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United States Nuclear Regulatory Commission
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NUREG-1437
Supplement 26
Second Renewal

Site-Specific Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 26, Second Renewal

Regarding Subsequent License Renewal for Monticello Nuclear Generating Plant, Unit 1

Draft Report for Comment

Office of Nuclear Material Safety and Safeguards

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Draft Report for Comment

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Office of Nuclear Material Safety and Safeguards

COMMENTS ON DRAFT REPORT

Proposed Action Issuance of renewed facility operating license DPR-22 for Monticello Nuclear Generating Plant, Unit 1, located in central Minnesota in Sherburne and Wright Counties, Minnesota

Type of Statement Draft Supplemental Environmental Impact Statement

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Comments:

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Responsible Agency: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards

Title: Site-Specific Environmental Impact Statement for Subsequent License Renewal of Monticello Nuclear Generating Plant, Unit 1, Second Renewal, Draft Report for Comment.

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) prepared this site-specific environmental impact statement (EIS) as part of its environmental review of Xcel Energy's request to renew the operating license for Monticello Nuclear Generating Plant, Unit 1 (Monticello) for an additional 20 years. This EIS includes the site-specific evaluation of the environmental impacts of the proposed action (Monticello subsequent license renewal [SLR]), and alternatives to SLR. As alternatives, the NRC considered: (1) natural gas and renewables; (2) renewables and storage; (3) new nuclear small modular reactors, and (4) the no-action alternative.

This EIS considers information contained in Xcel Energy's January 9, 2023, submittal (Agencywide Documents Access and Management System Accession No. ML23009A352). Xcel Energy prepared the Monticello SLR application in accordance with Commission direction. Specifically, in February 2022, the Commission issued three memoranda and orders: Commission Legal Issuance (CLI)-22-02, CLI-22-03, and CLI-22-04 (NRC 2022-TN8182, NRC 2022-TN9844, and NRC 2022-TN9553), concerning SLR environmental reviews. In CLI-22-02, the Commission found that the License Renewal Generic Environmental Impact Statement (LR GEIS) did not cover the SLR period and that 10 CFR 51.53(c)(3) (TN250) does not apply to SLR applicants and, therefore, the NRC staff may not exclusively rely on the 2013 License Renewal Generic Environmental Impact Statement and Table B–1 for the evaluation of Category 1 issues for SLR. In its decisions, the Commission directed the staff to revise the LR GEIS and Title 10 of the *Code of Federal Regulations* Part 51 to address SLR and determined that the NRC staff must address these impacts on a site-specific basis in an EIS if an SLR applicant elects not to await the issuance of a revised GEIS and rule.

Following its receipt of Xcel Energy's SLR application and site-specific environmental report, the NRC staff issued a notice of the staff's intent to conduct a scoping process and to publish a site-specific EIS for Monticello SLR (88 FR 15103-TN9715). The NRC staff conducted the scoping process, and then published a scoping summary report (NRC 2024-TN9817).

The NRC staff has prepared this site-specific EIS in accordance with CLI-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN9844). This EIS considers, among other things, the information contained in Xcel Energy's January 9, 2023, SLR application submittal (Xcel 2023-TN9084), and evaluates all the environmental impacts applicable to Monticello SLR on a site-specific basis.

Based on its evaluation of environmental impacts, the NRC staff's preliminary recommendation is that the adverse environmental impacts of Monticello SLR are not so great that preserving the option of SLR for energy planning decisionmakers would be unreasonable. The EIS also considers the comments submitted during the NRC environmental scoping period conducted in March 2023 as summarized in the NRC staff's scoping summary report (NRC 2024-TN9817). The NRC staff based its preliminary recommendation on the following:

- Xcel Energy's environmental report
- consultation with Federal, State, Tribal, and local governmental agencies
- the NRC staff's independent environmental review
- the consideration of public comments received during the scoping process

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EXECUTIVE SUMMARY

Background

By letter dated January 9, 2023 (Xcel 2023-TN9084), Xcel Energy submitted an application requesting subsequent license renewal (SLR) for the Monticello Nuclear Generating Plant, Unit 1 (Monticello) operating license to the U.S. Nuclear Regulatory Commission (NRC). The Monticello renewed facility operating license for Unit 1 (DPR-22) expires at midnight on September 8, 2030. In its application, Xcel Energy requested a subsequent renewed operating license for a period of 20 years beyond the current renewed license expiration date (i.e., from September 8, 2030, to September 8, 2050).

