle (BTU/hour)] - [Gross electrical output (BTU/hour)].

NON-RADIOACTIVE WASTEWATERS

Certain low volume and chemical wastewaters from this facility with no detectable radioactivity, as defined by the Nuclear Regulatory Commission plant effluent release limits may be commingled and treated with similar wastewaters from Waterford 1 & 2 and controlled under terms of LPDES Permit Number LA0007439.

WATER TREATMENT CLARIFIER SLUDGE WASTES

Water treatment clarifier sludge wastes may be returned to the stream without treatment if not previously combined with any other untreated waste source, including demineralizer and softener wastes.

ZEBRA MUSSEL TREATMENT

The terms and conditions of the zebra mussel treatment program submitted by Entergy Operations, Inc., Waterford 3 and approved by this Office on June 23, 1998, shall be enforceable as if part of this permit.

According to section 3.d., "Samples and Composites", of the biomonitoring requirements paragraph of this permit, the permittee must collect composite samples that "are representative of any periodic episodes of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis". Anytime the treatment method involves an increase in the concentration of a treatment chemical, a change in type of treatment chemical used, or if any event occurs that creates the potential for an effluent with a higher toxic nature, additional biomonitoring according to the terms and conditions of the biomonitoring section of Part II of this permit shall be required.

The permittee must notify this Office if changes occur in the zebra mussel control plan and obtain approval prior to initiating the new treatment. If chlorine is applied to control zebra mussels, the permittee must comply with a daily maximum Total Residual Chlorine (TRC) concentration limit of 0.2 mg/L. Monitoring shall be performed at a frequency of 1/day, by grab sample, during periods of chlorine application.

PERMIT REOPENER CLAUSE

This permit may be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitations issued or approved under sections 301(b)(2) and (D); 304(b)(2); and 307(a)(2) of the Clean Water Act, or more stringent discharge limitations and/or additional restrictions in the future to maintain the water quality integrity and the designated uses of the receiving water bodies based upon additional water quality studies and/or TMDL's, if the effluent standard, limitations, water quality studies or TMDL's so issued or approved:

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or

2. Controls any pollutant not limited in the permit; or

3. Require reassessment due to change in 303(d) status of waterbody; or

4. Incorporates the results of any total maximum daily load allocation, which may be approved for the receiving water body.

The Louisiana Department of Environmental Quality (LDEQ) reserves the right to modify or revoke and reissue this permit based upon any changes to established TMDL's for this discharge, or to accommodate for pollutant trading provisions in approved TMDL watersheds as necessary to achieve compliance with water quality standards. Therefore, prior to upgrading or expanding this facility, the permittee should contact the Department to determine the status of the work being done to establish future effluent limitations and additional permit conditions.

316(b) PHASE II RULE REQUIREMENTS

- July 6, 2004, EPA promulgated 'Phase II' regulations in accordance with section 316(b) of the Clean Water Act (CWA).
- January 25, 2007, the Second U.S. Circuit Court of Appeals remanded several provisions of the Phase II rule.
- March 20, 2007, EPA issued a memo saying, "the rule should be considered suspended".
- July 9, 2007, Federal Register notice suspending all parts of the Phase II regulations except 40 CFR 125.90(b) [LAC 33:IX.4731.B]

According to EPA, 316(b) 'Phase II' regulations are under complete reconsideration at this time. LAC 33:IX.4731.B provides for regulating the cooling water intake structure (CWIS) for existing facilities on a case-by-case basis using best professional judgment.

This facility was issued a number of previous NPDES and/or LPDES permits and has been withdrawing once-through, non-contact cooling water without any identified problems. LDEQ has no information which either identifies or verifies any past or current adverse environmental impacts associated with the withdrawal of the applicable cooling water. The facility is located in the main channel of the Mississippi River at River Mile 129.5 on the west descending bank. The intake structure extends out 162 feet from the bank and is equipped with a skimmer wall as to prevent debris and surface swimming organisms from entering the CWIS. The offshore location of the CWIS minimizes fish and shellfish from entering the system as the conditions of the Mississippi River (i.e., high velocity, increased debris, shifting river bed, lack of habitat/vegetation, and reduction of food source) at the location of the intake structure are not easily tolerated. LDEQ has made the determination that this CWIS represents the best technology available. This determination is based on current information available and will be re-evaluated either upon promulgation of revised 316(b) Phase II regulations or upon evaluation of the environmental impacts of their CWIS as described below. The revised 316(b) Phase II regulation will supersede any requirements contained in the applicable permit.

A permit modification, effective January 10, 2008, required Entergy Operations, Inc. to characterize the fish/shellfish in the vicinity of the CWIS and assess impingement mortality and entrainment (IM&E). The assessment results were received by LDEQ on July 10, 2008 (EDMS document 37109798). In this permit, LDEQ will require an assessment of the cooling water system as described in the following paragraphs:

The permittee shall comply with effective regulations promulgated in accordance with section 316(b) of the CWA for cooling water intake structures. The permittee shall submit the cooling water system assessment results to LDEQ no later than four (4) years from the effective date of this permit. Based on the information submitted to LDEQ, the permit may be reopened to incorporate limitations and/or requirements for the CWIS.

The assessment of the cooling water system must include the following:

> An assessment of the cooling water system which includes a discussion or description of how structural or operational actions currently in place reduce adverse environmental impacts caused by your CWIS, and a discussion of additional structural or operational actions, if any, that have been reviewed or evaluated as possible measures to further reduce environmental impacts caused by your CWIS.

<u>STORMWATER POLLUTION PREVENTION PLAN (SWPPP3) REQUIREMENT</u>

In accordance with LAC 33:IX.2707.I.3 and 4, a Part II condition is proposed for applicability to all stormwater discharges from the facility, either through permitted outfalls or through outfalls which are not listed in the permit or as sheetflow. **For first time permit issuance,** the Part II condition requires a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. **For renewal permit issuance,** the Part II condition requires that the Storm Water Pollution Prevention Plan (SWP3) be reviewed and updated, if necessary, within six (6) months of the effective date of the final permit. If the permittee maintains other plans that contain duplicative information, those plans could be incorporated by reference to the SWP3. Examples of these type plans include, but are not limited to: Spill Prevention Control and Countermeasures Plan (SPCC), Best Management Plan (BMP), Response Plans, etc. The conditions will be found in the draft permit. Including Best Management Practice (BMP) controls in the form of a SWP3 is consistent with other LPDES and EPA permits regulating similar discharges of stormwater associated with industrial activity, as defined in LAC 33:IX.2522.B.14 [40 CFR 122.26(b)(14)].

12. Compliance History/DMR Review:

A. Inspections: There was an inspection at the facility on November 25, 2008. All areas evaluated were found to be satisfactory. (EDMS

Doc No. 39933315)

B. Enforcement Actions (COs, NOVs, Warning Letters, etc.): N/A

EPA has does not have Enforcement Authority of this facility.

C. DMRs: A DMR review was retrieved from ICIS. No excursions were found for the last 3 years. All DMR's were submitted in accordance with the existing permit.

D. Company Compliance History: An email was sent to Office of Environmental Compliance on May 19, 2010, for a list of open enforcement actions for this facility. To date, there has been no response.

E. Permit Actions Taken: N/A

Please be aware that the Department has the authority to reduce monitoring frequencies when a permittee demonstrates two or more consecutive years of permit compliance. Monitoring frequencies established in LPDES permits are based on a number of factors, including but not limited to, the size of the discharge, the type of wastewater being discharged, the specific operations at the facility, past compliance history, similar facilities and best professional judgment of the reviewer. We encourage and invite each permittee to institute positive measures to ensure continued compliance with the LPDES permit, thereby qualifying for reduced monitoring frequencies upon permit reissuance. As a reminder, the Department will also consider an increase in monitoring frequency upon permit reissuance when the permittee demonstrates continued non-compliance.

13. Water Quality Consideratons:

Subsegment 070301 is not listed on LDEQ's Final 2006 303(d) List as impaired, and to date no TMDL's have been established.

Subsegment 020202 is listed on LDEQ's Final 2006 303(d) List as impaired for dissolved oxygen. To date no TMDLs have been completed for this waterbody. A reopener clause will be established in the permit to allow for the requirement of more stringent effluent limitations and requirements as imposed by a TMDL. Until completion of TMDLs for the Barataria Basin, those suspected causes for impairment which are not directly attributed to the steam electric generating station point source category have been eliminated in the formulation of effluent limitations and other requirements of this permit. Additionally, suspected causes of impairment which could be attributed to pollutants which were not determined to be discharged at a level which would cause, have the reasonable potential to cause or contribute to an excursion above any present state water quality standard were also eliminated.

Based on the evaluation of the discharges from this facility, it was determined that the facility has the potential to discharge pollutants which may contribute to the dissolved oxygen impairment of the receiving waterbody. However, compliance with the limitations established in the permit should not result in the discharge of pollutant concentrations which would cause or contribute to the further impairment of water quality standards.

14. **Endangered Species:**

The receiving waterbody, Subsegment 070301 of the Mississippi River Basin, has been identified by the U.S. Fish and Wildlife Service (FWS) as habitat for the Pallid Sturgeon, which is listed as threatened and/or endangered species. This draft permit has been submitted to the FWS for review in accordance with a letter dated January 5, 2010, from Rieck (FWS) to Nolan (LDEQ). As set forth in the Memorandum of Understanding between the LDEQ and the FWS, and after consultation with FWS, LDEQ has determined that the issuance of the LPDES permit is not likely to have an adverse effect upon the Pallid Sturgeon. The effluent limitations established in the permit ensure protection of aquatic life and maintenance of the receiving water as aquatic habitat. Therefore, the issuance of the LPDES permit is not likely to have an adverse effect on any endangered or candidate species or the critical habitat.

The receiving waterbody, Subsegment 020202 of the Barataria Basin is not listed in Section II.2 of the Implementation Strategy as requiring consultation with the U.S. Fish and Wildlife Service (FWS). This strategy was submitted with a letter dated January 5, 2010 from Rieck (FWS) to Nolan (LDEQ). Therefore, in accordance with the Memorandum of Understanding between the LDEQ and the FWS, no further informal (Section 7, Endangered Species Act) consultation is required. The effluent limitations established in the permit ensure protection of aquatic life and maintenance of the receiving water as aquatic habitat. Therefore, the issuance of the LPDES permit is not likely to have an adverse effect on any endangered or candidate species or the critical habitat.

15. Historic Sites:

The discharge is from an existing facility location, which does not include an expansion on undisturbed soils. Therefore, there should be no potential effect to sites or properties on or eligible for listing on the National Register of Historic Places, and in accordance with the "Memorandum of Understanding for the Protection of Historic Properties in Louisiana Regarding LPDES Permits" no consultation with the Louisiana State Historic Preservation Officer is required.

16. Tentative Determination:

On the basis of preliminary staff review, the Department of Environmental Quality has made a tentative determination to reissue a permit for the discharge described in the application.

17. Public Notices:

Upon publication of the public notice, a public comment period shall begin on the date of publication and last for at least 30 days thereafter. During this period, any interested persons may submit written comments on the draft permit and may request a public hearing to clarify issues involved in the permit decision at this Office's address on the first page of the fact. A request for a public hearing shall be in writing and shall state the nature of the issues proposed to be raised in the hearing.

Public notice published in:

Local newspaper of general circulation

Office of Environmental Services Public Notice Mailing List

Appendix A
Biomonitoring Recommendation

BIOMONITORING FREQUENCY RECOMMENDATION AND RATIONALE FOR ADDITIONAL REQUIREMENTS

Permit Number: **LA0007374**
Facility Name: **Entergy Operations, Inc./Waterford 3 Steam Electric Station**
Previous Critical Biomonitoring Dilution: **46% (10:1 ACR)**
Proposed Critical Biomonitoring Dilution: **31% (10:1 ACR)**
Outfall Discharge Flow: **994 MGD**
Receiving stream 7Q10: **141,955 cfs**
Date of Review: **01/15/10**
Name of Reviewer: **Laura Thompson**

Recommended Frequency by Species:

***Pimephales promelas* (Fathead minnow):** **Once/Quarter**[1]
***Daphnia pulex* (water flea):** **Once/Quarter**[1]

Recommended Dilution Series: **13%, 18%, 24%, 31%, and 42%**

Number of Tests Performed during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **11**
***Daphnia pulex* (water flea):** **11**
***Ceriodaphnia dubia* (water flea):** **N/A – Testing of species was not required**

Number of Failed Tests during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **No failures on file during the past 5 years**
***Daphnia pulex* (water flea):** **No failures on file during the past 5 years**
***Ceriodaphnia dubia* (water flea):** **N/A – Testing of species was not required**

Failed Test Dates during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **No failures on file during the past 5 years**
***Daphnia pulex* (water flea):** **No failures on file during the past 5 years**
***Ceriodaphnia dubia* (water flea):** **N/A – Testing of species was not required**

Previous TRE Activities: **N/A – No previous TRE Activities**

[1] If there are no lethal effects demonstrated after the first year of quarterly testing, the permittee may certify fulfillment of the WET testing requirements in writing to the permitting authority. If granted, the biomonitoring frequency for the test species may be reduced to not less than once per year for the less sensitive species (usually *Pimephales promelas*) and not less than twice per year for the more sensitive species (usually *Daphnia pulex*). Upon expiration of the permit, the biomonitoring frequency for both species shall revert to once per quarter until the permit is re-issued.

Additional Requirements (including WET Limits) Rationale / Comments Concerning Permitting:

Entergy Operations, Inc./Waterford 3 Steam Electric Station owns and operates a steam electric generating facility in Killona, St. Charles Parish, Louisiana. LPDES Permit LA0007374, effective February 1, 2003, contained acute freshwater biomonitoring as an effluent characteristic of Outfall 001 for *Pimephales promelas* and *Daphnia pulex*. The effluent series consisted of 19%, 26%, 34%, 46%, and 61% concentrations, with 46% being defined as the critical biomonitoring dilution. Testing was to be performed quarterly for both *Pimephales promelas* and *Daphnia pulex*. Data on file indicate that the permittee has complied with the biomonitoring requirements contained in LA0007374 with no toxicity failures in the last five years.

It is recommended that freshwater acute biomonitoring be an effluent characteristic of Outfall 001 (continuous discharge of 994 mgd of once through non-contact cooling water, and previously monitored intermittent discharges including but not limited to steam generator blowdown, cooling tower blowdown, metal cleaning wastewater, low volume wastewater, and stormwater) in LA0007374. The effluent biomonitoring dilution series shall be 13%, 18%, 24%, 31%, and 42% concentrations, with the 31% effluent concentration being defined as the critical biomonitoring dilution (the 10:1 Acute-to-Chronic ratio has been implemented). In accordance with the Environmental Protection Agency (Region 6) WET testing frequency acceleration(s), the biomonitoring frequency shall be once per quarter for *Daphnia pulex* and *Pimephales promelas*. If there are no significant lethal effects demonstrated at or below the critical biomonitoring dilution during the first four quarters of testing, the permittee may certify fulfillment of the WET testing requirements to the permitting authority and WET testing may be reduced to not less than once per six months for the more sensitive species (usually *Daphnia pulex*) and not less than once per year for the less sensitive species (usually *Pimephales promelas*) for the remainder of the term of the permit. Upon expiration of the permit, the biomonitoring frequency for both test species shall revert to once per quarter until the permit is re-issued.

This recommendation is in accordance with the LDEQ/OES Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, Water Quality Management Plan Volume 3. Version 6 (April 16, 2008), and the Best Professional Judgment (BPJ) of the reviewer.

Appendix B
Water Quality Calculations & Explanations

Developer: Bruce Fielding Time: 02:48 PM

Software: Lotus 4.0 LA0007374, AI35260

Revision date: 08/07/08

Water Quality Screen for Entergy Operations, Inc./Waterford 3

Input variables:

Receiving Water Characteristics:	
Receiving Water Name=	Mississippi River
Critical flow (Qr) cfs=	141955
Harm. mean/avg tidal cfs=	366748
Drinking Water=1 HHNPCR=2	1
MW=1, BW=2, 0=n	
Rec. Water Hardness=	153.4
Rec. Water TSS=	32
Fisch/Specific=1,Stream=0	
Diffuser Ratio=	

Effluent Characteristics:	
Permittee=	Entergy Operations, Inc./Waterford 3
Permit Number=	LA0007374, AI35260
Facility flow (Qef),MGD=	994
Outfall Number =	001
Eff. data, 2=lbs/day	2
MQL, 2=lbs/day	1
Effluent Hardness=	N/A
Effluent TSS=	N/A
WQBL ind. 0=y, 1=n	
Acute/Chr. ratio 0=n, 1=y	1
Aquatic,acute only1=y,0=n	

Page Numbering/Labeling	
Appendix	Appendix B-1
Page Numbers 1=y, 0=n	1
Input Page # 1=y, 0=n	1

Fischer/Site Specific inputs:	
Pipe=1,Canal=2,Specific=3	
Pipe width, feet	
ZID plume dist., feet	
MZ plume dist., feet	
HHnc plume dist., feet	
HHc plume dist., feet	

Fischer/site specific dilutions:	
·ilution =	---
F/specific MZ Dilution =	---
F/specific HHnc Dilution=	---
F/specific HHc Dilution=	---

Dilution:	
ZID Fs =	0.033333
MZ Fs =	0.333333
Critical Qr (MGD)=	91745.52
Harm. Mean (MGD)=	237029.2
ZID Dilution =	0.2453
MZ Dilution =	0.03148
HHnc Dilution=	0.010718
HHc Dilution=	0.004176
ZID Upstream =	3.076644
MZ Upstream =	30.76644
MZhhnc Upstream=	92.29931
MZhhc Upstream=	238.46
ZID Hardness=	---
MZ Hardness=	---
ZID TSS=	---
MZ TSS=	---

Multipliers:	
WLAa --> LTAa	0.32
WLAc --> LTAc	0.53
LTA a,c-->WQBL avg	1.31
LTA a,c-->WQBL max	3.11
LTA h --> WQBL max	2.38
WQBL-limit/report	2.13
WLA Fraction	1
WQBL Fraction	1

Conversions:	
ug/L-->lbs/day Qef	8.28996
ug/L-->lbs/day Qeo	0
ug/L-->lbs/day Qr	1183.905
lbs/day-->ug/L Qeo	0.120628
lbs/day-->ug/L Qef	0.120628
diss-->tot 1=y0=n	1
Cu diss->tot1=y0=n	1
cfs-->MGD	0.6463

Receiving Stream:	
Default Hardness=	25
Default TSS=	10
99 Crit., 1=y, 0=n	1

Toxicity Dilution Series:	
Biomonitoring dilution:	0.314798
Dilution Series Factor:	0.75
	Percent Effluent
Dilution No. 1	41.973%
Dilution No. 2	31.4798%
Dilution No. 3	23.6098%
Dilution No. 4	17.7074%
Dilution No. 5	13.2805%

Partition Coefficients; Dissolved-->Total

METALS	FW
Total Arsenic	2.223578
Total Cadmium	3.549121
Chromium III	5.282524
Chromium VI	1
Total Copper	3.56078
Total Lead	6.6
Total Mercury	2.785159
Total Nickel	3.174756
Total Zinc	4.535534

Aquatic Life, Dissolved
Metal Criteria, ug/L

METALS	ACUTE	CHRONIC
Arsenic	339.8	150
Cadmium	50.5572	1.414322
Chromium III	779.0334	252.7104
Chromium VI	15.712	10.582
Copper	27.5752	17.70626
Lead	102.5669	3.996886
Mercury	1.734	0.012
Nickel	2032.775	225.756
Zinc	164.4582	150.1753

Site Specific Multiplier Values:	
CV =	---
N =	---
WLAa --> LTAa	---
WLAc --> LTAc	---
LTA a,c-->WQBL avg	---
LTA a,c-->WQBL max	---
LTA h --> WQBL max	---

(*1) Toxic Parameters	(*2) Cu Instream Conc. ug/L	(*3) Effluent /Tech (Avg) lbs/day	(*4) Effluent /Tech (Max) lbs/day	(*5) MQL ug/L	(*6) Effluent 1=No 95% 0=95 %	(*7) 95th % estimate Non-Tech lbs/day	(*8) Numerical Criteria Acute FW ug/L	(*9) Numerical Criteria Chronic FW ug/L	(*10) Numerical Criteria HHDW ug/L	(*11) HH Carcinogen Indicator "C"
NONCONVENTIONAL										
Total Phenols (4AAP)				5			700	350	5	
3-Chlorophenol				10					0.1	
4-Chlorophenol				10			383	192	0.1	
2,3-Dichlorophenol				10					0.04	
2,5-Dichlorophenol				10					0.5	
2,6-Dichlorophenol				10					0.2	
3,4-Dichlorophenol				10					0.3	
2,4-Dichlorophenocy-acetic acid (2,4-D)				---					100	
2-(2,4,5-Trichlorophen-oxy) propionic acid (2,4,5-TP, Silvex)				---					10	
METALS AND CYANIDE										
Total Arsenic				10			755.5719	333.5367	111.1789	
Total Cadmium				1			179.4336	5.019602	35.49121	
Chromium III				10			4115.263	1334.949	264.1262	
Chromium VI				10			15.712	10.582	50	C
Total Copper				10			98.18922	63.04811	3560.78	
Total Lead				5			676.9417	26.37945	330	
Total Mercury				0.2			4.829466	0.033422	5.570319	
Total Nickel				40			6453.566	716.7203		
Total Zinc				20			745.906	681.1252	22677.67	
Total Cyanide				20			45.9	5.4	663.8	
DIOXIN										
2,3,7,8 TCDD; dioxin				1.0E-05					7.1E-07	C
VOLATILE COMPOUNDS										
Benzene				10			2249	1125	1.1	C
Bromoform				10			2930	1465	3.9	C
Bromodichloromethane				10					0.2	C
Carbon Tetrachloride				10			2730	1365	0.22	C
Chloroform				10			2890	1445	5.3	C
Dibromochloromethane				10					0.39	C
1,2-Dichloroethane				10			11800	5900	0.36	C
1,1-Dichloroethylene				10			1160	580	0.05	C
1,3-Dichloropropylene				10			606	303	9.86	
Ethylbenzene				10			3200	1600	2390	
Methyl Chloride				50			55000	27500		
Methylene Chloride				20			19300	9650	4.4	C
1,1,2,2-Tetrachloro-ethane				10			932	466	0.16	C

(*1) Toxic Parameters	(*12) WLAa Acute ug/L	(*13) WLAc Chronic ug/L	(*14) WLAh HHDW ug/L	(*15) LTAa Acute ug/L	(*16) LTAc Chronic ug/L	(*17) LTAh HHDW ug/L	(*18) Limiting A,C,HH ug/L	(*19) WQBL Avg 001 ug/L	(*20) WQBL Max 001 ug/L	(*21) WQBL Avg 001 lbs/day	(*22) WQBL Max 001 lbs/day	(*23) Need WQBL?
NONCONVENTIONAL												
Total Phenols (4AAP)	2853.6506	11118.253	466.49656	913.1682	5892.6741	466.49656	466.49656	466.49656	1110.2618	3867.2378	9204.0261	no
3-Chlorophenol	---	---	9.3299312	---	---	9.3299312	9.3299312	9.3299312	22.205236	77.344757	184.08052	no
4-Chlorophenol	1561.3546	6099.156	9.3299312	499.63346	3232.5527	9.3299312	9.3299312	9.3299312	22.205236	77.344757	184.08052	no
2,3-Dichlorophenol	---	---	3.7319725	---	---	3.7319725	3.7319725	3.7319725	8.8820945	30.937903	73.632208	no
2,5-Dichlorophenol	---	---	46.649656	---	---	46.649656	46.649656	46.649656	111.02618	386.72378	920.40261	no
2,6-Dichlorophenol	---	---	18.659862	---	---	18.659862	18.659862	18.659862	44.410473	154.68951	368.16104	no
3,4-Dichlorophenol	---	---	27.989794	---	---	27.989794	27.989794	27.989794	66.615709	232.03427	552.24156	no
2,4-Dichlorophenocy-acetic acid (2,4-D)	---	---	9329.9312	---	---	9329.9312	9329.9312	9329.9312	22205.236	77344.757	184080.52	no
2-(2,4,5-Trichlorophen-oxy) propionic acid (2,4,5-TP, Silvex)	---	---	932.99312	---	---	932.99312	932.99312	932.99312	2220.5236	7734.4757	18408.052	no
METALS AND CYANIDE												
Total Arsenic	3080.1974	10595.274	10372.916	985.66315	5615.4951	10372.916	985.66315	1291.2187	3065.4124	10704.152	25412.146	no
Total Cadmium	731.48697	159.45487	3311.3057	234.07583	84.51108	3311.3057	84.51108	110.70951	262.82946	917.77745	2178.8457	no
Chromium III	16776.46	42406.563	24642.791	5368.4671	22475.478	24642.791	5368.4671	7032.6919	16695.933	58300.734	138408.61	no
Chromium VI	64.052227	336.15244	11973	20.496712	178.16079	11973	20.496712	26.850693	63.744776	222.59117	528.44164	no
Total Copper	400.28246	2002.8137	332218.36	128.09039	1061.4913	332218.36	128.09039	167.79841	398.3611	1391.0421	3302.3976	no
Total Lead	2759.6501	837.981	30788.773	883.08802	444.12993	30788.773	444.12993	581.81021	1381.2441	4823.1834	11450.458	no
Total Mercury	19.688014	1.0616951	519.70691	6.3001645	0.5626984	519.70691	0.5626984	0.7371349	1.749992	6.1108189	14.507364	no
Total Nickel	26308.891	22767.651	---	8418.8452	12066.855	---	8418.8452	11028.687	26182.608	91427.375	217052.78	no
Total Zinc	3040.7928	21636.923	2115811	973.05371	11467.569	2115811	973.05371	1274.7004	3026.197	10567.215	25087.052	no
Total Cyanide	187.11795	171.53876	61932.084	59.877743	90.915544	61932.084	59.877743	78.439844	186.21978	650.26317	1543.7545	no
DIOXIN												
2,3,7,8 TCDD; dioxin	---	---	0.00017	---	---	0.00017	0.00017	0.00017	0.0004046	0.0014094	0.0033544	no
VOLATILE COMPOUNDS												
Benzene	9168.3718	35737.242	263.40599	2933.879	18940.738	263.40599	263.40599	263.40599	626.90626	2183.6251	5197.0278	no
Bromoform	11944.566	46537.831	933.89397	3822.2612	24665.05	933.89397	933.89397	933.89397	2222.6676	7741.9437	18425.826	no
Bromodichloromethane	---	---	47.891998	---	---	47.891998	47.891998	47.891998	113.98296	397.02275	944.91415	no
Carbon Tetrachloride	11129.237	43361.187	52.681198	3561.356	22981.429	52.681198	52.681198	52.681198	125.38125	436.72503	1039.4056	no
Chloroform	11781.5	45902.502	1269.138	3770.0801	24328.326	1269.138	1269.138	1269.138	3020.5483	10521.103	25040.225	no
Dibromochloromethane	---	---	93.389397	---	---	93.389397	93.389397	93.389397	222.26676	774.19437	1842.5826	no
1,2-Dichloroethane	48104.396	187421.98	86.205597	15393.407	99333.65	86.205597	86.205597	86.205597	205.16932	714.64095	1700.8455	no
1,1-Dichloroethylene	4728.9067	18424.534	11.973	1513.2502	9765.0029	11.973	11.973	11.973	28.495739	99.255688	236.22854	no
1,3-Dichloropropylene	2470.4461	9625.2305	919.93122	790.54276	5101.3722	919.93122	790.54276	1035.611	2458.588	8585.1738	20381.596	no
Ethylbenzene	13045.26	50826.3	222985.36	4174.4832	26937.939	222985.36	4174.4832	5468.573	12982.643	45334.251	107625.59	no
Methyl Chloride	224215.41	873577.03	---	71748.93	462995.83	---	71748.93	93991.098	223139.17	779182.44	1849814.8	no
Methylene Chloride	78679.224	306546.12	1053.624	25177.352	162469.44	1053.624	1053.624	1053.624	2507.625	8734.5005	20788.111	no
1,1,2,2-Tetrachloro-ethane	3799.432	14803.16	38.313599	1215.8182	7845.6747	38.313599	38.313599	38.313599	91.186365	317.6182	755.93132	no

(*1)	(*2)	(*3)	(*4)	(*5)	(*6)	(*7)	(*8)	(*9)	(*10)	(*11)
Toxic	Cu	Effluent	Effluent	MQL	Effluent	95th %	Numerical Criteria			HH
Parameters	Instream	/Tech	/Tech		1=No 95%	estimate	Acute	Chronic	HHDW	Carcinogen
	Conc.	(Avg)	(Max)		0=95 %	Non-Tech	FW	FW		Indicator
	ug/L	lbs/day	lbs/day	ug/L		lbs/day	ug/L	ug/L	ug/L	"C"
VOLATILE COMPOUNDS (cont'd)										
Tetrachloroethylene				10			1290	645	0.65	C
Toluene				10			1270	635	6100	
1,1,1-Trichloroethane				10			5280	2640	200	
1,1,2-Trichloroethane				10			1800	900	0.56	C
Trichloroethylene				10			3900	1950	2.8	C
Vinyl Chloride				10					1.9	C
ACID COMPOUNDS										
2-Chlorophenol				10			258	129	0.1	
2,4-Dichlorophenol				10			202	101	0.3	
BASE NEUTRAL COMPOUNDS										
Benzidine				50			250	125	0.00008	C
Hexachlorobenzene				10					0.00025	C
Hexachlorabutadiene				10			5.1	1.02	0.09	C
PESTICIDES										
Aldrin				0.05			3		0.00004	C
Hexachlorocyclohexane (gamma BHC, Lindane)				0.05			5.3	0.21	0.11	C
Chlordane				0.2			2.4	0.0043	0.00019	C
4,4'-DDT				0.1			1.1	0.001	0.00019	C
4,4'-DDE				0.1			52.5	10.5	0.00019	C
4,4'-DDD				0.1			0.03	0.006	0.00027	C
Dieldrin				0.1			0.2374	0.0557	0.00005	C
Endosulfan				0.1			0.22	0.056	0.47	
Endrin				0.1			0.0864	0.0375	0.26	
Heptachlor				0.05			0.52	0.0038	0.00007	C
							2	0.014		
Toxaphene				5			0.73	0.0002	0.00024	C
Other Parameters:										
Fecal Col.(col/100ml)										
Chlorine							19	11		
Ammonia										
Chlorides										
Sulfates										
TDS										

Entergy Operations, Inc./Waterford 3

LA0007374, AI35260

(*1) Toxic Parameters	(*12) WLAa Acute ug/L	(*13) WLAc Chronic ug/L	(*14) WLAh HHDW ug/L	(*15) LTAa Acute ug/L	(*16) LTAc Chronic ug/L	(*17) LTAh HHDW ug/L	(*18) Limiting A,C,HH ug/L	(*19) WQBL Avg 001 ug/L	(*20) WQBL Max 001 ug/L	(*21) WQBL Avg 001 lbs/day	(*22) WQBL Max 001 lbs/day	(*23) Need WQBL?
Tetrachloroethylene	5258.8704	20489.352	155.649	1682.8385	10859.357	155.649	155.649	155.649	370.44461	1290.3239	3070.971	no
Toluene	5177.3376	20171.688	569125.81	1656.748	10690.995	569125.81	1656.748	2170.3399	5152.4863	17992.031	42713.906	no
1,1,1-Trichloroethane	21524.679	83863.395	18659.862	6887.8973	44447.599	18659.862	6887.8973	9023.1454	21421.361	74801.515	177582.22	no
1,1,2-Trichloroethane	7337.9587	28589.794	134.0976	2348.1468	15152.591	134.0976	134.0976	134.0976	319.15228	1111.6637	2645.7596	no
Trichloroethylene	15898.911	61944.553	670.48798	5087.6514	32830.613	670.48798	670.48798	670.48798	1595.7614	5558.3185	13228.798	no
Vinyl Chloride	---	---	454.97399	---	---	454.97399	454.97399	454.97399	1082.8381	3771.7161	8976.6844	no
ACID COMPOUNDS												
2-Chlorophenol	1051.7741	4097.8704	9.3299312	336.56771	2171.8713	9.3299312	9.3299312	9.3299312	22.205236	77.344757	184.08052	no
2,4-Dichlorophenol	823.48204	3208.4102	27.989794	263.51425	1700.4574	27.989794	27.989794	27.989794	66.615709	232.03427	552.24156	no
BASE NEUTRAL COMPOUNDS												
Benzidine	1019.1609	3970.8047	0.0191568	326.1315	2104.5265	0.0191568	0.0191568	0.0191568	0.0455932	0.1588091	0.3779657	no
Hexachlorobenzene	---	---	0.059865	---	---	0.059865	0.059865	0.059865	0.1424787	0.4962784	1.1811427	no
Hexachlorabutadiene	20.790883	32.401766	21.551399	6.6530826	17.172936	21.551399	6.6530826	8.7155382	20.691087	72.251463	171.52828	no
PESTICIDES												
Aldrin	12.229931	---	0.0095784	3.913578	---	0.0095784	0.0095784	0.0095784	0.0227966	0.0794046	0.1889828	no
Hexachlorocyclohexane												
(gamma BHC, Lindane)	21.606212	6.6709519	26.340599	6.9139878	3.5356045	26.340599	3.5356045	4.6316419	10.99573	38.396126	91.154162	no
Chlordane	9.783945	0.1365957	0.0454974	3.1308624	0.0723957	0.0454974	0.0454974	0.0454974	0.1082838	0.3771716	0.8976684	no
4,4'-DDT	4.4843081	0.0317664	0.0454974	1.4349786	0.0168362	0.0454974	0.0168362	0.0220554	0.0523606	0.1828387	0.4340674	no
4,4'-DDE	214.0238	333.54759	0.0454974	68.487615	176.78022	0.0454974	0.0454974	0.0454974	0.1082838	0.3771716	0.8976684	no
4,4'-DDD	0.1222993	0.1905986	0.0646542	0.0391358	0.1010173	0.0646542	0.0391358	0.0512679	0.1217123	0.4250086	1.0089899	no
Dieldrin	0.9677952	1.7693906	0.011973	0.3096945	0.937777	0.011973	0.011973	0.011973	0.0284957	0.0992557	0.2362285	no
Endosulfan	0.8968616	1.7789205	43.850677	0.2869957	0.9428279	43.850677	0.2869957	0.3759644	0.8925567	3.1167298	7.3992592	no
Endrin	0.352222	1.1912414	24.257821	0.112711	0.6313579	24.257821	0.112711	0.1476515	0.3505314	1.2240248	2.9058909	no
Heptachlor	2.1198547	0.1207125	0.0167622	0.6783535	0.0639776	0.0167622	0.0167622	0.0167622	0.039894	0.138958	0.33072	no
Toxaphene	2.9759499	0.0063533	0.0574704	0.952304	0.0033672	0.0574704	0.0033672	0.0044111	0.0104721	0.0365677	0.0868135	no
Other Parameters:												
Fecal Col.(col/100ml)	---	---	---	---	---	---	---	---	---	---	---	no
Chlorine	77.456231	349.43081	---	24.785994	185.19833	---	24.785994	32.469652	77.084441	269.17212	639.02693	no
Ammonia	---	---	---	---	---	---	---	---	---	---	---	no
Chlorides	---	---	---	---	---	---	---	---	---	---	---	no
Sulfates	---	---	---	---	---	---	---	---	---	---	---	no
TDS	---	---	---	---	---	---	---	---	---	---	---	no
	---	---	---	---	---	---	---	---	---	---	---	no
	---	---	---	---	---	---	---	---	---	---	---	no

APPENDIX B-2 LA0007374, AI No. 35260

Documentation and Explanation of Water Quality Screen
and Associated Lotus Spreadsheet

Each reference column is marked by a set of parentheses enclosing a number and asterisk, for example (*1) or (*19). These columns represent inputs, existing data sets, calculation points, and results for determining Water Quality Based Limits for an effluent of concern. The following represents a summary of information used in calculating the water quality screen:

Receiving Water Characteristics:

Receiving Water: Mississippi River
Critical Flow, Qrc (cfs): 141,955
Harmonic Mean Flow, Qrh (cfs): 366,758
Segment No.: 070301
Receiving Stream Hardness (mg/L): 153.4
Receiving Stream TSS (mg/L): 32
MZ Stream Factor, Fs: 1
Plume distance, Pf: N/A

Effluent Characteristics:

Company: Entergy Operations, Inc.
Outfall 001 flow, Qe (MGD): 994
Effluent Hardness: N/A
Effluent TSS: N/A
Pipe/canal width, Pw: N/A
Permit Number: LA0007374

Variable Definition:
Qrc, critical flow of receiving stream, cfs
Qrh, harmonic mean flow of the receiving stream, cfs
Pf = Allowable plume distance in feet, specified in LAC 33:IX.1115.D
Pw = Pipe width or canal width in feet
Qe, total facility flow , MGD
Fs, stream factor from LAC.33.IX Chapter 11 (1 for harmonic mean flow)
Cu, ambient concentration, ug/L
Cr, numerical criteria from LAC.33.IX.1113, Table 1
WLA, wasteload allocation
LTA, long term average calculations
WQBL, effluent water quality based limit
ZID, Zone of Initial Dilution in % effluent
MZ, Mixing Zone in % effluent

Formulas used in aquatic life water quality screen (dilution type WLA):

Streams:

$$\text{Dilution Factor} = \frac{Qe}{(Qrc \times 0.6463 \times Fs + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Static water bodies (in the absence of a site specific dilution):

Discharge from a pipe:

$$\text{Critical Dilution} = \frac{(2.8)\ Pw\ \pi^{1/2}}{Pf}$$

$$WLA = \frac{(Cr-Cu)\ Pf}{(2.8)\ Pw\ \pi^{1/2}}$$

Discharge from a canal:

$$\text{Critical Dilution} = \frac{(2.38)(Pw^{1/2})}{(Pf)^{1/2}}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{1/2}}{2.38\ Pw^{1/2}}$$

Formulas used in human health water quality screen, human health non-carcinogens (dilution type WLA):

Streams:

$$\text{Dilution Factor} = \frac{Qe}{(Qrc \times 0.6463 + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Qrc \times 0.6463 \times Cu)}{Qe}$$

Formulas used in human health water quality screen, human health carcinogens (dilution type WLA):

$$\text{Dilution Factor} = \frac{Qe}{(Qrh \times 0.6463 + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Qrh \times 0.6463 \times Cu)}{Qe}$$

Static water bodies in the absence of a site specific dilution (human health carcinogens and human health non-carcinogens):

Discharge from a pipe:

$$\text{Critical Dilution} = \frac{(2.8)\ Pw\ \pi^{1/2}}{Pf}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{*}}{(2.8)\ Pw\ \pi^{1/2}}$$

Discharge from a canal:

$$\text{Critical Dilution} = \frac{(2.38)(Pw^{1/2})}{(Pf)^{1/2}}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{1/2*}}{2.38\ Pw^{1/2}}$$

* Pf is set equal to the mixing zone distance specified in LAC 33:IX.1115 for the static water body type, i.e., lake, estuary, Gulf of Mexico, etc.

If a site specific dilution is used, WLA are calculated by subtracting Cu from Cr and dividing by the site specific dilution for human health and aquatic life criteria.

$$WLA = \frac{(Cr-Cu)}{\text{site specific dilution}}$$

Long Term Average Calculations:
LTAa = WLAa X 0.32
LTAc = WLAc X 0.53
LTAh = WLAh

WQBL Calculations:
Select most limiting LTA to calculate daily max and monthly avg WQBL

If aquatic life LTA is more limiting:
Daily Maximum = Min(LTAa, LTAc) X 3.11
Monthly Average = Min(LTAc, LTAc) X 1.31

If human health LTA is more limiting:
Daily Maximum = LTAh X 2.38
Monthly Average = LTAh

Mass Balance Formulas:

mass (lbs/day): (ug/L) X 1/1000 X (flow, MGD) X 8.34 = lbs/day

$$\text{concentration(ug/L)}: \frac{\text{lbs/day}}{\text{(flow, MGD) X 8.34 X 1/1000}} = \text{ug/L}$$

The following is an explanation of the references in the spreadsheet.

(*1) Parameter being screened.
(*2) Instream concentration for the parameter being screened in ug/L. In the absence of accurate supporting data, the instream concentration is assumed to be zero (0).
(*3) Monthly average effluent or technology value in concentration units of ug/L or mass units of lbs/day. Units determined on a case-by-case basis as appropriate to the particular situation.
(*4) Daily maximum technology value in concentration units of ug/L or mass units of lbs/day. Units determined on a case-by-case basis as appropriate to the particular situation.
(*5) Minimum analytical Quantification Levels (MQLs). Established in a letter dated January 27, 1994 from Wren Stenger of EPA Region 6 to Kilren Vidrine of LDEQ and from the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". The applicant must test for the parameter at a level at least as sensitive as the specified MQL. If this is not done, the MQL becomes the application value for screening purposes if the pollutant is suspected to be present

on-site and/or in the waste stream. Units are in ug/l or lbs/day depending on the units of the effluent data.

(*6) States whether effluent data is based on 95th percentile estimation. A "1" indicates that a 95th percentile approximation is being used, a "0" indicates that no 95th percentile approximation is being used.

(*7) 95th percentile approximation multiplier (2.13). The constant, 2.13, was established in memorandum of understanding dated October 8, 1991 from Jack Ferguson of Region 6 to Jesse Chang of LDEQ and included in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". This value is screened against effluent Water Quality Based Limits established in columns (*18) - (*21). Units are in ug/l or lbs/day depending on the units of the measured effluent data.

(*8) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, freshwater (FW) or marine water (MW) (whichever is applicable) aquatic life protection, acute criteria. Units are specified. Some metals are hardness dependent. The hardness of the receiving stream shall generally be used, however a flow weighted hardness may be determined in site-specific situations. Dissolved metals are converted to Total metals using partition coefficients in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Similar to hardness, the TSS of the receiving stream shall generally be used, however, a flow weighted TSS may be determined in site-specific situations.

Hardness Dependent Criteria:

<u>Metal</u>	<u>Formula</u>
Cadmium	$e^{(1.1280[\ln(hardness)] - 1.6774)}$
Chromium III	$e^{(0.8190[\ln(hardness)] + 3.6880)}$
Copper	$e^{(0.9422[\ln(hardness)] - 1.3884)}$
Lead	$e^{(1.2730[\ln(hardness)] - 1.4600)}$
Nickel	$e^{(0.8460[\ln(hardness)] + 3.3612)}$
Zinc	$e^{(0.8473[\ln(hardness)] + 0.8604)}$

Dissolved to Total Metal Multipliers for Freshwater Streams (TSS dependent):

<u>Metal</u>	<u>Multiplier</u>
Arsenic	$1 + 0.48 \times TSS^{-0.73} \times TSS$
Cadmium	$1 + 4.00 \times TSS^{-1.13} \times TSS$
Chromium III	$1 + 3.36 \times TSS^{-0.93} \times TSS$
Copper	$1 + 1.04 \times TSS^{-0.74} \times TSS$
Lead	$1 + 2.80 \times TSS^{-0.80} \times TSS$
Mercury	$1 + 2.90 \times TSS^{-1.14} \times TSS$
Nickel	$1 + 0.49 \times TSS^{-0.57} \times TSS$
Zinc	$1 + 1.25 \times TSS^{-0.70} \times TSS$

Dissolved to Total Metal Multipliers for Marine Environments (TSS dependent):

<u>Metal</u>	<u>Multiplier</u>

Copper	$1 + (10^{4.86} \times TSS^{-0.72} \times TSS) \times 10^{-6}$
Lead	$1 + (10^{6.06} \times TSS^{-0.85} \times TSS) \times 10^{-6}$
Zinc	$1 + (10^{5.36} \times TSS^{-0.52} \times TSS) \times 10^{-6}$

If a metal does not have multiplier listed above, then the dissolved to total metal multiplier shall be 1.