The NRC's environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," (TN250) implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.; TN661). This Act is commonly referred to as National Environmental Policy Act (NEPA). The regulations in 10 CFR Part 51 require the NRC to prepare an environmental impact statement (EIS) before deciding whether to issue an operating license or a renewed operating license for a nuclear power plant.

On February 24, 2022, the Commission issued three memoranda and orders that addressed SLR proceedings for five operating nuclear power plants. Two of these orders, Commission Legal Issuance (CLI)-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN9844), are relevant to the Monticello SLR environmental review. In these orders, the Commission concluded that the License Renewal Generic Environmental Impact Statement (LR GEIS), which the NRC staff relies on in part to meet its obligations under 10 CFR Part 51 (TN250) and NEPA, did not consider the impacts from operation during the SLR period of extended operations. Therefore, the Commission determined that the NRC staff's NEPA reviews for the affected nuclear power plants were inadequate.

In CLI-22-03 (NRC 2022-TN9844), the Commission directed the NRC staff to review and update the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Revision 1, Final Report (NUREG-1437; NRC 2013-TN2654; LR GEIS) so that it covers nuclear power plant operation during the SLR period. The Commission stated that it believed the most efficient way to proceed would be for the NRC staff to review and update the LR GEIS and then take appropriate action with respect to pending SLR applications to ensure that the environmental impacts for the period of SLR are considered. However, the Commission allowed that SLR applicants may submit a revised environmental report providing information on environmental impacts during the SLR period on a site-specific basis. In such a submittal, SLR applicants must evaluate the impacts of those environmental issues dispositioned in the LR GEIS and Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) as generic (Category 1) issues, as well as the impacts of site -specific (Category 2) issues. The NRC staff would then address the impacts of all such issues during the SLR period in site-specific EISs.

On January 9, 2023, Xcel Energy submitted an environmental report of the impacts of continued operations of Monticello during the SLR period (Xcel 2023-TN9084). The report addressed on a site-specific basis each environmental issue, including issues that were previously dispositioned as Category 1 issues in the 2013 LR GEIS. On March 10, 2023, the NRC staff published a notice of its intent to conduct a scoping process and to prepare a site-specific environmental impact statement for Monticello SLR (88 FR 15103-TN9715). The NRC staff then conducted an environmental scoping process and published a scoping summary report in March 2024 (NRC 2024-TN9817).

Proposed Action

The proposed Federal action (subsequent renewal of the Monticello renewed operating license) was initiated by Xcel Energy's submittal of an SLR application. The current renewed Monticello operating license is set to expire at midnight on September 8, 2030. The NRC's Federal action is to determine whether to renew the Monticello operating license for an additional 20 years. If the NRC renews the operating license, Xcel Energy would be authorized to operate Monticello until September 8, 2050.

Purpose and Need for Action

The purpose and need for the proposed action (subsequent renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by energy planning decisionmakers, such as State regulators, utility owners, and, where authorized, Federal agencies other than the NRC. The definition of purpose and need reflects the Commission's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954, as amended, or in the NEPA environmental analysis, that would lead the NRC to reject a license renewal application, the NRC has no role in the energy planning decisions of utility officials and State regulators as to whether a nuclear power plant should continue to operate.

Environmental Impacts of Subsequent License Renewal

This site-specific EIS evaluates the potential environmental impacts of the proposed action and reasonable alternatives to that action. The environmental impacts of the proposed action and reasonable alternatives are designated as SMALL, MODERATE, or LARGE, which represent three established significance levels for potential impacts, presented in a footnote to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250), and defined as follows:

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

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

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

In this EIS, the NRC staff evaluates, on a site-specific basis, all environmental issues that are applicable to Monticello SLR, including the impacts of license renewal issues that had been determined to be site-specific (Category 2) in the LR GEIS, as well as issues that had been determined to be generic (Category 1) in the LR GEIS. The LR GEIS and Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) identify issues as either "generic" ("Category 1") or "site-specific" ("Category 2"). However, as explained under "Background," the Commission determined that the staff cannot rely on the LR GEIS and Table B-1 for its SLR reviews pending updates to the LR GEIS and 10 CFR Part 51. Therefore, in this site-specific EIS, the NRC addresses each of the environmental issues identified in the LR GEIS and Table B-1 on a site-specific basis. As a result, the NRC staff conducted site-specific analyses and made site-specific findings of SMALL, MODERATE, or LARGE for each of the applicable environmental issues.

Table ES-1 lists the environmental issues applicable to Monticello SLR and the findings related to these issues. Footnotes denote those issues that were formerly addressed in the LR GEIS as Category 1 issues.

Table ES-1 Summary of Site-Specific Conclusions Regarding Monticello Nuclear Generating Plant Subsequent License Renewal

Resource Area	Environmental Issue	Impacts
Land Use	Onsite land use[(a)]	SMALL
Land Use	Offsite land use[(a)]	SMALL
Land Use	Offsite land use in transmission line right-of-ways (ROWs)[(a)]	SMALL
Visual Resources	Aesthetic impacts[(a)]	SMALL
Air Quality	Air quality impacts (all plants)[(a)]	SMALL
Air Quality	Air quality effects of transmission lines[(a)]	SMALL
Noise	Noise impacts[(a)]	SMALL
Geologic Environment	Geology and soils[(a)]	SMALL
Surface Water Resources	Surface water use and quality (non-cooling system impacts)[(a)]	SMALL
Surface Water Resources	Altered current patterns at intake and discharge structures[(a)]	SMALL
Surface Water Resources	Scouring caused by discharged cooling water[(a)]	SMALL
Surface Water Resources	Discharge of metals in cooling system effluent[(a)]	SMALL
Surface Water Resources	Discharge of biocides, sanitary wastes, and minor chemical spills[(a)]	SMALL
Surface Water Resources	Surface water use conflicts (plants with once-through cooling systems)[(a)]	SMALL
Surface Water Resources	Effects of dredging on surface water quality[(a)]	SMALL
Surface Water Resources	Temperature effects on sediment transport capacity[(a)]	SMALL
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)[(a)]	SMALL
Groundwater Resources	Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	SMALL
Groundwater Resources	Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	SMALL
Groundwater Resources	Radionuclides released to groundwater	SMALL to MODERATE
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides[(a)]	SMALL
Terrestrial Resources	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)[(a)]	SMALL
Terrestrial Resources	Cooling tower impacts on vegetation (plants with cooling towers)[(a)]	SMALL

Table ES-1 Summary of Site-Specific Conclusions Regarding Monticello Nuclear Generating Plant Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Terrestrial Resources	Bird collisions with plant structures and transmission lines[(a)]	SMALL
Terrestrial Resources	Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL
Terrestrial Resources	Transmission line right-of-way (ROW) management impacts on terrestrial resources[(a)]	SMALL
Terrestrial Resources	Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)[(a)]	SMALL
Aquatic Resources	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)[(a)]	SMALL
Aquatic Resources	Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Infrequently reported thermal impacts (all plants)[(a)]	SMALL
Aquatic Resources	Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication[(a)]	SMALL
Aquatic Resources	Effects of nonradiological contaminants on aquatic organisms[(a)]	SMALL
Aquatic Resources	Exposure of aquatic organisms to radionuclides[(a)]	SMALL
Aquatic Resources	Effects of dredging on aquatic organisms[(a)]	SMALL
Aquatic Resources	Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL
Aquatic Resources	Effects on aquatic resources (non-cooling system impacts)[(a)]	SMALL
Aquatic Resources	Impacts of transmission line right-of-way (ROW) management on aquatic resources[(a)]	SMALL
Aquatic Resources	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses[(a)]	SMALL
Special Status Species and Habitats	Threatened, endangered, and protected species and essential fish habitat	May affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, whooping crane, and monarch butterfly; no effect on essential fish habitat; no effect on sanctuary resources of National Marine Sanctuaries