(*9) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, freshwater (FW) or marine water (MW) (whichever is applicable) aquatic life protection, chronic criteria. Units are specified. Some metals are hardness dependent. The hardness of the receiving stream shall generally be used, however a flow weighted hardness may be determined in site-specific situations. Dissolved metals are converted to Total metals using partition coefficients in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Similar to hardness, the TSS of the receiving stream shall generally be used, however, a flow weighted TSS may be determined in site-specific situations.
Hardness dependent criteria:

<u>Metal</u>	<u>Formula</u>
Cadmium	$e^{(0.7852[\ln(hardness)] - 3.4900)}$
Chromium III	$e^{(0.8473[\ln(hardness)] + 0.7614)}$
Copper	$e^{(0.8545[\ln(hardness)] - 1.3860)}$
Lead	$e^{(1.2730[\ln(hardness)] - 4.7050)}$
Nickel	$e^{(0.8460[\ln(hardness)] + 1.1645)}$
Zinc	$e^{(0.8473[\ln(hardness)] + 0.7614)}$

Dissolved to total metal multiplier formulas are the same as (*8), acute numerical criteria for aquatic life protection.

(*10) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, human health protection, drinking water supply (HHDW), non-drinking water supply criteria (HHNDW), or human health non-primarry contact recreation (HHNPCR) (whichever is applicable). A DEQ and EPA approved Use Attainability Analysis is required before HHNPCR is used, e.g., Monte Sano Bayou. Units are specified.

(*11) C if screened and carcinogenic. If a parameter is being screened and is carcinogenic a "C" will appear in this column.

(*12) Wasteload Allocation for acute aquatic criteria (WLAa). Dilution type WLAa is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the acute aquatic numerical criteria for that parameter. Units are in ug/L.
Dilution WLAa formulas for streams:

$$WLAa = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAa formulas for static water bodies:

$$WLAa = (Cr-Cu)/\text{Dilution Factor}$$

Cr represents aquatic acute numerical criteria from column (*8).
If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*13) Wasteload Allocation for chronic aquatic criteria (WLAc). Dilution type WLAc is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the chronic aquatic numerical criteria for that parameter. Units are in ug/L.

Dilution WLAc formula:

$$WLAc = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAc formulas for static water bodies:

WLAc = (Cr-Cu)/Dilution Factor)

Cr represents aquatic chronic numerical criteria from column (*9).

If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*14) Wasteload Allocation for human health criteria (WLAh). Dilution type WLAh is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the human health numerical criteria for that parameter. Units are in ug/L. Dilution WLAh formula:

$$WLAh = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc,Qrh \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAh formulas for static water bodies:

WLAh = (Cr-Cu)/Dilution Factor)

Cr represents human health numerical criteria from column (*10).

If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*15) Long Term Average for aquatic numerical criteria (LTAa). WLAa numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 0.32. WLAa X 0.32 = LTAa.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*16) Long Term Average for chronic numerical criteria (LTAc). WLAc numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 0.53. WLAc X 0.53 = LTAc.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*17) Long Term Average for human health numerical criteria (LTAh). WLAh numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 1. WLAc X 1 = LTAh.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then a blank shall appear in this column.

(*18) Limiting Acute, Chronic or Human Health LTA's. The most limiting LTA is placed in this column. Units are consistent with the WLA calculation.

If standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then the type of limit, Aquatic or Human Health (HH), is indicated.

(*19) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of concentration, ug/L. If aquatic life criteria was the most limiting LTA then the limiting LTA is multiplied by 1.31 to determine the average WQBL ($LTA_{limiting\ aquatic}$ X 1.31 = $WQBL_{monthly\ average}$). If human health criteria was the most limiting criteria then LTAh = $WQBL_{monthly\ average}$. If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then either the human health criteria or the chronic aquatic life criteria shall appear in this column depending on which is more limiting.

(*20) End of pipe Water Quality Based Limit (WQBL) daily maximum in terms of concentration, ug/L. If aquatic life criteria was the most limiting LTA then the limiting LTA is multiplied by 3.11 to determine the daily maximum WQBL ($LTA_{limiting\ aquatic}$ X 3.11 = $WQBL_{daily\ max}$). If human health criteria was the most limiting criteria then LTAh is multiplied by 2.38 to determine the daily maximum WQBL ($LTA_{limiting\ aquatic}$ X 2.38 = $WQBL_{daily\ max}$). If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDLs, then either the human health criteria or the acute aquatic life criteria shall appear in this column depending on which is more limiting.

(*21) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of mass, lbs/day. The mass limit is determined by using the mass balance equations above. Monthly average WQBL, ug/l/1000 X facility flow, MGD X 8.34 = monthly average WQBL, lbs/day.

(*22) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of mass, lbs/day. Mass limit is determined by using the mass balance equations above. Daily maximum WQBL, ug/l/1000 X facility flow, MGD X 8.34 = daily maximum WQBL, lbs/day.

(*23) Indicates whether the screened effluent value(s) need water quality based limits for the parameter of concern. A "yes" indicates that a water quality based limit is needed in the permit; a "no" indicates the reverse.

Invoice No.________________ January 21, 2010 Page 1

LOUISIANA WATER POLLUTION CONTROL FEE SYSTEM RATING WORKSHEET

PERMIT NO. LA0007374 AI NO. 35260 Activity No.: PER20090001

1.a. Company Name Entergy Operations, Inc.

1.b. Facility Name Waterford 3 Steam Electric Station

2. Local Mailing Address 17265 River Road

Killona, Louisiana 70057

3. Billing Address (If different)________________

4.a. Facility Location 17265 River Road, Killona

4.b. Parish St. Charles

5. Facility Type steam electric generating station

6. Products Produced________________

6.a. Raw materials stored or used________________

6.b. By-products produced________________

7. Primary SIC Code 4911 7.a. Other SIC Codes________________

8. Fac. Manager________________ 8.a. Telephone________________

9. Owner________________ 9.a. Telephone________________

10. Env. Contact Rodney LeBlanc 10.a. Telephone (504)464-3267

11. State Permit No.________________	12. NPDES Permit No. LA0007374
11.a. Date Issued________________	12.a. Effective Date February 1, 2005
11.b. New________Modified________	12.b. Expiration Date January 31, 2010

13. Number and Identification of Outfalls Outfall 001 - once through non-contact cooling water, intermittent discharge including utilities and maintenance wastewaters and stormwater; Outfall 004 - intermittent discharges of stormwater runoff and maintenance wastewaters; Outfall 005 - treated sanitary wastewater

14. Number of Injection Wells N/A

15. Water Source(s)________________

16. Receiving Water(s) Outfall 001 - Mississippi River; Outfalls 004 and 005 - 40 Arpent Canal

17. River Basin Mississippi, Barataria

18. Basin Segment No. 070301, 020202

TOTAL RATING POINTS ASSIGNED 305

mlb Initials of Rater

PERMIT NO. LA0007374, AI No. 35260,PER20090001

1. FACILITY COMPLEXITY DESIGNATION
   Primary SIC 4911   Other SIC ____
   Complexity Designation =

____	I	(0 points)
____	II	(10 points)
____	III	(20 points)
____	IV	(30 points)
✓	V	(40 points)
____	VI	(50 points)

COMPLEXITY DESIGNATION POINTS 40

2. FLOW VOLUME AND TYPE
   A. Wastewater Type I
   Is total Daily Average Discharge greater than 400 mgd?
   ✓ Yes, then points = 200
   ____ No, then
   Points = 0.5 X Total Daily Average Discharge (mgd)
   Points = 0.5 X ________ = ________
   Total points = 200

   B. Wastewater Type II
   Points = 10 X Total Daily Average Discharge (mgd)
   Points = 10 X ________ = ________
   Total points = ________

   C. Wastewater Type III
   Points = 2 X Total Daily Average Discharge (mgd)
   Points = 2 X ________ = ________
   Total points = 0

FLOW VOLUME AND TYPE POINTS 200

3. POLLUTANTS
   A. BOD or ________
   Daily Average Load =

✓	≤ 50 lb/day	(0 points)
____	> 50 - 500	(5 points)
____	> 500 - 1000	(10 points)
____	> 1000 - 3000	(20 points)
____	> 3000 - 5000	(30 points)
____	> 5000 lb/day	(calculate)

   Points = 0.008 X Daily Average Load (lbs)
   Points = 0.008 X 0 = 0

   COD or ________
   Daily Average Load =

✓	≤ 100 lb/day	(0 points)
____	> 100 - 500	(5 points)
____	> 500 - 1000	(10 points)
____	> 1000 - 5000	(20 points)
____	> 5000 - 10000	(30 points)
____	> 10000 lb/day	(calculate)

   Points = 0.004 X Daily Average Load (lbs)
   Points = 0.004 X 0 = 0

BOD OR COD DEMAND POINTS 0
(whichever is greater)

B. TSS

Daily Average Load =

✓	≤ 100 lb/day	(0 points)
____	> 100 - 500	(5 points)
____	> 500 - 1000	(10 points)
____	> 1000 - 5000	(20 points)
____	> 5000 - 10000	(30 points)
____	> 10000 lb/day	(calculate)

Points = 0.004 X Daily Average Load (lbs)
Points = 0.004 X ___0___ = ___0___

TSS POINTS___0___

C. TOXICS

Total Annual Discharge to Water = ___0___(lbs)

Points = 0.01 X Annual discharge (lbs)
Points = 0.01 X ___0___ = ___0___

TOXIC POINTS___0___

TOTAL POLLUTANT POINTS___0___

4. TEMPERATURE (HEAT LOAD)

Heat Load = Average Summer flow (mgd) X $^\Delta$T X 0.00834
where $^\Delta$T = Permit Limit (Max. Temp.) -70°
Heat Load = ___**1125**___(mgd) X ___**48**___ X 0.00834 = ___**450**___Billion BTU

Heat Load =

0	≤ 4 billion BTU	(0 points)
____	> 4-20 billion BTU	(5 points)
____	> 20-100 billion BTU	(10 points)
____	> 100-200 billion BTU	(15 points)
✓	> 200 billion BTU	(20 points)

HEAT LOAD POINTS___20___

5. POTENTIAL PUBLIC HEALTH IMPACTS

Is the receiving water to which the wastewater is discharged or a water body to which it is a tributary used as a drinking water supply source within 50 miles downstream?

________No (0 points)
___✓___Yes, then . . .

Complexity Designation

____	I, II	(0 points)
____	III	(5 points)
____	IV	(10 points)
✓	V	(20 points)
____	VI	(30 points)

POTENTIAL PUBLIC HEALTH IMPACT POINTS___20___

6. MAJOR/MINOR FACILITY DESIGNATION

Has your facility been designated a Major Facility by the administrative authority?

___✓___Yes, then Points = 25
________No, then

were effluent limitations assigned to the discharge based on water quality factors in the receiving stream?

___✓___No, then Points = 0
________Yes, then Points = 5

TOTAL MAJOR/MINOR POINTS___25___

TOTAL RATING POINTS ASSIGNED___305___

Bobby Jindal
GOVERNOR

Peggy M. Hatch
SECRETARY

State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

Ms. Kelli M. Dowell
Entergy Services, Inc.
Post Office Box 1640
Jackson, Mississippi 39201

January 30, 2015

AI No.: 35260
Activity No.: PER20140002

RE: Entergy Operations, Inc. – Waterford Steam Electric Station Unit 3
Water Quality Certification

Dear Ms. Dowell:

The Louisiana Department of Environmental Quality, Water Permits Division (LDEQ), has received the request from Entergy Operations, Inc. (Entergy) regarding the water quality certification (WQC) issued to Entergy's Waterford Steam Electric Station Unit 3 (WF3) and its upcoming operating license renewal with the United States Nuclear Regulatory Commission (NRC).

LDEQ has reviewed the request and confirms:

(i) LDEQ requires no new or additional water quality certification pursuant to Section 401 of the Federal Clean Water Act, 33 U.S.C. Section 1341, for WF3 in support of its license renewal application.

(ii) LDEQ deems the WQC issued by the State of Louisiana Stream Control Commission on June 21, 1972, valid for Waterford Units 1, 2, and 3 to be a certification obtained pursuant to paragraph (1) of 33 U.S.C. Section 1341(a) with respect to the construction of WF3; and

(iii) LDEQ deems the currently issued Louisiana Pollution Discharge Elimination System (LPDES) permit LA0007374 issued on October 1, 2010, to be a certification obtained pursuant to paragraph (1) of 33 U.S.C. Section 1341(a) with respect to the operation of WF3.

Should you have any questions concerning any part of this certification, please contact Elizabeth Johnson at (225) 219-3225, or by email at elizabeth.johnson@la.gov. To ensure all correspondence regarding this certification is properly filed into the Department's Electronic Document Management System, please reference Agency Interest (AI) number 35260 on all future correspondence to this Department.

Sincerely,

Scott Guilliams
Administrator
Water Permits Division

c: IO-W
Corps of Engineers – New Orleans District

Post Office Box 4313 • Baton Rouge, Louisiana 70821-4313 • Phone 225-219-3181 • Fax 225-219-3309
www.deq.louisiana.gov

Attachment B

Threatened and Endangered Species Consultation

Attachment B

Threatened and Endangered Species Consultation

- Rick Buckley, Entergy Services, Inc., to David Bernhart, NOAA Fisheries Service—Southeast Regional Office. May 28, 2015.
- Rick Buckley, Entergy Services, Inc., to Brad Rieck, U.S. Fish and Wildlife Service—Louisiana Field Office. May 28, 2015.
- Rick Buckley, Entergy Services, Inc., to Carolyn Michon, Louisiana Natural Heritage Program—Department of Wildlife and Fisheries. May 28, 2015.
- Amity Bass, Natural Heritage Program—Louisiana Department of Wildlife and Fisheries, to Rick Buckley, Entergy Services, LLC. June 18, 2015.
- Kelly Shotts, NOAA Southeast Regional Office—National Marine Fisheries Service, to Rick Buckley, Entergy Services, Inc. June 24, 2015.
- Deborah Fuller, U.S. Fish and Wildlife Service—Louisiana Field Office, to Rick Buckley, Entergy Services, Inc. June 26, 2015.

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

May 28, 2015

Mr. David Bernhart
Assistant Regional Administrator
NOAA Fisheries Service
Southeast Regional Office
Protected Resources Division
263 13th Avenue South
Saint Petersburg, Florida 33701

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00051

Dear Mr. Bernhart,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 for an additional 20 years until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on designated essential fish habitat (EFH) or protected marine mammals within the immediate environs of the WF3 site (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with the Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act.

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the WF3 license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

During Entergy's review, it was determined that no designated EFH exists for the Federally-listed threatened gulf sturgeon, *Acipenser oxyrinchus desotoi*, which may pass the WF3 site during the spawning season. Although the West Indian manatee, *Trichechus manatus,* is known to inhabit Lakes Pontchartrain and Maurepas and associated coastal waters and streams during summer months, the last known sighting of this species in the Mississippi River was 1975. We do not believe that suitable habitat exists at the ELL site for manatees either.

However, even with designated EFH for the gulf sturgeon or the presence of the West Indian manatee in the immediate environs of WF3 (Figure 1), Entergy does not expect WF3 operations during the license renewal term to adversely affect either species since there are no plans to alter current operations during the 20-year license renewal period, and the fact that license renewal will not involve any offsite activities. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility changes do occur, no changes are planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to designated EFH for the gulf sturgeon or protection of the West Indian manatee within the immediate environs of WF3, or alternatively, confirming our conclusion that there is no designated EFH for the gulf sturgeon within the immediate environs and that the likelihood of the West Indian manatee being adversely affected as a result of continued operations of WF3 for an additional 20 years would be minimal. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

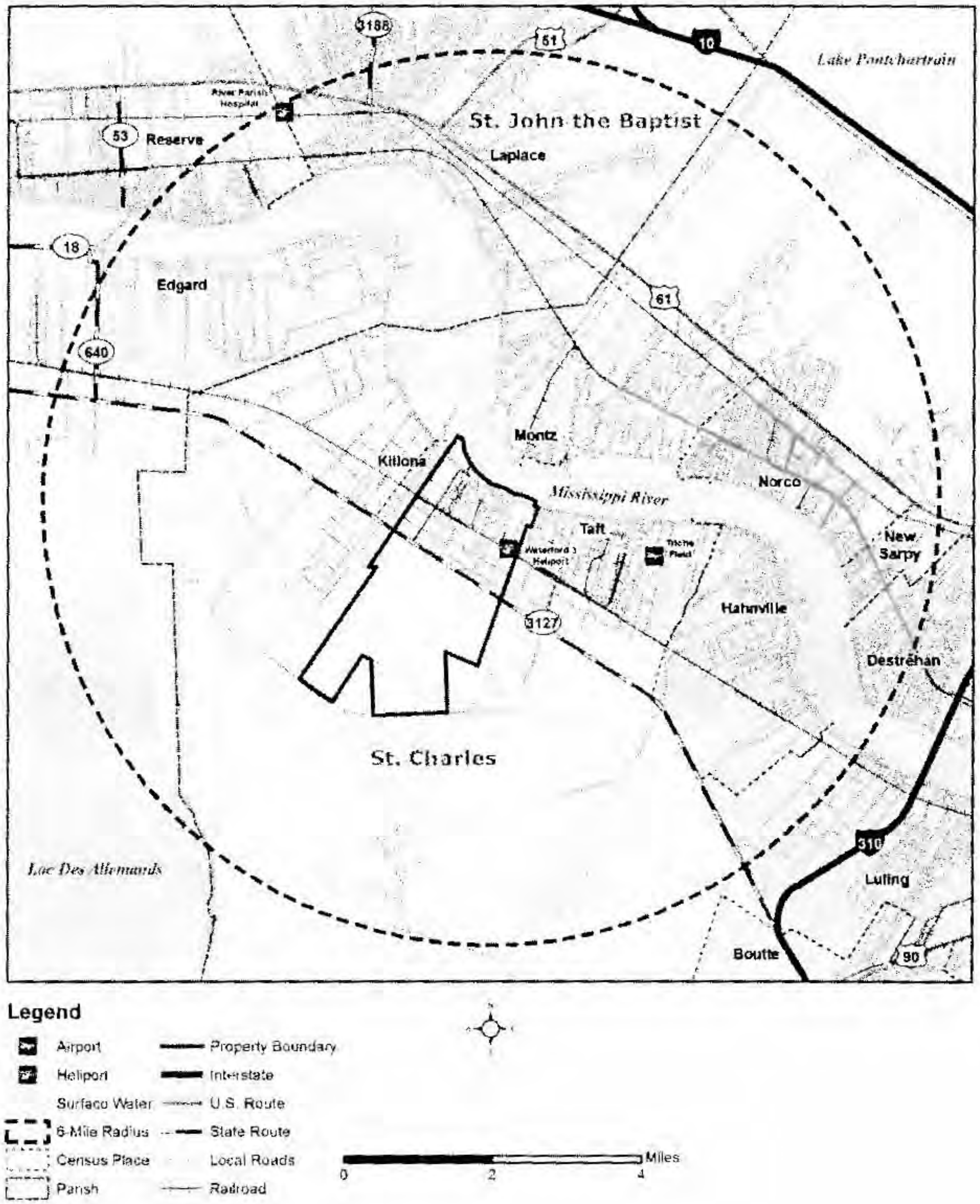
If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

May 28, 2015

Mr. Brad Rieck
Deputy Field Supervisor
U.S. Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00052

Dear Mr. Rieck,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 for an additional 20 years until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses potential environmental impacts from plant operations during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on Federally-listed threatened, endangered or candidate species and designated critical habitat located on the WF3 property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 7 of the Endangered Species Act.

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the WF3 license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC (ELL) owned property that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the ELL property. The length of these transmission lines is approximately 0.6 miles, and there is limited right-of-way since the lines cross the WF3 industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 threatened, endangered and candidate species identified as being Federally-listed in St. Charles and St. John the Baptist parishes, of which portions of are included within a 6-mile radius of WF3 (Figure 1). As shown in Table 1, no suitable habitat for these species was identified on the ELL property during a pedestrian survey conducted on October 29, 2014, or was any species observed during the survey. Entergy does not anticipate that the one Federally-listed species identified only in St. John the Baptist Parish (Alabama heelsplitter mussel, *Lasmigona alabamensis*) would be affected by the renewal of the WF3 operating license since the Mississippi River does not provide suitable habitat for this species. In addition during Entergy's review, no designated critical habitat was identified for the species listed in Table 1 within the immediate environs (6-mile radius) of WF3.

However, Entergy does not expect that WF3's operations during the license renewal term would result in adverse effects to threatened, endangered or candidate species and designated critical habitats even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to threatened, endangered or candidate species and designated critical habitat on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that these species and habitats will not be adversely affected as a result of renewing the WF3 operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Table 1

Federal-Listed Species, St. Charles and St. John the Baptist Parishes

Common Name	Scientific Name	Applicable Parish	Federal Status	Habitat Present on ELL Property	Species Present on ELL Property
Mammals					
West Indian Manatee	*Trichechus manatus*	SC/SJB	E	No	No
Birds					
Sprague's Pipit	*Anthus spragueii*	SC/SJB	C	No	No
Fish					
Atlantic Sturgeon	*Acipenser oxyrinchus desotoi*	SC/SJB	T	No	No
Pallid Sturgeon	*Scaphirhynchus albus*	SC/SJB	E	No	No
Mollusks					
Alabama Heelsplitter Mussel	*Lasmigona alabamensis*	SJB	T	No	No

SC = St. Charles Parish

SJB = St. John the Baptist Parish

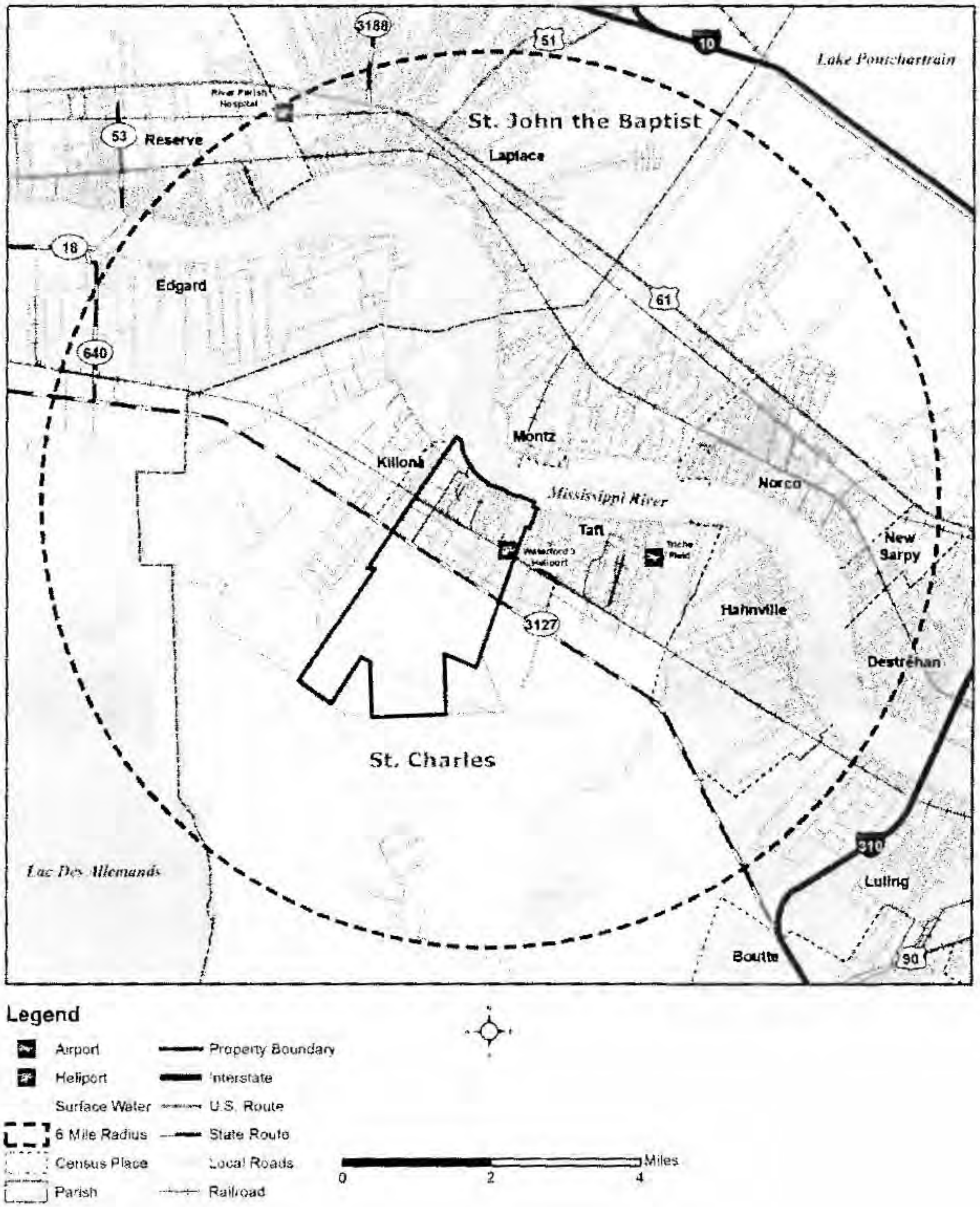
T = Threatened

E = Endangered

C = Candidate Species

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

May 28, 2015

Ms. Carolyn Michon
Assistant Data Manager
Louisiana Natural Heritage Program
Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00053

Dear Ms. Michon,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 for an additional 20 years until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts for consideration would be the effect of license renewal on state-listed species and designated critical habitat located on the WF3 property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53).

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the WF3 license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC (ELL) owned property that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the ELL property. The length of these transmission lines is approximately 0.6 miles, and there is limited right-of-way since the lines cross the WF3 industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 species identified as being state-listed in St. Charles and St. John the Baptist parishes, of which portions of are included within a 6-mile radius of WF3 (Figure 1). Although suitable habitat does exist on the ELL property for two species as shown in Table 1 (western antler fern, *Ceratopteris pteridoides*, and square-stemmed monkey flower, *Mimulus ringens*) based on a pedestrian survey conducted on October 29, 2014, these species were not observed during the survey. Entergy does not anticipate that the three state-listed species identified only in St. John the Baptist Parish (osprey (*Pandion haliaetus*), alligator snapping turtle (*Macrochelys temminckii*), and rooted spike rush (*Eleocharis radicans*)) would be affected by the renewal of the WF3 operating license since license renewal will not involve any offsite activities. In addition during Entergy's review, no designated critical habitat was identified for the species listed in Table 1 on the ELL property or within the immediate environs (6-mile radius) of WF3.

However, Entergy does not expect WF3's operations during the license renewal term would result in adverse effects to state-listed species or designated critical habitats even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to state-listed species or designated critical habitat on the property where WF3 is located, or the immediate environs (6-mile radius), or alternatively, confirming our conclusion these species and habitats will not be adversely affected as a result of renewing the WF3 operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Table 1

State-Listed Species, St. Charles and St. John the Baptist Parishes

Common Name	Scientific Name	Applicable Parish	State Status	Habitat Present on ELL Property	Species Present on ELL Property
Mammals					
West Indian Manatee	*Trichechus manatus*	SC/SJB	SNA	No	No
Birds					
Bald Eagle	*Haliaeetus leucocephalus*	SC/SJB	S2N, S3B	No	No
Osprey	*Pandion haliaetus*	SJB	S2B,S3N		No
Fish					
Pallid Sturgeon	*Scaphirhynchus albus*	SC/SJB	S1	No	No
Paddlefish	*Polyodon spathula*	SC/SJB	S3	No	No
Reptiles					
Alligator Snapping Turtle	*Macrochelys temminckii*	SJB	S3		No
Plants					
Swamp Milkweed	*Asclepias incarnata*	SC/SJB	S2	No	No
Golden Canna	*Canna flaccida*	SC	S4?	No	No
Floating Antler Fern	*Ceratopteris pteridoides*	SC/SJB	S2	Yes	No
Marshland Flatsedge	*Cyperus distinctus*	SC	S1	No	No
Western Umbrella Sedge	*Fuirena simplex var. aristulata*	SC	S1	Yes	No
Correll's False Dragon-Head	*Phvsosteqia correllii*	SC	S1	No	No
Square-Stemmed Monkey Flower	*Mimulus ringens*	SC	S2	Yes	No
Rooted Spike Rush	*Eleocharis radicans*	SJB	S1?	No	No

SC = St. Charles Parish

SJB = St. John the Baptist Parish

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

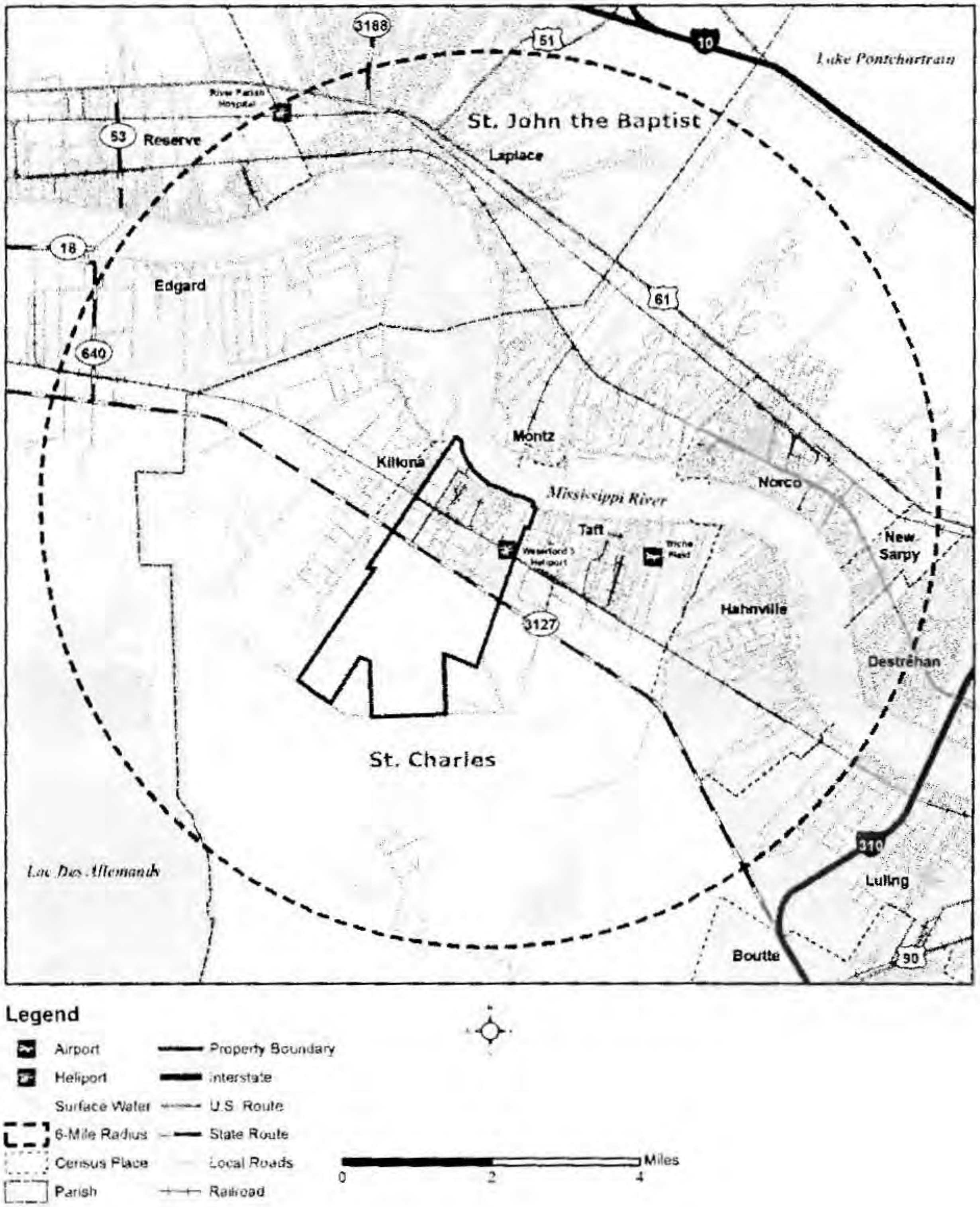
S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations)

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations)

Figure 1

Location of Entergy Property, 6-Mile Radius Map



BOBBY JINDAL
GOVERNOR

State of Louisiana
DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

ROBERT J. BARHAM
SECRETARY
JIMMY L. ANTHONY
ASSISTANT SECRETARY

Date	June 18, 2015
Name	Rick Buckley
Company	Entergy Services, LLC
Street Address	1340 Echelon Parkway
City, State, Zip	Jackson, Mississippi 39213
Project	Entergy Louisiana, LLC Waterford 3 Steam Electric Station Unit 3
Project ID	1202015
Invoice Number	15061801

Personnel of the Coastal & Nongame Resources Division have reviewed the preliminary data for the captioned project.

Our records indicate that the proposed project may potentially impact a Bald Eagle (Haliaeetus leucocephalus) nesting site located within the project site. This species is protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) and the Migratory Bird Treaty Act (16 U.S.C. 703-712) and is protected by the state of Louisiana. All bald eagle nests (active, inactive or seemingly abandoned) should be protected, and no large trees should be removed. Please refer to the Bald Eagle Management Guidelines for more information regarding buffer zones and other information on avoiding impacts to bald eagles: http://www.fws.gov/southeast/es/baldeagle/.

After careful review of our database, no other impacts to rare, threatened, or endangered species or critical habitats are anticipated for the proposed project. No state or federal parks, wildlife refuges, scenic streams, or wildlife management areas are known at the specified site within Louisiana's boundaries.

The Louisiana Natural Heritage Program (LNHP) has compiled data on rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features throughout the state of Louisiana. Heritage reports summarize the existing information known at the time of the request regarding the location in question. The quantity and quality of data collected by the LNHP are dependent on the research and observations of many individuals. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Louisiana have not been surveyed. This report does not address the occurrence of wetlands at the site in question. Heritage reports should not be considered final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. LNHP requires that this office be acknowledged in all reports as the source of all data provided here. If at any time Heritage tracked species are encountered within the project area, please contact the LNHP Data Manager at 225-765-2643. If you have any questions, or need additional information, please call 225-765-2357.

Sincerely,

Amity Bass, Coordinator
Natural Heritage Program

P.O. BOX 98000 • BATON ROUGE, LOUISIANA 70898-9000 • PHONE (225) 765-2800
AN EQUAL OPPORTUNITY EMPLOYER

From: Kelly Shotts - NOAA Federal <kelly.shotts@noaa.gov>
Sent: Wednesday, June 24, 2015 2:32 PM
To: BUCKLEY, RICKY N
Subject: Re: Waterford 3 Steam Electric Station Unit 3 - Gulf sturgeon

EXTERNAL SENDER. DO NOT click links if sender is unknown. DO NOT provide your user ID or password.

Hi Rick,

Thank you for speaking with me earlier today. As we discussed, under the Magnuson-Stevens Fishery Conservation and Management Act, EFH is designated for federally managed fishery species (e.g., shrimp, reef fish, and red drum). There is no Essential Fish Habitat (EFH) designated for Gulf sturgeon. More information on EFH can be found at the following website:

http://sero.nmfs.noaa.gov/habitat_conservation/efh/index.html

Gulf sturgeon is not a fishery species, rather it is listed as threatened under the Endangered Species Act. Critical habitat for Gulf sturgeon has been designated in the Gulf of Mexico, including in Lake Pontchartrain (Unit 8). Gulf sturgeon information and maps of Gulf sturgeon critical habitat can be found at the following websites:

Species Information
http://www.nmfs.noaa.gov/pr/species/fish/gulfsturgeon.htm

Critical Habitat Maps and GIS files
http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/critical_habitat/index.html

Based on the shortest distance between the project location you provided in your letter and the closest area designated as Gulf sturgeon critical habitat, your project appears to be at least 19 miles away from critical habitat. However, please confirm this yourself using the information provided above.

If you have any other questions, please feel free to contact me.

Kelly

On Wed, Jun 24, 2015 at 9:37 AM, Kelly Shotts - NOAA Federal <kelly.shotts@noaa.gov> wrote:
Hi Rick,

I just left you a voicemail pertaining to your May 28, 2015, letter regarding the subject project. Please give me a call at your earliest convenience to discuss issues related to Gulf sturgeon and their habitat. My direct line is 727-551-5603.

Thanks for coordinating with us!
Kelly

--
Kelly Shotts
Section 7 Coordinator
Protected Resources Division
NOAA Southeast Regional Office
National Marine Fisheries Service
263 13th Ave S
St. Petersburg, FL 33701

Ph: 727-824-5312
Fax: 727-824-5309
kelly.shotts@noaa.gov

--
Kelly Shotts
Section 7 Coordinator
Protected Resources Division
NOAA Southeast Regional Office
National Marine Fisheries Service
263 13th Ave S
St. Petersburg, FL 33701

Ph: 727-824-5312
Fax: 727-824-5309
kelly.shotts@noaa.gov

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

May 28, 2015

Mr. Brad Rieck
Deputy Field Supervisor
U.S. Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

This [illegible] has been [illegible] effects to Federal trust resources [illegible] the Endangered [illegible] proposed,
(✓) [illegible]
( ) [illegible]
[illegible] of the Act.

Acting Supervisor, Louisiana Field Office, U.S. Fish and Wildlife Service — Date: June 26, 2015

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00052

Dear Mr. Rieck,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 for an additional 20 years until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses potential environmental impacts from plant operations during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on Federally-listed threatened, endangered or candidate species and designated critical habitat located on the WF3 property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 7 of the Endangered Species Act.

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the WF3 license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

WF3 is located on approximately 3,560 acres of Entergy Louisiana, LLC (ELL) owned property that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the ELL property. The length of these transmission lines is approximately 0.6 miles, and there is limited right-of-way since the lines cross the WF3 industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 threatened, endangered and candidate species identified as being Federally-listed in St. Charles and St. John the Baptist parishes, of which portions of are included within a 6-mile radius of WF3 (Figure 1). As shown in Table 1, no suitable habitat for these species was identified on the ELL property during a pedestrian survey conducted on October 29, 2014, or was any species observed during the survey. Entergy does not anticipate that the one Federally-listed species identified only in St. John the Baptist Parish (Alabama heelsplitter mussel, *Lasmigona alabamensis*) would be affected by the renewal of the WF3 operating license since the Mississippi River does not provide suitable habitat for this species. In addition during Entergy's review, no designated critical habitat was identified for the species listed in Table 1 within the immediate environs (6-mile radius) of WF3.

However, Entergy does not expect that WF3's operations during the license renewal term would result in adverse effects to threatened, endangered or candidate species and designated critical habitats even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to threatened, endangered or candidate species and designated critical habitat on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that these species and habitats will not be adversely affected as a result of renewing the WF3 operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

This project has been reviewed for effects to Federal trust resources under our jurisdiction and currently protected by the Endangered Species Act of 1973 (Act). The project, as proposed,

(✔) Will have no effect on those resources

( ) Is not likely to adversely affect those resources.

This finding fulfills the requirements under Section 7(a)(2) of the Act.

Acting Supervisor Date
Louisiana Field Office
U.S. Fish and Wildlife Service

Attachment C

Cultural Resources Consultation

Attachment C

Cultural Resources Consultation

- Rick Buckley, Entergy Services, Inc., to Phil Boggan, Office of Historic Preservation—Division of Historic Preservation. June 1, 2015.
- Rick Buckley, Entergy Services, Inc., to Kimberly Walden, Tribal Historic Preservation Officer—Chitimacha Tribe of Louisiana. June 1, 2015.
- Rick Buckley, Entergy Services, Inc., to Dr. Linda Langley, Tribal Historic Preservation Officer—Coushatta Tribe of Louisiana. June 1, 2015.
- Rick Buckley, Entergy Services, Inc., to Alina Shively, Deputy Tribal Historic Preservation Officer—Jena Band of Choctaw Indians. June 1, 2015.
- Rick Buckley, Entergy Services, Inc., to Earl J. Barbry, Jr, Tribal Historic Preservation Officer—Tunica-Biloxi Tribe of Louisiana. June 1, 2015.
- Jill Crawford, Section 106 Coordinator—Coushatta Tribe of Louisiana, to Rick Buckley, Entergy Service, Inc. June 5, 2015.
- Pam Breaux, State Historic Preservation Officer, to Rick Buckley, Entergy Services, Inc. June 8, 2015.
- Alina Shively, Deputy Tribal Historic Preservation Officer—Jena Band of Choctaw Indians, to Rick Buckley, Entergy Services, Inc. July 15, 2015.
- Phil Boggan, Deputy State Historic Preservation Officer (stamp of receipt/review/acceptance), to Rick Buckley, Entergy Services, Inc. July 15, 2015.

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 1, 2015

Mr. Phil Boggan
Office of Historic Preservation
Division of Historic Preservation
Post Office Box 44247
Baton Rouge, LA 70804

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00054

Dear Mr. Boggan,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the WF3 site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid.

Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

WF3 is located on approximately 3,560 acres of Entergy owned land (Figure 1) that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish, with the exception of the property south of LA-3127. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the property.

Although not required, Entergy voluntarily contracted with Coastal Environments, Inc. to conduct a Phase 1A literature review and archaeological sensitivity assessment of the Entergy property in August and September 2014 to supplement WF3's existing administrative controls to ensure that potential resources are properly managed during the license renewal period. This assessment, which is included in Attachment 1, determined that no cultural resources would be impacted as a result of renewal of the WF3 operating license.

Table 1 lists archaeological resources within a 6-mile radius of WF3 while Table 2 lists National Register of Historic Places (NRHP) properties within this same radius that were identified by Entergy during our view. For the one partially eligible/unknown property in Table 1 that is located on the ELL property (16SC41), WF3 has a site-specific cultural resource protection plan that is incorporated by reference in the Environmental Protection Plan to the operating license to protect those areas on the property determined to be eligible for the NRHP, specifically the Waterford Plantation (16SC41). This requirement ensures that cultural resource remains are not damaged and are protected from unauthorized removal, and ensures that in the event that ground disturbance is required in these areas, remains will be appropriately protected for their cultural resource information value.