Table ES-1 Summary of Site-Specific Conclusions Regarding Monticello Nuclear Generating Plant Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Historic and Cultural Resources	Historic and cultural resources	Would not adversely affect known historic properties or historic and cultural resources
Socioeconomics	Employment and income, recreation, and tourism[(a)]	SMALL
Socioeconomics	Tax revenues[(a)]	SMALL
Socioeconomics	Community services and education[(a)]	SMALL
Socioeconomics	Population and housing[(a)]	SMALL
Socioeconomics	Transportation[(a)]	SMALL
Human Health	Radiation exposures to the public[(a)]	SMALL
Human Health	Radiation exposures to plant workers[(a)]	SMALL
Human Health	Human health impact from chemicals[(a)]	SMALL
Human Health	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	SMALL
Human Health	Microbiological hazards to plant workers[(a)]	SMALL
Human Health	Chronic effects of electromagnetic fields (EMFs)	Uncertain impact
Human Health	Physical occupational hazards[(a)]	SMALL
Human Health	Electric shock hazards	SMALL
Postulated Accidents	Design-basis accidents[(a)]	SMALL
Postulated Accidents	Severe accidents	See EIS Appendix F
Environmental Justice	Minority and low-income populations	No disproportionate and adverse human health and environmental effects on minority and low-income populations
Waste Management	Low-level waste storage and disposal[(a)]	SMALL
Waste Management	Onsite storage of spent nuclear fuel[(a)]	SMALL
Waste Management	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal[(a)]	[(b)]
Waste Management	Mixed-waste storage and disposal[(a)]	SMALL
Waste Management	Nonradioactive waste storage and disposal[(a)]	SMALL
Cumulative Impacts	Cumulative impacts	See EIS Section 3.15
Uranium Fuel Cycle	Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste[(a)]	SMALL
Uranium Fuel Cycle	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste[(a)]	[(c)]
Uranium Fuel Cycle	Nonradiological impacts of the uranium fuel cycle[(a)]	SMALL
Uranium Fuel Cycle	Transportation[(a)]	SMALL

Table ES-1 Summary of Site-Specific Conclusions Regarding Monticello Nuclear Generating Plant Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Termination of Nuclear Power Plant Operations and Decommissioning	Termination of plant operations and decommissioning[(a)]	SMALL

EIS = environmental impact statement; EMF = electromagnetic fields; gpm = gallon(s) per minute; gps = gallon(s) per minute; ROW = right-of-way; SAMA = severe accident mitigation alternatives.

(a) Dispositioned as generic (Category 1) for initial license renewal of nuclear power plants in Table B–1 in Appendix B to Subpart A of Title 10 CFR Part 51 (TN250).

(b) The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants and does not warrant a site-specific analysis.

(c) 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. As stated in the 2013 LR GEIS, "The Commission concludes that these impacts 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 (TN4878) should be eliminated" (10 CFR Part 54-TN4878) (Section 3.13.3.3 of this EIS).

Alternatives

As part of its environmental review, the NRC is required to consider reasonable alternatives to SLR and to evaluate the environmental impacts associated with each alternative. These alternatives can include other methods of power generation (replacement energy alternatives), as well as not renewing the Monticello operating licenses (no-action alternative).

The NRC staff considered 17 alternatives to the proposed action and eliminated 14 from detailed study due to technical, resource availability, or commercial limitations that are likely to exist when the current renewed Monticello operating licenses expire. Three replacement energy alternatives were determined to be commercially viable, and include:

- combination of natural gas and renewables
- combination of renewables and storage
- new nuclear small modular reactor

These alternatives, along with the no-action alternative, were evaluated in detail in this EIS. In addition, the NRC staff also evaluated new and significant information that could alter the conclusions of the severe accident mitigation alternatives analysis previously performed for the Monticello initial license renewal in 2006, which authorized continued reactor operation for an additional 20 years beyond the original 40-year operating license term.