However, Entergy does not expect WF3 operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of WF3 during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Table 1

Archaeological Sites within a 6-Mile Radius of WF3

Site Number	Parish	Quadrangle	NRHP Status
16SC10	St. Charles	Laplace	Unknown
16SC19	St. Charles	Hahnville	Unknown
16SC21	St. Charles	Hahnville	Unknown
16SC22	St. Charles	Hahnville	Unknown
16SC24	St. Charles	Hahnville	Unknown
16SC31	St. Charles	Laplace	Partially Ineligible/Unknown[a]
16SC39	St. Charles	Hahnville	Unknown
16SC41[b]	St. Charles	Hahnville	Partially Eligible/Unknown[c]
16SC47	St. Charles	Hahnville	Unknown
16SC50	St. Charles	Laplace	Listed
16SC51	St. Charles	Laplace	Listed
16SC52	St. Charles	Laplace	Ineligible
16SC53	St. Charles	Laplace	Ineligible
16SC54	St. Charles	Laplace	Ineligible
16SC55	St. Charles	Hahnville	Ineligible
16SC56	St. Charles	Hahnville	Unknown
16SC57	St. Charles	Hahnville	Unknown
16SC58	St. Charles	Hahnville	Unknown
16SC59	St. Charles	Hahnville	Unknown
16SC65	St. Charles	Hahnville	Ineligible
16SC71	St. Charles	Hahnville	Unknown
16SC72	St. Charles	Hahnville	Partially Ineligible/Unknown[a]
16SC79	St. Charles	Laplace	Ineligible
16SC80	St. Charles	Laplace	Eligible
16SC85	St. Charles	Laplace	Ineligible
16SC86	St. Charles	Hahnville	Unknown
16SC88	St. Charles	Laplace	Unknown
16SJB6	St. John the Baptist	Reserve	Unknown
16SJB8	St. John the Baptist	Reserve	Unknown
16SJB10	St. John the Baptist	Reserve	Unknown
16SJB12	St. John the Baptist	Reserve	Unknown
16SJB22	St. John the Baptist	Reserve	Unknown
16SJB24	St. John the Baptist	Laplace	Unknown
16SJB25	St. John the Baptist	Laplace	Unknown
16SJB27	St. John the Baptist	Reserve	Unknown
16SJB67	St. John the Baptist	Laplace	Unknown

a. Only a portion of the site is determined not eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

b. Located on WF3 property.

c. Only a portion of the site is determined eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

Table 2

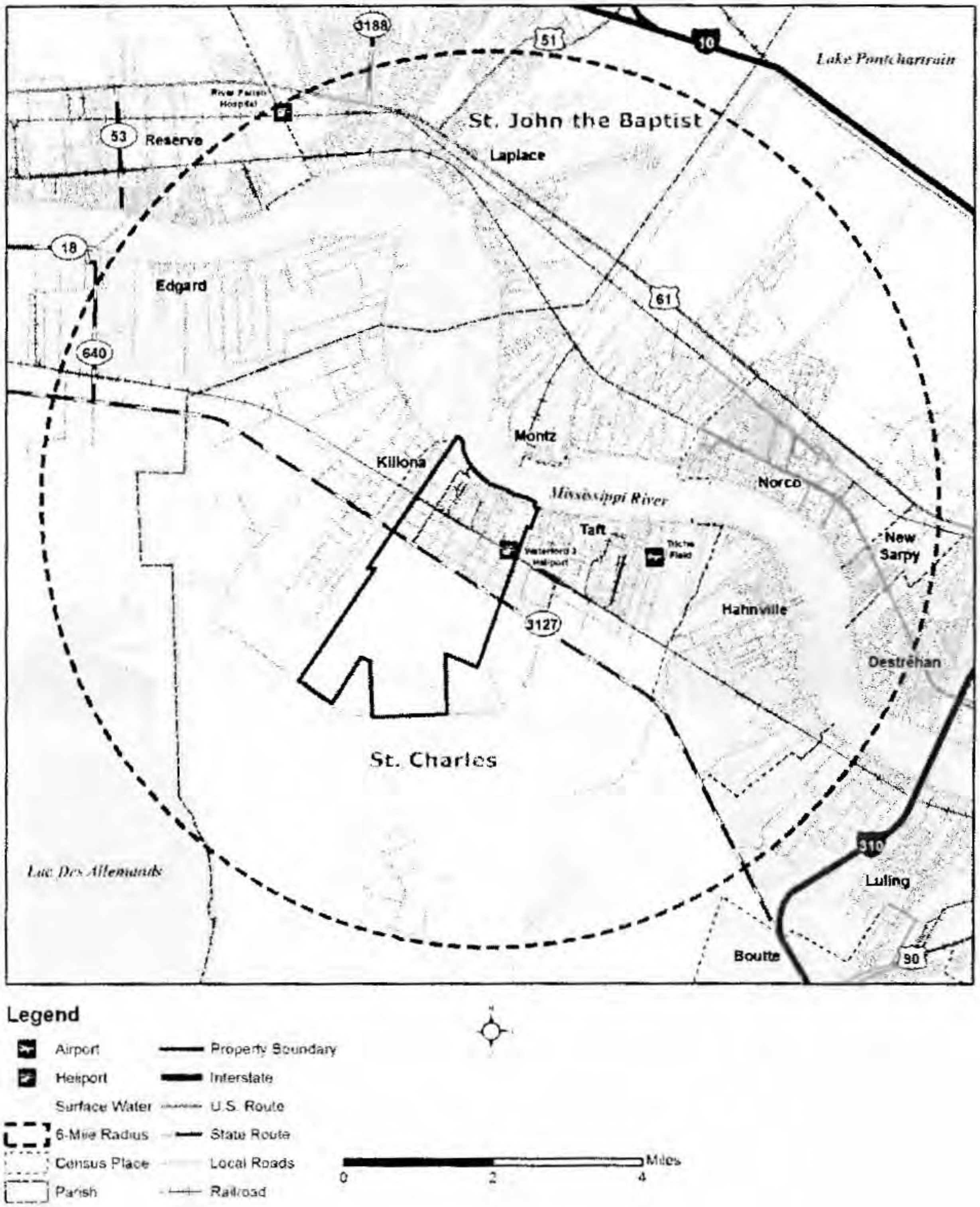
NRHP-Listed Properties within a 6-Mile Radius of WF3

Parish	Resource Name	Quadrangle	NRHP Listed	Distance from WF3[a]
St. Charles	Dorvin House, Mollere House, Rosedon	Hahnville	1990	3.1 mi
St. Charles	Homeplace Plantation House, Keller Homestead	Hahnville	1970	4.1 mi
St. Charles	Kenner and Kugler Cemeteries Archaeological District (16SC50 and 16SC51)	Laplace	1987	2.0 mi[b]
St. Charles	Ormond Plantation House	Hahnville	1990	5.8 mi
St. John the Baptist	Haydel-Jones House	Reserve	2010	6.0 mi
St. John the Baptist	Montegut Plantation House	Laplace	1988	4.4 mi
St. John the Baptist	Sorapuru House	Reserve/Laplace	1999	3.9 mi

a. Distances are approximate and based on the WF3 reactor center point and NRHP location data.

b. The NRHP lists Kenner and Kugler Cemeteries as "address restricted." The distance given was created using GIS to compare the two cemetery locations and background landmarks depicted in the February 8, 2012, USACE Bonnet Carre Public Meeting - Long Term Management Report to a USGS topographic map. An approximate equidistant point was placed between the two locations to estimate distance.

Figure 1
Location of Entergy Property, 6-Mile Radius



Attachment 1

Phase 1A Literature Review and Archaeological Sensitivity Assessment of the Waterford Steam Electric Station Unit 3

The attachment noted here that was sent to the Louisiana Historic Preservation Office is not enclosed because it contains sensitive information.

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 1, 2015

Ms. Kimberly Walden
Tribal Historic Preservation Officer
Chitimacha Tribe of Louisiana
Post Office Box 661
Charenton, LA 70523

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00055

Dear Ms. Walden,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the WF3 site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid.

Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

WF3 is located on approximately 3,560 acres of Entergy owned land (Figure 1) that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish, with the exception of the property south of LA-3127. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the Entergy property.

Entergy does not expect WF3 operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of WF3 during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

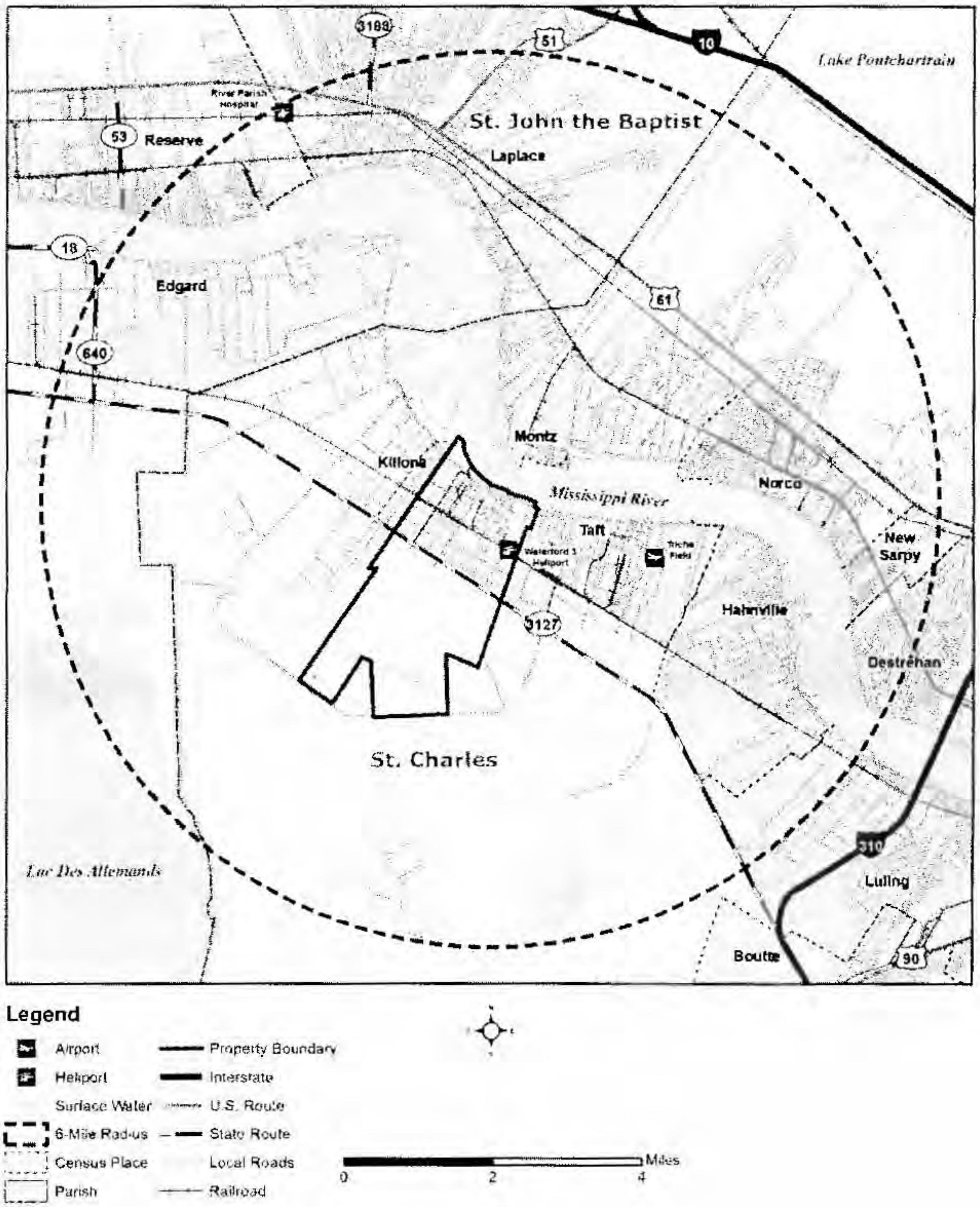
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 1, 2015

Dr. Linda Langley
Tribal Historic Preservation Officer
Coushatta Tribe of Louisiana
Post Office Box 10
Elton, LA 70532

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00056

Dear Dr. Langley,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the WF3 site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid.

Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

WF3 is located on approximately 3,560 acres of Entergy owned land (Figure 1) that consists primarily of wetlands, agriculture, and developed areas. The WF3 plant area itself covers 40.1 acres and is zoned as an industrial area by St. Charles Parish, with the exception of the property south of LA-3127. The land in the vicinity of the WF3 site is mostly wetlands. Transmission lines that connect WF3 to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the WF3 operating license are located entirely within the Entergy property.

Entergy does not expect WF3 operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of WF3 would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of WF3 during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

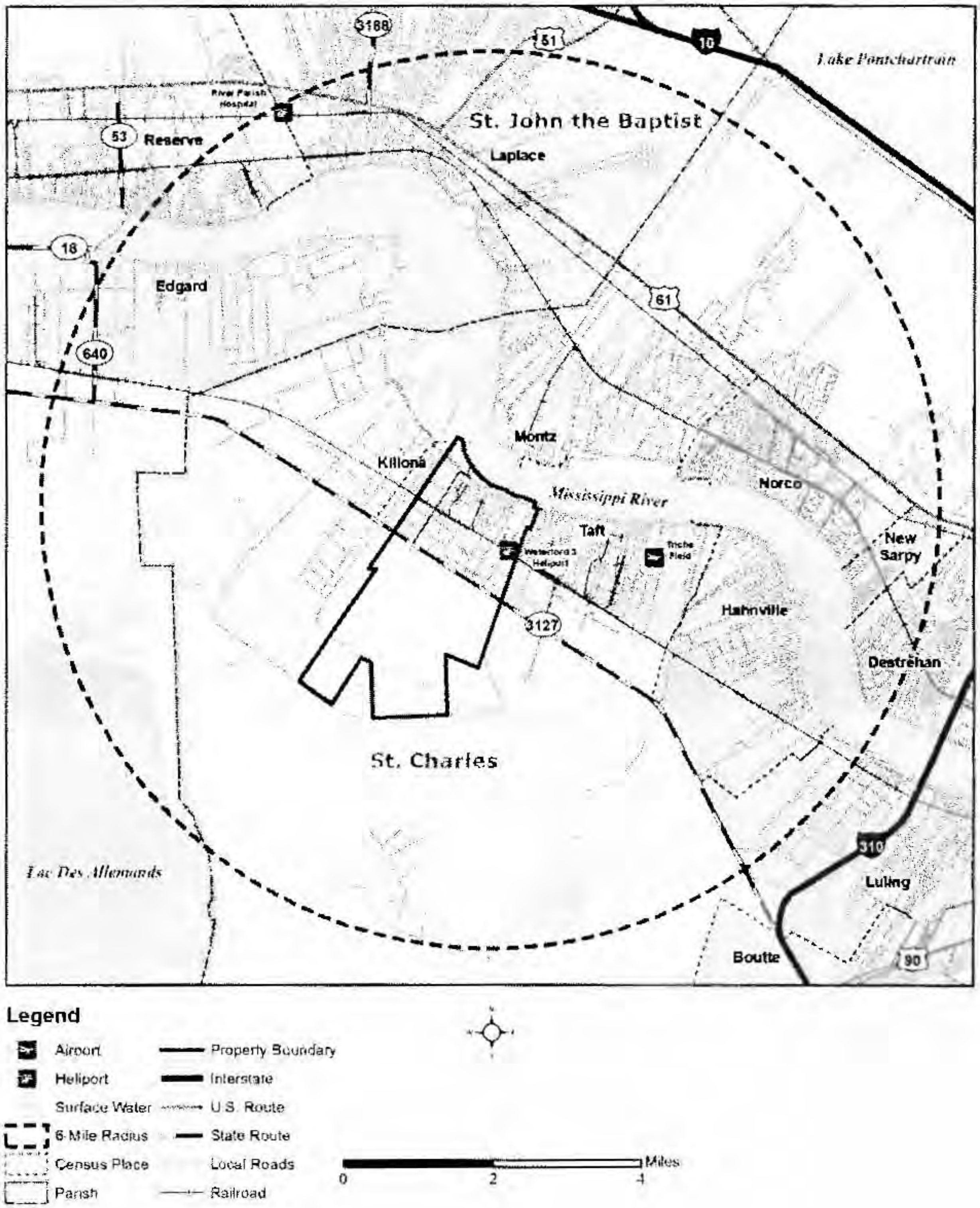
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 1, 2015

Ms. Alina Shively
Deputy Tribal Historic Preservation Officer
Jena Band of Choctaw Indians
Post Office Box 14
Jena, LA 71342

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00057

Dear Ms. Shively,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for WF3 include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the WF3 site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid.

Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

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After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where WF3 is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of WF3 during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the WF3 license renewal application.

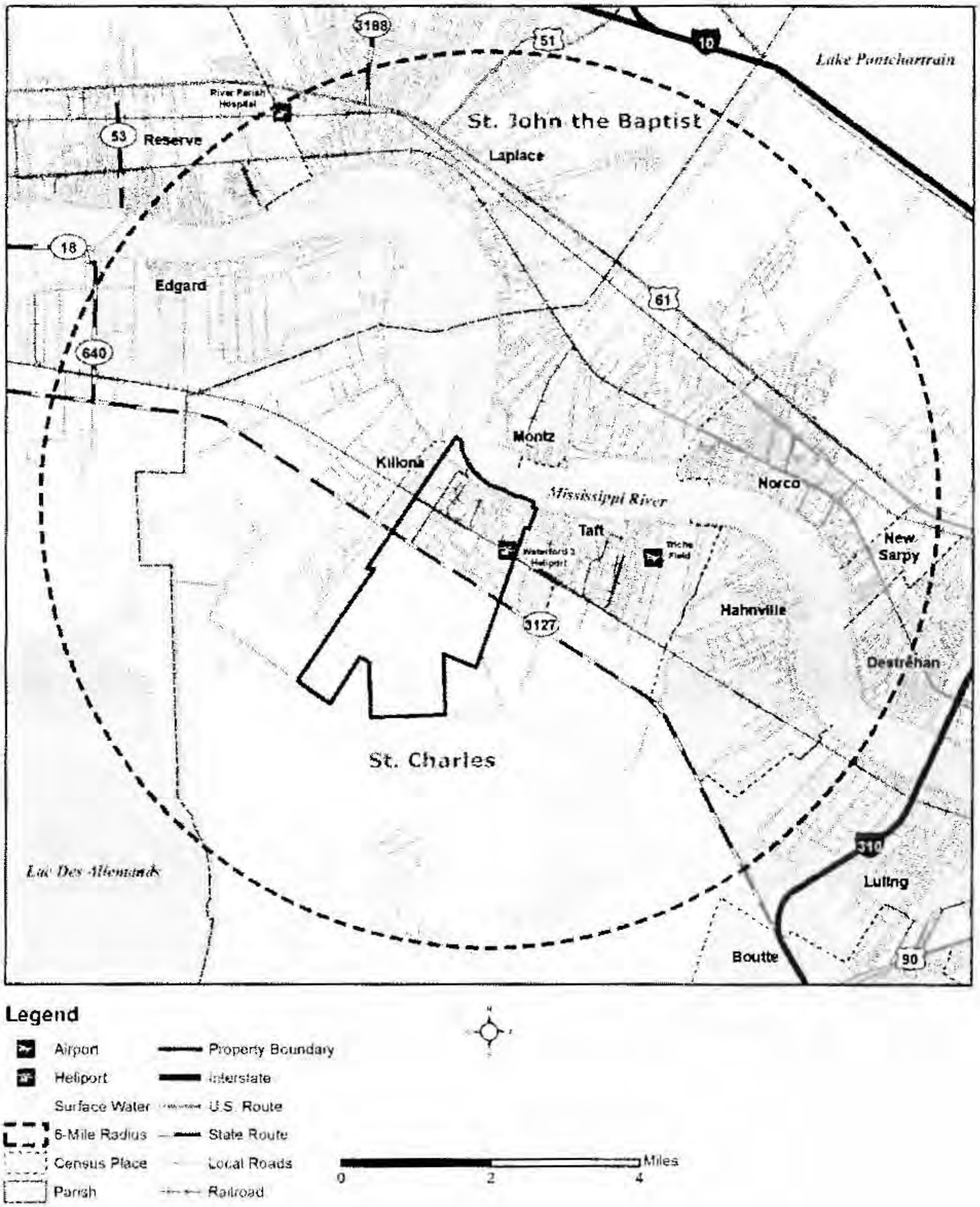
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 1, 2015

Mr. Earl J. Barbry, Jr
Tribal Historic Preservation Officer
Tunica-Biloxi Tribe of Louisiana
Post Office Box 1589
Marksville, LA 71351

SUBJECT: Waterford 3 Steam Electric Station Unit 3
License Renewal Application

CEO 2015-00058

Dear Mr. Barbry,

In 2016, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the Waterford Steam Electric Station Unit 3 (WF3), which is located in St. Charles Parish, Louisiana on the west (right descending) bank of the Mississippi River at River Mile 129.6, approximately 25 miles west of New Orleans, Louisiana and 50 miles southeast of Baton Rouge, Louisiana. The existing operating license for WF3 was issued for a 40-year term that expires in 2024. If the NRC approves the application, Entergy will then have the option to continue operating WF3 until 2044. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

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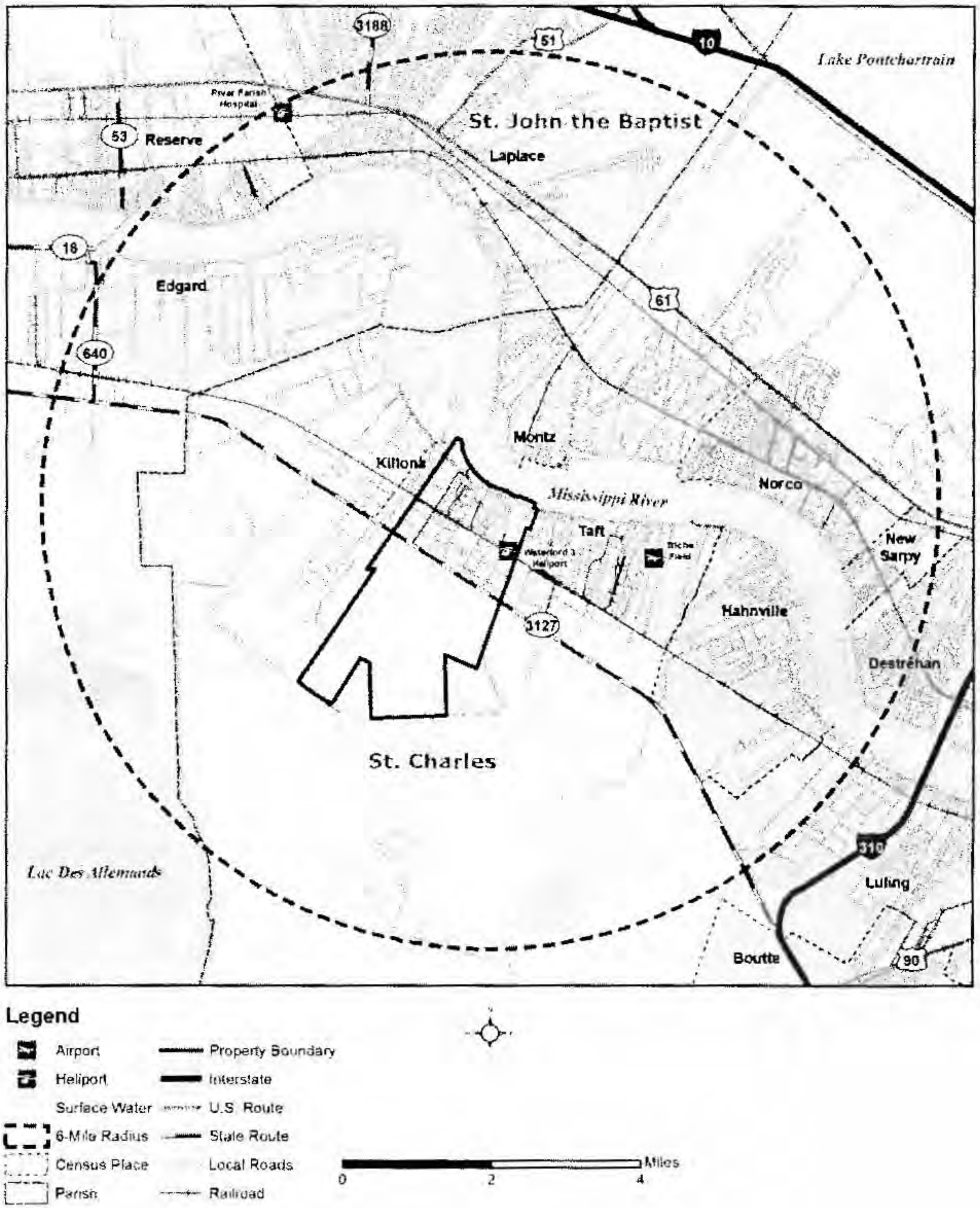
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



COUSHATTA TRIBE

OF LOUISIANA

HERITAGE DEPARTMENT

June 5, 2015

Rick Buckley
Entergy Service, Inc
1340 Echelon Parkway
Jackson Mississippi 39213

Subject: Waterford 3 Steam Electric Station Unit 3, License Renewal Application

Dear Mr. Buckley

The Coushatta Tribe of Louisiana Heritage Department has reviewed the above reference proposed undertaking, and we are in concurrence with your findings of "no historical properties affected".

At this time, I know of no known sacred or ceremonial sites in the immediate area, and do not require further Section 106 consultation on this project. However, if any cultural resources such as, bone, pottery, stone tools, etc., are found subsequently, we may elect to discuss additional mitigation steps, including on-site monitoring. In the event that archaeological properties or human remains are discovered, please stop work and contact us immediately, consistent with Section IX of the Nationwide Programmatic Agreement and applicable laws.

Sincerely,

Jill Crawford

Jill Crawford,
Section 106 Coordinator

KOWASSAATON NATHIHILKAS--LET US SPEAK KOASATI

337-584-1560 337-584-1616 (FAX) PO BOX 10 ELTON, LA 70532

JAY DARDENNE
LIEUTENANT GOVERNOR

State of Louisiana

OFFICE OF THE LIEUTENANT GOVERNOR
DEPARTMENT OF CULTURE, RECREATION & TOURISM
OFFICE OF CULTURAL DEVELOPMENT

CHARLES R. DAVIS
DEPUTY SECRETARY

PAM BREAUX
ASSISTANT SECRETARY

8 June 2015

Rick Buckley
Sr. Project Manager
Entergy Services, Inc.
1340 Echelon Parkway
Jackson, MS 39213

Re: Draft Report
La Division of Archaeology Report No. 22-4955
Phase 1A Literature Review and Archaeological Sensitivity Assessment of the Waterford Steam Electric Station Unit 3, Killona, St. Charles Parish, Louisiana

Dear Mr. Buckley:

We acknowledge receipt of your letter dated 1 June 2015 and one copy of the above referenced report. We have completed our review of this report and have no comments to offer.

The above-referenced report provides a thorough and sufficient evaluation of the known and potential cultural resources on the Waterford 3 property. As noted in the report and attached to it, the facility has an existing Cultural Resources Protection Plan with our office and we believe this plan will be appropriate in the future. We concur that the operation of Waterford 3 during the license renewal term will have no effect on known historic properties.

We look forward to receiving two bound copies of the final report along with a pdf of the report. If you have any questions, please contact Chip McGimsey in the Division of Archaeology by email at cmcgimsey@crt.la.gov or by phone at 225-219-4598.

Sincerely,

Pam Breaux

Pam Breaux
State Historic Preservation Officer

PB:crm

P.O. BOX 44247 • BATON ROUGE, LOUISIANA 70804-4247 • PHONE (225) 342-8200 • FAX (225) 219-9772 • WWW.CRT.STATE.LA.US

From: Alina Shively <ashively@jenachoctaw.org>
Sent: Wednesday, July 15, 2015 11:32 AM
To: BUCKLEY, RICKY N
Subject: RE: Waterford 3 Steam Station Unit 3, License Renewal; CEO 2015-00057

Dear Sir:

After researching the site files, it seems this location is on top of a prehistoric site that is considered ineligible. Several artifacts were found at the site, per the state's documentation and record; however, we hereby offer the determination of No Adverse Effect. Should any inadvertent discoveries of cultural resources occur, please contact our office immediately. Thank you.

Sincerely,

Alina J. Shively
Jena Band of Choctaw Indians
Deputy Tribal Historic Preservation Officer
P.O. Box 14
Jena, LA 71342
(318) 992-1205
ashively@jenachoctaw.org

From: BUCKLEY, RICKY N [mailto:RBUCKLE@entergy.com]
Sent: Tuesday, July 14, 2015 4:39 PM
To: Alina Shively <ashively@jenachoctaw.org>
Subject: RE: Waterford 3 Steam Station Unit 3, License Renewal; CEO 2015-00057

Alina,

The coordinates for Waterford 3 are "latitude 30 degrees, 45 minutes, 26 seconds north;
longitude 91 degrees, 19 minutes, 54 seconds west.

The conversion to decimal degrees is 30.757222 and -91.331666. The site will fall in the
correct location when you run it in google earth.

Please let me know if this satisfies your requests or if you need additional information.

Thanks,

Rick Buckley, CHMM, REM
Sr. Project Manager
Entergy Nuclear
Post Office Box 31995
Jackson, MS 39286-1995
601-368-5823 (Office)
601-927-5132 (Cellular)
601-368-5812 (Fax)
rbuckle@entergy.com

From: Alina Shively [mailto:ashively@jenachoctaw.org]
Sent: Tuesday, July 14, 2015 3:25 PM
To: BUCKLEY, RICKY N
Subject: Waterford 3 Steam Station Unit 3, License Renewal; CEO 2015-00057

Dear Sir:

Regarding the above-mentioned project, the Jena Band of Choctaw Indians' requests GPS coordinates, so that we may check the state site files. We request this information in order to properly comment.

Sincerely,

Alina J. Shively
Jena Band of Choctaw Indians
Deputy Tribal Historic Preservation Officer
P.O. Box 14
Jena, LA 71342
(318) 992-1205
ashively@jenachoctaw.org

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

Ms. Pam Breaux
Office of Historic Preservation
Division of Historic Preservation
Post Office Box 44247
Baton Rouge, LA 70804

SUBJECT: La Division of Archaeology Report No. 22-4955
Phase IA Literature Review and Archaeological Sensitivity Assessment of the Waterford Steam Electric Station Unit 3, Killona, St. Charles Parish, Louisiana

Dear Ms. Breaux,

As requested in June 8, 2015 letter, enclosed are two bound copies of the final Phase IA Literature Review and Archaeological Sensitivity Assessment of the Waterford Steam Electric Station Unit 3 report along with a pdf copy of the report.

If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

The Final Report has been reviewed and accepted.

Phil Boggan 15 July 2015
Phil Boggan Date
Deputy State Historic Preservation Officer

Attachment D

Severe Accident Mitigation Alternatives Analysis

Attachment D

Severe Accident Mitigation Alternatives Analysis

Attachment D contains the following sections:

D.1 – Evaluation of Probabilistic Risk Analysis Model

D.2 – Evaluation of WF3 SAMA Candidates

Table of Contents

List of Tables

List of Acronyms

Acronym	**Definition**
ABWR	Advanced Boiling Water Reactor
AC	Alternating Current
ACCW	Auxiliary Component Cooling Water
ADV	Atmospheric Dump Valve
AFW	Auxiliary Feedwater
AMSAC	ATWS Mitigating System Actuation Circuit
AOV	Air-Operated Valve
ASME	American Society of Mechanical Engineers
ATWS	Anticipated Transient Without Scram
BWR	Boiling Water Reactor
CCF	Common Cause Failure
CCW	Component Cooling Water
CDF	Core Damage Frequency
CET	Containment Event Tree
CFC	Containment Fan Coolers
CHR	Containment Heat Removal
COE	Cost of Enhancement
CS	Containment Spray
CSP	Condensate Storage Pool
CSS	Containment Spray System
CST	Condensate Storage Tank
DC	Direct Current
DCH	Direct Containment Heating
DG	Diesel Generator
DWST	Demineralized Water Storage Tank
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EFW	Emergency Feedwater
EOOS	Equipment Out of Service
EOP	Emergency Operating Procedure
EPRI	Electrical Power Research Institute
EPU	Extended Power Uprate
EPZ	Emergency Planning Zone
ERFBS	Electric Raceway Fire Barrier System
ESF	Engineered Safety Features
ESFAS	Engineered Safety Features Actuation System
ETE	Evacuation Time Estimates
FIVE	Fire Induced Vulnerability Evaluation
FP	Fission Product
FPS	Fire Protection System
FW	Feedwater
FWCS	Feedwater Control System
HEAF	High Energy Arcing Fault
HPCI	High Pressure Coolant Injection
HPSI	High Pressure Safety Injection
HVAC	Heating Ventilation and Air Conditioning

Acronym	Definition
IA	Instrument Air
ILRT	Integrated Leak Rate Test
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISLOCA	Interfacing Systems Loss of Coolant Accident
L1	Level 1
L2	Level 2
LAR	License Amendment Request
LERF	Large Early Release Frequency
LOCA	Loss of Coolant Accident
LOOP or LOSP	Loss of Off-site Power
LPSI	Low Pressure Safety Injection
MAAP	Modular Accident Analysis Program
MACCS2	Melcor Accident Consequences Code System 2
MCCI	Molten Corium-Concrete Interaction
MCR	Main Control Room
MDAFW	Motor-Driven Auxiliary Feedwater
MOV	Motor-Operated Valve
MSIV	Main Steam Isolation Valve
MSL	Mean Sea Level
MSLB	Main Steam Line Break
MSSV	Main Steam Safety Valve
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OECR	Off-site Economic Cost Risk
OSP	Off-site Power
PDR	Population Dose Risk
PDS	Plant Damage State
PORV	Pressure-Operated Relief Valve
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PWR	Pressurized Water Reactor
RAS	Recirculation Actuation System
RCIC	Reactor Core Isolation Cooling
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RRW	Risk Reduction Worth
RWSP	Refueling Water Storage Pool
RWST	Refueling Water Storage Tank
SAMA	Severe Accident Mitigation Alternative
SAMDA	Severe Accident Mitigation Design Alternative
SAMG	Severe Accident Management Guideline
SBO	Station Blackout
SCV	Steel Containment Vessel
SDC	Shutdown Cooling

Acronym	**Definition**
SER	Safety Evaluation Report
SG	Steam Generator
SGTR	Steam Generator Tube Rupture
SI	Safety Injection
SIS	Safety Injection System
SMA	Seismic Margin Assessment
SPDS	Safety Parameter Display System
SQUG	Seismic Qualification Utility Group
SRV	Safety Relief Valve
SSC	Systems, Structures, and Components
SSEL	Safe Shutdown Equipment List
SUPS	Static Uninterruptible Power Supply
SW	Service Water
TDAFP	Turbine-Driven Auxiliary Feedwater Pump
TDEFW	Turbine-Drive Emergency Feedwater
UHS	Ultimate Heat Sink
VB	Vessel Breach
WCT	Wet Cooling Tower
WF3	Waterford Steam Electric Station Unit 3
WinMACCS	Windows Melcor Accident Consequences Code System

Attachment D.1

Evaluation of Probabilistic Safety Analysis Model

D.1 EVALUATION OF PROBABILISTIC SAFETY ANALYSIS MODEL

The severe accident risk was estimated using the Probabilistic Safety Analysis (PSA) model and a Level 3 model developed using the most recent version (version 3.10.0) of the Windows Melcor Accident Consequences Code System (WinMACCS code). The CAFTA code was used to develop the Waterford 3 (WF3) PSA Level 1 and Level 2 models. This section provides descriptions of the WF3 PSA levels 1, 2, and 3 analyses, Core Damage Frequency (CDF) uncertainty, Individual Plant Examination of External Events (IPEEE) and NFPA 805 analyses, and PSA model peer review.

D.1.1 PSA Model – Level 1 Analysis

The SAMA analysis was performed using the most recent WF3 internal events risk models (Level 1 and Level 2). The Level 1 model is documented in PSA-WF3-01-QU [D.1-1] and the Level 2 model is documented in PSA-WF3-01-L2-01 [D.1-2]. The WF3 model adopts the small event tree / large fault tree approach and uses the CAFTA code for quantifying risk.

The PSA model has had four major revisions since the IPE due to the following:

Modeling changes – The PSA model was updated with the latest information

Power Uprate – Several different analyses were conducted to reflect the Extended Power Update (EPU) plant.

Modeling Updates – The PSA model was refined to incorporate the latest state of knowledge and recommendations from internal and industry peer reviews.

The internal events PRA model contains the major initiators leading to core damage with baseline CDFs listed in Table D.1-1.

The WF3 Level 1 Model was reviewed to identify those potential risk contributors that made a significant contribution to CDF. CDF-based Risk Reduction Worth (RRW) rankings were reviewed down to 1.005. Events below this point would influence the CDF by less than 0.5% and are judged to be highly unlikely contributors for the identification of cost-beneficial enhancements. These basic events; including component failures, operator actions, and initiating events, were reviewed to determine if additional SAMA actions may need to be considered.

Table D.1-2 provides a correlation between the Level 1 RRW risk significant events (component failures, operator actions, and initiating events) down to 1.005 identified from the WF3 PSA model and the SAMAs evaluated in Section D.2.