Preliminary Recommendation

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

- Xcel Energy’s environmental report
- consultation with Federal, State, Tribal, and local governmental agencies
- the NRC staff’s independent environmental review
- the consideration of public comments received during the scoping process

ABBREVIATIONS AND ACRONYMS

µm	micrometer(s)
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
ac	acre(s)
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
APE	area of potential effect
BEIR	Biological Effects of Ionizing Radiation
bgs	below ground surface
BMP	best management practice
BWR	boiling water reactor
BTA	best technology available
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic foot(feet) per second
CLB	current licensing basis
CLI	Commission Legal Issuance
CliMAT	Minnesota Climate Mapping and Analysis Tool
cm	centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	CO_2 equivalent
CRD	control rod drive
CWA	Clean Water Act
DBA	Design-Basis Accidents
DOE	U.S. Department of Energy
EDA	Economic Development Authority
EFH	essential fish habitat
EI	exposure index
EIA	Energy Information Administration

EIS	Environmental impact statement
EMF	Electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPU	extended power uprate
ER	environmental report
ESA	Endangered Species Act
FPPA	Farmland Protection Policy Act
FR	*Federal Register*
ft	foot(feet)
ft^3	cubic foot(feet)
FWS	U.S. Fish and Wildlife Services
g	gravity
gal	gallon(s)
GEIS	generic environmental impact statement
GHG	greenhouse gas
gpm	gallon(s) per minute
Gy/d	gray(s) per day
ha	hectare(s)
HZI	Hydraulic Zone of Influence
in.	inch(es)
IPaC	Information for Planning and Consultation
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination -– External Events
ISFSI	independent spent fuel storage installation
km	kilometer(s)
kV	kilovolt(s)
LERF	large early release frequency
LOS	level-of-service
L/min	liter(s) per minute
LR	license renewal
LR GEIS	License Renewal Generic Environmental Impact Statement

m	meter(s)
m^3	cubic meter(s)
MACCS	MELCOR Accident Consequence Code System
MBTA	Migratory Bird Treaty Act
MDCT	mechanical draft cooling tower
MDNR	Minnesota Department of Natural Resources
MET	meteorological towers
mGy/hr	milligray(s) per hour
MHRA	Monticello Housing Redevelopment Authority
mi	mile(s)
mm	millimeter(s)
mph	mile(s) per hour
Monticello	Monticello Nuclear Generating Plant
MPCA	Minnesota Pollution Control Agency
MSA	Magnuson–Stevens Fisheries Conservation and Management Act
MSL	mean sea level
MT	metric ton(s)
MW	megawatt(s)
MWe	megawatt(s) electrical
MWd/MTU	megawatt-day(s) per metric ton uranium
MWt	megawatt(s) thermal

NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMC	Nuclear Management Company
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NO	nitric oxide
NOAA	National Oceanic and Atmospheric Administration
NOV	notice of violation
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSPM	Northern States Power Company

OSHA	Occupational Safety and Health Administration

PCB	polychlorinated biphenyl
PM	particulate matter
PRA	probabilistic risk assessment
PV	photovoltaic
rad/d	rad(s) per day
RAI	Request for Additional Information
RCP	representative concentration pathway
RG	Regulatory Guide
RKM	river kilometer(s)
RM	river mile(s)
ROI	region of influence
RCRA	Resources Conservation Recovery Act
REMP	radiological environmental monitoring program
ROW	right-of-way
RY	reactor-year
s	second(s)
SAMA	severe accident mitigation alternative
SAR	safety analysis report
SEIS	supplemental environmental impact statement
SFP	Spent Fuel Pool
SLR	subsequent license renewal
SMR	small modular reactor
SO_2	sulfur dioxide
SOARCA	state-of-art reactor consequence analysis
SPCC	Spill Prevention, Control, and Countermeasure
SSP	shared socioeconomic pathways
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
TPY	ton(s) per year
UCB	upper-confidence bounds
USACE	U.S. Army Corps of Engineers
U.S.C	U.S. Code
USCB	U.S. Census Bureau
USGCRP	United States Global Change Research Program

USGS	U.S. Geological Survey
Xcel	Xcel Energy
yd^3	cubic yard(s)
yr	year(s)

1 INTRODUCTION AND GENERAL DISCUSSION

The U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 et seq.; TN661). The regulations at 10 CFR Part 51 require, in part, the NRC to prepare an environmental impact statement (EIS) before the issuance or renewal of a license to operate a nuclear power plant.