Table D.1-1

WF3 Model CDF Results by Major Initiators

Initiating Event Group	Total IE Group Probability	% CDF
LARGE LOCA	4.87E-09	0.05%
AOV SI-405A DISK RUPTURE WHILE INDICATING CLOSED (YEAR)	2.22E-10	0.00%
AOV SI-405B DISK RUPTURE WHILE INDICATING CLOSED (YEAR)	2.22E-10	0.00%
SI CHECK VALVE 335A RUPTURE (PER YEAR)	1.59E-11	0.00%
SI CHECK VALVE 336B RUPTURE (PER YEAR)	1.59E-11	0.00%
SI CHECK VALVE 336A RUPTURE (PER YEAR)	1.59E-11	0.00%
SI CHECK VALVE 336B RUPTURE (PER YEAR)	1.59E-11	0.00%
CCF OF 2 FWIVs FAIL TO REMAIN OPEN	3.39E-09	0.03%
INADVERTENT OPEN RELIEF VALVE	4.80E-07	4.58%
Medium LOCA	3.75E-08	0.36%
SI MOV 401A RUPTURES (PER YEAR)	2.22E-10	0.00%
SI MOV 401B RUPTURES (PER YEAR)	2.22E-10	0.00%
Steam Generator Tube Rupture	1.03E-07	0.98%
RCP SEAL LOCA	9.31E-08	0.89%
Small LOCA	9.49E-07	9.04%
Reactor Trip (General Transient)	1.18E-07	1.13%
Loss of Condenser Heat Sink	2.51E-08	0.24%
Turbine Trip (General Transient)	1.95E-07	1.86%

Initiating Event Group	Total IE Group Probability	% CDF
Loss of Main Feedwater	9.86E-08	0.94%
Loss of Offsite Power	4.42E-06	42.14%
Steam Line Break / Leak Inside Containment	4.05E-10	0.00%
Steam Line Break Outside Containment or Inadvertent Closure of MSIVs	3.57E-08	0.34%
Feedwater Line Break / Leak	5.63E-08	0.54%
Loss of Condensate System	6.30E-08	0.60%
Loss of CCW System	4.97E-08	0.47%
CCW Loss to RCPs Only Initiator	6.30E-09	0.06%
Loss Of 6.9KV Bus A	3.45E-09	0.03%
Loss Of 6.9KV Bus B	4.18E-09	0.04%
LOSS OF 4.16KV BUS 3A3-S	8.79E-07	8.38%
LOSS OF 4.16KV BUS 3B3-S	2.53E-06	24.13%
LOSS OF 480V BUS 3A31-S	2.75E-08	0.26%
LOSS OF 480V BUS 3B31-S	2.86E-08	0.27%
LOSS OF 480 V BUS 3AB31-S	7.87E-08	0.75%
LOSS OF 480V MCC 3AB311-S	1.44E-09	0.01%
Loss of DC Bus A IE	6.94E-08	0.66%
Loss of DC Bus B IE	8.17E-08	0.78%
Loss of DC Bus AB IE	3.08E-10	0.00%

Initiating Event Group	Total IE Group Probability	% CDF
Loss Of PDP 3014-AB IE	3.02E-10	0.00%
Loss of DC Bus TGB IE	6.18E-11	0.00%
Loss of Instrument Air System	1.16E-08	0.11%
Loss of Turbine Cooling Water System	1.78E-09	0.02%
Reactor Vessel Rupture Initiator	3.20E-08	0.30%
Total CDF	**1.05E-05**	**100.0%**
Total ATWS[1]	≈ 1.45E-07	1.38%
Total SBO[1]	≈ 3.61E-06	34.37%

Note 1: SBO and ATWS may occur following multiple initiators, thus their contributions to CDF are listed separately.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
#RX	1.00E+00	1.0087	RX Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#SBO	1.00E+00	1.5237	SBO Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#SU	1.00E+00	1.0287	SU Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#SX	1.00E+00	1.1318	SX Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#TB	1.00E+00	1.49	TB Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#TK	1.00E+00	1.014	ATWS Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#TQX	1.00E+00	1.1767	TQX Sequence Marker	This term is a flag. No SAMAs need to be aligned.
%IORV	1.83E-03	1.048	INADVERTENT OPEN RELIEF VALVE <INITIATOR>	This term represents an inadvertent open relief valve, which has similar consequences as a small LOCA. Phase II SAMAs 13 and 18 for reducing the frequency of core melt from a small LOCA were evaluated.
%R	2.07E-03	1.0099	Steam Generator Tube Rupture	This term represents a steam generator tube rupture (SGTR). Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
%RCP	3.67E-04	1.009	RCP SEAL LOCA <INITIATOR>	This term represents a Reactor Coolant Pump (RCP) seal LOCA. Phase II SAMAs 57, 59, 25, 26 and 27 for reducing the likelihood of an RCP seal LOCA were evaluated.
%S	3.50E-03	1.0995	Small LOCA	This term represents a small LOCA. Phase II SAMAs 13 and 18 for reducing the frequency of core melt from a small LOCA were evaluated.
%T1	2.12E-01	1.0114	Reactor Trip (General Transient)	This term represents a general transient reactor trip. Phase II SAMA 20 for elimination of ECCS dependency on component cooling system; SAMAs 22, 23, 24, and 25 for increased availability of cooling water; and SAMAs 14, 15, and 17 for improved core injection capability were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
%T3	2.17E-01	1.0189	Turbine Trip (General Transient)	This term represents a general transient turbine trip. Phase II SAMA 20 for elimination of ECCS dependency on component cooling system; SAMAs 22, 23, 24, and 25 for increased availability of cooling water; SAMAs 14, 15, and 17 for improved core injection capability were evaluated.
%T4	7.96E-02	1.0095	Loss of Main Feedwater	This term represents a loss of Main Feedwater. Phase II SAMAs 31, 32, and 33 for increased feedwater availability; and SAMA 34 for improved feedwater supply were evaluated.
%T5	2.62E-02	1.7282	Loss of Offsite Power	This term represents a loss of offsite power (LOOP). Phase II SAMAs 13 and 24 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
%T7	1.83E-03	1.0054	Feedwater Line Break / Leak	This term represents a feedwater line break or leak. Phase II SAMAs 32 and 33 for increased feedwater availability; and SAMA 34 for improved feedwater supply were evaluated.
%T8	2.52E-02	1.006	Loss of Condensate System	This term represents a loss of the condensate system. Phase II SAMA 32 to create ability for emergency connection of existing or new water sources to feedwater and condensate systems was evaluated.
%TAC3	2.18E-03	1.0914	LOSS OF 4.16KV BUS 3A3-S	This term represents a loss of 4.16kV power to bus 3A3-S. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated.
%TAC4	2.18E-03	1.318	LOSS OF 4.16KV BUS 3B3-S	This term represents a loss of 4.16kV power to bus 3B3-S. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated.
%TAC7	5.22E-04	1.0076	LOSS OF 480 V BUS 3AB31-S	This term represents a loss of a 480 VAC bus 3AB31-S. Phase II SAMA 13 to install an independent active or passive high pressure injection system; and phase II SAMAs 35 and 36 to enhance HVAC were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
%TDC1	1.84E-04	1.0067	Loss of DC Bus A IE	This term represents a loss of DC bus A. Phase II SAMAs 1, 2 and 3 for improving DC power availability were evaluated.
%TDC2	1.84E-04	1.0078	Loss of DC Bus B IE	This term represents a loss of DC bus B. Phase II SAMAs 1, 2 and 3 for improving DC power availability were evaluated.
AABATT3ABD	1.00E+00	1.8819	Battery life extended and battery drain occurs	This term is a flag for successful battery load shedding. No SAMAs need to be aligned.
AACSPEMPTY	1.00E+00	1.0119	CSP is Empty Flag	This term is a flag. No SAMAs need to be aligned.
AALOSPEVTB	1.00E+00	1.4935	Logic flag that indicates Loss of all SG Feed Water (LOSP recovery Flag)	This term is a flag. No SAMAs need to be aligned.
AA_FAIL3AS	1.00E+00	1.7326	Logic flag that indicates that DG/TEDG to 3A3-S has failed (LOSP recovery Flag	This term is a flag. No SAMAs need to be aligned.
AA_FAIL3BS	1.00E+00	1.775	Logic flag that indicates that DG/TEDG to 3B3-S has failed (LOSP recovery Flag	This term is a flag. No SAMAs need to be aligned.
A_TO_AB	5.00E-01	1.0137	AB ELECTRIC POWER IS ALIGNED TO A TRAIN	This term is a flag. No SAMAs need to be aligned.
B_TO_AB	5.00E-01	1.0381	AB ELECTRIC POWER IS ALIGNED TO B TRAIN	This term is a flag. No SAMAs need to be aligned.
CCWABSTBY	3.30E-01	1.0717	CC Pump AB in standby	This term is a flag. No SAMAs need to be aligned.
CCWASTBY	3.30E-01	1.0715	CC Pump A in standby	This term is a flag. No SAMAs need to be aligned.
DHFBAT_LSP	1.00E+00	1.2475	Operators fail to shed battery loads for A or B or AB battery	This term represents a failure of bus load shedding to extend battery depletion time. Phase II SAMAs 1, 2 and 3 for improving DC power availability were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
EB1003A3SF	3.34E-05	1.0087	BUS 3A3-S FAULT	This term represents a loss of 4.16kV power to bus 3A3-S. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated.
EB1003B3SF	3.34E-05	1.0201	BUS 3B3-S FAULT	This term represents a loss of 4.16kV power to bus 3B3-S. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated.
ECB0002A1D	2.39E-03	1.0201	AC BREAKER 0002A1 FAILS TO OPERATE	This term represents a failure of breaker 0002A1 which fails bus 3A2. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ECB0002A4D	2.39E-03	1.0201	AC BREAKER 0002A4 FAILS TO OPERATE	This term represents a failure of breaker 0002A4 which fails bus 3A2. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ECB0002B1D	2.39E-03	1.0232	AC BREAKER 0002B1 FAILS TO OPERATE	This term represents a failure of breaker 0002B1 which fails bus 3B2. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ECB0002B4D	2.39E-03	1.0232	AC BREAKER 0002B4 FAILS TO OPERATE	This term represents a failure of breaker 0002B4 which fails bus 3B2. Phase II SAMAs 5 and 7 for increased availability of on-site AC power and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ECB312A8MD	2.39E-03	1.0278	A312 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3A-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.
ECB312B8MD	2.39E-03	1.0261	B312 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3B-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
ECB313A8MD	2.39E-03	1.0278	A313 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3A-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.
ECB313B8MD	2.39E-03	1.0261	B313 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3B-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.
ECB314A2MD	2.39E-03	1.0278	A314 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3A-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.
ECB314B2MD	2.39E-03	1.0261	B314 ASSOCIATED CIRCUITS FAIL TO STRIP ON DEMAND	This term represents a breaker failure that leads to DG 3B-S failing to start. Phase II SAMAs 5, 6, 7, and 10 for increased availability of AC power were evaluated.
ECC000SUTF	1.60E-04	1.0177	CCF 2 OF 2 SUT FAIL TO PROVIDE OUTPUT	This term represents a loss of startup transformers. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ECCDGNORUN	7.20E-05	1.0108	CCF DIESEL GENERATORS FAIL TO RUN	This term represents the diesel generators failing to run. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
ECCDGSTART	1.92E-05	1.0059	CCF DIESEL GENERATORS FAIL TO START	This term represents the diesel generators failing to start. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
ECCFOXFRA	1.41E-04	1.0454	CCF Diesel Fuel Oil Transfer Pumps Fail to Start	This term represents a loss of Diesel Fuel Oil, which leads to loss of DGs A and B. Phase II SAMAs 5, 6, 7, 10, and 11 for increased availability of AC power were evaluated.
EDG0DG3ASAE	1.56E-03	1.0178	DIESEL GENERATOR 3A-S FAILS TO START	This term represents a failure of DG 3A-S to start. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
EDG0DG3ASFE	5.48E-03	1.0381	DIESEL GENERATOR 3A-S FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure of DG 3A-S to run after the first hour of operation. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
EDG0DG3BSAE	1.56E-03	1.0167	DIESEL GENERATOR 3B-S FAILS TO START	This term represents a failure of DG 3B-S to start. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
EDG0DG3BSFE	5.48E-03	1.0371	DIESEL GENERATOR 3B-S FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure of DG 3B-S to run after the first hour of operation. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
EHFALNAB_P	1.00E+00	1.0481	Failure to energize bus 3AB3-S from bus opposite initial supply--recovery flag	This term represents a failure of a human action to energize bus AB3-S from bus opposite initial supply. Phase II SAMAs 6, 7, and 10 for increased availability of on-site and offsite power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated. In addition, the failure of this human action causes a loss of battery power due to a loss of AC power in which phase II SAMAs 1 and 2 for improving DC power availability were evaluated.
EMFEXFANAA	8.42E-04	1.0094	MOTOR-DRIVEN FAN EXFANA FAILS TO START	This term represents a failure of the exhaust fan for DG 3A-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
EMFEXFANAF	1.04E-03	1.0068	MOTOR-DRIVEN FAN EXFANA FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure of the exhaust fan for DG 3A-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
EMFEXFANAL	1.07E-03	1.0121	MOTOR-DRIVEN FAN EXFANA FAILS TO RUN DURING FIRST HOUR OF OPERATION	This term represents a failure of the exhaust fan for DG 3A-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
EMFEXFANBA	8.42E-04	1.0089	MOTOR-DRIVEN FAN EXFANB FAILS TO START	This term represents a failure of the exhaust fan for DG 3B-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
EMFEXFANBF	1.04E-03	1.0066	MOTOR-DRIVEN FAN EXFANB FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure of the exhaust fan for DG 3B-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
EMFEXFANBL	1.07E-03	1.0113	MOTOR-DRIVEN FAN EXFANB FAILS TO RUN DURING FIRST HOUR OF OPERATION	This term represents a failure of the exhaust fan for DG 3B-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
EMPOILTRAA	5.68E-03	1.0695	Fuel Oil Transfer Pump EDG-MPMP-0001A Fails to Start	This term represents a loss of Diesel Fuel Oil, which leads to loss of DG 3A-S.Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
EMPOILTRBA	5.68E-03	1.0651	Fuel Oil Transfer Pump EDG-MPMP-0001B Fails to Start	This term represents a loss of Diesel Fuel Oil, which leads to loss of DG 3B-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
ETM00DG3AS	4.00E-03	1.0352	DIESEL GENERATOR 3A-S IN TEST OR MAINTENANCE	This term represents the unavailability of DG 3A-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
ETM00DG3BS	6.09E-03	1.0568	DIESEL GENERATOR 3B-S IN TEST OR MAINTENENCE	This term represents the unavailability of DG 3B-S. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
ETM_SUT-3A	1.75E-03	1.0142	STARTUP TRANSFORMER 3A IN TEST OR MAINTENANCE	This term represents a loss of a startup transformer 3A. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ETM_SUT-3B	1.75E-03	1.0165	STARTUP TRANSFORMER 3B IN TEST OR MAINTENANCE	This term represents a loss of a startup transformer 3B. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
HCCISOMNAC	1.11E-05	1.0062	CCF of SI-120A and 121A to Close After RAS	This term represents a failure to isolate HPSI pump recirculation lines after initiation of sump recirc. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HCCISOMNBC	1.11E-05	1.0062	CCF of SI-120B and 121B to Close After RAS	This term represents a failure to isolate HPSI pump recirculation lines after initiation of sump recirc. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
HCCPMPSBCF	1.46E-05	1.0084	CCF FOR HPSI PUMPS FAIL TO RUN	This term represents HPSI pumps failing to run. Phase II SAMAs 13 and 17 for decreasing HPSI pump CCF were evaluated and Phase II SAMA 12 for increasing the availability of charging which is a backup to HPSI was evaluated.
HCCSI0602N	1.04E-05	1.0058	CCF SI-602 FAIL TO OPEN ON RAS	This term represents a failure of HPSI pump recirculation. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
HHFALNAB_P	1.00E+00	1.0158	Failure to align standby HPSI pump to replace failed pump--recovery flag	This term represents a failure of a human action to align the standby HPSI pump to replace the failed pump. Phase II SAMAs 13 and 17 for enhancing the HPSI system by adding or enhancing the HPSI pumps were evaluated and Phase II SAMA 27 for increasing the availability of charging which is a backup to HPSI was evaluated.
HHFISOMINP	1.00E+00	1.0183	Failure to isolate HPSI pump recirculation lines after initiation of sump recirc	This term represents a failure of a human action to isolate HPSI pump recirculation lines after initiation of sump recirculation. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
HMVSI602AN	9.63E-04	1.0059	MOV-602A FAILS TO OPEN ON DEMAND	This term results in a failure of HPSI train A recirc mode. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
HMVSI602BN	9.63E-04	1.0053	MOV-602B FAILS TO OPEN ON DEMAND	This term results in a failure of HPSI train B recirc mode. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
HPIABISSTBY	3.30E-01	1.0051	HPSI AB IS ALIGNED AS STANDBY PUMP	This term is an alignment flag. No SAMAs need to be aligned.
HPIAISASTBY	3.30E-01	1.0067	HPSI A is the Standby pump for Train A (IPE)	This term is an alignment flag. No SAMAs need to be aligned.
HPIBISBSTBY	3.30E-01	1.0067	HPSI B is the standby pump for Train B (IPE)	This term is an alignment flag. No SAMAs need to be aligned.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
KMTC0	4.00E-01	1.0137	ADVERSE MTC (-1.145 MTC)	This term represents adverse MTC during an ATWS event. Phase II SAMAs 63, 64, 65, and 66 for improved reliability during an ATWS were evaluated.
KRTMECH	8.40E-07	1.014	FAILURE OF REACTOR TRIP (MECHANICAL)	This term represents a mechanical failure of the reactor to trip. Phase II SAMAs 63, 64, 65, and 66 for improved reliability during an ATWS were evaluated.
LOSP-EPRI	1.00E-03	1.0105	Conditional LOSP after a plant trip	This term is a loss of offsite power (LOOP) after a plant trip. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
OHFRCPTRIP	1.00E+00	1.177	Failure to trip RCPs following loss of seal cooling	This term represents a failure of a human action to trip the RCPs following a loss of seal cooling leading to a Reactor Coolant Pump (RCP) seal LOCA. Phase II SAMAs 23, 24, 25, 26, and 27 for reducing the likelihood of an RCP seal LOCA were evaluated.
QCC442234N	3.74E-06	1.0139	CCF 4 of 4 EFW AOVs 223A, 223B, 224A, 224B	This term represents a failure of EFW due to CCF valve failures. Phase II SAMAs 32, 33 and 34 for increased feedwater availability were evaluated.
QCC442289N	3.74E-06	1.0139	CCF 4 of 4 EFW AOVs 228A, 228B, 229A, 229B	This term represents a failure of EFW due to CCF valve failures. Phase II SAMAs 32, 33 and 34 for increased feedwater availability were evaluated.
QCCPMDPSSF	8.66E-05	1.0153	CCF EFW MDP FAIL TO RUN	This term represents a failure of EFW Motor driven pumps. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QCCPUMPSSF	1.33E-05	1.0518	CCF ALL EFW PUMPS FAIL TO RUN	This term represents a failure of all EFW pumps. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QHFCSPEMPP	1.00E+00	1.0052	Failure to supply makeup to CSP during EFW operation	This term represents failure of a human action to supply makeup to the CSP during EFW operation. This term is essentially a flag for the HFE and no combination or HFE with the associated probability are contained in the RRW tables. Phase II SAMA 32 is also evaluated for making the transfer of the condensate storage pool to the DWST automatic.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
QHFCSPWCTP	1.00E+00	1.0085	Failure to align EFW suction to WCT after CSP depletion	This term represents failure of a human action to align EFW suction to WCT after CSP depletion. This term is essentially a flag for the HFE and no combination or HFE with the associated probability are contained in the RRW tables. Phase II SAMA 32 is also evaluated for making the transfer of the condensate storage pool to the DWST automatic.
QMPEFPMPAAQ	5.75E-04	1.0068	MOTOR-DRIVEN PUMP EFW PMP A FAILS TO START	This term represents a failure to start of EFW pump A. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QMPEFPMPAF	2.83E-03	1.0354	MOTOR-DRIVEN PUMP EFW PMP A FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure to run of EFW pump A. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QMPEFPMPBAQ	5.75E-04	1.0068	MOTOR-DRIVEN PUMP EFW PMP B FAILS TO START	This term represents a failure to start of EFW pump B. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QTMEFWPPAM	6.27E-04	1.0067	EFW MDP A TRAIN UNAVAILABLE (MAINTENANCE)	This term represents unavailability of EFW pump A. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QTMEFWPPBM	6.27E-04	1.007	EFW MDP B TRAIN UNAVAILABLE (MAINTENANCE)	This term represents unavailability of EFW pump B. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QTP3PMPABF	3.06E-02	1.0974	TURBINE-DRIVEN PUMP 3PMPAB FAILS TO RUN AFTER FIRST HOUR OF OPERATION	This term represents a failure of the turbine-driven EFW pump. Phase II SAMAs 32, 33, and 34 for increased feedwater availability were evaluated.
QXVCMU142K	5.53E-04	1.0052	MANUAL VALVE CMU142 TRANSFERS CLOSED	This term represents the transfer closed of a manual valve that results in failure of the DWST to CSP flow path. Phase II SAMA 32 is evaluated for making the transfer of the condensate storage pool to the DWST automatic.
SAVCC413AN	9.51E-04	1.0107	AIR-OPERATED VALVE CC413A FAILS TO OPEN	This leads to a loss of Component Cooling Water (CCW) to DG 3A-S. Phase II SAMAs 8 and 9 for backup sources of diesel generator cooling were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
SAVCC413BN	9.51E-04	1.01	AIR-OPERATED VALVE CC-413B FAILS TO OPEN	This leads to a loss of Component Cooling Water (CCW) to DG 3B-S. Phase II SAMAs 8 and 9 for backup sources of diesel generator cooling were evaluated.
SCCPMPISON	1.85E-05	1.0104	CCF of ACCW Pump Discharge Isolation MOVs ACC-110A/B Fail To Open	This represents CCF of the ACCW pump discharge isolation valves. Phase II SAMAs 22 and 23 to decrease the importance of ACCW were evaluated.
SHFABCCWRP	1.00E+00	1.1549	Failure to align CCW train AB to replace lost train A or B	This term represents failure of a human action to align CCW train AB to replace lost train A or B. Phase II SAMAs 8, 9, 20, 23, and 27 to decrease the importance of and enhance the availability and reliability of the CCW system to provide cooling water were evaluated.
STMCCTRNBF	1.17E-03	1.015	CCW TRAIN B UNAVAILABLE DUE TO TEST/MAINTENANCE	This term represents unavailability of CCW train B. Phase II SAMAs 8, 9, 20, 23, and 27 to decrease the importance of and enhance the availability and reliability of the CCW system to provide cooling water were evaluated.
UCCEDGFANA	8.42E-05	1.0266	CCF EDG EXHAUST FANS FAIL TO START	This term represents a failure of the exhaust fans for both DGs. Phase II SAMAs 5, 6, 7, 10, and 13 for increased availability of AC power were evaluated.
UCCEDGFANF	1.07E-04	1.0161	CCF EDG EXHAUST FAN FAILS TO RUN	This term represents a failure of the exhaust fans for both DGs. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
UMCHV501AN	5.80E-04	1.0064	INLET DAMPER HVR-501A FAILS TO OPEN	This term represents a failure of room cooling for DG 3A-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
UMCHV501BN	5.80E-04	1.006	INLET DAMPER HVR-501B FAILS TO OPEN	This term represents a failure of room cooling for DG 3B-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
UTMFANA3AS	2.00E-03	1.0193	EDG EXHAUST FAN UNAVAILABLE DUE TO TEST OR MAINTENANCE	This term represents a failure of the exhaust fan for DG 3A-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
UTMFANB3BS	2.00E-03	1.0192	EDG EXHAUST FAN B IN TEST OR MAINTENANCE	This term represents a failure of the exhaust fan for DG 3B-S. Phase II SAMAs 5, 6, 7, 10, 11, and 13 for increased availability of AC power were evaluated.
XCCWCTSTRP	3.60E-05	1.0204	CCF ACCW BASIN STRAINERS PLUGGED	This represents CCF of the ACCW basin strainers. Phase II SAMAs 22, 23, 24, 25 and 26 to decrease the importance of ACCW were evaluated.
XMP3ACCWAAX	1.54E-03	1.0071	MOTOR DRIVEN PUMP ACCW-1A FAILS TO START	This represents a failure of MDP ACCW-1A. Phase II SAMAs 19, 21, 22, 23, 24, 25 and 26 to decrease the importance of ACCW were evaluated.
XMP3ACCWBAX	1.54E-03	1.0062	MOTOR DRIVEN PUMP ACCW-1B FAILS TO START	This represents a failure of MDP ACCW-1B. Phase II SAMAs 19, 21, 22, 23, 24, 25 and 26 to decrease the importance of ACCW were evaluated.
ZDHFBAT_LSP	8.40E-02	1.0398	Failure to shed loads on the A or B battery	This term represents a failure of a human action to perform bus load shedding. Phase II SAMAs 1, 2, and 3 for improving DC power availability were evaluated.
ZHF-C2-011	8.20E-04	1.1294	Failure to align CCW train AB to replace lost train A or B and failure to trip RCPs after loss of seal cooling (SHFABCCWRP * OHFRCPTRIP)	This term represents a failure of a human action to align CCW train AB to replace lost train A or B and failure to trip RCPs after loss of seal cooling. Phase II SAMAs 8, 9, 20, 23, and 27 to decrease the importance of and enhance the availability and reliability of the CCW system to provide cooling water were evaluated. Phase II SAMAs 24, 25, and 26 for reducing the likelihood of an RCP seal LOCA were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
ZHF-C2-052	1.20E-04	1.0128	Failure to trip RCPs or swap AB bus supply (OHFRCPTRIP * EHFALNAB_P)	This term represents a failure of a human action to trip RCPs or swap AB bus supply. Phase II SAMAs 23, 24, 25, 26, and 27 for reducing the likelihood of an RCP seal LOCA were evaluated. Phase II SAMAs 6, 7, and 10 for increased availability of on-site and offsite power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated. In addition, the failure of this human action causes a loss of battery power due to a loss of AC power in which phase II SAMAs 1 and2 for improving DC power availability were evaluated.
ZHF-C3-020	1.20E-04	1.0168	Failure to align CCW train AB to replace lost train A or B and failure to trip RCPs after loss of seal cooling and failure to energize bus 3AB3-S from bus opposite initial supply (SHFABCCWRP * OHFRCPTRIP * EHFALNAB_P)	This term represents a failure of a human action to align CCW train AB to replace lost train A or B and failure to trip RCPs after loss of seal cooling and failure to energize bus 3AB3-S from bus opposite initial supply. Phase II SAMAs 8, 9, 20, 23, and 27 to decrease the importance of and enhance the availability and reliability of the CCW system to provide cooling water were evaluated. Phase II SAMAs 24, 25, and 26 for reducing the likelihood of an RCP seal LOCA were evaluated. Phase II SAMAs 6, 7, and 10 for increased availability of on-site and offsite power and SAMAs 8, 9, and 11 for increased diesel generator availability were evaluated. In addition, the failure of this human action causes a loss of battery power due to a loss of AC power in which phase II SAMAs 1 and 2 for improving DC power availability were evaluated.
ZHFISOMINP	3.20E-05	1.0181	Failure to isolate HPSI pump recirculation lines after initiation of sump recirc	This term represents a failure of a human action to isolate HPSI pump recirculation lines after initiation of sump recirculation. Phase II SAMAs 29 and 30 for greater RWSP inventory were evaluated.
ZHFRCPTRIP	2.20E-03	1.0057	Failure to trip RCPs following loss of seal cooling	This term represents a failure of a human action to trip the RCPs following a loss of seal cooling leading to a Reactor Coolant Pump (RCP) seal LOCA. Phase II SAMAs 23, 24, 25, 26, and 27 for reducing the likelihood of an RCP seal LOCA were evaluated.

Table D.1-2

Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
ZLOOP_B0	9.52E-02	1.2877	LOOP Recovery with Batt Depl and 0 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ZLOOP_B0NL	1.59E-01	1.0323	LOOP Recovery with Batt Depl and 0 Run Fail (No Load Shed)	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ZLOOP_B1	4.34E-02	1.0674	LOOP Recovery with Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_B1NL	5.77E-02	1.0069	LOOP Recovery with Batt Depl and 1 Run Fail (No Load Shed)	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_D1	1.07E-01	1.0092	LOOP Recovery without Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.

CDF Uncertainty

The uncertainty associated with core damage frequency was estimated and documented in the WF3 PSA Uncertainty and Sensitivity Analysis Report [D.1-3].

The ratio of the 95th percentile CDF to the mean is approximately 1.99. An uncertainty factor of 1.99 was applied to determine the internal and external benefit with uncertainty as described in Section 4.15.1.4.4.

D.1.2 PSA Model – Level 2 Analysis

D.1.2.1 Containment Performance Analysis

The WF3 Level 2 PSA model used for the SAMA analysis is the most recent internal events risk model.

The WF3 Level 2 model includes two types of considerations: 1) a deterministic analysis of the physical processes for a spectrum of severe accident progressions, and 2) a probabilistic analysis component in which the likelihood of the various outcomes are assessed. The deterministic analysis examines the response of the containment to the physical processes during a severe accident. This response is performed by

- utilization of the MAAP 4.0.6 code [D.1-2] to simulate severe accidents that have been identified as dominant contributors to core damage in the Level 1 analysis, and
- reference calculation of several hydrodynamic and heat transfer phenomena that occur during the progression of severe accidents. Examples include debris cool-ability, pressure spikes due to ex-vessel steam explosions, direct containment heating, high pressure melt ejection, molten debris filling the pedestal area and flowing over the drywell floor, containment bypass, deflagration and detonation of hydrogen, and thrust forces at reactor vessel failure.

The development of the CET was based on the plant-specific information and conditions associated with the Level 1 event tree end states that result in a plant core damage state. Using the information from the Level 1 core damage states including the accident sequence, equipment availability, and Containment Heat Removal (CHR) systems, the Level 1 core damage states were used to define the initial states for the Level 2. The progression of these Level 2 initial states through the CETs ends in a radionuclide release end state (CET end state). The WF3 Level 2 containment event trees model the postulated course of core melt progression events. This CET tool integrates the sequence-based accident scenario with the plant mitigation features (active and passive), operator actions, phenomenological effects, and containment capability to calculate the fission product (FP) distribution.

Four CETs have been developed to address the core melt progression and radioactive releases associated with the Level 2 plant response [D.1-2].

The event tree headings are based on previously developed CETs [D.1-4] and results obtained from the deterministic MAAP calculations for each of the Level 2 accident sequences. A summary of the CET tops are included in table D.1-3.

The Large Early Release Frequency (LERF) is an indicator of containment performance from the Level 2 results because the magnitude and timing of these releases provide the greatest potential for early health effects to the public. The frequency calculated is approximately 1.88E-06/ry. LERF represents a fraction (~18%) of all release end states. Table D.1-4 provides a correlation between the Level 2 LERF RRW risk significant events (severe accident phenomenon, initiating events, component failures and operator actions) and Table D.1-5 provides the correlation between all level 2 release states RRW risk significant events down to 1.005 identified from the WF3 PRA Level 2 model and the SAMAs evaluated in Section D.2.

Table D.1-3

CONTAINMENT EVENT TREE TOPS

CET Top	Description of CET Top
CFC	Containment Fans ON
CS	Containment Sprays ON
CB	Containment Bypass
CI	Containment Isolation
I-SGTR	Induced SGTR Occurs
DP	Depressurization Successful
REC	RPV Water Level Sufficient
EXC	Successful Ex-Vessel Cooling
CFE	No Early Containment Failure
CAV	Wet Cavity
VB	Vessel Intact – No Breach
BMT	Basemat Melt Through
CFL	No Late Containment Failure

Because deterministic MAAP calculations were performed for each of the Level 1 core damage sequences, no binning of the accident sequences was performed to group plant damage states with similar accident sequence characteristics, mitigating systems, and containment responses. The sequence-specific Level 2 responses were evaluated directly from the MAAP results. To provide a more accurate determination of the Level 2 sequence response, different configurations of Containment Heat Removal (CHR) system performance was applied to each Level 2 sequence and evaluated independently.

CHR systems are key to integrity and performance of the containment structure during the Level 2 accidents analysis. As a result, four CHR configurations were developed to represent the specific combination of the CHR systems available during the accident progression. These configurations of the Level 2 sequences and CHR systems are represented in four separate event trees as follows:

- Tree B: Both containment spray system (CSS) and containment fan coolers (CFC) are available and operate (CHR-B)
- Tree D: CFC is available and operates; CSS are not available or fail to operate (CHR-D)
- Tree F: CSS is available and operates; CFC are not available or fail to operate (CHR-F)
- Tree H: Neither CSS nor CFC is available or successfully operates (CHR-H)

The sections below describe top events used in the development of the CET.

D.1.2.1.1 CFC - Containment Fans ON

The CFC CET Top considers the operation of the containment fans for the removal of heat from the containment atmosphere and the reduction of containment pressure. The configuration of the containment heat removal systems has been integrated with the Level 1 core damage sequences as part of the generation of the Level 2 accident sequence. This integration is consistent with the previous WF3 Level 2 analysis [D.1-4].

Level 2 accident sequences with the CHR configuration of B or D are considered to have successful operation of the containment fans, whereas CHR configurations of F and H are not considered to be successful due to failure of the containment fans to operate. Success of the CFC top is considered as the successful start and long-term operation of 2 of 4 containment cooling fans [D.1-5, D.1-6].

For SBO sequences, the loss of power results in the failure of the containment cooling fans to start. As a result, no operation of the containment fans is considered for SBO sequences.

D.1.2.1.2 CS - Containment Sprays ON

The CS CET Top considers the operation of the CSS for the removal of heat from the containment atmosphere, the reduction of containment pressures, limiting hydrogen concentrations, and the removal of radioactive components. Like the CFC CET Top, the CS CET Top is integrated with the Level 1 core damage sequences as part of the generation and evaluation of the Level 2 accident sequences and is consistent with the previous WF3 Level 2 analysis [D.1-4].

Level 2 accident sequences with the CHR configuration of B or F are considered to have successful operation of the containment sprays, whereas CHR configurations of D and H are not considered to be successful due to failure of the containment sprays to operate. Success of the CS top is considered as the successful start and operation of 1 of 2 containment spray trains [D.1-5, D.1-6]. The Level 2 does not consider refilling of the RWSP or alternate water sources, and as a result, the operation of the containment spray following depletion of the RWSP is not considered. In addition, the operation of containment spray in recirculation mode is not considered in the Level 2 because the Level 1 sequences with successful recirculation do not progress to core damage.

For SBO sequences, the initial loss of power results in the failure of the containment spray system. For SBO sequences where the batteries are credited for short-term, no credit is assumed for the operation of the containment spray system.

D.1.2.1.3 CB - Containment Bypass

The CB CET Top considers a unique set of Level 2 accident sequences where an early pathway opens as a result of a pipe break outside of containment that would allow for the unmitigated release of fission products (FP) to the environment. Because a bypass sequence results in a containment release at a time point coincident with the initiation of the accident, the FP releases from the bypass sequence are characterized as unmitigated. The shortened residence time of the FP in containment are released without the benefit of radioactive decay time, scrubbing effects, or gravitational settling.

Accident sequences with the potential to bypass a traditional containment failure include SGTR and ISLOCA. In addition to the early containment release pathway, mitigation actions engaged during an ISLOCA and SGTR sequence result in the release of RWSP water outside of containment. This depletion of water available for cooling of the core or corium, or scrubbing of FP releases, contributes to the potential for severe consequences associated with these containment bypass sequences.

As a result of the early unmitigated release pathway, all containment bypass sequences are characterized as high-early release scenarios.

The CB CET Top is successful when no containment bypasses occur.

D.1.2.1.4 CI - Containment Isolation

The CI CET Top considers containment isolation failures in excess of 2.25 inches [D.1-6, D.1-7] which is consistent with the definition associated with the LERF analysis. Release scenarios associated with the CI top include all non-bypass core damage sequences accompanied by a containment isolation failure. Two types of containment isolation failures have been considered, including (1) pre-existing containment flaw failure and (2) isolation failures of the valves, piping, and systems associated with the Containment Isolation System.

Containment failure due to pre-existing errors, cracks or tears represent a potential direct release pathway for FP release outside of containment. Based on an evaluation of pre-existing flaws conducted as part of the LERF analysis, the WF3 leakage liner tear is found to be less than the LERF sizing of 2.25-inches. As a result, the pre-existing flaw isolation failure was not considered for the LERF in that they represent a small isolation failure. For the purpose of the Level 2, the pre-existing flaw containment isolation failure is conservatively retained and considered as a potential CI failure. Although the liner leakage tear size does not meet the minimum release sizes, this containment isolation failure will be considered in the Level 2 based on the uncertainty associated with the significance of liner cracks and tears in the steel containment vessel (SCV).

Failure of containment valves, piping, and systems to properly isolate represents another potential containment isolation pathway for FP releases. These failures occur as a result of the failure to isolate containment given actuation of a CIAS signal (pressurizer pressure decreases to 1684 psia or containment pressure increases above 17.1 psia). Penetrations and valves with flow diameters of 2.25-inches and above are considered as potential containment isolation pathways. These CI pathways and their failure modes have been developed as part of the Level 1 and LERF analyses [D.1-8, D.1-6].

Like the containment bypass sequences, a containment isolation failure has the potential to release radionuclides early in the accident progression. As a result of the early unmitigated release pathway, all containment isolation sequences are characterized as high-early release scenarios. A containment isolation failure is considered for all L2 accident sequences.

The CET Top CI is successful when no containment isolation failures occur.

D.1.2.1.5 I-SGTR - INDUCED STEAM GENERATOR TUBE RUPTURE

Induced Steam Generator Tube Rupture (I-SGTR) represents a containment bypass similar to a SGTR sequence. The I-SGTR CET Top represents a failure of a SG tube as a result of severe accident conditions, either pressure-induced or temperature-induced tube failures. These induced tube failures are similar in nature with other SGTR accident sequences in that they result in a containment bypass release scenario. However, these I-SGTR failures differ from the SGTR sequence in that the tube failures have the potential to occur later in the sequence and may occur in combination with other severe accident sequences.

The I-SGTR CET Top considers only sequences with potential for induced SG tube failures. I-SGTR can be caused by temperature-induced mechanisms or pressure-induced mechanisms. Temperature-induced SGTR (TI-SGTR) failures result from long-term exposure to high temperatures that result in creep rupture of the tube wall with elevated pressure differential across the primary to secondary system sides. Pressure-induced SGTR (PI-SGTR) failures result from a high pressure differential between the primary to secondary system sides.

Based on the L2 MAAP deterministic calculations, potential induced-SGTR failures were identified for sequences with the potential for long-term, high temperature exposure of the tubes and thinning of the tube walls, for sequences with high primary-secondary differential pressures, and for sequences with loss of heat removal.

Characteristics used to identify potential PI-SGTR accident sequences included the following [D.1-9, D.1-10]:

- Primary-secondary heat removal failures
- High pressure differential between primary and secondary side (~2500 psid)
- Timing of rupture likely to occur early, well before core damage

Characteristics used to identify potential TI-SGTR accident sequences included the following [D.1-9, D.1-10]:

- Primary-secondary heat removal failures
- Accident sequences with loss of feedwater and/or SG dryout
- Likely to occur after core damage
- High SG tube surface temperatures
- Occur in sequences where creep-related failures of RCS piping and other pressure boundary failures are also likely to occur.

Once potential I-SGTR scenarios were identified, the timing of the failure was estimated and compared to the timing of other sequence events such as containment failure and creep rupture. For sequences where conditions characterizing either PI-SGTR or TI-SGTR occurred at or near the timing of a hot leg creep rupture or before containment failure, a potential I-SGTR was identified. For conditions of I-SGTR occurring later in the sequence, no probability of an I-SGTR was assumed to occur. Because no actual tube ruptures occurred based on the MAAP calculations, a probability of occurrence (PI_SGTR, PI_SGTR_SBO and TI_SGTR) was developed to account for the uncertainty in the understanding of the phenomena and the application of the analyses [D.1-2].

The CET Top I-SGTR represents success when no induced SGTR failure occurs. The failure branch, I-SGTR, represents an early I-SGTR that occurs and results in the release of FP. I-SGTR are included in the Level 2 model under the gates named TI-SGTR, PI-NSGTR and PI-SGTR_SBO.

D.1.2.1.6 DP Depressurization

The CET Top DP represents the successful depressurization of the RCS to a pressure below the high pressure melt ejection (HPME) minimum of approximately 200 psig [D.1-11]. Successful depressurization allows for the operation of SI systems to initiate and aid in lowering the pressure in the RPV to below a pressure where HPME is not expected to occur (approximately 200 psig) prior to a vessel breach.

Several depressurization mechanisms are available and can be implemented in response to a Level 2 severe accident sequence including:

- Phenomena based on initiating events (IE)
- Creep rupture failure of the RCS
- Sequence-based depressurization

<u>IE Phenomena</u>

Certain initiating events result in the depressurization of the RCS to levels below the HPME minimum pressure of 200 psig. For WF3, initiating events that lead to depressurization include large, medium, and small break LOCA.

- DPL – The DPL gate represents a LOCA break scenario in combination with the other features of the accident progression that lead to successful depressurization of the RPV. The #DP_LOCA flag has value of 1.0 and represents the inadvertent depressurization associated with a LOCA break.
- xDPL – The gate, xDPL, is included to address the potential for unsuccessful depressurization of the RPV as a result of the LOCA. The #NO_DP_LOCA flag has value of 1.0 and represents accident conditions in which a LOCA break is unsuccessful in providing depressurization in a timely manner.

<u>Creep Rupture</u>

Another method by which RCS pressure may be reduced prior to RPV failure is by a thermally induced failure of an RCS hot leg. During core melt progression, heat is transferred throughout the RCS piping causing increased gas temperatures in the pipes. When surface temperatures in the piping reach temperatures consistent with failure properties of the metal, a pipe failure due to a thinning of the pipe wall can create an opening in the RCS pipe that acts to depressurize the RCS. RCS piping susceptible to creep failures include the hot legs and pressurizer surge lines.

The occurrence of a hot leg creep, as indicated by the Level 2 MAAP calculations, facilitates a mechanism by which the RCS begins to depressurize. Due to the small size of the creep rupture openings, a creep rupture alone is not always sufficient to reduce pressure levels to below 200 psig. However, the contribution of the hot leg rupture phenomena is accounted for in the progression of the accident sequence. The following gates are included for phenomena related to the occurrence of hot leg creep ruptures.

- #HLCREEP – The #HLCREEP gate represents the creep failure of a hot leg with the accompanied unintentional depressurization of the RCS prior to containment failure. This flag has a value of 1.0 and is represented by the flag event #HLCREEP.

- #NO_HLCREEP – The #NO_HLCREEP gate represents an intact hot leg with no creep damage failure and without any unintentional depressurization. This flag has a value of 1.0 and is represented by the flag event #NO_HLCREEP.

Sequence-Based Depressurization

During the progression of Level 2 accident sequences, operating systems are available and operated to reduce the RCS pressure. Because success of these operating systems is required to the specific sequences, the success and failure of these systems to perform their depressurization functions and to achieve sufficient depressurization to below 200 psig is considered. These sequence-based depressurization operations include:

- PT01 – This gate models RCS pressure control via the pressurizer to adequately control RCS pressure using SRVs. The function is part of the sequence-specific success criteria and is applied to TRANS sequences that support depressurization of the RPV. The function for successful RCS pressure control is applied to sequences TB, TQX, TQB, and TQU [D.1-5] as part of the sequence definition.
- @PRATWS - This gate models the failure of the PRVs to provide depressurization as required for the ATWS sequence [D.1-12]. The function is part of the sequence-specific success criteria applied to ATWS sequences that aid in the depressurization of the RPV. The function for successful operation of the PRVs is applied to sequences TKC, TKX, and TKW [D.1-12] as part of the sequence definition.
- SBORCPLOCA – This gate represents a leakage failure through the RCP seals. This is a sequence-based event that supports inadvertent depressurization due to RCP seal rupture for SBORCP accident sequences. For the Level 2 analyses, this function is included as part the SBORCP sequence definition under the gate SBORCP

The Level 2 MAAP calculations evaluate the successful depressurization of the RPV. The CET Top DP success branch represents RPV depressurization to below the HPME minimum of 200 psig. Similarly, the failure branch represents the failure to adequately reduce RPV pressures. However, Level 2 sequences may include the success operation of systems or other measures that provide depressurization, but these are ineffective in lowering the RPV below 200 psig.

D.1.2.1.7 REC – Reactor Pressure Vessel Reflood and Refill

The REC CET Top represents successful SI injection to refill and maintain the RPV water level to ensure core cooling and to prevent vessel breach. Re-flooding of the RPV and maintaining a water level in the RPV serves to re-establish core cooling and to end the core melt progression and subsequent hydrogen generation (zirconium oxide and water reaction). A side effect of re-flooding of the core is the generation of significant amounts of steam that re-pressurize the RPV and re-start the zirconium-water reaction.

Successful RPV injection and core reflood is dependent upon the operation of the HPI or LPI systems to provide a source of water to provide in vessel cooling of the core, to retain the corium in vessel, and maintain vessel integrity. For ATWS sequences, the successful injection of borated water into the RCS by the charging pumps is also considered as a potential injection source to refill the RPV. No other active systems or recovery actions are credited to supplement water levels in the RPV.

Results from the deterministic MAAP calculations were used to evaluate the success of the REC top. Successful core reflood is defined as restoration of the RPV water level to greater than 22 ft. at the end of injection. This water level represents the elevation of the top of the active fuel within the RPV (MAAP Parameter ZCRU = 21.926 ft.).

Reflooding of the RPV to water levels less than 22.0 ft. is considered unsuccessful in the CET Trees despite the successful operation of injection systems. The in-vessel arrest of core melt in accidents that progress rapidly to core melt and/or lead to early core relocation may not be accomplished by SI injection. The timing of the RPV reflood must take place such that appreciable core relocation to the plenum is arrested [D.1-2].

The following tops are used to model the success and failure of the REC CET top.

- REC1
- REC2

For Level 2 accident sequences where no injection sources are credited, a successful REC Top is not considered in the event tree, and the sequence progresses to the next CET top on the down branch. Likewise, no consideration of RPV reflood and recovery is considered in the Level 2 model for these sequences.

REC1
The REC1 top models HPSI injection as a source of water for re-flooding the RPV. The use of this gate is specific to the success criteria associated with Level 2 accident sequences. Failures in the HPSI system are modeled by the gate H1000 and would lead to a failure of vessel reflood and recovery. As a result, any failures of the system operations and components in the H1000 gate would subsequently result in the failure of the REC1 top. For Level 2 sequences where the HPSI system is credited for RPV re-flood, the REC1 gate is included under the sequence-specific accident sequences.

REC2
The REC2 top models emergency boration as an injection source for re-flooding of the RPV. The use of this gate is specific to the success criteria associated with Level 2 accident sequences and is used only for ATWS sequences. Failures in the emergency boration system would lead to a failure of vessel re-flood and recovery. For Level 2 accident sequences where emergency boration is credited for RPV re-flood, the REC2 gate is included under the sequence-specific accident sequences.

D.1.2.1.8 EXC - Ex-Vessel Cooling

The EXC CET Top represents the contribution of outside factors to aid in the cooling of the RPV and subsequently the core and corium within the vessel. The contribution of these external cooling factors associated with the EXC CET Top is considered for sequences where internal cooling of the core and restoration of RPV water levels have been unsuccessful (REC). EXC is considered for sequences where RPV injection sources are not considered during the progression of the accident, as well as sequences where active injection sources have been unsuccessful in providing full reflood of the RPV.

Deterministic MAAP calculations are used to assess the success of the ex-vessel cooling on mitigating in vessel core melt and preventing rupture of the RPV. Successful ex-vessel cooling is defined as a water level in the reactor cavity sufficient to cover the lower head of the RPV. A dry reactor cavity allows for unmitigated heating of the corium to occur in the RPV due to a lack of cooling to the RPV. The presence of water in the cavity insulates the RPV and prevents the direct contact of the RPV with these hot gases. A minimum cavity water of 15.5' is defined as successful ex-vessel cooling. This elevation of water column in the cavity corresponds to the elevation of the bottom of active fuel (MAAP Parameter ZCRL = 9.428 ft.) above the bottom of the RPV (MAAP Parameter ZNVP = 6.0 ft.). Maintenance of this water level in the RPV ensures that the lower head is submerged [D.1-2].

Successful EXC has been shown to occur in large LOCA sequences and in accident sequences with operating containment sprays for containment heat removal. Under these conditions, a large amount of water is being deposited into containment either through the break in the RCS piping or the containment spray headers. This water is conveyed through the floor drain system and ends up in the Containment Sump. With a minimum water level of 3.0 feet in the containment sump, leakage through the gaskets and under the marine access door provides a continuous source of water to fill the Reactor Cavity. Without the contribution from the operating containment sprays, water levels in the reactor cavity are insufficient to submerge the lower RPV head.

D.1.2.1.9 BURN - Hydrogen Burns in Containment Compartments

Hydrogen combustion burns can cause large, rapid increases in pressure and high spikes in temperature that result in a combination of mechanical and thermal load with potential impact to containment integrity. The BURN CET Top assesses the containment compartment conditions that lead to the occurrence of hydrogen burns. With the presence of sufficient concentrations of hydrogen and at elevated temperature, localized burn and global burns have the potential to occur and result in challenges to containment. The success branch of the CET top xBURN represents conditions in the containment compartments that are insufficient to support and propagate hydrogen burns. Similarly, the down failure branch to CET BURN represents conditions conducive to facilitating hydrogen burns that challenge containment and can lead to containment failure.

Burns that occur in the upper, annular, or upper RPV dome portions of the WF3 containment are considered to lead to containment failures due to the proximity of these containment compartments to the SCV. Burns that occur in other portions of the containment are not considered as events that will challenge containment or result in failure of containment.

During the progression of severe accident scenarios, several mechanisms have the potential to produce concentrations of hydrogen both in-vessel and ex-vessel. Some of these mechanisms that produce hydrogen include:

- Zircaloy oxidation
- Molten corium-concrete interaction (MCCI)
- Steam Reactions with boron carbide, uranium, or steel
- Corium debris Interactions

Because hydrogen is a burnable gas in the presence of air, the WF3 large dry containment supports hydrogen burn scenarios.

<u>In-Vessel</u>
When the reactor core uncovers, zirconium oxidation of the fuel cladding may occur when the cladding comes in contact with steam. Hydrogen is generated during this reaction and is produced at the onset of core damage. As core degradation continues, hydrogen continues to be

generated as more cladding becomes exposed and the core begins to relocate. If reflooding and quenching of the relocated debris in the RPV occurs, the ziracloy oxidation increases, which in turn increases steam generation due to the cooling effect that also results in increased hydrogen generation. During severe accidents, the hydrogen generated and contained in the RPV can escape through openings in the RCS piping, RCP seal leaks, and lifting of safety and relief valves. If large quantities of hydrogen are generated, hydrogen burns after in-vessel recovery could result in an early release of radionuclides that escaped the fuel during the initial heatup.

Ex-Vessel
If the core degradation and relocation progress and a vessel rupture occurs, the corium debris is ejected from the RPV and into cavity compartments contributing to hydrogen concentrations occurring outside of the vessel. At the point of vessel breach, the hydrogen contained in the vessel is released to the cavity and can migrate through containment. Also, as a result of the vessel breach, the corium debris is ejected and deposited onto the concrete floor of the cavity. This MCCI interaction between the concrete and the ejected core materials will lead to additional hydrogen generation as a result of concrete ablation. If quantities of water are present in the cavity, the rapid cooling of the ejected corium debris in the water pool can result in large quantities of steam to be produced.

The concentration of steam present is an important factor in the potential occurrence of a hydrogen burn. The flammability limits of the two-component mixture (hydrogen:air) differ from the flammability limits of a three-component mixture (hydrogen:air:steam). The changes in flammability limits leads to steam inerting attributed to a change in the dominant heat transfer pathway by combination of both convective and radiative mechanisms. In environments with moderate quantities of steam present, hydrogen burns can be precluded due the presence of the steam concentrations. Steam concentrations above which denotation can occur in the three-component mixture have been reported from 55% up to 75% for a steam mass fraction.

Deterministic MAAP calculations are used to assess the likelihood and occurrence of hydrogen burns in containment. Factors evaluated to assess hydrogen burns include the following:

- Concentration of hydrogen present in the containment atmosphere
- Steam concentration
- Operating containment heat removal systems – ignition source
- Ability for a Hydrogen burn to cause a containment failure

Hydrogen Concentration
Hydrogen gas has the potential to ignite in normal air concentrations at concentrations as low as 4% LEL (lower explosive limit) and up to concentrations of about 75% UEL (upper explosive limit). These limits are based on the two-component mixture (hydrogen:air). These explosive limits are affected by the presence of steam concentrations as discussed below.

Steam Concentration
Steam inerting due the presence of moderate to high mole concentrations of steam (a range in excess of 55% to 75%) have been shown to prevent hydrogen burns. The Level 2 MAAP calculations used the higher steam fraction of 75%. When steam concentrations exceed this concentration, no hydrogen burns are allowed. This represents an upper limit, which would conservatively allow for the likelihood of more hydrogen burns to occur.

Containment Spray Systems

The operation of the containment spray systems affect the localized and global distribution of hydrogen concentrations within the containment environment. The containment spray system introduces water droplets from the spray header located in the upper portion of containment. As the water droplets fall, steam condensation occurs on the surface of the droplet lowering the steam within containment and thereby the containment pressure. However, the reduction in the concentration of steam corresponds to an increase in hydrogen concentrations within Containment.

Burn Causes Containment Failure

Hydrogen burns provide challenges to the integrity of containment, including both the thermal and pressure loads and spikes from the propagation of dynamic pressure pulses. This phenomena is not modeled specifically in the MAAP code used for the deterministic Level 2 MAAP calculations. However, for the CET BURN tops, hydrogen burns occurring in the upper, annular, or upper RPV dome portions of the WF3 containment were considered to have the potential to lead to a containment failure given the presence of an ignition source. If AC power is available in the containment, which is required for the operation of the containment heat removal systems, many potential sources of ignition will be present and an ignition source is almost assured.

D.1.2.1.10 CFE - Containment Failure Early

Early containment failures are failures that occur concurrent with or shortly after the RPV has ruptured. The timing of these failures are based on time of less than 4 hours between vessel rupture and containment failure. The CFE CET Top assesses the Level 2 accident progression and containment compartment conditions that lead to the occurrence of an early containment failure. The success branch of the CET Top xCFE represents an intact early containment status. Similarly, the down failure branch to the CET Top CFE represents a containment status where failure has occurred early.

Based on the characteristics and capacity of the WF3 containment, the following forms of early containment failure mechanisms were considered and evaluated as part of the Level 2 analysis.

- Hydrogen Burns
- Direct Containment Heating (DCH)
- Containment Penetration Isolation Failure
- Mechanical integrity Failures
- Steam Explosions

Hydrogen Burns

As discussed in D.1.2.1.9 and considered in the CET Top BURN, hydrogen burns present challenges to containment stemming from high thermal and pressure loads and the propagation of dynamic pressure pulses. As a result, hydrogen burns occurring in the upper, annular, or upper RPV dome portions of the WF3 containment are considered to have the potential to lead to a containment failure. Based on the timing of the containment burns, these containment failures may present an early containment challenge.

Direct Containment Heating

Direct containment heating of the RPV vessel has the potential to lead to an early containment failure. In the event of a high pressure ejection of molten corium from the RPV breach, the potential exists for fragmented core to travel to outside of the cavity to other areas of containment. Oxidation of these fragmented corium particles may produce significant quantities of heat and hydrogen that can challenge containment. The combination of the RPV breach and containment failure provides significant impact to health and safety due to the early timing of the release and the short residence time in containment to aid in the retention of the fission products.

Mechanical Integrity Failures

Mechanical integrity failures of containment can occur in a number of ways. When a catastrophic vessel breach occurs (initiating event %V), the potential exists for the vessel or pieces of the vessel to become airborne or otherwise dislodged. The uplifting of the vessel structure and/or generation of missiles is likely to result in damage to the containment and/or cavity structure.

Steam Explosions

An in-vessel steam explosion in the RPV can occur when a large amount of corium relocates to the lower plenum where it comes in contact with water in the lower head. This encounter with water in the lower head can result in an in vessel explosive steam explosion which may lead to an induced lower head failure or may cause internal RPV structure to be thrust upwards inducing an upper head failure. Due to the energy of these failures, it is likely to result in damage to the containment and/or cavity structure.

CFE2

The CFE2 gate is used to model an early containment failure with a given vessel breach. During the vessel breach, the core melt is ejected into the cavity bottom. If the cavity conditions are such that a pool of water has collected, the rapid cooling of the ejected core materials generates large quantities of steam. The WF3 cavity design does permit the conveyance and collection of the water within the cavity. Based on the L2 MAAP deterministic calculations, an early containment failure occurs as a result of the ejection of the core melt, which causes a rapid formation of steam that leads to containment over-pressurization. Without the operation of containment fans, the cooling and condensation of the steam is limited, and containment pressures increases. Upon reaching the ultimate containment capacity, containment fails.

Based on the Level 2 MAAP deterministic results, early containment failures only occur in sequences where both forms of containment heat removal fail to operate. The consideration of this CET Top is only addressed in the CET H event tree.

D.1.2.1.11 VB Vessel Breach

The VB CET Top represents the conditions within the RPV where significant core degradation has occurred such that the integrity of the reactor pressure vessel has been challenged with a subsequent RPV breach. The fundamental process controlling RPV integrity is the heat removal and cooling of the molten corium pool within the RPV. The success VB branch (No_VB) in the CETs occurs with sequences where RPV injection source are available and operating (REC) or when sources of water are available in sufficient quantities to support external cooling of the vessel (EXC). The failure VB branch (VB) in the CET considers the remaining sequences where core and vessel cooling mechanisms are unavailable or ineffective. These sequences have a likelihood of leading to extensive rupture of the vessel given the degree of core degradation and in-vessel geometry of the core debris.

For the accident sequences where in-vessel and ex-vessel cooling actions have not been successful, the core melt has progressed to the lower plenum and subsequently to the RPV bottom. At this point, the melt-vessel interface is the contact point at which the corium melt and the RPV material interact. The RPV lower head is subjected to the internal system pressure, thermal loads from the corium melt, and dead loads associated with the relocation of the corium. These factors challenge the mechanical integrity of the RPV and lead the way for creep rupture of the RPV material to occur. Creep of RPV materials occurs at temperatures above 600 ^{o}C (1100 ^{o}F).

The VB CET top considers the following vessel breach mechanisms for the WF3 Level 2:

- Catastrophic Vessel Breach
- Lower Head Failure Mechanism

Catastrophic Vessel Breach

Catastrophic vessel ruptures are characterized as an unrecoverable vessel failure. Scenarios such as in-vessel steam explosion or vessel failure due to internal relocation of loads are considered as catastrophic failures.

Lower Head Failure Mechanisms

Mechanisms for lower head vessel breach include the following:

- Heat up and/or Failure of Instrument Tubes, CRD Tubes, and Drain Line
- Ejection of Instrument Tubes, CRD Tubes, and Drain Line (not applicable)
- Jet ablation of the vessel wall
- Attack of wall by overlaying steel
- Creep rupture

Because the RPV lower head has no penetrations, the tube ejections and failures are not applicable to the WF3 vessel breach evaluation. The primary mechanism for the vessel breach failure is an extensive creep rupture. A creep rupture represents the long-term exposure of the RPV materials to temperature and pressures that result in thermal stresses that cause thinning of the material walls.

Deterministic MAAP calculations were used to evaluate the RPV integrity for the Level 2 sequences. The MAAP analysis considers vessel failure mechanisms and accounts for a layered lower debris bed model. Creep rupture fractions in the lower head were used to determine the status of the RPV vessel. Failure to maintain an intact VB was determined to be a lower head creep damage fraction in a single node that exceeds 0.4. Creep damage fractions in excess of 0.4 lead to failure of the RPV.

Based on the Level 2 MAAP calculations, a breach of the WF3 vessel only occurs with no containment heat removal systems operating. As a result, the VB CET Top is only addressed in the CET H event tree.

D.1.2.1.12 CAV - Cavity Status

The CAV CET Top represents the status of the reactor cavity at the time of vessel breach. A wet cavity has a sufficient quantity of water to receive the corium ejected during the vessel breach and mitigate the transport of materials to other areas outside of containment. A dry cavity cannot fully submerge to ejected corium debris and is thus limited in potential to capture and retain the corium within the cavity.

Successful CAV requires the operation of the containment sprays. Under these conditions, spray water is deposited into containment via the containment spray headers. Some of this water is conveyed through the floor drain system and ends up in the Containment Sump. With a minimum water level in the containment sump, leakage through the gaskets and under the marine access door provides a continuous source of water to fill the Reactor Cavity. Without the contribution from the operating containment sprays, water levels in the reactor cavity are insufficient to submerge the lower RPV head.

Results from the deterministic MAAP calculations were used to evaluate the success of the CET Top CAV. A wet cavity is defined as a cavity water level greater than 6 ft. (MAAP Parameter ZNVP) at the time of vessel breach. Maintenance of this water level in the RPV will provide a wet cavity in the event of an ejection of corium debris for the purpose of capturing and mitigating the dispersion of these materials to other areas of within containment. The CET Top CAV is considered following a VB and is included on the VB failure branch of the CET H event tree.

D.1.2.1.13 BMT – Basemat Melt Through

The BMT CET Top represents the status of the corium debris released from the RPV during VB that is ejected and received in the reactor cavity. The loads released from the RPV can fail containment due to thermal attacks of corium melt on the concrete basemat. This attack by the corium melt can lead to basemat concrete erosion and generation of hydrogen gas and steam which can pressurize containment. Because of the high energies and heat associated with the corium debris, the potential exists for the ejected material to become a long-term source of FP for release.

Factors that affect the retention and stabilization of the corium debris include the quantities of material released, the pressure of the RPV at the time of release, and the mechanisms in place to provide cooling or retention of the released corium. The amount of material released to the cavity and the cavity geometry determines the initial depth of the corium. Debris beds with depths greater than 25 cm are considered uncoolable and represent a failure to arrest ex-vessel corium melt [D.1-11]. The failure to arrest the corium debris melt in the cavity can lead to a breach of containment through the lower basemat.

An unmitigated core melt on the cavity floor can result in a failure of the basemat. The basemat concrete depth on the floor of the cavity is 12.0 feet thick. A depth of erosion greater than 12.0 feet would have the potential to fail the basemat. In addition, corium spread to the cavity tunnel has the potential to fail the marine access door that separates the cavity tunnel from the Containment Sump. Failures to the access door could result from the degradation of the gasket seal material or deformation of the door steel plate. However, due to the uncertainty and unknowns associated with basemat melt scenarios, unquenched corium pools with increasing erosion depths are assumed to lead to containment breach based on basemat melt-through.

Debris depths following vessel breach were used to evaluate and determine the ability to cease the ex-vessel corium melt based on the deterministic MAAP calculations. The success branch of the CET top BMT represents a debris depth in the cavity of less than 25 cm (0.82 ft) where cooling and stabilization of the corium debris spread is still possible. Similarly, the down failure branch to the CET Top (xBMT) represents a debris depth in the cavity of more than 25 cm. The BMT CET Top is considered following VB and is included on the VB failure branch of the CET H event tree.

D.1.2.1.14 CFL - Late Containment Failure

Late containment failures are failures of the containment as a result of a vessel breach as well as challenges other than those associated with a breach of the RPV. The timing of these containment failures are based on times of greater than 4 hours from the time of core damage to the time of containment failure. The CET Top CFL assesses the Level 2 accident progression and containment compartment conditions that lead to the occurrence of a late containment failure. The success branch of the CET Top (xCFL) represents an intact late containment status given no early containment failure has occurred. Similarly, the down failure branch to the CET Top CFL represents a containment status where failure has occurred late.

Based on the characteristics and capacity of the WF3 containment, the following forms of late containment failure mechanisms were considered and evaluated as part of the Level 2 analysis.

- Hydrogen Burns
- Containment Over-pressurization above the Ultimate Containment Capacity

Hydrogen Burns
As discussed in Section D.1.2.1.9 and considered in the CET Top BURN, hydrogen burns present challenges to containment stemming from high thermal and pressure loads and the propagation of dynamic pressure pulses. As a result, hydrogen burns occurring in the upper, annular or upper RPV dome portions of the WF3 containment are considered to have the potential to lead to a containment failure. Based on the timing of the containment burns, these containment failures may present an early or late containment challenge. Late containment challenges are considered in the CFL CET Top.

Containment Over-Pressurization
During the progression of severe accident sequences, mechanisms generate quantities of steam as a result of the heating and oxidation of the core materials, the introduction of sources of cooling water, and the lifting of safety and relief valves. These quantities of steam contribute to a buildup of pressure in containment. At pressures in excess of the containment capacity, containment fails and releases FP outside of containment to the environment.

For Level 2 accident sequences where an early containment failure occurs, the CET Top CFL is not considered in the event tree. A successful CFL Top, xCFL, represents an intact containment. A late containment failure is represented on the failure branch of the CET Top CFL branch. The following gates are used to model the failure of the CET Top CFL.

- CFL2
- CFL3
- CFL4
- CFL5

CFL2
The CFL2 gate is used to model a late containment failure with a vessel breach. Based on the L2 MAAP deterministic calculations, vessel breaches can occur when both containment spray and containment cooling fans fail to operate. As a result, the CFL2 can only occur without the operation of containment heat removal systems fans. Under these conditions, containment pressures increase due to increasing steam concentration from both the release of hydrogen

from the RPV and the ex-vessel corium melt, as well as the pressure increases associated with long-term buildup of steam due to no containment heat removal.

CFL3

The CFL3 CET Top models a late containment failure due to over-pressurization. For these sequences, the RPV remains intact, but the containment pressure is slowly allowed to increase in containment due to the failure of containment fans to operate. Once the containment pressure in one of the containment compartments - annular, upper dome or upper RPV head – exceeds the containment capacity of 99.3 psig, a rupture in containment occurs and release of FP begins.

CFL4

The CFL4 CET Top is used to model a late containment failure due to a hydrogen burn. Based on the L2 MAAP deterministic calculations, a late containment failure due to a hydrogen burn can occur when containment cooling fans operate. Without the operation of containment fans, steam concentrations increase rapidly to levels where steam inerting inhibits hydrogen burns.

CFL5

The CFL5 CET Top is used to model containment isolation failures that have the potential to occur as a result of high temperatures (T-CIF) inside of containment. Temperatures in containment in excess of 600 ^{o}F are considered in the Level 2 analysis based on the FEA analyses performed to evaluate the ultimate containment capacity [D.1-13]. The containment over pressurization at 600 ^{o}F was determined to be 104 psi. Using this over pressurization value, a probability of occurrence corresponds to 0.601.

Figure D.1-1
WF3 Radionuclide Release Category Summary

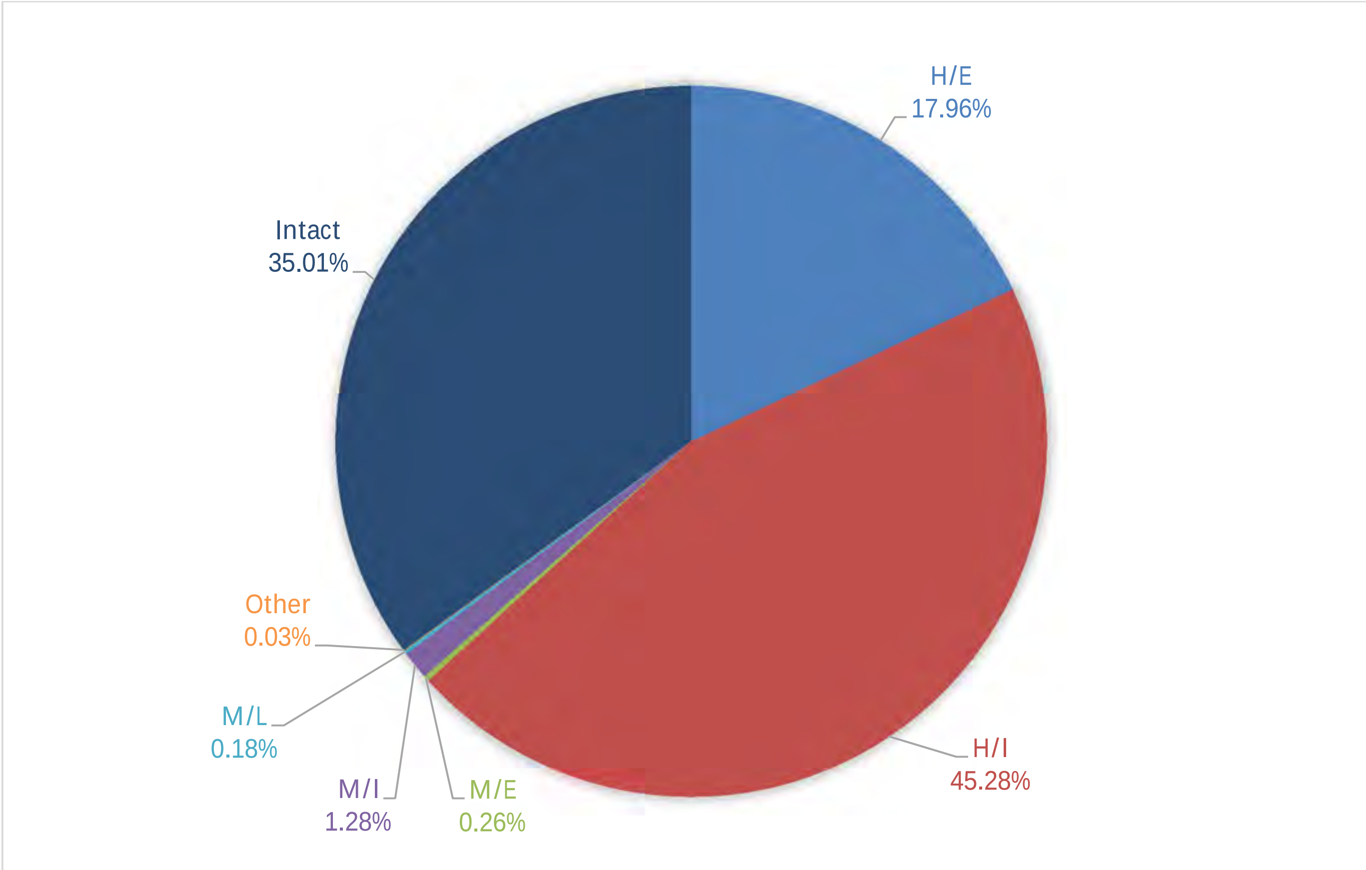


Table D.1-4

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Large Early Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
#CFE2	1.00E+00	5.3337	EARLY CONTAINMENT FAILURE WITH VESSEL FAILURE	This term is a flag. No SAMAs need to be aligned.
#CHR_B	1.00E+00	1.0683	CHR SEQUENCE MARKER B - Both Sprays and Fans are available and operate	This term is a flag. No SAMAs need to be aligned.
#CHR_H	1.00E+00	5.5758	CHR_H - Neither Sprays nor Fans are available or successfully operate	This term is a flag. No SAMAs need to be aligned.
#HLCREEP	1.00E+00	5.3337	HOT LEG CREEP RUPTURE OCCURS	This term is a flag. No SAMAs need to be aligned.
#PI-SGTR	1.00E+00	1.0086	PRESURE INDUCED STEAM GENERATOR TUBE RUPTURE - NON SBO	This term is a flag. No SAMAs need to be aligned.
#PI-SGTR-SBO	1.00E+00	1.1052	PRESURE INDUCED STEAM GENERATOR TUBE RUPTURE - SBO	This term is a flag. No SAMAs need to be aligned.
#TI-SGTR	1.00E+00	1.0073	THERMALLY INDUCED STEAM GENERATOR TUBE RUPTURE - NON SBO	This term is a flag. No SAMAs need to be aligned.
#V	1.00E+00	1.0173	V Sequence Marker	This term is a flag. No SAMAs need to be aligned.

Table D.1-4

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Large Early Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
#X_VB	1.00E+00	5.3337	NO LOWER HEAD FAILURE OF RPV - NO CREEP RUPTURE MAAP ANALYSES	This term is a flag. No SAMAs need to be aligned.
%T9	1.75E-05	1.0237	Loss of CCW System	This term represents a loss of the CCW system. Phase II SAMAs 8, 9, 20, 23, and 27 to decrease the importance of and enhance the availability and reliability of the CCW system to provide cooling water were evaluated.
%V	3.20E-08	1.0173	Reactor Vessel Rupture Initiator	This term represents a reactor vessel rupture initiator. Phase II SAMA 44 to create a large concrete crucible with heat removal potential to contain molten core debris was evaluated.
CHR_FAIL	1.00E+00	1.0251	CHR Flag	This term is a flag. No SAMAs need to be aligned.
EA2_SBO	1.00E+00	1.1348	SBO Flag	This term is a flag. No SAMAs need to be aligned.
EA3_SBO	1.00E+00	1.1358	SBO Flag	This term is a flag. No SAMAs need to be aligned.
EB2_SBO	1.00E+00	1.1382	SBO Flag	This term is a flag. No SAMAs need to be aligned.
EB3_SBO	1.00E+00	9.3555	SBO Flag	This term is a flag. No SAMAs need to be aligned.
LOSP-ECCS	1.00E-02	1.0184	Conditional LOSP given SIAS signal after a plant trip	This term represents a conditional LOSP given SIAS signal after a plant trip. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.

Table D.1-4

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Large Early Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
OHFSGTRCDP	1.00E+00	1.0212	Failure to initiate cooldown of the RCS following a SGTR	This term represents a failure of a human action to initiate cooldown of the RCS following a steam generator tube rupture (SGTR). Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
PHFSGTRBDP	1.00E+00	1.0069	Failure to blowdown steam generator to prevent overfilling affected generator	This term represents a failure of a human action to blowdown the steam generator to prevent overfilling the affected generator. Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
PI_SGTR	4.80E-03	1.0086	PI-SGTR NON-SBO FAILURE OCCURS	This term represents a pressure induced steam generator tube rupture without a SBO. Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
PI_SGTR_SBO	4.41E-03	1.1052	PI-SGTR SBO FAILURE OCCURS	This term represents a pressure induced steam generator tube rupture with a SBO. Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
P_FCONTVB	9.90E-01	5.3337	PROBABILITY THAT VESSEL BREACH FAILS CONTAINMENT	This term is a split fraction. No SAMAs need to be aligned.

Table D.1-4

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Large Early Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
RABCVCASA	5.00E-01	1.0142	AB charging pump is assigned to emergency start in place of A	This term is a flag. No SAMAs need to be aligned.
RABCVCASB	5.00E-01	1.0123	AB Charging pump is assigned to emergency start in place of B	This term is a flag. No SAMAs need to be aligned.
RSGTRONSG1	5.00E-01	1.0285	Weighting factor for likelihood that SGTR happens in SG1	This term is a flag. No SAMAs need to be aligned.
RSGTRONSG2	5.00E-01	1.0285	Weighting factor for likelihood that SGTR happens in SG2	This term is a flag. No SAMAs need to be aligned.
TI_SGTR	3.19E-02	1.0073	TI-SGTR - INTACT CONTAINMENT OR BEFORE VB	This term represents a thermally induced steam generator tube rupture. Phase II SAMA 54 to modify procedures such that the water loop seals in the reactor cooling system (RCS) cold legs are not cleared following core damage was evaluated.
X_VB	9.90E-01	5.3337	NO LOWER HEAD FAILURE OF RPV - NO CREEP RUPTURE MAAP ANALYSES	This term is a split fraction. No SAMAs need to be aligned.
ZHFSGTRBDP	2.70E-02	1.0068	Failure to use steam generator blowdown to prevent overfilling affected S/G	This term represents a failure of a human action to blowdown the steam generator to prevent overfilling the affected generator. Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.

Table D.1-4

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Large Early Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
ZHFSGTRCDP	1.80E-05	1.0202	Failure to initiate cooldown of the RCS following a SGTR	This term represents a failure of a human action to initiate cooldown of the RCS following a steam generator tube rupture (SGTR). Phase II SAMA 57 for eliminating a release pathway to the environment following a SGTR; SAMAs 58, 59, 60, and 61 for reducing the consequences of a SGTR; and SAMA 56 for reducing the frequency of SGTRs were evaluated.
ZLOOP_CSP	6.30E-02	1.0109	LOOP Recovery with CSP Depletion	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_RF_B0	9.15E-01	1.0541	LERF LOOP Recovery with Batt Depl and 0 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_RF_B1	9.59E-01	1.0344	LERF LOOP Recovery with Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.

Note: Basic events that are correlated in Table D.1-2 are not listed again in Table D.1-4 if they are equivalent basic events.

Table D.1-5

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Level 2 Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
#CAV	1.00E+00	3.2723	WATER LEVEL IN CAVITY BELOW BOTTOM OF RPV [> 6 FT]	This term is a flag. No SAMAs need to be aligned.
#CFL2	1.00E+00	1.3031	LATE CONTAINMENT FAILURE WITH VESSEL BREACH	This term is a flag. No SAMAs need to be aligned.
#CFL3	1.00E+00	1.0227	LATE CONTAINMENT FAILURE DUE TO LOSS OF CONTAINMENT FANS	This term is a flag. No SAMAs need to be aligned.
#CS_UNAVAIL	1.00E+00	3.4449	FAILURE OF EX VESSEL SYSTEMS TO MAINTAIN ADEQUATE WATER LEVELS	This term is a flag. No SAMAs need to be aligned.
#DP_LOCA	1.00E+00	1.0223	LOCA DEPRESSURIZATION OCCURS	This term is a flag. No SAMAs need to be aligned.
#TQU	1.00E+00	1.0386	TQU Sequence Marker	This term is a flag. No SAMAs need to be aligned.
#VB	1.00E+00	3.2723	RPS VESSEL HAS BEEN BREACHED	This term is a flag. No SAMAs need to be aligned.
BMT	1.00E-02	1.0062	CONTAINMENT FAILURE - DUE TO CONCRETE EROSION OF BASEMAT	This term represents containment failure due to concrete erosion of the basemat. Phase II SAMAs 44 and 46 to reduce the probability of basemat melt-through were evaluated.

Table D.1-5

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Level 2 Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
GHFFANM	1.00E+00	3.4536	FAILURE TO MANUALLY RECOVER COOLING FANS TO PREVENT LATE FAILURE	This term represents a failure of a human action to manually recover cooling fans to prevent late failure. Currently this is a flag and no SAMAs need to be aligned.
X_BMT	9.90E-01	3.2081	NO BASEMAT FAILURE DUE TO CONCRETE EROSION	This term is a split fraction. No SAMAs need to be aligned.
ZLOOP_LERF_NRF_B0	8.47E-02	1.4337	LERF LOOP Non-Recovery with Batt Depl and 0 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_NRF_B0NL	1.35E-01	1.0362	LERF LOOP Non-Recovery with Batt Depl and 0 Run Fail (No Load Shed)	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8 and 9 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_NRF_B1	4.06E-02	1.0984	LERF LOOP Non-Recovery with Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_NRF_B1NL	5.27E-02	1.0083	LERF LOOP Non-Recovery with Batt Depl and 1 Run Fail (No Load Shed)	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.

Table D.1-5

Correlation of Level 2 Risk Significant Terms to Evaluated SAMAs (Based on Level 2 Release Frequency)

Event Name	Probability	RRW	Event Description	Disposition
ZLOOP_LERF_NRF_B2	3.18E-02	1.006	LERF LOOP Non-Recovery with Batt Depl and 2 or more Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_NRF_D1	9.50E-02	1.0107	LERF LOOP Non-Recovery without Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_RF_CSP	9.42E-01	1.0094	LERF LOOP Recovery with CSP Depletion	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.
ZLOOP_LERF_RF_D1	9.05E-01	1.0058	LERF LOOP Recovery without Batt Depl and 1 Run Fail	This term represents a failure to recover offsite power when lost. Phase II SAMAs 6 and 10 for improving offsite power reliability; SAMAs 5 and 7 for increased availability of on-site AC power; and SAMAs 8, 9, and 11 for increasing diesel generator availability were evaluated.

Note: Basic events that are correlated in Tables D.1-2 and D.1-4 are not listed again in Table D.1-5 if they are equivalent basic events.

D.1.2.2 Radionuclide Analysis

D.1.2.2.1 <u>Introduction</u>

The goal of the radionuclide release characterization is to capture and collect accident scenarios resulting in releases from containment in a manner that best represents potential outcomes to public health consequences.

By using the end states of the CET, the progression of each accident sequence is passed through the CET to an end state. Associated with each of these end states is an accident release scenario that is characterized by the mechanism by which FPs are released outside of containment, the magnitude of FP release, and the timing of the release mechanism. The nature of the radioactive release categories is such that the spectrum of severe accidents is divided up into bins that represent a group with similar public health consequences. However, the determination of these public health consequences can be affected by a number of factors that impact the characterization of the radionuclide characterization.

The main characteristics of the containment end states for consideration in the development of the radionuclide release categories are shown below and are discussed in the following sections.

- Containment Failure Mechanism
- Timing of The Release
- Magnitude of the Release

D.1.2.2.2 <u>Containment Failure Mechanism</u>

The containment failure mechanism by which the FP releases occur affects the magnitude of the release and are considered in the classification of radionuclide releases. Factors for consideration regarding the containment failure pathways include:

- Size of the Containment Breach
  - Containment Failure
  - SGTR
  - Containment Isolation
- Location of Containment Breach

The size of the containment breach is dictated by the specific accident sequence and the type of breach. The relative size of the outside opening in the RCB can determine the ability and capacity of the RCB to retain and contain FP from being released.

A containment failure represents a catastrophic rupture of the containment vessel based on exceeding the ultimate containment capacity.

SGTR releases bypass containment and are directly released outside of the RCB. The size of this containment breach is consistent with the break size of a single SG tube. However, no retention time exists to retain FP prior to release, and scrubbing of the releases can only occur if the tube break is below the SG water level.

Failure of containment isolation systems to operate are defined as 2.25-inches or greater in size.

CI failures also provide a direct release of FP outside of containment. However, FP must travel through containment prior to release, allowing for natural deposition and gravitational settling mechanisms to attenuate the FP releases.

Similarly, the location of the containment failure breach plays a role in reducing the FP released. The distance the FP must travel inside of containment to the point of release can reduce the magnitude of radionuclides reduced. For containment failures, the release point was determined to be the escape hatch located in the lower portion of the annular compartment based on the finite element analysis of the WF3 containment [D.1-13].

D.1.2.2.3 Timing of Release

Release timing of the accident sequences are based on a number of considerations including the timing of the containment release against the implementation of plant responses actions to control and contain the release. Of equal importance to the determination of release timings is the timing of notification to the public to ensure adequate warning for implementation of protective actions, such as evacuation.

The WF3 Emergency Plan identified four classes of Emergencies: Unusual Event, Alert, Site Area Emergency and General Emergency. Issuance of a General Emergency is made based on core degradation with a potential challenge to containment integrity and requires the initiation of predetermined protective actions for the public. The WF3 plant maintains a readiness level to declare an emergency within 15 minutes of indication showing exceedance of an emergency action level [D.1-14].

In consideration of response times, the Emergency Plan provides the conditions for deriving accident response times. A Category F accident, characterized as degraded FP barrier, requires the loss of two barriers with a potential loss of the third barrier for declaration of a WF3 General Emergency.

With regard to characterization of release timing, the indication timing of the second FP barrier would indicate the beginning of the emergency action timing. The timing to the failure of the third FP barrier would indicate the timing of the accident release.

An evacuation study was performed for WF3 to evaluate evacuation time estimates (ETE) under varied conditions. These ETEs address mobilization times and voluntary evacuations of the permanent residents and the shadow population in the Emergency Planning Zone (EPZ). The time to clear 90% of the affected population in the EPZ boundary under worst case conditions is 3 hours and 45 minutes [D.1-15]. An evacuation from WF3 would be considered to be complete within 4 hours from the start of the evacuation, which accounts for the 15 minute timing to declare the General Emergency and the worst-case ETE. This evaluation is used to characterize "early" radionuclide releases as any release initiated less than four (4) hours following the declaration of a General Emergency, which would not allow the population in the EPZ to evacuate in time.

The following timing categories were used for the Level 2 radionuclide release classification. Release timings used in the Level 2 are based on the actual accident scenario timing (failure of the FP barriers) as determined by the MAAP calculations and include MAAP timing to core damage, vessel breach, containment failure, low SG water level and high containment pressure, as calculated in the MAAP calculation spreadsheets.

Table D.1-6

Release Timing Classification

Classification Abbreviation	Classification Category	Time of Initial Release Relative to Time for General Emergency Declaration
E	Early	Time < 4 hours
I	Intermediate	4 to 24 hours
L	Late	> 24 hours

D.1.2.2.4 Magnitude of Release

The source term values were determined from the deterministic Level 2 sequence calculations using the MAAP code. MAAP results were used to classify the magnitude of the FP releases for each Level 2 accident sequence. Because sequence-specific data was obtained for every sequence, no estimation of FP releases was required for the Level 2 analysis. Each source term is characterized by a set of release fractions quantifying the releases of those FP of interest because of possible deleterious effects to humans and the environment. Based on a review of the MAAP results, the following classification was selected to characterize the severity of the radionuclide releases based on the fraction of cesium iodide (CsI) released.

Table D.1-7

WF3 Release Categories

Classification Abbreviation	Classification Category	Cs Iodide % in Release
H	High	CsI > 10 %
M	Moderate	1 - 10 %
L	Low	0.1 - 1 %
LL	Low-Low	<< 0.1 %
Negligible	Intact	0

D.1.2.2.5 Release Category Bin Assignments

The combination of the timing and magnitude of release categories results in 12 different release categories with an additional intact category as shown in Table D.1-8. The actual magnitude of the release for each Level 2 scenario was evaluated to the maximum release fraction of CsI over the duration of the run as found in the MAAP results.

Table D.1-8

WF3 Release Categories

Identifier	Description	Definition
Intact	Containment Intact	Nominal leakage rate. Intact
H-E	High – Early Release Category	CsI > 10% Release Time < 4 hours
M-E	Moderate – Early Release Category	CsI: 1 - 10% Release Time < 4 hours
L-E	Low – Early Release Category	CsI: 0.1 - 1% Release Time < 4 hours
LL-E	Low Low – Early Release Category	CsI << 0.1% Release Time < 4 hours
H-I	High– Intermediate Release Category	CsI > 10% Release Time: 4 – 24 hours
M-I	Medium– Intermediate Release Category	CsI: 1 - 10% Release Time: 4 – 24 hours
L-I	Low – Intermediate Release Category	CsI: 0.1 - 1% Release Time: 4 – 24 hours
LL-I	Low Low– Intermediate Release Category	CsI << 0.1% Release Time: 4 – 24 hours
H-L	High – Late Release Category	CsI > 10% Release Time: > 24 hours
M-L	Medium – Late Release Category	CsI: 1 - 10% Release Time: > 24 hours
L-L	Low – Late Release Category	CsI: 0.1 - 1% Release Time > 24 hours
LL-L	Low Low – Late Release Category	CsI << 0.1% Release Time > 24 hours

D.1.2.2.6 Mapping of Level 1 Results into the Various Release Categories

The purpose of the Level 1 is to identify and capture accident sequences that have the potential to result in core damage. These sequences include the core damage states from the Level 1 PRA [D.1-5, D.1-16 & D.1-12]. Success criteria used in the Level 1 look at sequences that result in core damage with a 24-hour time frame. Once core damage has occurred, the accident sequences are no longer considered for success and are labeled as "core damage".

Guidance for performing Level 2 analyses and determination of LERF identifies core damage sequences and groups them into four containment failure plant states as shown below [D.1-6].

- Containment Bypass
- Containment Isolation
- Containment Failure with low RCS pressure
- Containment Failure with high RCS pressure

The WF3 Level 2 considers these containment failure states as identified in the guidance. The purpose of this guidance is to ensure that accident sequences with the potential to impact off-site emergency response, public health and the corresponding protective measures have been identified and addressed. The potential exists for the identification of accident sequences that lead to core damage, but can be returned to a safe and stable state as a result of plant response measures (safeguard systems) within a period of time. These sequences would then be precluded from further Level 2 analysis due to establishing a safe and stable state and the mitigation of offsite impacts.

These accident sequences were evaluated deterministically using the MAAP 4.0.6 code and a 36-hour accident time period. This time period was selected to ensure that sufficient time was allotted to allow for late failures and to capture the peak steady-state FP release concentrations. Accident sequences identified and evaluated as Level 2 sequences include:

- Transients
- Large Loss of Coolant Accidents (LOCA) - ALOCA
- Medium Loss of Coolant Accidents - MLOCA
- Small Loss of Coolant Accidents - SLOCA
- Steam Generator Tube Rupture Accidents - SGTR
- Station Blackout Accidents - SBO
- Anticipated Transients Without Scram - ATWS
- Interfacing System LOCA – ISLOCA

Bridge trees can be used to convert the results from the Level 1 into the inputs for the Level 2 accident sequences. The Level 2 accident sequences are comprised of elements from the Level 1 core damage sequence to include both the success and failure accident-sequence pathways in combination with the containment safeguard systems. The resulting Level 2 accident sequences from the bridge tree process results in plant damage states (PDS).

To simplify the process and reduce the number of Level 2 accident sequences, these PDS can then be grouped based on a shared containment response. The previous WF3 Level 2 performed as part of the IPE used this binning process to combine the sequences into the following groups as shown below [D.1-11]:

I – Medium Pressure RCS at core uncovery, No HPI
II – Medium Pressure RCS at core uncovery, No RAS
III – High Pressure RCS at core uncovery, No HPI
IV – Small LOCA with SG dryout, High pressure RCS at core uncover prevents HPI
V – Large LOCA, no HPSI
VI - Large LOCA, no RAS

For the WF3 Level 2 analysis, no grouping into PDS was performed to group accident sequences with similar safety features and containment failure responses. A more rigorous approach was taken where each Level 2 accident sequence was assessed individually based on the accident-specific containment response.

The WF3 Level 2 accident sequences were named using the two or three letter identification for the CD sequences from the Level 1 core damage event trees (i.e., AX, MU, SB, TQX, TKQ, and RB) and combined with a one-letter code to represent core melt sequences (core damage with containment safeguard systems).

D.1.2.2.7 Process Used to Group the Source Terms

With the development of the Level 2 release scenarios based on the integration of the Level 1 accident sequences, the containment safeguard configurations, and the Level 2 phenomena, these sequences were grouped under one of the 12 Release Categories identified in Table D.1-9. These groupings are based on the release timing and magnitude of FP as determined by the deterministic MAAP Level 2 calculations.

Exceptions were made in the classification of the release scenario associated with the following:

- Containment Bypass Sequences
- Containment Isolation Sequences
- Reactor Vessel Rupture Events
- Interfacing System LOCA Events

Containment Bypass Sequences
SGTR and I-SGTR sequences are characterized as bypass sequences due to a direct opening outside of containment at the onset of the accident sequence. These sequences were grouped with the H-E (high-early) release category based on an early release with minimal potential for mitigation of the FP releases. No consideration of FP scrubbing, retention, or deposition was considered for the bypass sequences.

Containment Isolation Sequences
Containment isolation failures are defined as early failures based on open pathways through the containment at the onset of the accident sequences. These sequences were grouped with the H-E (high-early) release category based on an early release with minimal potential for mitigation of the FP releases. No consideration of FP scrubbing, retention, or deposition was considered for the containment isolation sequences.

Reactor Vessel Rupture Events
Catastrophic reactor vessel rupture events pose a high likelihood of the occurrence of a containment failure concurrent with the vessel breach. As a result, these sequences were grouped with the H-E (high-early) release category based on an early release with maximum potential for the release of significant quantities of FP. No consideration of FP scrubbing, retention, or deposition was considered for the catastrophic vessel rupture sequences.

Interfacing System LOCA Events
Like the SGTR sequences, the ISLOCA events are characterized as bypass sequences due to a direct opening outside of containment at the onset of the accident sequence. These sequences were grouped with the H-E (high-early) release category based on an early

release with minimal potential for mitigation of the FP releases. No consideration of FP scrubbing, retention, or deposition was considered for the ISLOCA sequences.

Table D.1-9

Summary of Containment Event Tree Quantification

Release Category (Magnitude/Timing)	Release Frequency (Per ry)
H-E	1.88E-06
H-I	4.75E-06
H-L	0.00E+00
L-E	0.00E+00
L-I	2.42E-09
L-L	5.56E-10
LL-E	0.00E+00
LL-I	0.00E+00
LL-L	3.85E-10
M-E	2.74E-08
M-I	1.34E-07
M-L	1.84E-08
Intact[1]	3.67E-06
CDF	**1.05E-05**

[1] The "intact" column is calculated as (Base CDF - Total Release).

Nomenclature:

Timing (time between General Emergency Declaration and initial release):
Late (L) – Greater than 24 hours
Intermediate (I) – 4.0 to 24 hours
Early (E) – Less than 4.0 hours

Magnitude:

Intact – Much less than 0.1% CsI release fraction
Low-Low (LL) – Less than 0.1% CsI release fraction
Low (L) – 0.1% to 1% CsI release fraction
Medium (M) – 1% to 10% CsI release fraction
High (H) – Greater than 10% CsI release fraction

D.1.2.2.8 Consequence Analysis Source Terms

Input to the Level 3 WF3 model from the Level 2 model is a combination of radionuclide release fractions, timing of radionuclide releases, and frequencies at which the releases occur. This combination of information is used in conjunction with WF3 site characteristics in the Level 3 model to evaluate the off-site consequences of a core damage event.

Source terms were developed for the release categories identified in Table D.1-8. Table D.1-10 provides a summary of the Level 2 results that were used as Level 3 input for the WF3 SAMA analysis (the baseline analysis case).

Consequences corresponding to each of the release categories are developed in the WF3 Level 3 model, which is discussed in section D.1.5.

D.1.2.2.9 Release Magnitude Calculations

The MAAP computer code is used to assign both the radionuclide release magnitude and timing based on the accident progression characterization. Specifically, MAAP provides the following information:

- containment pressure and temperature (time of containment failure is determined by comparing these values with the nominal containment capability);
- radionuclide release timing and magnitude for a large number of radioisotopes; and
- release fractions for twelve radionuclide species.

Table D.1-10

WF3 Release Category Source Terms

Release Cat.	Release Freq. (per year)	Level 2 MAAP Run ID	RDOALARM MACCS - Time to declare GE, sec	Warning Time (sec) Measured from scram time; uses 15 minute GE declaration	RDPDELAY - Start of Plume release - from scram time (sec)	MAAP Timing Release Ends (sec)	RDPLUDUR - Duration of Release (sec)	RDPLHITE - Height of plume release - centerline of Escape Hatch (26.5 ft)	Energy of Release EREL(6), W	RDRELFRC001 - Release Fractions								
										Noble Gases	I	Cs	Te	Sr	Ru	La	Ce	Ba
Intact	3.68E-06	TPQU_BI	900.00	3224.35														
		Plume #1			2324	88724	86400	65.38	2.07E+03	6.59E-03	3.20E-04	1.91E-04	1.18E-04	2.15E-07	9.28E-07	3.30E-09	7.80E-08	4.80E-07
		Plume #2			88724	129600	40876	65.38	2.45E+03	9.99E-03	3.24E-04	1.92E-04	1.18E-04	2.15E-07	9.28E-07	3.30E-09	7.80E-08	4.81E-07
H-E	1.88E-06	TQX_H	900.00	49288.77														
		Plume #1			48389	50042	1653	65.38	2.45E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Plume #2			50042	129600	79558	8.08	4.11E+06	0.9998	0.2129	0.1987	0.2352	9.90E-04	1.36E-02	4.43E-05	1.02E-04	6.49E-03
H-I	4.75E-06	SBO	900.00	8233.16														
		Plume #1			7333	80630	73297	65.38	2.45E+03	5.89E-03	1.01E-04	3.89E-05	1.36E-04	1.29E-06	7.58E-05	3.44E-08	1.05E-07	8.69E-06
		Plume #2			80630	129600	48970	8.08	7.57E+05	0.9803	0.2563	1.17E-01	1.64E-01	1.76E-03	9.04E-04	2.90E-05	1.08E-03	9.11E-04
H-L	NA[1]	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-E	2.74E-08	SX_B	900.00	32997.73														
		Plume #1			32098	82532	50434	65.38	2.45E+03	3.25E-03	3.30E-04	1.88E-04	2.70E-04	3.24E-07	3.10E-06	2.01E-08	4.49E-08	2.71E-06
		Plume #2			50434	129600	79166	8.08	2.09E+04	0.4946	0.0542	1.33E-02	7.49E-03	5.88E-06	5.86E-05	3.58E-07	7.62E-07	7.11E-05
M-I	1.34E-07	SU_H	900.00	3270.88														
		Plume #1			2371	43200	40829	65.38	2.45E+03	0.8415	5.65E-02	1.62E-02	4.64E-02	1.48E-03	2.42E-02	7.69E-05	1.42E-04	6.26E-03
		Plume #2			43200	129600	86400	8.08	5.03E+06	0.8801	7.69E-02	2.42E-02	4.87E-02	1.57E-03	2.57E-02	8.04E-05	1.48E-04	6.61E-03
M-L	1.84E-08	TB_F	900.00	3198.58														
		Plume #1			2299	72608	70310	65.38	2.45E+03	5.85E-03	4.30E-04	2.02E-04	1.66E-04	1.81E-08	5.45E-07	1.77E-09	4.39E-09	1.92E-07
		Plume #2			72608	129600	56992	8.08	4.54E+06	0.9996	7.85E-02	2.10E-02	1.16E-02	2.84E-08	5.75E-07	1.87E-09	4.88E-09	5.39E-06
L-E	NA[1]	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
L-I	2.42E-09	MU_H	900.00	3735.56														
		Plume #1			2836	43200	40364	8.08	1.39E+07	0.8260	7.47E-03	7.42E-03	4.32E-02	1.75E-02	3.29E-02	8.76E-04	3.72E-03	4.91E-02
		Plume #2			43200	129600	86400	8.08	5.05E+06	0.9016	7.93E-03	7.83E-03	6.59E-02	2.39E-02	3.48E-02	1.17E-03	5.06E-03	5.25E-02
L-L	5.56E-10	TQX_B	900.00	19751.58														
		Plume #1			18852	105252	86400	65.38	2.45E+03	6.08E-03	1.27E-04	8.81E-05	9.61E-05	4.00E-07	7.79E-06	2.17E-08	1.44E-07	2.29E-06
		Plume #2			105252	129600	24348	8.08	2.35E+04	4.56E-01	2.48E-03	8.41E-04	3.53E-02	4.54E-07	8.65E-06	2.42E-08	1.61E-07	4.21E-06
LL-E	NA[1]	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
LL-I	NA[1]	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
LL-L	3.85E-10	AX_D	900.00	910.00														
		Plume #1			10	86410	86400	65.38	2.45E+03	6.27E-03	3.03E-04	2.10E-04	2.11E-04	2.19E-06	5.54E-06	6.24E-08	1.69E-07	7.05E-06

Release Cat.	Release Freq. (per year)	Level 2 MAAP Run ID	RDOALARM MACCS - Time to declare GE, sec	Warning Time (sec) Measured from scram time; uses 15 minute GE declaration	RDPDELAY - Start of Plume release - from scram time (sec)	MAAP Timing Release Ends (sec)	RDPLUDUR - Duration of Release (sec)	RDPLHITE - Height of plume release - centerline of Escape Hatch (26.5 ft)	Energy of Release EREL(6), W	RDRELFRC001 - Release Fractions								
										Noble Gases	I	Cs	Te	Sr	Ru	La	Ce	Ba
		Plume #2			86410	129600	43190	8.08	3.81E+05	0.5375	5.06E-04	5.49E-03	3.09E-03	2.22E-06	5.65E-06	6.33E-08	1.71E-07	1.08E-05

[1] These Release Categories were included as part of the level 2 model, but were not present in the level 2 results. As a result, release scenarios were not developed as part of the level 3 analysis.

D.1.3 External Events and Internal Flooding

D.1.3.1 Seismic Analysis

The WF3 PRA used for the SAMA analysis does not include external events. In the absence of such an analysis, Entergy used the WF3 IPEEE and more recent analyses to estimate the benefit of potential SAMAs using an external events benefit modifier as discussed in Section 4.15.1.4.4. The seismic portion of the WF3 IPEEE [D.1-17] follows the guidance of NUREG-1407 [D.1-18], defined as a reduced scope plant, and EPRI NP-6041-SL [D.1-19]. This was accomplished by performing a Seismic Margins Assessment (SMA) of the Safe Shutdown Equipment List (SSEL) with plant walkdowns in accordance with the guidelines and procedures documented in Electrical Power Research Institute (EPRI) Report NP-6041-SL. The SMA approach is a deterministic and conservative evaluation that does not calculate risk on a probabilistic basis. Therefore, its results should not be compared directly with the best-estimate internal events results.

The conclusions of the WF3 IPEEE seismic margin analysis are as follows:

1. Walkdowns resulted in no outliers that are operability issues at the plant.

2. No unique decay heat removal vulnerabilities to seismic events were found.

3. Seismic-induced flooding and fires do not pose major risks.

4. No unique seismic-induced containment failure mechanisms were identified.

However, there were three unresolved issues at the completion of the walkdowns. These issues are not significant to seismic risk and were made to conform to standard practice in seismic design. The issues and resolutions are [D.1-20]:

Issue	Resolution
Loose items in the Control Room	The equipment identified was analyzed for potential impact to safety-related equipment. As good engineering practice the book cases near CP-22 and the tool cart in the EDG Room B were removed and there was no additional impact to safety related equipment following the evaluation.
Station air pipe not meeting clearance requirements	CR-94-1111 contains the evaluation that the existing clearance for the station air pipe which is adjacent to 4KVESWGR3B will have no significant adverse impact during a seismic condition.
Storage of temporary equipment	Procedural guidance was updated for temporary storage in UNT-007-060 to prevent potentially hazardous situations under seismic conditions.

Though the IPEEE did not calculate a CDF due to seismic events, an Integrated Leak Rate Test (ILRT) Interval Extension Report from August 2014 [D.1-21] conservatively estimated a value of

6.87E-07 for the seismic CDF. For conservatism in the SAMA benefit analysis, this value will used to calculate the internal/external events benefit multiplier discussed in Section 4.15.1.4.4.

D.1.3.2 Fire Analysis

The Waterford 3 (WF3) IPEEE included an internal fire analysis employing EPRI's FIVE methodology [D.1-22]. The NRC's IPEEE SER for WF3 reports a total fire CDF of 7.0E-06/yr. However, the IPEEE fire analysis has been superseded by the WF3 fire PRA created for NFPA 805, which utilizes guidance in NUREG/CR-6850 [D.1-23].

The WF3 fire PRA was not used in the SAMA analysis to estimate the risk reduction of individual SAMAs. Rather, the WF3 fire PRA was used in the SAMA analysis for determining the fire contribution to the external events multiplier, as well as for identifying potential SAMAs to mitigate the internal fire risk.

Since the WF3 fire PRA model is not fully integrated with the most recent Level 2 and 3 analyses, it wasn't used directly for the SAMA analysis. In addition, the WF3 fire PRA is based on NFPA 805 modifications that have not been implemented. However, the SAMA evaluation should be performed using the best available information on risk insights. Considering that the interim fire PRA model is a more current analysis of the fire risk at WF3 than the IPEEE fire analysis, and, therefore, is the best currently available fire risk information, use of the fire PRA model provides an acceptable basis (best available information) for identifying and evaluating SAMA candidates.

The total fire CDF was reported to be 1.62E-05/yr per the fire PRA model associated with the most recent LAR submittal [D.1-24]. In May 2015, an updated fire CDF of 1.80E-05/yr was calculated in PRA-W3-05-049 [D.1-25] due to changes resulting from NRC RAIs. Since the CDF reported in PRA-W3-05-049 is the most recent value, this value was used in calculating the SAMA internal/external events multiplier discussed in Section 4.15.1.4.4.

D.1.3.3 Other External Hazards

The WF3 IPEEE submittal, in addition to the internal fires and seismic events, examined a number of other external hazards:

- high winds and tornadoes;
- external flooding; and
- ice, hazardous chemical, transportation, and nearby facility incidents

The WF3 Individual Plant Examination of External Events (IPEEE) concluded for high winds, floods, and other external events that WF3 meets the applicable NRC SRP requirements, and therefore has an acceptably low risk with respect to these hazards. As these events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible.

D.1.3.4 Internal Flooding

An internal flooding analysis was performed in response to Generic Letter 88-20 (November 23, 1988) issued by the NRC. An updated analysis was performed with significant changes including how small diameter lines are handled, the assumed duration of releases, the handling of drains and turbine building floods, the characterization of rupture frequencies and sizes, and elimination of any screening of potential core damage scenarios by rupture frequency. These changes allowed the internal flooding analysis to satisfy the requirements in the ASME Standard and Regulatory Guide 1.200.

Revision 3 of the internal flooding notebook, PRA-W3-01-002 [D.1-45], calculates a total CDF contribution of 2.48E-06 from internal floods. This value was used, along with external events CDF values discussed above, to calculate the internal/external events multiplier discussed in Section 4.15.1.4.4. The multiplier was utilized because the current internal flooding model hasn't been integrated with the current internal events model or the Level 2 and 3 models.

D.1.4 PSA Model Revisions and Peer Review Summary

The summary of the WF3 PSA models CDF and LERF is presented in the table below.

Summary of Major PSA Models		
PSA Model	**CDF (/rx-yr)**	**LERF (/rx-yr)**
1992 (IPE) (R1)	1.70E-05	1.50E-06
2000 (R2)	2.54E-05	5.33E-07
2003 (R3)	6.75E-06	2.42E-07
2009 (R4)	3.96E-06	4.94E-07
2015 (R5)	1.05E-05	1.36E-07

D.1.4.1 Major Differences Between the 2000 (R2) PSA Model and the IPE Model

The WF3 IPE model was created in 1992 [D.1-26]. The model was updated in 2000 and documented in Reports EC-S00-001 Rev. 0 [D.1-39], EC-S93-008 Rev. 1, Rev. 1C1, and Rev. 1C2 [D.1-27]; with the final CDF and LERF values documented in ILRT Interval Extension Report W3F1-2001-0108 [D.1-28]. Changes to the model are summarized below.

- The main focus of Revision 2 was to remove asymmetries existing in the model for standby components (i.e. – the HPSI, CCW, CVC and CHW systems) and incorporate missed support functions (i.e. – EDG dependency on DC power).
- DC control power dependencies were also added to FW-173A&B, AB bus alignment, ACC pumps, CCW AB pump, HPSI Pumps, LPSI Pumps, CS Pumps, EFW Pumps, and the AB Switchgear.
- Incorporated changes from a plant modification (DC-3402) which moved some loads from the AB battery to the turbine building battery.
- Updated EDG fail to run and start rates.
- Updated Loss of Offsite Power recovery analysis.

D.1.4.2 Major Differences Between the 2003 (R3) PSA Model and the 2002 (R2) PSA Model

- Included ISLOCA and ATWS sequences.
- Improved RCP seal LOCA modeling.
- Updated human reliability analysis.
- Updated generic and plant-specific failure rates.
- Improved Loss of Offsite Power recovery analysis.
- Improved common cause failure analysis.
- Updated HRA and LOSP analyses to reflect the Extended Power Uprate (EPU). The EPU changes the times available for operator actions and recovery of offsite power.

- Hot Leg Injection was added to mitigate medium and large LOCAs after the EPU which increased power that created the need for hot leg injection.
- Added Primary Safety Valve LOCA Initiating Event.
- Updated the Level 1 containment heat removal logic to 1 of 2 containment spray trains OR 2 of 4 containment cooling system fans.

Calculations EC-S00-001, Rev.1 [D.1-40], ECS93-008 [D.1-29], DRN_05-142, DRN 06-26, and PRA-W3-01-001S12 [D.1-30] summarize changes incorporated in the Revision 3 model, the overall core damage frequency results, and other additional information from the Revision 3 version of the model.

D.1.4.3 Major Differences Between the 2009 R4C1 (R4) PSA Model and the 2003 WSES-3 PSA (R3) PSA model

The update of the Revision 4 Model is designated as the WF3 Level-1 Model R4C1 [D.1-31]. The following list describes the most significant changes from the WF3 PSA model R3 to PSA model 2009 R4C1 Model.

- Updated initiating event data for plant operating experience with Bayesian updates using NUREG/CR-5750.
- Added safety injection (SI) valve rupture initiating events.
- Added instrument air system initiating event.
- Updated ATWS system interactions and failure propagations.
- Added initiating event %FVIVCC to the AFW system modeling.
- Updated the loss of offsite power (LOOP) logic to address both the consequential LOOP and the LOOP frequency for conditions such as severe weather, grid degradation, and switchyard work.
- Updated generic failure rates and component boundaries using NUREG/CR-6928.
- Added logic to the dry and wet cooling tower fans to allow for out of service selections as required for EOOS-related activities.
- Added emergency feedwater (EFW) recirculation line and component failures.
- Removed or replaced NOT gates in the model logic where possible.
- Added common cause failures for the diesel generator fuel oil transfer pumps.
- Added initiating event %T6OC, for a line break outside of containment.
- Addressed most peer review and expert panel model comments.

D.1.4.4 Major Differences Between the 2015 (R5) PSA Model and the 2009 (R4) PSA Model

Several changes were made in the Revision 5 PSA model update. The most significant changes are listed below.

- Resolved Peer Review findings.
- Updated success criteria associated with the number of dry cooling towers and wet cooling towers required to mitigate various accident sequences.
- Developed WF3-specific LOCA break sizes and associated frequencies.
- Converted from "flag" set alignments to conditional probability alignments.
- Updated generic and plant-specific failure rate data.
- Updated common cause failure (CCF) event probabilities.

- Updated initiator frequencies.
- Updated human failure events.
- HVAC dependencies were removed from the switchgear rooms and some pump rooms based on NRC comments and available room heat-up calculations associated with the room.
- A main control room (MCR) notebook and model was developed and included in the integrated model.
- Removed dependency to refill nitrogen accumulators by extending credited operation time from 10 hours to 24 hours.
- Revised modeling of refill of the CSP to reflect current procedural guidance.
- Added containment cooling system fan coil isolation valves.
- Revised battery depletion modeling to credit new procedural direction to strip batteries to extend battery life.

Details about the changes are included in calculation PSA-WF3-01-QU [D.1-32].

In addition, a full level 2 model was created which is based on the 2015 internal events model.

D.1.4.5 PSA Model Peer Review

The Waterford 3 IPE [D.1-26] PRA was reviewed by an independent review team in three levels. The first consisted of normal engineering Quality Assurance carried out by the organization performing the analysis. A qualified individual with knowledge of PRA methods and plant systems performed an independent review of all assumptions, calculations, and results for each task and system model in the Level 1 analysis (except the Internal Flood analysis).

The second level of review was performed by plant personnel not directly involved with the development of the PRA model. This consisted of individuals from Operations, Engineering, Training, and licensing groups which reviewed the system models and accident sequence description. This provided diverse expertise with plant design and operations knowledge to review the system fault trees for accuracy.

The third level of review was performed by PRA experts from ERIN Engineering. This review provided broad insights on techniques and results based on experience from other plant PRAs. This review was conducted in two phases. During the first phase, the review team concentrated on the overall PRA methodology, accident sequence analysis, and system fault trees. The intent was to provide early feedback to the Waterford 3 staff concerning the adequacy and accuracy of the reviewed products. The second phase included Level 1 results, human failure and recovery analysis, preliminary plant damage state cutsets that combined Level 1 with containment system failures, and a preliminary CET.

An additional review was performed near the end of the project on the Level 2 analysis by experts from ABB Combustion Engineering. The intent of this review was to ensure that all important phenomena were considered and modeled correctly. Design features unique to CE plants were given particular emphasis. Detailed and specific comments on analysis methods, assumptions, and results were obtained.

The review teams found that the project was successfully meeting those objectives with a sound methodology and relatively minor adjustments necessary. The major comments are summarized below:

- The overall methodology reflects the current state of the art for PRAs and will meet the requirements of GL 88-20.

- Cutset results were found to be complete and reasonable with few modeling errors.

- Several conservatisms were identified in the success criteria, system modeling, and failure data used.

- The level of documentation was generally found to be good with more detail recommended for the accident sequence descriptions, treatment of RCP seal failures, and human recovery analysis. Some inconsistencies between the documentation and the modeling were found.

- Control of changes to the model should be improved so as to document which files were used for a particular solution.

- The EFW turbine driven pump can be expected to continue to operate with low quality steam or even water at the turbine inlet.

- Plant damage state category IV (high RCS pressure with late core melt) contained no cutsets due to the method of modeling. Although this is adequate for categorizing risk at the plant, it should be kept in mind during accident management guidance development that sequences such as those in category IV can in fact exist.

- Instrument air initiators should be included in the model.

In August 2009 the WF3 PRA was peer reviewed against the requirements of the American Society of Mechanical Engineers (ASME) PRA standard and the requirements of Regulatory Guide (RG) 1.200, Revision 1. This peer review was performed using the process defined in Nuclear Energy Institute (NEI) 05-04. The ASME PRA Standard contains a total of 327 numbered supporting requirements in nine technical elements and the configuration control element. Thirteen of the SRs represent deleted requirements, and of the remaining 314 SRs, thirteen were determined to be not applicable to the WF3 PRA. Of the 301 remaining SRs, 244 SRs (81%) were rated as Capability Category II or greater and approximately 9% were Capability Category I. Only 10% of the SRs were rated as not met. In the course of this review, ninety-six new Facts and Observations (F&Os) were prepared, including two "Best Practices".

Many of the findings pertained to documentation issues. However, there were some technical Issues in various parts of the PRA. The F&Os were resolved and resulted in documentation updates, model updates, human action updates, and procedure updates.

The documentation of the Integration and Quantification Work Package, PRA-W3-01-001S02, was found to be a Best Practice because it was well-written and appropriately detailed. Also, in the Systems Analysis, the documentation of the Component Dependency tables was found to be a Best Practice because of the completeness, clarity, and ease of use of the tables.

D.1.5 The WinMACCS Model—Level 3 Analysis

D.1.5.1 Introduction

SAMA evaluation relies on Level 3 PRA results to measure the effects of potential plant modifications. A Level 3 PRA model using version 3.10.0 of the Windows Melcor Accident Consequences Code System (WinMACCS) [D.1-33] was created for WF3. A WinMACCS calculation consists of three phases: input processing and validation, phenomenological modeling, and output processing. The phenomenological models are based mostly on empirical data. The modeling software is subdivided into three modules:

- ATMOS treats atmospheric transport and dispersion of material and its deposition from the air utilizing a Gaussian plume model with Pasquill-Gifford dispersion parameters.
- EARLY models consequences of the accident to the surrounding area during an emergency action period. The emergency action period is the duration that begins when the first plume of the release arrives and ranges between 1 and 7 days.
- CHRONC considers the intermediate long-term impact in the period subsequent to the emergency action period.

Detailed site-specific meteorological, population, and economic data are required. Model parameters can be varied by the user via input files, thus facilitating the analysis of consequence sensitivities due to uncertainties in specific model parameters. Assumptions associated with the model parameters can be found in the input document [D.1-34].

The Level 3 report evaluates a base case and two sensitivity cases to account for variations in data and assumptions for postulated internal events. The base case uses estimated evacuation speed and times for evacuation based on site-specific evacuation calculations and consequence analysis best practices [D.1-35, D.1-34]. A sensitivity case (TIME) is the base case with the initial time to seek shelter extended from 2 hours to 3 hours. The other sensitivity case (SPEED) is the base case with a slower evacuation speed.

The population dose risk (PDR) was estimated by summing the product of population dose (obtained via WinMACCS calculation) and frequency for each accidental release over all releases. The offsite economic cost risk (OECR) was estimated by summing the product of offsite economic cost (obtained via WinMACCS calculation) and frequency for each accidental release over all releases. The offsite economic cost includes costs that could be incurred during the emergency response phase and the long-term protective action phase.

D.1.5.2 Input

The following sections describe the site-specific input parameters used to obtain the off-site dose and economic impacts for cost-benefit analyses.

D.1.5.2.1 Projected Total Population

Projected permanent, transient, and total population estimates in parish and sector geography was developed. Sector geography consists of fifteen concentric bands at 0-0.914 km (0.568-mi.), 0.914-1.61 km (1-mi.), 1.61-3.22 km (2-mi.), 3.22-4.83 km (3-mi.), 4.83-6.44 km (4-mi.), 6.44-8.05 km (5-mi.), 8.05-9.66 km (6-mi.), 9.66-11.27 km (7-mi.), 11.27-12.87 km (8-mi.), 12.87-14.48 km

(9-mi.) 14.48-16.09 km (10-mi.), 16.09-32.19 km (20-mi.), 32.19-48.28 km (30-mi.), 48.28-64.37 km (40-mi.), and 64.37-80.47km (50 mi.) from the center point in 22.5 degree segments centered on the 16 compass points .

2010 Census information found the following:

- Permanent Population within 20 Miles = 371,976 persons
- 20 Mile Population Density (371,976/Area) = 296 persons/square mile
- Permanent Population within 50 Miles = 2,006,583 persons
- 50 Mile Density (2,006,583/Area) = 255 persons/square mile

2045 Total Population = 2,882,454

2010-2045 Annual Growth Rate for all Parishes within the Region = 0.92.

Additional details of the distribution of the population can be found in reference WF3-EP-14-00012 [D.1-34]

D.1.5.2.2 Land Fraction

The percentage of land in each of the 240 spatial elements is required by WinMACCS. The National Hydrography Dataset (NHD) for the watersheds and the area within the 50-mile region was used to calculate the ratio of land to surface water coverage [D.1-36]. Swampland was included as land, rather than water, so that WinMACCS habitability and farmability decisions would be applied to the swampland, resulting in a conservative estimate of the costs for decontamination, interdiction, and condemnation. Calculated values ranged from 0.00 to 1.00. A value of 1.00 indicates the spatial element area is all land, with no significant surface water.

D.1.5.2.3 Watershed Class

Watershed Index is defined by NUREG/CR-4551, Volume 2, Rev. 1 as areas drained by rivers (Class 1) or large water bodies (Class 2). Class 2 is intended only for use with a very large lake, similar in size to Lake Michigan. Thus for WF3, a watershed index of 1 (drained by rivers) was used for all spatial elements.

D.1.5.2.4 Regional Economic Data

Economic data were obtained from SECPOP 2013 [D.1-41], U.S. Census of Agriculture for 2012 [D.1-42], Global Insight [D.1-43] and Department of Labor Statistics [D.1-44].

Region Index

Each spatial element was assigned to an economic region, defined in this report as a parish. When a spatial element was comprised of more than one parish, it was assigned to the parish that had the most area in that spatial element. Four parishes in Louisiana (Iberia, St. Helena, St. Mary, and West Baton Rouge) were not assigned due to their small representation in any one spatial element.

Regional Economic Data

Economic data were obtained from SECPOP 2013 [D.1-41], U.S. Census of Agriculture [D.1-42] for 2012, Global Insight [D.1-43] and Department of Labor Statistics [D.1-44].

VALWF– Value of Farm Wealth

WinMACCS input requires VALWF, an average value of farm wealth (dollars/hectare) for the 50-mile radius area. This value is calculated by first, converting each parish's VFRM to dollars per county using U.S. Census of Agriculture item approximate land area (acres, 2012) and the conversion factor of 0.4047 ha/acre. These values are then weighted by the area each of the 21 parishes has in the WF3 50-mile area. Finally, the resultant values are then summed, producing a dollar value for the region, and divided by the total number of hectares within the region. The resulting value is $9281.53/ha.

VALWNF– Value of Non-Farm Wealth

WinMACCS input requires a regional average value of non-farm wealth. This value is calculated by first multiplying the VNFRM by the 2010 parish permanent population, and then weighting by the area each of the 21 parishes have in the WF3 50-mile region. These resultant values are then summed, producing a dollar value for the region, and divided by 2010 permanent population within the 50-mile region. The 2010 permanent population within the region was obtained from the U.S. Census Bureau (USCB 2010). The regional value of non-farm wealth is $448,741.03/person. VALWNF is based upon fixed, reproducible, tangible wealth, a measure of the durable goods owned in an area. This value was modified by adding a measure of total economic activity based upon the state gross domestic product (GDP). The modified VALWNF is $512,597.99/person.

D.1.5.2.5 Agriculture Data

WinMACCS requires input regarding the crop type, growing season, and average fraction of farmland devoted to each crop type. The WinMACCS model requires average values for the 50-mile radius area instead of specific values for each of the 240 spatial elements. Agriculture data were obtained from the 2012 Census of Agriculture for the 21 parishes of interest in Louisiana [D.1-37]. The acres for each crop type and land in area (acres) were downloaded for each parish and the crop data were classified into seven crop categories, as defined in NUREG/CR-4551 Evaluation of Severe Accident Risks: Quantification of Major Input Parameters.

D.1.5.2.6 Meteorological Data

Meteorological data representative of the WF3 site was collected to support the Level 3 analysis. This data included wind speed, wind direction, atmospheric stability class, accumulated precipitation, and atmospheric mixing heights. The required data were obtained from the onsite WF3 meteorological monitoring system and regional National Weather Service stations [Slidell, LA (National Weather Service Station No. 53813) and Armstrong International Airport, LA

(National Weather Service Station No. 72231)]. Data records were collected for years 2004 through 2013 [D.1-34] and converted into formatted files for use in the WinMACCS model.

Site-Specific Data

The site-specific meteorological data from the refined data set was used to produce fourteen separate WinMACCS input files, one for each year from 2004 through 2009 and two for each year from 2010 through 2013. Any missing hourly data was filled in the WinMACCS input files using data from approved data substitution methods as needed. Data from years 2010 through 2013 was missing seasonal mixing height averages. As a result, both minimum and maximum mixing heights were calculated for these years and incorporated into the meteorological data

Regional Mixing Height Data

The NCDC daily values for morning and afternoon mixing heights were averaged for each season and year. Calculated seasonal mixing height values were rounded to the nearest hundred and divided by 100 to express values in hundreds of meters for the WinMACCS model. Because data was not available for 2010 through 2013, the minimum and maximum average seasonal values for the years 2000 through 2009 were used for these years.

D.1.5.2.7 Evacuation Scenario

Two cohorts were used to define the WF3 evacuation scenario for the evacuation of 90% of the affected population [D.1-33]. Cohort 1 defines the evacuation of 90% of the affected population while Cohort 2 defines the remaining 10% of the population that does not evacuate. The emergency response implementation for the execution of these 2 cohorts is defined by the parameters ESPEED, DLTSHL, TIMHOT, and TIMNRM as described below.

Travel Speed of Evacuees [ESPEED]

This value is the speed at which the evacuees move through the area based on evacuation of a full 10 mile EPZ [D.1-35]. This value is 1.192 m/s based on traveling the full 10 miles in 3 hours and 45 minutes. The 3 hour and 45 minute evacuation time is determined based on the longest evacuation time occurring in Regions R14 and R15 as part of the Evacuation Time Estimate evaluations [D.1-34].

Delay to Shelter [DLTSHL]

The delay to shelter (DLTSHL) is the time it takes for residents in the EPZ to receive the alert and notification and to enter a shelter (their residence, workplace, etc.) This value reflects the time required to execute the activities prior to beginning the evacuation trip [D.1-34]. This value is 7200 seconds based on the maximum time for all employees, residents and commuters [D.1-34]. This time includes the 1:45 minute time for trip generation based on the 90^{th} percentile evacuation time plus 15 minutes for the remaining 10^{th} of evacuation times to begin.

Hotspot Relocation Time [TIMHOT] & Normal Relocation Time [TIMNRM]

These times are associated with the hotspot and normal time required to relocate residents from the area based on EPA Protective Action Guides (PAGs) [D.1-35]. Times of 43,200 and 86,400 seconds were used for TIMHOT and TIMNRM, respectively, and are based on NRC guidance [D.1-35].

D.1.5.2.8 Core Inventory

The WF3 core inventory input to the WinMACCS model [D.1-33] is based on a core thermal power of 3735 MWt [D.1-38]. The core inventory is shown in Table D.1-11.

Table D.1-11 Estimated WF3 Core Inventory (Becquerels)*

Nuclide	Inventory	Nuclide	Inventory
Co-58	3.53E+16	Te-131m	5.75E+17
Co-60	2.70E+16	Te-132	5.61E+18
Kr-85	4.92E+16	I-131	3.94E+18
Kr-85m	1.45E+18	I-132	5.70E+18
Kr-87	2.94E+18	I-133	7.97E+18
Kr-88	4.15E+18	I-134	8.87E+18
Rb-86	2.07E+15	I-135	7.48E+18
Sr-89	4.06E+18	Xe-133	7.80E+18
Sr-90	3.96E+17	Xe-135	2.29E+18
Sr-91	5.43E+18	Cs-134	1.11E+18
Sr-92	5.26E+18	Cs-136	2.92E+17
Y-90	4.18E+17	Cs-137	5.91E+17
Y-91	5.09E+18	Ba-139	6.88E+18
Y-92	5.28E+18	Ba-140	7.03E+18
Y-93	5.97E+18	La-140	7.30E+18
Zr-95	6.61E+18	La-141	6.38E+18
Zr-97	6.30E+18	La-142	6.15E+18
Nb-95	6.61E+18	Ce-141	6.19E+18
Mo-99	7.15E+18	Ce-143	6.34E+18
Tc-99M	6.26E+18	Ce-144	4.73E+18
Ru-103	6.23E+18	Pr-143	6.15E+18
Ru-105	3.23E+18	Nd-147	2.64E+18
Ru-106	2.38E+18	Np-239	7.08E+19
Rh-105	2.24E+18	Pu-238	4.01E+15
Sb-127	3.05E+17	Pu-239	9.04E+14
Sb-129	1.29E+18	Pu-240	1.14E+15
Te-127	2.95E+17	Pu-241	1.92E+17
Te-127m	3.90E+16	Am-241	1.27E+14
Te-129	1.27E+18	Cm-242	4.86E+16
Te-129m	1.88E+17	Cm-244	2.84E+15

***** Based on a thermal power of 3735 MWt (100.5% of upgraded power level of 3716 MWt)

D.1.5.2.9 Source Terms

Twelve release categories, corresponding to internal event sequences, were part of the WinMACCS input. Section D.1.2.2.7 provides details of the source terms for postulated internal events. Based on the Level 2 results, a review of the dominant accident classes and maximum release of fission products was performed to select a representative accident sequence for each release category. The representative accident sequences selected for each release category represented both the dominant accident class based on the Level 2 results and the maximum release of fission products from the MAAP analyses.

Based on regulatory guidance and best practices [D.1-35], two plume segments were used to represent each release category based on the MAAP results from the Level 2 [D.1-2]. In general, these plumes characterize the two-phases of the source term release associated with (1) the initial accident sequence from core damage up to containment failure, and (2) the accident sequence following containment failure.

D.1.5.3 RESULTS

The WinMACCS model was run with each of the fourteen separate WinMACCS input files, one for each year from 2004 through 2009 and two for each year from 2010 through 2013 (one with the minimum average mixing heights and one with the maximum average mixing heights). The results showed that the site-specific meteorological data from year 2010, with the minimum average mixing heights, generated the highest population dose and the highest offsite economic cost. Therefore, the base case results are those obtained using the site-specific meteorological data from year 2010, with the minimum average mixing heights.

Risk estimates for a base case and two sensitivity cases were analyzed to account for variations in data and assumptions with WinMACCS. The base case uses estimated evacuation speed (1.192 m/s) and sheltering times (2 hours). A sensitivity case, SPEED, is the base case with a slower evacuation speed (reduced by a factor of 2 from 1.192 m/s (base) to 0.596 m/s) with the sensitivity case, TIME, being a longer sheltering time (increased from 2 hours to 3 hours). These sensitivities were evaluated to conservatively reflect and quantify the uncertainties in specific model parameters. Results from the Level 3 sensitivities are shown in Table D.1-13.

Table D.1-12 shows estimated base case mean risk values for each release mode. The estimated mean values of PDR and offsite OECR for WF3 are 15.9 person-rem/yr and $147,339/yr, respectively [D.1-33].

Table D.1-12 Base Case Mean PDR and OECR Values for Postulated Internal Events

Characteristics of Release Mode		Results - Year 2010M	
Release ID	Frequency (per year)	Population Dose person-sv	Offsite Economic Cost ($)
Intact	3.68E-06	1.39E+03	1.59E+08
H-E	1.88E-06	2.94E+04	2.79E+10
H-I	4.75E-06	1.96E+04	1.92E+10
M-E	2.74E-08	1.01E+04	6.02E+09
M-I	1.34E-07	3.43E+04	2.04E+10
M-L	1.84E-08	1.18E+04	8.53E+09
L-I	2.42E-09	4.01E+04	1.87E+10
L-L	5.56E-10	3.55E+03	4.44E+08
LL-L	3.85E-10	6.83E+03	2.41E+09
	Totals	1.59E+01 person-rem/yr	1.47E+05 $/yr

1 Conversion Factor: 1 sv = 100 rem

A sensitivity case (SPEED) was performed to assume an evacuation speed that is reduced from 1.192 m/s (base) to 0.596 m/s. This sensitivity case (SPEED) assumes a lower average evacuation speed. Results of sensitivity analyses as shown in Table D.1-13 indicate that a slower evacuation speed slightly increases the population dose offsite consequences by less than 1% with no change to economic impact.

A sensitivity case (TIME) was conducted assuming a longer delay in the initial time to seek sheltering (parameter DLTSHL). The sheltering time of 2 hrs was used for the baseline. This time was increased to time of 3 hrs (10,800 sec) evacuation for the sensitivity run. Results of sensitivity analyses as shown in Table D.1-13 indicate that a longer period between the onset of the accident and the start of the sheltering period does not significantly impact population doses (less than 1%) or the offsite costs.

Table D.1-13 Summary of Offsite Consequence Results for Sensitivity Cases

Characteristics of Release Mode		Population Dose (person-sv)[1]			Offsite Economic Cost ($)		
ID	Frequency (per year)	Baseline (person-sv)	Speed (person-sv)	Time (person-sv)	Baseline ($)	Speed ($)	Time ($)
Intact	3.68E-06	1.39E+03	1.40E+03	1.39E+03	1.59E+08	1.59E+08	1.59E+08
H-E	1.88E-06	2.94E+04	2.94E+04	2.94E+04	2.79E+10	2.79E+10	2.79E+10
H-I	4.75E-06	1.96E+04	1.96E+04	1.96E+04	1.92E+10	1.92E+10	1.92E+10
M-E	2.74E-08	1.01E+04	1.01E+04	1.01E+04	6.02E+09	6.02E+09	6.02E+09
M-I	1.34E-07	3.43E+04	4.06E+04	3.59E+04	2.04E+10	2.04E+10	2.04E+10
M-L	1.84E-08	1.18E+04	1.18E+04	1.18E+04	8.53E+09	8.53E+09	8.53E+09
L-I	2.42E-09	4.01E+04	4.85E+04	4.21E+04	1.87E+10	1.87E+10	1.87E+10
L-L	5.56E-10	3.55E+03	3.56E+03	3.55E+03	4.44E+08	4.44E+08	4.44E+08
LL-L	3.85E-10	6.83E+03	6.84E+03	6.83E+03	2.41E+09	2.41E+09	2.41E+09

	Baseline	Speed	Time	Baseline	Speed	Time
Totals	1.59E+01	1.60E+01	1.59E+01	1.47E+05	1.47E+05	1.47E+05
% Change	NA	0.57%	0.14%	NA	0.00%	0.00%
Units	person- rem/yr	person- rem/yr	person- rem/yr	$/yr	$/yr	$/yr

1 Conversion Factor: 1 sv = 100 rem

D.1.6 References

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Attachment D.2

Evaluation of WF3 SAMA Candidates

D.2 EVALUATION OF WF3 SAMA CANDIDATES

This section describes the generation of the initial list of potential SAMA candidates, screening methods, and the analysis of the remaining SAMA candidates.

D.2.1 SAMA List Compilation

Candidate SAMAs are defined as potential enhancements to the plant design, operating procedures, inspection programs, or maintenance programs that have the potential to reduce the severe accident risk of WF3. These SAMAs can be characterized as either hardware (e.g., physical modification of plant structure, systems, and components) or non-hardware enhancements (e.g., operation, maintenance programs, and procedure changes), or a combination of the two. The candidate SAMAs considered for WF3 encompass both hardware and non-hardware enhancements.

A list of SAMA candidates was developed by reviewing industry documents and considering other plant-specific enhancements not identified in the published industry documents. Since WF3 is a PWR, considerable attention was paid to the SAMA candidates from SAMA analyses for other PWR plants. Industry documents reviewed included the following.

- NEI 05-01 – Severe Accident Mitigation Alternatives Analysis [D.2-1]
- Davis-Besse Nuclear Power Station SAMA Analysis [D.2-2]
- South Texas Project, Units 1 and 2 SAMA Analysis [D.2-3]
- Callaway Plant SAMA Analysis [D.2-4]
- Seabrook Station SAMA Analysis [D.2-5]
- Sequoyah Nuclear Plant, Units 1 and 2 SAMA Analysis [D.2-6]

In addition to SAMA candidates from review of industry documents, additional SAMA candidates were obtained from plant-specific sources, such as the WF3 Individual Plant Examination (IPE) [D.2-7] and the WF3 Individual Plant Examination of External Events (IPEEE) [D.2-8]. In the IPE and IPEEE several enhancements related to severe accident insights were recommended and implemented. These enhancements are included in the comprehensive list of phase I SAMA candidates as 183 through 195 (Table D.2-1). The current WF3 PSA Level 1 and 2 models were also used to identify plant-specific modifications for inclusion in the comprehensive list of SAMA candidates. The risk significant events from the current PSA model were reviewed for similar failure modes and effects that could be addressed through a potential enhancement to the plant. The correlation between SAMAs and the risk significant terms are listed in Tables D.1-2, D.1-4, and D.1-5.

The comprehensive list of 201 candidate SAMAs considered for implementation at WF3 is provided in onsite documentation [D.2-10].

D.2.2 Qualitative Screening of SAMA Candidates (Phase I)

The purpose of the preliminary SAMA screening was to eliminate from further consideration enhancements that were not viable for implementation at WF3. Potential SAMA candidates were screened out if they modified features not applicable to WF3, if they had already been implemented at WF3, or if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate. During this process, 48 of the Phase I SAMA candidates were screened out because they were not applicable to WF3, 11 of the Phase I SAMA candidates were screened out because they were similar in nature and could be combined with another SAMA candidate, and 68 of the Phase I SAMA candidates were screened out because they had already been implemented at WF3, leaving 74 SAMA candidates for further analysis. The final screening process involved identifying and eliminating those items whose implementation cost would exceed their benefit as described below. Table D.2-2 provides a description of each of the 74 Phase II SAMA candidates.

D.2.3 Final Screening and Cost Benefit Evaluation of SAMA Candidates (Phase II)

To assess the viability of each SAMA considered for a final cost-benefit evaluation, the cost of implementing that particular SAMA was estimated and compared with the estimated benefit. If the cost of implementation was greater than the attainable benefit of a particular SAMA, then the modification was not considered economically viable and was eliminated from further consideration.

The expected cost of enhancement to implement each SAMA (COE) was established from existing estimates of similar modifications combined with engineering judgment. Most of the cost estimates were developed from similar modifications considered in previously performed SAMA analyses. In particular, these cost-estimates were derived from the following major sources.

- Davis-Besse [D.2-2]
- South Texas project [D.2-3]
- Callaway [D.2-4]
- Seabrook Station [D.2-5]
- Sequoyah [D.2-6]
- ANO-2 [D.2-11]
- Indian Point [D.2-12]

Detailed cost estimates were often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit. The implementation costs for of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis case. Nonetheless, the cost of each SAMA candidate was conceptually estimated to the point where conclusions regarding the economic viability of the proposed modification could be adequately gauged.

Based on a review of previous submittals, SAMA evaluations, and an evaluation of expected implementation costs at WF3, the following estimated cost ranges for each type of proposed SAMA were used.

Type of Change	ESTIMATED COST RANGE
Procedural only	$25K-$50K
Procedural change with engineering or training required	$50K-$200K
Procedural change with engineering and testing/training required	$200K-$300K
Hardware modification	$100K to >$1000K

Detailed cost estimates were based on the engineering judgment of project engineers experienced in performing design changes at the facility. The detailed cost estimates considered engineering, labor, materials, and support functions such as planning, scheduling, health physics, quality assurance, security, safety, and firewatch. The estimates included a 20%-30% contingency on the design and a 30%-40% contingency on the installation costs, but did not account for inflation, replacement power during extended outages necessary for SAMA implementation, or increased maintenance or operation costs following SAMA implementation.

The cost benefit comparison and disposition of each of the 74 Phase II SAMA candidates is presented in Table D.2-2. Three of the Phase II SAMA candidates were retained without evaluation as they are already commitments in the NFPA 805 LAR [D.2-13]

Bounding evaluations (or analysis cases) were performed to address specific SAMA candidates or groups of similar SAMA candidates. These analysis cases overestimated the benefit and thus were conservative calculations. For example, if the objective of the SAMA was to reduce the likelihood of a certain failure mode, then eliminating the failure mode from the PSA bounded the benefit, even though the SAMA would not be expected to be 100% effective in eliminating the failure. This calculation obviously overestimated the benefit, but if the inflated benefit indicated that the SAMA candidate was not cost beneficial, then the purpose of the analysis was satisfied.

A description of the analysis cases used in the evaluation follows.

Case 1: SBO Reduction

This analysis case was used to evaluate the change in plant risk from providing additional DC or AC power to reduce SBO contribution. A bounding analysis was performed by eliminating the SBO contribution from the PSA model by setting events #SBO and #SBORCP to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $5,597,783. This analysis case was used to model the benefit of Phase II SAMAs 1, 2, and 7.

Case 2: Improve Feedwater Reliability

This SAMA analysis case was used to evaluate the change in plant risk from installing a digital feed water upgrade. A bounding analysis was performed by eliminating the failure of feedwater by setting the %T4 initiator to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $35,361. This analysis case was used to model the benefit of phase II SAMA 31.

Case 3: Add DC System Cross-ties

This analysis case was used to evaluate the change in plant risk from providing DC bus cross-ties. A bounding analysis was performed where the failure of DC bus 3B-DC-S (gate D100) was ANDed with the failures of DC busses 3A-DC-S (gate D200) and 3AB-DC-S (D300) below gate D605. Similarly, below gate D605A, gates D100A, D200A, and D300AW were ANDed; below gate D352, gates D100_AX, D201A, and D301AW were ANDed; and below gate H0217, gates D100_AD, D200_AD, and D300_AD were ANDed. Also, BEs DBD03BDCSF (DC BUS 03BDCS FAULT) and %TDC2 (Loss of DC Bus B IE) were set to zero. This resulted in an internal and external benefit (with uncertainty) of approximately $3,912,412. This analysis case was used to model the benefit of phase II SAMA 3.

Case 4: Increase Availability of On-Site AC Power

This analysis case was used to evaluate the change in plant risk from improving the 4.16 kV bus cross-tie ability. Two bounding analyses were performed, conservatively ANDing the failure of 4.16 kV bus 3B3-S logic (E100) with the logic for 4.16 kV BUS 3A3-S (E300) and vice versa. It was determined that adding a crosstie from 4.16 kV BUS 3B3-S to 4.16 kV BUS 3A3-S would give the maximum CDF reduction, and the following changes were made in order to evaluate this SAMA case: Gate E100 was ANDed with E300, gate E100JZ was ANDed with E300JZ, gate E100-L2 was ANDed with E300-L2, gate E100X was ANDed with E300X, and gates E0003B3S_L1 and E0003A3S_L1 were ANDed under gates E507A, E508A, and E510A. This SAMA case resulted in an internal and external benefit (with uncertainty) of approximately $4,047,285. This analysis case was used to model the benefit of Phase II SAMA 5.

Case 5: Reduce Loss of Off-Site Power

This SAMA analysis evaluated the change in plant risk from installing an additional buried off-site power source or burying off-site power lines. A bounding analysis was performed by changing the frequency of %T5 initiator to 1.79E-02 /rx-critical-yr by removing severe weather contribution based on PSA-WF3-01-IE-01, which resulted in an internal and external benefit (with uncertainty) of approximately $1,816,135. This analysis case was used to model the benefit of Phase II SAMAs 6 and 10.

Case 6: Provide Backup EDG Cooling

This analysis case was used to evaluate the change in plant risk from increasing EDG reliability by adding a backup source of diesel cooling. A bounding analysis was performed by eliminating failure of CCW cooling to the EDG gates. Gates EMMCCAVALV, S002, S002-L2, and BE SCCMDPSTRT were deleted from gates E340 and E340-L2 and gates EMMCCBVALV, S502, S502-L2, and event SCCMDPSTRT were deleted from gates E140 and E140-L2. Also, gate EMMCCAVALV was deleted from E340X and EMMCCBVALV was deleted from E140X, which resulted in an internal and external benefit (with uncertainty) of approximately $1,337,906. This analysis case was used to model the benefit of phase II SAMAs 8 and 9.

Case 7: Reduced Frequency of Loss of Auxiliary Component Cooling Water

This analysis case was used to evaluate the change in plant risk from adding the ability to cross-tie the ACCW trains. Since Waterford 3 does not have a traditional service water system, the closest system is the ACCW system. WF3 can't currently cross-tie the ACCW pumps for cooling. A bounding analysis was performed to evaluate adding the ability to cross-tie the ACCW trains by removing ACCW gates Q519, Q527, S133, S233, S133-L2, and S233-L2 which resulted in an internal and external benefit (with uncertainty) of approximately $183,427. This analysis case was used to model the benefit of phase II SAMAs 21, 22 and 23.

Case 8: Increased availability of feedwater

Description/Evaluation

This analysis case was used to evaluate the change in plant risk from increased availability of feedwater. A bounding analysis was performed by eliminating DWST failure to supply the CSP in the PSA model. Basic events QHFCSPEMPP, QPP6CD250J, QXVDW4411K, QCVCMU123N, QXVDW4414K, QXVCMU141K, QXVCMU142K, and QXVCMU141N were set to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $46,934. This analysis case was used to model the benefit of phase II SAMA 32.

Case 9: High Pressure Safety Injection System

This analysis case evaluated the change in plant risk from plant modifications that would increase the availability of high pressure safety injection. A bounding analysis was performed by eliminating failure of HPSI in the PSA model by replacing gates H1000, H1000_REC, and H2000 with a single basic event set to zero representing the new HPSI system, which resulted in an internal and external benefit (with uncertainty) of approximately $541,919. This analysis case was used to model the benefit of phase II SAMAs 13 and 17.

Case 10: Extend Reactor Water Storage Pool Capacity

This analysis case was used to evaluate the change in plant risk from throttling RWSP demands and providing additional makeup to the RWSP to maintain RWSP inventory. Due to an increase in RWSP inventory, more time is available to swap ECCS pump suction from the RWSP to the Safety Injection Sump. A bounding analysis was performed by setting two operator actions to zero, HHFISOMINP and HHFMANRA_P, and also setting the tank rupture probability, HTK3RWSPRJ, to zero. This resulted in an internal and external benefit (with uncertainty) of $37,457. This analysis case was used to model the benefit of phase II SAMAs 16, 29, 30, and 49.

Case 11: Eliminate ECCS Dependency on Component Cooling Water System

This analysis case was used to evaluate the change in plant risk from replacing ECCS pump motors with air-cooled motors. A bounding analysis was performed by eliminating failure of ECCS motor cooling due to failure of CCW in the PSA model [CCWTOA, CCWTOABA, CCWTOB, CCWTOABB, L130, and L230 were deleted], which resulted in an internal and external benefit (with uncertainty) of $361,328.This analysis case was used to model the benefit of phase II SAMA 20.

Case 12: Increase Availability of ACCW

This analysis case was used to evaluate the change in plant risk from adding redundant power to the dry cooling tower fans, wet cooling tower fans, and ACCW pumps. A bounding analysis was performed by eliminating the DC control power gates to the ACCW pumps (gate D200A under S135 and Gate D100A under S235) and the DC power logic to the dry and wet cooling tower fans (Gates SA51R3, SA52R3, SB51R3, and SB52R3), which resulted in an internal and external benefit (with uncertainty) of approximately $18,655.This analysis case was used to model the benefit of phase II SAMA 19.

Case 13: Low Pressure Safety Injection System

This analysis case was used to evaluate the change in plant risk from adding an alternate Low Pressure Safety Injection system. A bounding analysis was performed by eliminating failure of the Low Pressure Safety Injection system in the PSA model [gate L1000 was deleted], which resulted in an internal and external benefit (with uncertainty) of approximately $39. This analysis case was used to model the benefit of phase II SAMAs 14 and 15.

Case 14: Increase Component Cooling Water Availability

This analysis case was used to evaluate the change in plant risk from installing an additional component cooling water pump. A bounding analysis was performed by eliminating failure of CCW pump failures and CCFs in the PSA model. Events SCCMDPNRUN, SMPCCW-ABG, SMPCCW-ABB, SHFCCWPABA, STMCCWPABF, CCWABSTBY, SMP3CCW1BGS, STMCCWPPBF, SMP3CCW1BBS, CCWBSTBY, SMP3CCW1AGS, STMCCWPPAF, CCWASTBY, SMP3CCW1ABS were set to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $3,532,265. This analysis case was used to model the benefit of phase II SAMA 27.

Case 15: Decreased Charging Pump Failure

This analysis case was used to evaluate the change in plant risk from increasing availability of electrical power to the normal charging pump by adding an alternate power source. A bounding analysis was performed by eliminating the normal charging pump power gates in the PSA model. Gates E604 and R384 under R392, and gate E604 under RABFAIL were deleted, which resulted in an internal and external benefit (with uncertainty) of approximately $96,156. This analysis case was used to model the benefit of phase II SAMA 12.

Case 16: Reactor Coolant Pump Seals

This analysis case was used to evaluate the change in plant risk from improving the RCP seals or cooling system. A bounding analysis was performed by eliminating RCP Seal LOCA in the PSA model. Initiators %RCP and %T9RCP were set to zero and gate QT02 was deleted, which resulted in an internal and external benefit (with uncertainty) of approximately $3,969,811. This analysis case was used to model the benefit of phase II SAMAs 24, 25, and 26.

Case 17: Main Feedwater System Reliability

This analysis case was used to evaluate the change in plant risk from installing a motor-driven feedwater pump. A bounding analysis was performed by setting loss of main feedwater to zero in the PSA model. Initiator %T4 was set to zero and gate BT02 was deleted, which resulted in an internal and external benefit (with uncertainty) of approximately $2,637,923. This analysis case was used to model the benefit of phase II SAMA 33.

Case 18: EDG Fuel Oil

This analysis case was used to evaluate the change in plant risk from installing a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks. A bounding analysis was performed by setting the failure of the fuel oil pumps to zero in the PSA model [basic events ETKFDTNKAK, ETKFDTNKAG, ECVEG109AN, EXVEG117AK, EXVEG111AK, ETKFOSTKAJ, EXVFO105AK, ETKFOSTKAG, EHFFOXFRAA, ETKFDTNKBK, ETKFDTNKBG, ECVEG109BN,

EXVEG117BK, EXVEG111BK, ETKFOSTKBJ, EXVFO105BK, ETKFOSTKBG, EHFFOXFRBA, EMPOILTRAL, EMPOILTRAA, ECCFOXFRA, ECCFOXFRF, EMPOILTRBF, EMPOILTRBL, EMPOILTRBA, and EMPOILTRAF were set to zero] which resulted in an internal and external benefit (with uncertainty) of approximately $2,722,110. This analysis case was used to model the benefit of phase II SAMA 11.

Case 19: Intentionally Left Blank

Case 20: Create a reactor coolant depressurization system

This analysis case was used to evaluate the change in plant risk from creating a reactor coolant depressurization system. A bounding analysis was performed by eliminating small LOCA events by setting events #SB, #SU, and #SX to zero. This resulted in an internal and external benefit (with uncertainty) of approximately $465,700. This analysis case was used to model the benefit of phase II SAMA 18.

Case 21: Steam Generator Inventory

This analysis case was used to evaluate the change in plant risk from using the fire water system as a backup for steam generator inventory. A bounding analysis was performed by reducing the frequency of the turbine-driven AFW pump and failure of local operation of AFW during SBO in the PSA model [gates Q304, Q305, Q471, Q481, Q120, Q202, and EFW were ANDed with a basic event set to 1.0E-03 (based conservatively on the failure of the entire firewater system)], which resulted in an internal and external benefit (with uncertainty) of approximately $8,212,217. This analysis case was used to model the benefit of phase II SAMA 34.

Case 22: Instrument Air Reliability

This analysis case was used to evaluate the change in plant risk from increasing the reliability of the Instrument Air system. A bounding analysis was performed by eliminating the loss of the Instrument Air System initiating event in the PSA model [Initiator %TIA was set to zero, and gates I110, IMM3SLWTRA, IMM3SLWTRB, MMM3SLWTRA, MMM3SLWTRB, MMM3SLWTRC were pruned and set to zero], which resulted in an internal and external benefit (with uncertainty) of approximately $4,532. This analysis case was used to model the benefit of phase II SAMA 37.

Case 23: Increased availability of HVAC

This analysis case was used to evaluate the change in plant risk from a loss of HVAC in the battery, EDG, and main control rooms with temporary HVAC such as fans, portable coolers, or opening doors. A bounding analysis was performed by running three cases, each eliminating one system; MCR HVAC (gate W001), EDG room 3A cooling (gate U007), and EDG room 3B cooling (gate U008). It was determined that removing the EDG room 3A cooling gate U007 would provide the most benefit. This case resulted in an internal and external benefit (with uncertainty) of approximately $1,550,385. This analysis case was used to model the benefit of phase II SAMAs 35 and 36.

Case 24: Debris coolability and core concrete interaction

This analysis case was used to evaluate the change in plant risk from enhancing debris coolability and mitigating core concrete interaction. A bounding analysis was performed by eliminating failure of debris coolability and core concrete interaction in the PSA model [Gate CMR_3 under gate CMR, gate XCAV underneath gate HI_2F, and basic event CAV-FSUMP underneath gate VB_FAIL were deleted and basic event BMT was set to zero], which resulted in an internal and external benefit (with uncertainty) of approximately $61,182. This analysis case was used to model the benefit of phase II SAMAs 38, 47, 72, and 73.

Case 25: Decay Heat Removal Capability

This analysis case was used to evaluate the change in plant risk from installing a containment vent. A bounding analysis was performed by eliminating late containment failure due to over-pressurization in the PSA model [BE Flags #CFL2, #CFL3, #CFL4, and #CFL5 were set to FALSE], which resulted in an internal and external benefit (with uncertainty) of approximately $2,612,900. This analysis case was used to model the benefit of phase II SAMAs 41 and 42.

Case 26: Improve Containment Spray Capability

This analysis case was used to evaluate the change in plant risk from improving the Containment Spray system. A bounding analysis was performed by reducing failure of containment spray in the PSA model. Gate Y001L1 was ANDed with an event set to 1.0E-03, and events P_CSFAILS and YHFSPRAYLP were set to 1.0E-03 based conservatively on the failure of the entire containment spray system, which resulted in an internal and external benefit (with uncertainty) of approximately $3,864,827. This analysis case was used to model the benefit of phase II SAMAs 39, 40, and 50.

Case 27: Reduce Hydrogen Ignition

This analysis case was used to evaluate the change in plant risk from implementing means to reduce hydrogen ignition. A bounding analysis was performed by eliminating hydrogen detonation in the PSA model. Basic events H2GLOBCON, CNTH2FAILG, H2LOCCON, CNTH2FAILL, H2LCH, H2LCL, CNTFAILLCH, CNTFAILLCL, H2HCL, CNTFAILHCL, H2HCH, CNTFAILHCH, P_IGN, P_H2BURN were set to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $25,290. This analysis case was used to model the benefit of phase II SAMAs 43, 51, and 52.

Case 28: Increase Cooling and Containment of Molten Core Debris

This analysis case was used to evaluate the change in plant risk from creating a large concrete crucible to contain molten core debris or creating a core melt reduction system. A bounding analysis was performed by eliminating containment core melt propagation in the PSA model. Basic events BMT, X_BMT, and PRCOOLDBIV were set to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $6,946,981. This analysis case was used to model the benefit of phase II SAMAs 44, 45, and 46.

Case 29. High Pressure Core Ejection Occurrences

This analysis case was used to evaluate the change in plant risk from erecting a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure. A bounding analysis was performed by eliminating high pressure core ejection occurrences in the PSA model [basic events HPME, and X_BMT were set to zero], which resulted in an internal and external benefit (with uncertainty) of approximately $6,885,811. This analysis case was used to model the benefit of phase II SAMA 53.

Case 30: Reduce Probability of Containment Failure

This analysis case was used to evaluate the change in plant risk from constructing a building to be connected to the primary/secondary containment and maintained at a vacuum. A bounding analysis was performed by eliminating containment failure from the PSA model [BE Flags #CFE2, #CFL3, #CFL2, #CFL4 , and #CFL5 were set to FALSE], which resulted in an internal and external benefit (with uncertainty) of approximately $10,535,565. This analysis case was used to model the benefit of phase II SAMA 48.

Case 31: Containment Isolation

This analysis case was used to evaluate the change in plant risk from adding redundant and diverse limit switches to each containment isolation valve. A bounding analysis was performed by eliminating containment isolation failure by setting #CIF to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $14,752. This analysis case was used to model the benefit of Phase II SAMA 55.

Case 32: Reduce Frequency of Steam Generator Tube Ruptures

This SAMA analysis case was used to evaluate the change in plant risk with reducing the frequency of steam generator tube ruptures. A bounding analysis was performed by eliminating steam generator tube ruptures in the PSA model by setting events %R, #TI-SGTR, TI-SGTR_SBO, TI_SGTR and TI-SGTR_NOSBO, PI_SGTR_SBO, #PI-SGTR-SBO, PI-SGTR_NOSBO, PI_SGTR, and #PI-SGTR to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $694,437. This analysis case was used to model the benefit of phase II SAMAs 56, 57, 58, 59, and 60.

Case 33: Reduce Consequences of Steam Generator Tube Ruptures

This analysis case was used to evaluate the change in plant risk from implementing mitigation strategies for reducing steam generator tube rupture consequences. A bounding analysis was performed by reassigning the SGTR CDF contribution from H-E (2.17E-7 per year) to release category L-I. The frequency of 2.17E-7 was determined by eliminating the SGTR contribution to H-E by eliminating or setting to zero gates UR01_1 and UR01_2 along with basic events #TI-SGTR, TI-SGTR_SBO, TI_SGTR, TI-SGTR_NOSBO, PI_SGTR_SBO, #PI-SGTR-SBO, PI-SGTR_NOSBO, PI_SGTR, and #PI-SGTR. This resulted in an internal and external benefit (with uncertainty) of approximately $100,807. This analysis case was used to model the benefit of phase II SAMA 61.

Case 34: Reduce ATWS Frequency

This analysis case was used to evaluate the change in plant risk from reducing the ATWS frequency and consequences. A bounding analysis was performed by setting the ATWS events from the PSA model [#TK, #TKQ, and #TKC] to FALSE, which resulted in an internal and external benefit (with uncertainty) of approximately $39,577. This analysis case was used to model the benefit of phase II SAMAs 63, 64, 65, and 66.

Case 35: Intentionally Left Blank

Case 36: Intentionally Left Blank

Case 37: Reduce Probability of a LOCA

This analysis case was used to evaluate the change in plant risk from installing a digital large break LOCA protection system. A bounding analysis was performed by setting the initiators for a Large LOCA (%A) and a medium LOCA (%M) to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $28,650. This analysis case was used to model the benefit of phase II SAMA 69.

Case 38: Prevent Secondary Side Depressurization

This analysis case was used to evaluate the change in plant risk from installing secondary side guard pipes up to the main steam isolation valves. A bounding analysis was performed by eliminating the initiator for a steam line break outside containment or the inadvertent closure of MSIVs in the PSA model by setting events %T6 and %T6OC to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $10,417. This analysis case was used to model the benefit of phase II SAMA 70.

Case 39: Eliminate Thermally Induced Tube Ruptures Following Core Damage

This analysis case was used to evaluate modifying procedures such that the water loop seals in the reactor cooling system (RCS) cold legs are not cleared following core damage. A bounding analysis was performed by eliminating thermal induced steam generator tube rupture events by setting events #TI-SGTR, TI_SGTR, TI-SGTR_SBO, and TI-SGTR_NOSBO to zero. This resulted in an internal and external benefit (with uncertainty) of approximately $29,591. This analysis case was used to model the benefit of phase II SAMA 54.

Case 40: Replace CARMVAAA201-B with a fail closed AOV

This analysis case was used to evaluate replacing MOV CARMVAAA201-B to remove its AC power dependency. A bounding analysis was performed by eliminating motive power dependency from gate JMMCAR201C (Gate G024), which resulted in an internal and external benefit (with uncertainty) of approximately $0. This analysis case was used to model the benefit of phase II SAMA 62.

Case 41: Improve internal flooding response procedures and training

This analysis case was used to evaluate the change in plant risk from improving internal flooding response procedures and training to improve the response to internal flooding events.

The WF3 internal flooding notebook states the following for the modified operator actions:

Based on a review of the operator actions impacted by internal flooding three actions in Turbine Generator Building +15 elevation and one action on Reactor Auxiliary Building +46 elevation were identified. Therefore, two additional rule recovery files, recovery_rulesTB15.txt and recovery_rulesRAB46.txt, were developed that removed the actions on these elevations.

Since the internal event risk analysis does not include internal flooding, this internal flooding SAMA would not mitigate internal event risk. A bounding analysis was performed by assuming the SAMA would eliminate the contribution to internal flooding CDF in the Turbine Generator Building +15 elevation and Reactor Auxiliary Building +46 elevation. The total internal flooding CDF is 2.48E-06/rx-yr [D.2-9]. This analysis case was used to model the benefit of phase II SAMA 67.

The internal flooding CDF eliminated is as follows:

Event	**CDF**
RAB46-299-A	1.58E-08
RAB46-299-B	1.58E-08
RAB46-300-46E-46W-A	3.26E-09
RAB46-300-46E-46W-B	1.62E-09
TB15-250-3	1.94E-08
TB15-250-1B	1.13E-08
TB15-250-5	2.05E-09
TB15-250-2	6.47E-10
TB15-250-4	4.00E-10
TB15-250-1A	6.14E-11
TB15-250-1	3.29E-12
Total	7.03E-08

The percent reduction is 7.03E-08/2.48E-06 = 2.83%

The internal events model cannot be used to assess the benefit from this internal flooding SAMA. However, the consequences resulting from internal flooding core damage and internal event-induced core damage would be comparable. Since we have already estimated the maximum benefit from removing all internal event risk, the maximum benefit of removing all internal flooding risk can be estimated by reducing the maximum internal event benefit by the ratio of the total internal flooding CDF to the internal event CDF. The total internal flooding benefit is calculated below.

Given,

Maximum internal benefit is $2,163,103
Total internal flooding CDF = 2.48E-06/rx-yr [D.2-9]
Internal events CDF = 1.05E-05/rx-yr

Maximum internal flooding benefit = Maximum internal benefit x Total internal flooding CDF/Internal events CDF

Maximum internal flooding benefit = $2,163,103 x (2.48E-06/1.05E-05) = $510,904
SAMA case 41 benefit = 2.83% x (Maximum internal flooding benefit) = 0.0283 x $510,904
SAMA case 41 benefit = $14,459
Applying the uncertainty factor of 1.99,
SAMA case 41 benefit with uncertainty = $14,459 x 1.99 = $28,773

Case 42: Water tight doors for the largest contributor to internal flooding

This analysis case was used to evaluate the change in plant risk from installing flood doors to prevent water propagation in the electric board room. The electrical equipment rooms at WF3 do not have water tight flood doors. Specifically this SAMA will evaluate water tight doors for the largest contributor to internal flooding, which is flood zone RAB21-212/225B. This analysis case was used to model the benefit of phase II SAMA 68.

Since the internal event risk analysis does not include internal flooding, this internal flooding SAMA would not mitigate internal event risk. A bounding analysis was performed by assuming the SAMA would eliminate the contribution to internal flooding CDF from flood zone RAB21-212/225B.

The total internal flooding CDF is 2.48E-06/rx-yr [D.2-9].

The internal flooding CDF eliminated is as follows:

Event	CDF
RAB21-212-225B-80MIN	7.19E-07
RAB21-212-225B-45MIN	3.47E-10
RAB21-212-225B-15MIN	8.40E-11
RAB21-212-225B-15-45MIN	2.76E-11
Total	7.19E-07

The percent reduction is 7.19E-07/2.48E-06 = 28.99%

The internal events model cannot be used to assess the benefit from this internal flooding SAMA. However, the consequences resulting from internal flooding core damage and internal event-induced core damage would be comparable. Since we have already estimated the maximum benefit from removing all internal event risk, the maximum benefit of removing all internal flooding risk can be estimated by reducing the maximum internal event benefit by the ratio of the total internal flooding CDF to the internal event CDF. The total internal flooding benefit is calculated below.

Given,

Maximum internal benefit is $2,163,103
Total internal flooding CDF = 2.48E-06/rx-yr [D.2-9]
Internal events CDF = 1.05E-05/rx-yr

Maximum internal flooding benefit = Maximum internal benefit x Total internal flooding CDF/Internal events CDF

Maximum internal flooding benefit = $2,163,103 x (2.48E-06/1.05E-05) = $510,904
SAMA case 42 benefit = 28.99% x (Maximum internal flooding benefit) = 0.2899 x $510,904
SAMA case 42 benefit = $148,111
Applying the uncertainty factor of 1.99,
SAMA case 42 benefit with uncertainty = $148,111 x 1.99 = $294,741

Case 43: Gagging device to close a stuck open safety valve

This analysis case was used to evaluate installing a gagging device to close a stuck open safety valve. A bounding analysis was performed by eliminating the failure of stuck open relief valves by setting events PRYMS106BT, PRYMS112BT, PRYMS108BT, PRYMS113BT, PRYMS110BT, PRYMS114BT, PRYMS106AT, PRYMS112AT, PRYMS108AT, PRYMS113AT, PRYMS110AT, PRYMS114AT, and OHFMSSGAGR to zero, which resulted in an internal and external benefit (with uncertainty) of approximately $76. This analysis case was used to model the benefit of phase II SAMA 71.

D.2.4 Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of assumptions upon the analysis. The benefits estimated for each of these sensitivities are presented in Table D.2-3.

A description of each sensitivity case follows.

Sensitivity Case 1: Years Remaining Until End of Plant Life

The purpose of this sensitivity case was to investigate the sensitivity of assuming a 29-year period for remaining plant life (i.e. nine years on the original plant license plus the 20-year license renewal period), rather than the 20-year license renewal period used in the base case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

Sensitivity Case 2: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. The discount rate of 7.0% used in the base case analyses is conservative relative to corporate practices. Nonetheless, a lower discount rate of 3.0% was assumed in this case to investigate the impact on each analysis case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

D.2.5 References

D.2-1 Nuclear Energy Institute (NEI), NEI 05-01, *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document*, November 2005, Revision A.

D.2-2 U.S. Nuclear Regulatory Commission (USNRC), NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Davis-Besse Nuclear Power Station (NUREG-1437, Supplement 52) Final Report*, April 2015.

D.2-3 USNRC, NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding South Texas Project, Units 1 and 2 (NUREG-1437, Supplement 48) Final Report*, November 2013.

D.2-4 USNRC, NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Callaway Plant, Unit 1 (NUREG-1437, Supplement 51) Final Report*, October 2014.

D.2-5 USNRC, NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding* Seabrook Station *(NUREG-1437, Supplement 46) Final Report*, July 2015.

D.2-6 USNRC, NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Sequoyah Nuclear Plant, Units 1 and 2 (NUREG-1437, Supplement 53) Final Report*, March 2015.

D.2-7 Waterford 3 Probabilistic Risk Assessment Individual Plant Examination Submittal, August 1992.

D.2-8 WF3 IPEEE "Internal Plant Examination of External Events", Revision 0, July 1995.

D.2-9 WF3 Calculation No: PRA-W3-01-002, "W3 Internal Flooding Analysis", Revision 3.

D.2-10 WF3-EP-14-00014, "Cost-Benefit Analysis of Severe Accident Mitigation Alternatives," Revision 0.

D.2-11 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Arkansas Nuclear One, Unit 2 (NUREG-1437, Supplement 19) Final Report", April 2005.

D.2-12 Entergy Letter NL-14-143, "Reply to Request for Additional Information Regarding the License Renewal Application," November 20, 2014 (ML14337A042).

D.2-13 W3F1-2011-0074, "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001Edition)", November 2011.

Table D.2-1
Phase I SAMAs Related to IPE and IPEEE Insights

Phase I SAMA ID Number	SAMA Title	Result of Potential Enhancement	Screening Results	SAMA Disposition	Credited in PSA Model
183	Cross-tie of AC power trains.	Proceduralize the process to cross-tie power from train A to train B equipment. The ability to cross-tie power trains can have a significant impact on preventing core melt when failure of one train is due to power failures.	#2 - Similar item is addressed under other proposed SAMAs	See disposition on SAMA 11.	No
184	Install a portable generator to charge the AB battery.	A portable generator that can be used to continue to supply DC power to the EFW turbine driven pump controls (and necessary monitoring instrumentation) can decrease the likelihood of core melt before AC power is restored.	#3 - Already installed	The AB battery is generally utilized to power the TDEFW pump. The TDEFW control system is operable until the AB station battery reaches its minimum voltage. At this time local manual control of the TDEFW pump is implemented. Due to the length of time before battery depletion and the ability to perform manual operation it's not expected that additional charging capacity would have significant importance for the AB system. Therefore, the intent of this SAMA is considered to have already been implemented at WF3	Yes

Table D.2-1
Phase I SAMAs Related to IPE and IPEEE Insights

Phase I SAMA ID Number	SAMA Title	Result of Potential Enhancement	Screening Results	SAMA Disposition	Credited in PSA Model
185	Add guidance for aligning the LPSI pump for containment spray.	The LPSI pumps can be aligned to serve as containment spray pumps and therefore may provide a backup to this function. Guidance for this alignment would decrease the probability of containment failure caused by steam overpressurization.	#3 - Already installed	Using LPSI to replace containment spray is proceduralized in OP-902-009, Appendix 28. The containment spray system is utilized in response to a large LOCA, however, the operator action has not been included in the PRA model due to insufficient time to perform the alignment.	No
186	Enhance refill of condensate storage pool.	Emphasize the need to refill the condensate storage pool (CSP) with acceptable quality water (or switch to the wet cooling tower basin) in training. Makeup from other sources can extend the time for the cooldown or ensure continued heat removal.	#3 - Already installed	For Emergency Feedwater (EFW) the CSP inventory is not sufficient for the 24 mission time, so either CSP makeup or transfer of the EFW suction to the wet cooling towers (WCTs) via the ACCW system is needed. If CSP level drops below 25%, the operators are instructed to align EFW suction to ACCW per OP-902-009, Appendix 10. Operators are trained to this procedure.	Yes

Table D.2-1
Phase I SAMAs Related to IPE and IPEEE Insights

Phase I SAMA ID Number	SAMA Title	Result of Potential Enhancement	Screening Results	SAMA Disposition	Credited in PSA Model
187	Provide feedwater from the fire protection system to the steam generator	The fire protection system has its own diesel driven pumps. During station blackouts or total loss of feedwater, this system could provide an additional source of feedwater to remove heat from the RCS.	#2 - Similar item is addressed under other proposed SAMAs	See disposition on SAMA 83.	No
188	Provide additional guidance for chiller/HVAC failure.	Room cooling failures are important to the long term operation of the HPSI and EFW pumps. Additional guidance to address room cooling failures can provide information to identify actions to recover cooling and minimize the effects of room heatup.	#2 - Similar item is addressed under other proposed SAMAs	See SAMA 93 for implementing procedures for temporary HVAC.	No
189	Provide water from the fire protection system to the containment sump.	Providing water to the reactor cavity from the fire protection system may prevent vessel breach by allowing ex-vessel cooling.	Retain	This SAMA is being retained to consider providing water to the reactor cavity from the fire protection system.	No

Table D.2-1
Phase I SAMAs Related to IPE and IPEEE Insights

Phase I SAMA ID Number	SAMA Title	Result of Potential Enhancement	Screening Results	SAMA Disposition	Credited in PSA Model
190	Enhance communication between sump and cavity.	Increasing the flow area through the door in the ductwork (or removal of the door completely) will allow a more free flow of water from the containment sump into the reactor cavity.	Retain	This SAMA is being retained to consider removal of the door in the ductwork to allow increased flow of water from the containment sump into the reactor cavity.	No
191	Add a portable pump in the cooling tower area to mitigate excess ponding due to a PMP or probable maximum hurricane event.	Reduce risk due to external flooding in the cooling tower area.	#3 - Already installed	The licensee added a portable pump in the cooling tower area to mitigate excess ponding due to a postulated probable maximum precipitation or probable maximum hurricane event. This pump was added to the surveillance testing program.	No
192	Remove or restrain the lockers and file cabinets in the control room, remove book shelves in the vicinity of safety-related cabinets, and relocate or restrain other loose items in the vicinity of safety-related cabinets.	Reduce seismic risk in the Control Room	#3 - Already installed	The equipment identified was analyzed for potential impact to safety-related equipment. As good engineering practice the book cases near CP-22 and the tool cart in the EDG Room B were removed and there was no additional impact to safety related equipment following the evaluation.	No

Table D.2-1
Phase I SAMAs Related to IPE and IPEEE Insights

Phase I SAMA ID Number	SAMA Title	Result of Potential Enhancement	Screening Results	SAMA Disposition	Credited in PSA Model
193	Revise procedure FP-001-17, Transient Combustibles and Designated Storage Areas.	Include guidance for temporary storage of temp equipment inside the Seismic Category I buildings to prevent hazardous seismic interactions.	#3 - Already installed	Procedural guidance for temporary storage is provided in UNT-007-060 to prevent potentially hazardous situations under seismic conditions.	No
194	Add fire wrap to the B Chilled Water cables in the vicinity of the A Chiller.	A fire on Chiller A or Chilled Water Pump A could damage cables associated with Chiller train B. Adding fire wrap to the B train cables would add robustness of the plant to fire hazards in this fire area.	#3 - Already installed	Fire wrap has been installed in fire area RAB-2 to the B chilled water cables in the vicinity of the A chiller and is being maintained in the NFPA 805 submittal for defense in depth. Also, one of the NFPA-805 mods is in RAB 2 and is to construct a radiant heat barrier to further separate the A and B trains of chilled water pumps. This change protects each trains chiller pump (and associated nearby equipment) from a fire in the opposite train.	No
195	Evaluate why existing clearance for the station air pipe which is adjacent to 4KVESWGR3B XPANEL does not meet the clearance requirements stated on the design drawing.	Reduces seismic risk for the equipment in the panel.	#3 - Already installed	CR-94-1111 contains the evaluation that the existing clearance for the station air pipe which is adjacent to 4KVESWGR3B will have no significant adverse impact during a seismic condition.	No

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 1. SBO Reduction	Eliminated SBO contribution.	**34.4%**	**42.5%**	**44.5%**	**$2,812,956**	**$5,597,783**		
1. Provide additional DC battery capacity.	WF3 plant specific cost						$3,172,695	Retain
2. Replace lead-acid batteries with fuel cells.	WF3 plant specific cost						$6,185,319	Not cost effective
7. Install a gas turbine generator.	Davis-Besse cost estimate						$2,000,000	Retain
Case 2. Improve Feedwater Reliability	Eliminated failure of feedwater.	**0.9%**	**0.2%**	**0.2%**	**$17,769**	**$35,361**		
31. Install a digital feed water upgrade.	Seabrook Cost estimate						$6,100,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 3. Add DC System Cross-ties	Changed gates to require multiple DC bus failures.	**20.8%**	**31.0%**	**31.3%**	**$1,966,036**	**$3,912,412**		
3. Provide DC bus cross-ties.	WF3 plant specific cost						$1,449,686	Retain
Case 4. Increase Availability of On-Site AC Power	Changed gates to require multiple AC bus failures.	**22.2%**	**32.0%**	**32.3%**	**$2,033,811**	**$4,047,285**		
5. Improve 4.16-kV bus cross-tie ability.	WF3 plant specific cost						$1,554,988	Retain
Case 5. Reduce Loss of Off-Site Power	Reduce the frequency of the LOOP initiator by removing severe weather contribution.	**13.5%**	**13.7%**	**14.1%**	**$912,630**	**$1,816,135**		
10. Bury off-site power lines.	Seabrook Cost estimate						$3,000,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
6. Install an additional, buried off-site power source.	Seabrook Cost estimate						$3,000,000	Not cost effective
Case 6. Provide Backup EDG Cooling	Eliminated failure of CCW cooling to the EDGs.	**4.4%**	**10.8%**	**11.0%**	**$672,315**	**$1,337,906**		
8. Use fire water system as a backup source for diesel cooling.	Seabrook Cost estimate						$2,000,000	Not cost effective
9. Add a new backup source of diesel cooling.	Seabrook Cost estimate						$2,000,000	Not cost effective
Case 7. Reduced Frequency of Loss of Auxiliary Component Cooling Water	Eliminated failure of ACCW.	**6.4%**	**1.3%**	**0.7%**	**$92,174**	**$183,427**		
21. Enhance procedural guidance for use of cross- tied component cooling or service water pumps.	Generic cost estimate for procedural change with engineering and testing/training required.						$200,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
22. Add a service water pump.	Sequoyah cost estimate						$1,043,000	Not cost effective
23. On loss of essential raw cooling water, proceduralize shedding component cooling water loads to extend the component cooling water heat-up time.	Generic cost estimate for procedural change with engineering and testing/training required.						$200,000	Not cost effective
Case 8. Increased availability of feedwater	Eliminated DWST failure to supply the CSP.	**1.2%**	**0.3%**	**0.2%**	**$23,585**	**$46,934**		
32. Create ability for emergency connection of existing or new water sources to feedwater and condensate systems.	WF3 plant specific cost						$885,760	Not cost effective
Case 9. High Pressure Injection System	Eliminated failure of HPSI.	**8.4%**	**4.7%**	**3.4%**	**$272,321**	**$541,919**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
17. Replace two of the four electric safety injection pumps with diesel-powered pumps.	Callaway cost estimate						$1,500,000	Not cost effective
13. Install an independent active or passive high pressure injection system.	Callaway cost estimate						$1,500,000	Not cost effective
Case 10. Extend Reactor Water Storage Pool Capacity	Reduced failure from operator actions and tank rupture.	**1.8%**	**0.2%**	**0.1%**	**$18,822**	**$37,457**		
16. Throttle low pressure injection pumps earlier in medium or large-break LOCAs to maintain reactor water storage tank inventory.	Seabrook Cost estimate						$3,000,000	Not cost effective
29. RWST fill from firewater during containment injection—Modify 6 inch RWST flush flange to have a 2½-inch female fire hose adapter with isolation valve.	WF3 plant specific cost						$747,640	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
30. High-volume makeup to the refueling water storage tank.	Sequoyah cost estimate						$565,000	Not cost effective
49. Install automatic containment spray pump header throttle valves.	ANO-2 cost estimate						$2,500,000	Not cost effective
Case 11. Eliminate ECCS Dependency on Component Cooling Water System	Eliminated failure of ECCS motor cooling.	**0.7%**	**2.8%**	**3.1%**	**$181,572**	**$361,328**		
20. Replace ECCS pump motors with air-cooled motors.	Seabrook Cost estimate						$6,000,000	Not cost effective
Case 12. Increase Availability of ACCW	Eliminated the DC control power gates to the ACCW pumps.	**0.2%**	**0.1%**	**0.1%**	**$9,374**	**$18,655**		
19. Add redundant DC control power for SW pumps.	Callaway cost estimate						$100,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 13. Low Pressure Safety Injection System	Eliminated failure of the Low Pressure Safety Injection system.	**0.0%**	**0.0%**	**0.0%**	**$20**	**$39**		
14. Add a diverse low pressure injection system.	Callaway cost estimate						$1,000,000	Not cost effective
15. Provide capability for alternate injection via diesel-driven fire pump.	Davis-Besse cost estimate						$6,500,000	Not cost effective
Case 14. Increase Component Cooling Water Availability	Eliminated failure of CCW pump failures and CCFs.	**13.5%**	**28.1%**	**29.0%**	**$1,775,007**	**$3,532,265**		
27. Install an additional component cooling water pump.	Seabrook Cost estimate						$6,000,000	Not cost effective
Case 15. Decreased Charging Pump Failure	Eliminated the normal charging pump power gates.	**0.4%**	**0.8%**	**0.8%**	**$48,319**	**$96,156**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
12. Install modification to power the normal charging pump from an existing spare breaker from the alternate emergency power system.	Callaway cost estimate						$350,000	Not cost effective
Case 16. Reactor Coolant Pump Seals	Eliminated RCP Seal LOCA.	**16.0%**	**31.6%**	**32.4%**	**$1,994,880**	**$3,969,811**		
24. Install an independent reactor coolant pump seal injection system, with dedicated diesel.	Seabrook Cost estimate						$6,400,000	Not cost effective
25. Install an independent reactor coolant pump seal injection system, without dedicated diesel.	Seabrook Cost estimate						$6,400,000	Not cost effective
26. Install improved reactor coolant pump seals.	Seabrook Cost estimate						$2,000,000	Retain

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 17. Main Feedwater System Reliability	Set loss of main feedwater to zero.	**33.3%**	**19.5%**	**18.5%**	**$1,325,589**	**$2,637,923**		
33. Add a motor-driven feedwater pump.	Sequoyah cost estimate						$10,000,000	Not cost effective
Case 18. EDG Fuel Oil	Set the failure of fuel oil pumps to zero.	**17.1%**	**20.8%**	**21.5%**	**$1,367,894**	**$2,722,110**		
11. Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.	Callaway cost estimate						$150,000	Retain
Case 20. Create a reactor coolant depressurization system	Eliminated small LOCA events.	**14.5%**	**3.8%**	**1.9%**	**$234,020**	**$465,700**		
18. Create a reactor coolant depressurization system.	Callaway cost estimate						$500,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 21. Steam Generator Inventory	Reduced the frequency of turbine-driven AFW pump failure during SBO.	**67.3%**	**61.8%**	**62.9%**	**$4,126,742**	**$8,212,217**		
34. Use fire water system as a backup for steam generator inventory.	Cost from Indian Point (IP2)						$3,073,130	Retain
Case 22. Instrument Air Reliability	Eliminated the loss of Instrument Air.	**0.1%**	**0.0%**	**0.0%**	**$2,278**	**$4,532**		
37. Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans.	Callaway cost estimate						$500,000	Not cost effective
Case 23. Increased Availability of HVAC	Eliminated failure of EDG room 3A cooling.	**9.4%**	**11.9%**	**12.3%**	**$779,088**	**$1,550,385**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
35. Provide a redundant train or means of ventilation.	WF3 plant specific cost						$3,574,481	Not cost effective
36. Implement procedures for temporary HVAC.	Callaway cost estimate						$100,000	Retain
Case 24. Debris coolability and core concrete interaction	Eliminated failure of debris coolability and core concrete interaction.	**0.0%**	**0.5%**	**0.5%**	**$30,745**	**$61,182**		
38. Create a reactor cavity flooding system.	Cost from Indian Point (IP2)						$1,741,724	Not cost effective
47. Provide a reactor vessel exterior cooling system.	Cost from ANO-2						$2,500,000	Not cost effective
72. Provide water from the fire protection system to the containment sump.	WF3 plant specific cost						$715,918	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
73. Enhance communication between sump and cavity.	WF3 plant specific cost						$702,551	Not cost effective
Case 25. Decay Heat Removal Capability	Eliminated late containment failure due to over-pressurization.	**0.0%**	**21.5%**	**22.8%**	**$1,313,015**	**$2,612,900**		
41. Install an unfiltered, hardened containment vent.	Seabrook cost estimate						$3,000,000	Not cost effective
42. Install a filtered containment vent to remove decay heat Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber	Seabrook cost estimate						$20,000,000	Not cost effective
Case 26. Improve Containment Spray Capability	Reduced failure of containment spray.	**5.8%**	**17.2%**	**35.9%**	**$1,942,124**	**$3,864,827**		
39. Install a passive containment spray system.	Seabrook cost estimate						$10,000,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
50. Install a redundant containment spray system.	Seabrook cost estimate						$10,000,000	Not cost effective
40. Use the fire water system as a backup source for the containment spray system.	WF3 plant specific cost						$2,455,808	Retain
Case 27. Reduce Hydrogen Ignition	Eliminated hydrogen detonation.	**0.0%**	**0.3%**	**0.2%**	**$12,709**	**$25,290**		
43. Provide post-accident containment inerting capability.	Callaway cost estimate						$100,000	Not cost effective
51. Install an independent power supply to the hydrogen control system using either new batteries, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies, such as the security system	Callaway cost estimate						$100,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
diesel.								
52. Install a passive hydrogen control system.	Seabrook cost estimate						$100,000	Not cost effective
Case 28. Increase Cooling and Containment of Molten Core Debris	Eliminated containment core melt propagation.	**0.0%**	**54.3%**	**61.1%**	**$3,490,945**	**$6,946,981**		
44. Create a large concrete crucible with heat removal potential to contain molten core debris.	Callaway cost estimate						$10,000,000	Not cost effective
45. Create a core melt source reduction system.	Callaway cost estimate						$10,000,000	Not cost effective
46. Increase depth of the concrete base mat or use an alternate concrete material to ensure melt- through does not occur.	Callaway cost estimate						$10,000,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 29. High Pressure Core Ejection Occurrences	Eliminated high pressure core ejection occurrences.	**0.0%**	**53.8%**	**60.6%**	**$3,460,207**	**$6,885,811**		
53. Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure.	Callaway cost estimate						$10,000,000	Not cost effective
Case 30. Reduce Probability of Containment Failure	Eliminated containment failure.	**0.0%**	**84.6%**	**92.2%**	**$5,294,254**	**$10,535,565**		
48. Construct a building to be connected to primary/secondary containment and maintained at a vacuum.	Seabrook cost estimate						$56,700,000	Not cost effective
Case 31. Containment Isolation	Eliminated containment isolation failure.	**0.0%**	**0.1%**	**0.1%**	**$7,413**	**$14,752**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
55. Add redundant and diverse limit switches to each containment isolation valve.	Sequoyah cost estimate						$692,000	Not cost effective
Case 32. Reduce Frequency of Steam Generator Tube Ruptures	Eliminated steam generator tube ruptures.	**1.0%**	**5.6%**	**5.9%**	**$348,963**	**$694,437**		
56. Institute a maintenance practice to perform a 100% inspection of steam generator tubes during each refueling outage.	Callaway cost estimate						$3,000,000	Not cost effective
57. Increase the pressure capacity of the secondary side so that a steam generator tube rupture would not cause the relief valves to lift.	Callaway cost estimate						$10,000,000	Not cost effective
58. Install a redundant spray system to depressurize the primary system during a steam generator tube rupture	Callaway cost estimate						$10,000,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
59. Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove most of the fission products.	Callaway cost estimate						$10,000,000	Not cost effective
60. Install a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources	Callaway cost estimate						$10,000,000	Not cost effective
Case 33. Reduce Consequences of Steam Generator Tube Ruptures	Reassigned the SGTR CDF contribution from H-E release category to release category L-I.	**0%**	**0%**	**1.4%**	**$50,657**	**$100,807**		
61. Direct steam generator flooding after a steam generator tube rupture, prior to core damage.	Generic cost estimate for procedural change with engineering and testing/training required.						$200,000	Not cost effective
Case 34. Reduce ATWS Frequency	Eliminated ATWS contribution.	**1.4%**	**0.3%**	**0.2%**	**$19,888**	**$39,577**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
63. Add an independent boron injection system.	Seabrook cost estimate						$500,000	Not cost effective
64. Add a system of relief valves to prevent equipment damage from pressure spikes during an ATWS.	Seabrook cost estimate						$500,000	Not cost effective
65. Install motor generator set trip breakers in control room.	Sequoyah cost estimate						$100,000	Not cost effective
66. Provide capability to remove power from the bus powering the control rods.	Sequoyah cost estimate						$100,000	Not cost effective
Case 37. Reduce Probability of a LOCA	Eliminated the initiators for a Large LOCA and a medium LOCA.	**0.4%**	**0.2%**	**0.2%**	**$14,397**	**$28,650**		
69. Install digital large break LOCA protection system.	Seabrook cost estimate						$500,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 38. Prevent Secondary Side Depressurization	Eliminated the initiator for a steam line break outside containment and for inadvertent closure of MSIVs.	**0.3%**	**0.1%**	**0.0%**	**$5,235**	**$10,417**		
70. Install secondary side guard pipes up to the main steam isolation valves.	Seabrook cost estimate						$500,000	Not cost effective
Case 39. Eliminate Thermally Induced Tube Ruptures Following Core Damage	Eliminated thermal induced steam generator tube rupture.	**0.0%**	**0.2%**	**0.3%**	**$14,870**	**$29,591**		
54. Modify procedures such that the water loop seals in the reactor cooling system (RCS) cold legs are not cleared following core damage.	South Texas cost estimate						$100,000	Not cost effective
Case 40. Replace CARMVAAA201-B with a fail closed AOV	Eliminated motive power dependency from MOV CARMVAAA201-B.	**0.0%**	**0.0%**	**0.0%**	**$0**	**$0**		
62. Hardware change to eliminate MOV CS-V-17 AC power dependency.	Seabrook cost estimate						$300,000	Not cost effective

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
Case 41. Improve Internal Flooding Response Procedures and Training[1]	Eliminated the contribution to internal flooding CDF from floods in the Turbine Generator Building +15 elevation and Reactor Auxiliary Building +46 elevation.	**N/A**	**N/A**	**N/A**	**$14,459**	**$28,773**		
67. Improve internal flooding response procedures and training to improve the response to internal flooding events.	Sequoyah cost estimate						$400,000	Not cost effective
Case 42. Water tight doors for the largest contributor to internal flooding[1]	Eliminated the contribution to internal flooding CDF from floods in flood zone RAB21-212/225B.	**N/A**	**N/A**	**N/A**	**$148,111**	**$294,741**		
68. Install flood doors to prevent water propagation in the electric board room.	Sequoyah cost estimate						$4,695,000	Not cost effective
Case 43. Gagging device to close a stuck open safety valve	Eliminated failure events for of stuck open relief valves.	**0.0%**	**0.0%**	**0.0%**	**$38**	**$76**		

Table D.2-2
Summary of Phase II SAMA Candidates Considered in Cost-Benefit Evaluation

Analysis Case (bold) SAMA Number and Title	Assumptions	CDF Reduction (%)	PDR Reduction (%)	OECR Reduction (%)	Internal and External Benefit ($)	Internal and External Benefit with Uncert ($)	WF3 Cost Estimate ($)	Conclusion
71. Manufacture a gagging device for a steam generator safety valve and developing a procedure or work order for closing a stuck-open valve.	Seabrook cost estimate						$30,000	Not cost effective
These SAMA candidates were retained without evaluation as they are already commitments in the NFPA 805 LAR [D.2-13]	N/A	N/A	N/A	N/A	N/A	N/A		
74. In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.	This modification is from the Waterford 3 NFPA 805 LAR	N/A	N/A	N/A	N/A	N/A	N/A	Retain
75. In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.	This modification is from the Waterford 3 NFPA 805 LAR	N/A	N/A	N/A	N/A	N/A	N/A	Retain
76. In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.	This modification is from the Waterford 3 NFPA 805 LAR	N/A	N/A	N/A	N/A	N/A	N/A	Retain

(1) These analysis cases only impact internal flooding and have been evaluated as described in Section D.2.3.

Table D.2-3 Sensitivity Analysis Results				
Analysis Case (bold) SAMA Number and Title	**Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate**	**WF3 Cost Estimate ($)**
Case 1. SBO Reduction	**$2,812,956**	**$3,312,210**	**$3,889,025**	
1. Provide additional DC battery capacity.				$3,172,695
2. Replace lead-acid batteries with fuel cells.				$6,185,319
7. Install a gas turbine generator.				$2,000,000
Case 2. Improve Feedwater Reliability	**$17,769**	**$22,368**	**$23,693**	
31. Install a digital feed water upgrade.				$6,100,000
Case 3. Add DC System Cross-ties	**$1,966,036**	**$2,308,511**	**$2,722,034**	
3. Provide DC bus cross-ties.				$1,449,686
Case 4. Increase Availability of On-Site AC Power	**$2,033,811**	**$2,389,512**	**$2,815,012**	
5. Improve 4.16-kV bus cross-tie ability.				$1,554,988
Case 5. Reduce Loss of Off-Site Power	**$912,630**	**$1,079,233**	**$1,258,950**	
10. Bury off-site power lines.				$3,000,000
6. Install an additional, buried off-site power source.				$3,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
Case 6. Provide Backup EDG Cooling	**$672,315**	**$783,999**	**$934,124**	
8. Use fire water system as a backup source for diesel cooling.				$2,000,000
9. Add a new backup source of diesel cooling.				$2,000,000
Case 7. Reduced Frequency of Loss of Auxiliary Component Cooling Water	**$92,174**	**$119,090**	**$121,050**	
21. Enhance procedural guidance for use of cross-tied component cooling or service water pumps.				$200,000
22. Add a service water pump.				$1,043,000
23. On loss of essential raw cooling water, Proceduralize shedding component cooling water loads to extend the component cooling water heat-up time.				$200,000
Case 8. Increased availability of feedwater	**$23,585**	**$29,547**	**$31,533**	
32. Create ability for emergency connection of existing or new water sources to feedwater and condensate systems.				$885,760
Case 9. High Pressure Injection System	**$272,321**	**$330,726**	**$370,403**	
17. Replace two of the four electric safety injection pumps with diesel-powered pumps.				$1,500,000
13. Install an independent active or passive high pressure injection system.				$1,500,000
Case 10. Extend Reactor Water Storage Pool Capacity	**$18,822**	**$25,402**	**$24,064**	
16. Throttle low pressure injection pumps earlier in medium or large-break LOCAs to maintain reactor				$3,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
water storage tank inventory.				
29. RWST fill from firewater during containment injection—Modify 6 inch RWST flush flange to have a 2½-inch female fire hose adapter with isolation valve.				$747,640
30. High-volume makeup to the refueling water storage tank.				$565,000
49. Install automatic containment spray pump header throttle valves.				$2,500,000
Case 11. Eliminate ECCS Dependency on Component Cooling Water System	**$181,572**	**$210,796**	**$252,845**	
20. Replace ECCS pump motors with air-cooled motors.				$6,000,000
Case 12. Increase Availability of ACCW	**$9,374**	**$11,229**	**$12,845**	

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
19. Add redundant DC control power for SW pumps.				$100,000
Case 13. Low Pressure Safety Injection System	**$20**	**$23**	**$28**	
14. Add a diverse low pressure injection system.				$1,000,000
15. Provide capability for alternate injection via diesel-driven fire pump.				$6,500,000
Case 14. Increase Component Cooling Water Availability	**$1,775,007**	**$2,073,694**	**$2,463,907**	
27. Install an additional component cooling water pump.				$6,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
Case 15. Decreased Charging Pump Failure	**$48,319**	**$56,495**	**$67,046**	
12. Install modification to power the normal charging pump from an existing spare breaker from the alternate emergency power system.				$350,000
Case 16. Reactor Coolant Pump Seals	**$1,994,880**	**$2,332,233**	**$2,768,106**	
24. Install an independent reactor coolant pump seal injection system, with dedicated diesel.				$6,400,000
25. Install an independent reactor coolant pump seal injection system, without dedicated diesel.				$6,400,000
26. Install improved reactor coolant pump seals.				$2,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
Case 17. Main Feedwater System Reliability	**$1,325,589**	**$1,595,223**	**$1,811,895**	
33. Add a motor-driven feedwater pump.				$10,000,000
Case 18. EDG Fuel Oil	**$1,367,894**	**$1,611,548**	**$1,890,640**	
11. Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.				$150,000
Case 20. Create a reactor coolant depressurization system	**$234,020**	**$298,942**	**$309,396**	
18. Create a reactor coolant depressurization system.				$500,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
Case 21. Steam Generator Inventory	**$4,126,742**	**$4,893,060**	**$5,684,889**	
34. Use fire water system as a backup for steam generator inventory.				$3,073,130
Case 22. Instrument Air Reliability	**$2,278**	**$2,894**	**$3,021**	
37. Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans.				$500,000
Case 23. Increased Availability of HVAC	**$779,088**	**$917,204**	**$1,077,216**	
35. Provide a redundant train or means of ventilation.				$3,574,481

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
36. Implement procedures for temporary HVAC.				$100,000
Case 24. Debris coolability and core concrete interaction	**$30,745**	**$35,448**	**$42,962**	
38. Create a reactor cavity flooding system.				$1,741,724
47. Provide a reactor vessel exterior cooling system.				$2,500,000
72. Provide water from the fire protection system to the containment sump.				$715,918
73. Enhance communication between sump and cavity.				$702,551

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
Case 25. Decay Heat Removal Capability	**$1,313,015**	**$1,513,887**	**$1,834,753**	
41. Install an unfiltered, hardened containment vent.				$3,000,000
42. Install a filtered containment vent to remove decay heat Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber				$20,000,000
Case 26. Improve Containment Spray Capability	**$1,942,124**	**$2,250,883**	**$2,706,801**	
39. Install a passive containment spray system.				$10,000,000
50. Install a redundant containment spray system.				$10,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
40. Use the fire water system as a backup source for the containment spray system.				$2,455,808
Case 27. Reduce Hydrogen Ignition	**$12,709**	**$14,649**	**$17,761**	
43. Provide post-accident containment inerting capability.				$100,000
51. Install an independent power supply to the hydrogen control system using either new batteries, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies, such as the security system diesel.				$100,000
52. Install a passive hydrogen control system.				$100,000
Case 28. Increase Cooling and Containment of Molten Core Debris	**$3,490,945**	**$4,025,013**	**$4,878,098**	

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
44. Create a large concrete crucible with heat removal potential to contain molten core debris.				$10,000,000
45. Create a core melt source reduction system.				$10,000,000
46. Increase depth of the concrete base mat or use an alternate concrete material to ensure melt-through does not occur.				$10,000,000
Case 29. High Pressure Core Ejection Occurrences	**$3,460,207**	**$3,989,572**	**$4,835,145**	
53. Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure.				$10,000,000
Case 30. Reduce Probability of Containment Failure	**$5,294,254**	**$6,104,206**	**$7,397,963**	

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
48. Construct a building to be connected to primary/secondary containment and maintained at a vacuum.				$56,700,000
Case 31. Containment Isolation	**$7,413**	**$8,544**	**$10,361**	
55. Add redundant and diverse limit switches to each containment isolation valve.				$692,000
Case 32. Reduce Frequency of Steam Generator Tube Ruptures	**$348,963**	**$404,313**	**$486,439**	
56. Institute a maintenance practice to perform a 100% inspection of steam generator tubes during each refueling outage.				$3,000,000
57. Increase the pressure capacity of the secondary side so that a steam generator tube rupture would not cause the relief valves to lift.				$10,000,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
58. Install a redundant spray system to depressurize the primary system during a steam generator tube rupture				$10,000,000
59. Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove most of the fission products.				$10,000,000
60. Install a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources				$10,000,000
Case 33. Reduce Consequences of Steam Generator Tube Ruptures	**$50,657**	**$58,655**	**$70,635**	
61. Direct steam generator flooding after a steam generator tube rupture, prior to core damage.				$200,000
Case 34. Reduce ATWS Frequency	**$19,888**	**$25,698**	**$26,117**	

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
63. Add an independent boron injection system.				$500,000
64. Add a system of relief valves to prevent equipment damage from pressure spikes during an ATWS.				$500,000
65. Install motor generator set trip breakers in control room.				$100,000
66. Provide capability to remove power from the bus powering the control rods.				$100,000
Case 37. Reduce Probability of a LOCA	**$14,397**	**$17,406**	**$19,630**	
69. Install digital large break LOCA protection system.				$500,000

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	**Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate**	**WF3 Cost Estimate ($)**
Case 38. Prevent Secondary Side Depressurization	**$5,235**	**$6,722**	**$6,900**	
70. Install secondary side guard pipes up to the main steam isolation valves.				$500,000
Case 39. Eliminate Thermally Induced Tube Ruptures Following Core Damage	**$14,870**	**$17,141**	**$20,780**	
54. Modify procedures such that the water loop seals in the reactor cooling system (RCS) cold legs are not cleared following core damage.				$100,000
Case 40. Replace CARMVAAA201-B with a fail closed AOV	**$0**	**$0**	**$0**	
62. Hardware change to eliminate MOV CS-V-17 AC power dependency.				$300,000
Case 41. Improve Internal Flooding Response Procedures and Training[1]	**N/A**	**N/A**	**N/A**	

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	**Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate**	**Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate**	**WF3 Cost Estimate ($)**
67. Improve internal flooding response procedures and training to improve the response to internal flooding events.				$400,000
Case 42. Water tight doors for the largest contributor to internal flooding[1]	**N/A**	**N/A**	**N/A**	
68. Install flood doors to prevent water propagation in the electric board room.				$4,695,000
Case 43. Gagging device to close a stuck open safety valve	**$38**	**$44**	**$53**	
71. Manufacture a gagging device for a steam generator safety valve and developing a procedure or work order for closing a stuck-open valve.				$30,000
These SAMA candidates were retained without evaluation as they are already commitments in the NFPA 805 LAR [D.2-13]	N/A	N/A	N/A	N/A
74. In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.	N/A	N/A	N/A	N/A
75. In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.	N/A	N/A	N/A	N/A

Table D.2-3
Sensitivity Analysis Results

Analysis Case (bold) SAMA Number and Title	Internal and External Benefit, 20 yrs. Remaining, 7% Discount Rate	Sensitivity Case 1, Internal and External Benefit, 29 yrs. Remaining, 7% Discount Rate	Sensitivity Case 2, Internal and External Benefit, 20 years Remaining, 3% Discount Rate	WF3 Cost Estimate ($)
76. In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.	N/A	N/A	N/A	N/A

(1) These analysis cases only impact internal flooding and have been evaluated as shown in Section D.2.3.

Attachment E

Coastal Zone Consistency Determination

Attachment E

Coastal Zone Consistency Determination

- Rick Buckley, Entergy Services, Inc. to Jeff Harris, Louisiana Department of Natural Resources, Office of Coastal Management. April 9, 2015.
- Don Haydel, Louisiana Department of Natural Resources, Office of Coastal Management, to Rick Buckley, Entergy Services, Inc. April 14, 2015.

Entergy

Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

Date: April 9, 2015

Mr. Jeff Harris
Louisiana Department of Natural Resources
Office of Coastal Management
Post Office Box 94396
Baton Rouge, LA 70804-9396

Subject: Waterford Steam Electric Station, Unit 3
Coastal Zone Consistency Determination

CEO 2015-00033

Dear Mr. Harris,

Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") are applying to the Nuclear Regulatory Commission (NRC) for renewal of the Waterford Steam Electric Station Unit 3 (WF3) operating license (OL) for an additional 20 years to preserve the option for Entergy to continue to operate WF3 to provide reliable base-load power throughout the extended license renewal period. For WF3 (Facility OL NPF-38), the requested renewal would extend the license expiration date from December 18, 2024, to December 18, 2044.

On June 4, 2014, Entergy submitted a Coastal Use Permit application (Attachment 1) to your agency regarding a Request for Determination that the renewal of the WF3 OLdid not require a Coastal Use Permit. In your response letter dated June 18, 2014 (Attachment 2), it was determined that "the proposed activity is exempt and a Coastal Use Permit is not required".

As previously stated above, license renewal only preserves the option for Entergy to continue to operate WF3 to provide reliable base-load power throughout the extended license renewal period. It does not authorize changes to the WF3 facility or operations.

As stated in the Coastal Use Permit application submitted by Entergy and the response letter from your agency, no plant refurbishment or other license-renewal-related construction activities have been identified as necessary to support the continued operation of WF3 beyond the end of the existing operating license term.

Therefore, Entergy is requesting a determination from your agency that the proposed activity, renewal of the WF3 OL, will be consistent with Louisiana's Coastal Resources Program.

If you have any questions or need additional information, please contact me at 601-368-5823 or by email at rbuckle@entergy.com.

I certify to the best of my knowledge that the proposed activity complies with, and will be conducted in a manner that is consistent with the Louisiana Coastal Resources Program.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Attachment 1

Entergy's Request for Determination

Louisiana Department of Natural Resources
Office of Coastal Management
(OCM)

Joint Permit Application
For Work Within the Louisiana Coastal Zone

U.S. Army Corps Of Engineers
(COE)
New Orleans District

Print Application

Permit Number: P20140826 Date Received: 06/04/2014

Step 1 of 15 - Applicant Information

Applicant/Company Name: WATERFORD 3 STEAM ELECTRIC STATION

Applicant Type: INDUSTRY/OTHER

Mailing Address: 17265 RIVER ROAD
KILLONA, LA 70057

Contact Information: Rick Buckley

Daytime: 601 368 5823 ***Fax:*** 601 368 5812 ***Contact Email:*** rbuckle@entergy.com

Step 2 of 15 - Agent Information

Company Name:

Mailing Address:

Contact Information:

Daytime: ***Fax:*** ***Contact Email:***

Step 3 of 15 - Permit Type

☐ **Coastal Use Permit (CUP)** ☐ **Solicitation of Views (SOV)** ☒ **Request for Determination (RFD)**

Step 4 of 15 - Pre-Application Activity

a. Have you participated in a Pre-Application or Geological Review Meeting for the proposed project?

☐ **No** ☒ **Yes** **Date meeting was held:**

Attendees:

(Individual or Company Rep)	(OCM Representative)	(COE Representative)

b. Have you obtained an official wetland determination from the COE for the project site?

☒ **No** ☐ **Yes** **JD Number:**

c. Is this application a mitigation plan for another CUP?

☒ **No** ☐ **Yes** **OCM Permit Number:**

Step 5 of 15 - Project Information

a. Describe the project:

Entergy Louisiana, LLC will be submitting an application to the Nuclear Regulatory Commission during the first quarter of 2016 for renewal of the Waterford 3 Steam Electric Station (WF3) license which will preserve the option to continue to operate WF3 to provide reliable base-load power for an additional 20 years beyond its existing 40 year license to meet Entergy's system generating needs. For WF3, the requested renewal would extend the license expiration date from midnight December 18, 2024, to midnight December 18, 2044. In summary, there will be no changes related to this project with respect to operation of WF3 that would significantly change the plant’s effects on the environment during the period of extended operation. In addition, no plant refurbishment or other license-renewal-related construction activities have been identified as necessary to support the continued operation of WF3 beyond the end of the existing operating license term.

b. Is this application a change to an existing permit?

☒ **No** ☐ **Yes** **OCM Permit Number:**

c. Have you previously applied for a permit or emergency authorization for all or any part of the proposed project?

☒ **No** ☐ **Yes**

	Agency Name	Permit Number	Decision Status	Decision Date
OCM				
COE				
Other				

Step 6 of 15 - Project Location

a. Physical Location

Street: 17265 RIVER ROAD

City: KILLONA **Parish:** SAINT CHARLES **Zip:** 70057

Water Body: MISSISSIPPI RIVER

b. Latitude and Longitude

Latitude: 29 59 42 **Longitude:** -90 28 16

c. Section, Township, and Range

Section #: 26 **Township #:** 12S **Range #:** 20E

Section #: **Township #:** **Range #:**

d. Lot, Tract, Parcel, or Subdivision Name

Lot #: **Parcel #:**

Tract #: **Subdivision Name:**

e. Site Direction:

I-10 East toward New Orleans. Exit 220 to I-310 South toward Boutee/Houma. Exit #10 onto LA-3127 North toward Donaldsonville. Turn right on LA-3142 North. Turn left onto River Road. Turn left at the Entergy Waterford 3 SES Sign. Turn right, turn left and turn right into the Generation Support Building parking lot. - END.

Step 7 of 15 - Adjacent Landowners

Step 8 of 15 - Project Specifics

a. Project Name and/or Title: WATERFORD 3 STEAM ELECTRIC STATION LICENSE RENEWAL PROJECT

b. Project Type: Non-Residential

c. Source of Funding: Private

d. What will be done for the proposed project?

☐ **Bridge/Road**	☐ **Home Site/Driveway**	☐ **Pipeline/Flow Line**	☐ **Rip Rap/Erosion Control**
☐ **Bulkhead/Backfill**	☐ **Levee Construction**	☐ **Plug/Abandon**	☐ **Site Clearance**
☐ **Drainage Improvements**	☐ **Dredging**	☐ **Production Barge/Structure**	☐ **Subdivision**
☐ **Drill Barge/Structure**	☐ **Prop Washing**	☐ **Vegetative Plantings**	☐ **Wharf/Pier/Boathouse**

☐ **Drill Site** ☐ **Pilings** ☐ **Remove Structures**

☐ **Fill** ☐ **Marina** ☐ **Major Industrial/Commercial**

☒ **Other: RENEWAL OF AN EXISTING OPERATING LICENSE FOR AN ADDITIONAL 20 YEARS.**

e. Why is the proposed project needed?

The proposed project would renew the operating license for WF3 which would preserve the option for Entergy Louisiana, LLC to continue to operate WF3 to provide reliable base-load power for an additional 20 years beyond its existing 40 year license to meet Entergy's system generating needs. For WF3, the requested renewal would extend the license expiration date from midnight December 18, 2024, to midnight December 18, 2044.

Step 9 of 15 - Project Status

a. Proposed project start date: ***Proposed project completion date:***

b. Is any of the project work in progress?

☒ **No** ☐ **Yes**

c. Is any of the project work complete?

☒ **No** ☐ **Yes**

Step 10 of 15 - Structures, Materials, and Methods for the Proposed Project

a. Excavations

0 **yd^3** 0 **Acres**

b. Fill Areas

0 **yd^3** 0 **Acres**

c. Fill Materials

☐ **Concrete:**	**yd^3**	☐ **Rock:**	**yd^3**
☐ **Crushed Stone or Gravel:**	**yd^3**	☐ **Sand:**	**yd^3**
☐ **Excavated and placed onsite:**	**yd^3**	☐ **Hauled in topsoil/Dirt:**	**yd^3**
☐ **Excavated and hauled offsite:**	**yd^3**		
☒ **Other: NO FILL MATERIALS ARE INVOLVED.**	0 **yd^3**		

d. What equipment will be used for the proposed project?

- ☐ **Airboat**
- ☐ **Bulldozer/Grader**
- ☐ **Marsh Buggy**
- ☐ **Backhoe**
- ☐ **Dragline/Excavator**
- ☐ **Other Tracked or Wheeled Vehicles**
- ☐ **Barge Mounted Bucket Dredge**
- ☐ **Handjet**
- ☐ **Self Propelled Pipe Laying Barge**
- ☐ **Barge Mounted Drilling Rig**
- ☐ **Land Based Drilling Rig**
- ☐ **Tugboat**
- ☒ **Other: None. There is no construction activities associated with this project.**

Step 11 of 15 - Project Alternatives

a. Total acres of wetlands and/or waterbottoms filled and/or excavated.

acres

b. What alternative locations, methods, and access routes were considered to avoid impact to wetlands and/or waterbottoms?

c. What efforts were made to minimize impact to wetlands and/or waterbottoms?

d. How are unavoidable impacts to vegetated wetlands to be mitigated?

Step 12 of 15 - Permit Type and Owners

a. Are you applying for a Coastal Use Permit?

☒ **No** ☐ **Yes**

b. Are you the sole landowner/oyster lease holder?

☐ **No** ☒ **Yes**

☐ **The applicant is an owner of the property on which the proposed described activity is to occur.**

☐ **The applicant has made reasonable effort to determine the identity and current address of the owner(s) of the land on which the proposed described activity is to occur, which included, a search of the public records of the parish in which the proposed activity is to occur.**

☐ **The applicant hereby attests that a copy of the application has been distributed to the following landowners/oyster lease holders:**

c. Does the project involve drilling, production, and/or storage of oil and gas?

☒ No ☐ Yes

Step 13 of 15 - Maps and Drawing Instructions

CoastalZoneVicinityMap.jpg **06/04/2014 02:18:06 PM**

Step 14 of 15 - Payment

The fee for this permit is: $100.00

Step 15 of 15 - Payment Processed

Applicant Information

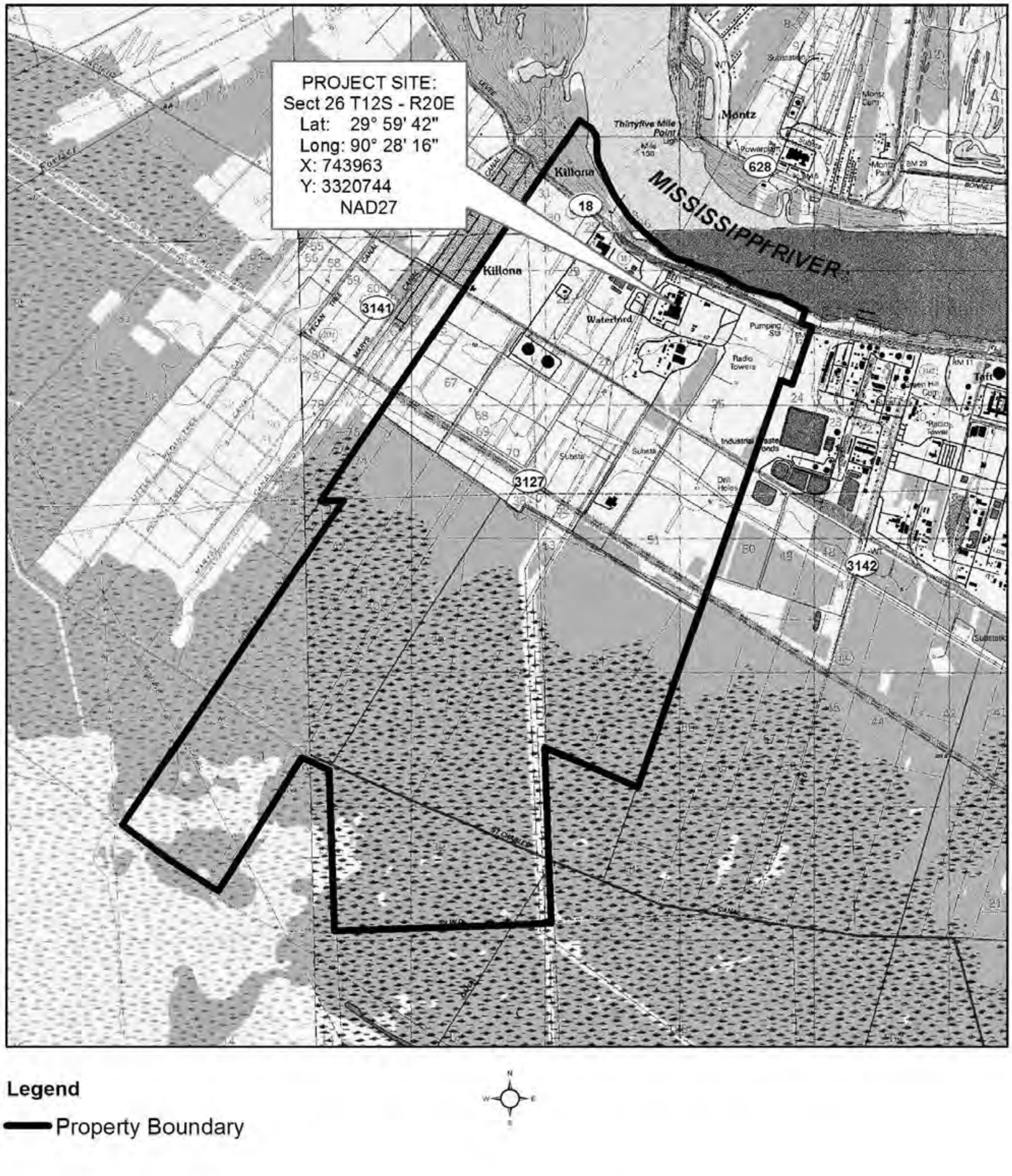
Applicant Name: WATERFORD 3 STEAM ELECTRIC STATION
Address: 17265 RIVER ROAD
City/State/Zip: KILLONA, LA 70057

Application Information

Permit Type: RFD

To the best of my knowledge the proposed activity described in this permit application complies with, and will be conducted in a manner that is consistent with the Louisiana Coastal Resources Program. If applicable, I also certify that the declarations in Step 12c, oil spill response, are complete and accurate.

View Comments related to this project


PROJECT SITE:
Sect 26 T12S - R20E
Lat: 29° 59' 42"
Long: 90° 28' 16"
X: 743963
Y: 3320744
NAD27
MISSISSIPPI RIVER
Killona
Waterford
Montz
Taft
18
628
3141
3127
3142
Legend
Property Boundary
Feet
0
2,000
4,000

Attachment 2

Louisiana Department of Natural Resources Determination

BOBBY JINDAL
GOVERNOR

STEPHEN CHUSTZ
SECRETARY

State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF COASTAL MANAGEMENT

06/18/2014

WATERFORD 3 STEAM ELECTRIC STATION
17265 RIVER ROAD
KILLONA, LA 70057

RE: **P20140826, Request for Determination**
WATERFORD 3 STEAM ELECTRIC STATION
Description: Entergy Louisiana, LLC will be submitting an application to the Nuclear Regulatory Commission during the first quarter of 2016 for renewal of the Waterford 3 Steam Electric Station (WF3) license. There will be no changes related to this project with respect to operation of WF3 that would significantly change the plant's effects on the environment during the period of extended operation. In addition, no plant refurbishment or other license-renewal-related construction activities have been identified as necessary to support the continued operation of WF3 beyond the end of the existing operating license term.
Location: Lat. 29º 59' 42" N, Long. -90º 28' 16" W; Section 26 T12S R20E; 17265 River Road, Killona
Saint Charles Parish, LA

Dear Rick Buckley:

We have received a Request for Determination for the above referenced project, which has been found to be inside the Louisiana Coastal Zone. In accordance with the State and Local Coastal Resources Management Act of 1978, as amended (La. R.S. 49:214.34.a), the proposed activity is exempt and a Coastal Use Permit is not required.

This determination is valid for two (2) years from the date of this letter. If the proposed activity is not initiated within this 2-year period, this determination will expire and the applicant will be required to submit a new application. This determination does not eliminate the need to obtain a permit from the United States Army, Corps of Engineers (USACE) or any other Federal, state, or local approval, that may be required by law.

This determination has been made on the basis of information provided by your application. If it is later established that you furnished erroneous data, you may be directed to alter or modify your plans, to remove structures you have installed, and/or to restore the work area to pre-project conditions at your own expense. If it is established that you knowingly furnished erroneous data, you could also be subject to legal action.

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov

The drawings submitted with your referenced application are attached hereto and made a part of the record. If you have any questions regarding this authorization, please contact our office at (225) 342-7591 or (800) 267-4019.

Sincerely,

Keith Lovell
For Karl L. Morgan,

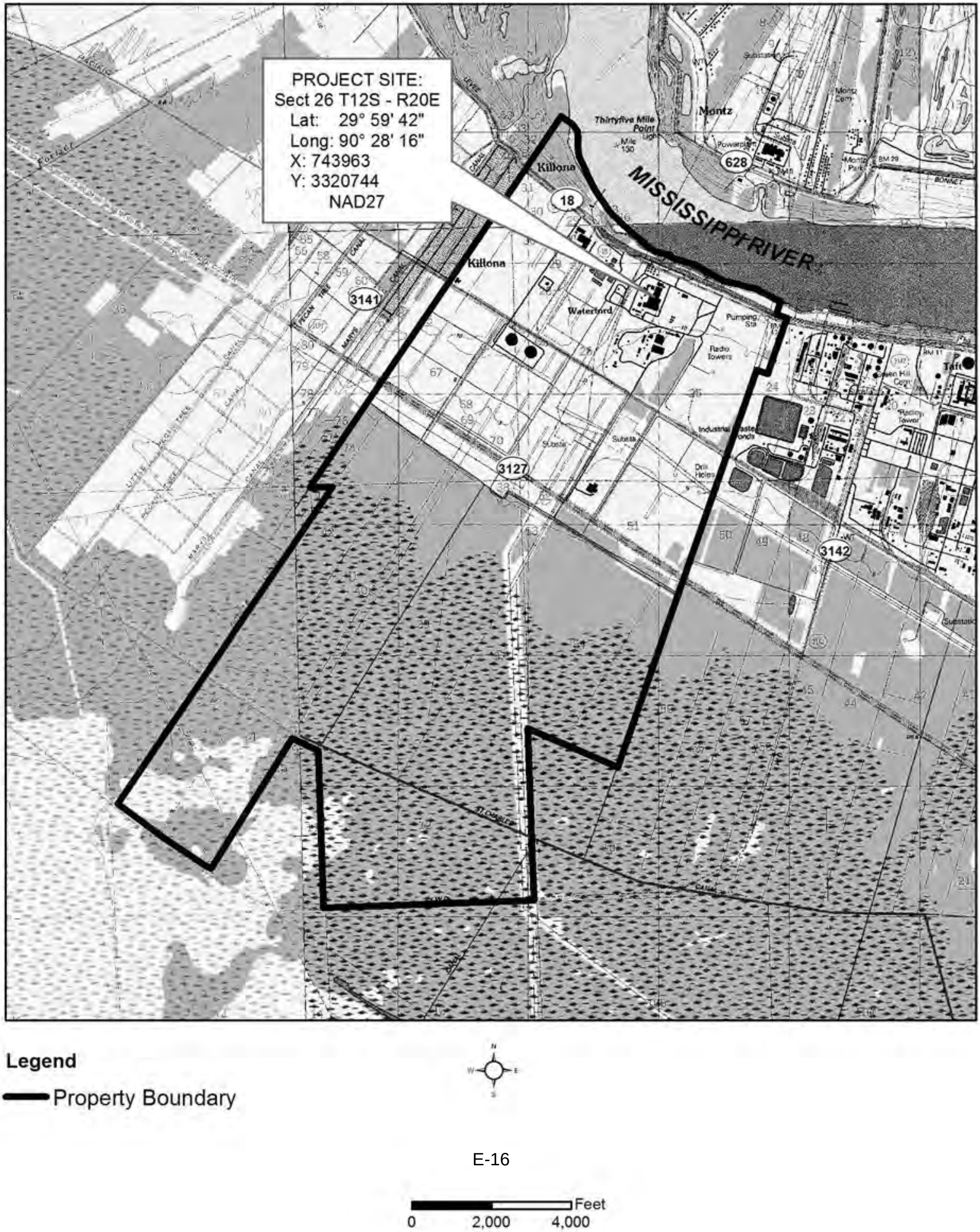
Administrator
Keith Lovell/aw

Attachments

Final Plats:

1) P20140826 Final Plats 06/04/2014

cc: Martin Mayer, COE w/plats
Dave Butler, LDWF w/plats
Jessica Diez, OCM w/plats
Lafourche Basin Levee District, LD w/plats
Kirk Kilgen, CMD/FI w/plats


PROJECT SITE:
Sect 26 T12S - R20E
Lat: 29° 59' 42"
Long: 90° 28' 16"
X: 743963
Y: 3320744
NAD27
MISSISSIPPI RIVER
Killona
Montz
Waterford
Taft
18
628
3141
3127
3142
Legend
Property Boundary
0
2,000
4,000
Feet

BOBBY JINDAL
GOVERNOR

STEPHEN CHUSTZ
SECRETARY

State of Louisiana

DEPARTMENT OF NATURAL RESOURCES
OFFICE OF COASTAL MANAGEMENT

April 14, 2015

Rick Buckley
Entergy Services Inc.
1340 Echelon Parkway
Jackson, MS 39213

RE: **C20150075,** Coastal Zone Consistency
Entergy Louisiana, LLC and Entergy Operations, Inc.
Nuclear Regulatory Commission
Federal License or Permit
Renewal of the operating license for the Waterford Steam Electric Station Unit 3, through December 18, 2044
St. Charles Parish, Louisiana

Dear Mr. Buckley:

The above referenced project has been reviewed for consistency with the approved Louisiana Coastal Resource Program (LCRP) as required by Section 307 of the Coastal Zone Management Act of 1972, as amended. The project, as proposed in the application, is consistent with the LCRP. If you have any questions concerning this determination, please contact Jeff Harris of the Consistency Section at (225) 342-7949 or 1-800-267-4019.

Sincerely yours,

/S/ Don Haydel
Acting Administrator
Interagency Affairs/Field Services Division

DH/SK/jdh

cc: Martin Mayer, NOD-COE
Dave Butler, LDWF
Kirk Kilgen, OCM FI

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