The Atomic Energy Act (AEA) of 1954, as amended (42 U.S.C. 2011 et seq.; TN663), specifies that licenses for commercial power reactors can be granted for up to 40 years. The initial licensing period of 40 years was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility. The NRC regulations permit these licenses to be renewed beyond the initial 40-year term for an additional period of time, limited to 20-year increments per renewal. Renewal is based on the results of (1) the environmental review and (2) the NRC staff's safety review (10 CFR 54.29, "Standards for Issuance of a Renewed License"; TN4878). Neither the AEA nor the NRC regulations restrict the number of times a license may be renewed. The decision to seek a renewed license rests entirely with nuclear power plant owners and typically is based on the power plant's economic viability and the investment necessary to continue to meet all safety and environmental requirements. The NRC makes the decision to grant or deny license renewal based on whether the applicant has demonstrated reasonable assurance that it can meet the environmental and safety requirements in the agency's regulations during the period of extended operation.

On February 24, 2022, the Commission issued three memoranda and orders that addressed subsequent license renewal (SLR) proceedings for five operating nuclear power plants. Two of these orders, Commission Legal Issuance (CLI)-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN9844), are relevant to the Monticello SLR environmental review. In these orders, the Commission concluded that the License Renewal Generic Environmental Impact Statement (LR GEIS), which the NRC staff relies on in part to meet its obligations under 10 CFR Part 51 (TN250) and NEPA, did not consider the impacts from operations during the SLR period of extended operations. Therefore, the Commission determined that the NRC staff's NEPA reviews for the affected nuclear power plants were inadequate. In CLI-22-03, the Commission directed the NRC staff to review and update the LR GEIS so that it covers nuclear power plant operation during the SLR period (NRC 2022-TN9844). The Commission stated that it believed the most efficient way to proceed would be for the NRC staff to review and update the LR GEIS and then take appropriate action with respect to pending SLR applications to ensure that the environmental impacts for the period of SLR are considered. However, the Commission allowed SLR applicants to submit a revised environmental report (ER) providing information on environmental impacts during the SLR period. In such a submittal, SLR applicants must evaluate, on a site-specific basis, the impacts of those environmental issues dispositioned in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the LR GEIS as generic (Category 1) issues. The NRC staff would then address the impacts of these issues during the SLR period in site-specific EISs.

Pursuant to 10 CFR Part 51 (TN250), the NRC conducted an environmental review of Xcel Energy's January 9, 2023, request for SLR (Xcel 2023-TN9084). Xcel Energy requested a renewed facility operating license for Monticello Nuclear Generating Plant, Unit 1 (Monticello) for a period of 20 years beyond the date when the current renewed facility operating license would expire (i.e., until September 8, 2050). As part of its SLR application, Xcel Energy submitted an ER (Xcel 2023-TN9084).

The NRC staff prepared this site-specific EIS in accordance with CLI-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN9844), and requirements in 10 CFR 51.70 (TN250), "Draft Environmental Impact Statements—General Requirements." This EIS considers the impacts of all license renewal (LR) issues applicable to Monticello SLR on a site-specific basis. This EIS considers information in Xcel Energy's SLR application; the NRC staff's consultation with Federal, State, Tribal, and local government agencies; consideration of comments received during the scoping process; and other new information, as appropriate.

Table B–1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the 2013 LR GEIS identify issues as either "generic" ("Category 1") or "site-specific" ("Category 2.").However, as explained under "Background," the Commission determined that the NRC staff cannot rely on the LR GEIS for SLR reviews pending updates to the generic environmental impact statement (GEIS) and 10 CFR Part 51. Therefore, in this EIS, each of these generic (Category 1) environmental issues are addressed on a site-specific basis. In addition, this site-specific draft EIS addresses the environmental issues that were addressed in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250) and the LR GEIS as site-specific (Category 2) issues. The NRC staff performed site-specific analyses and made site-specific findings of SMALL, MODERATE, or LARGE for each of these issues.

1.1 Proposed Federal Action

Xcel Energy initiated the proposed Federal action (subsequent renewal of the Monticello renewed operating license) by submitting an SLR request to the NRC. The initial renewed Monticello facility operating license is set to expire at midnight on September 8, 2030 (License No. DPR-22). The NRC's Federal action is to decide whether to renew the license authorizing an additional 20 years of operation. If the NRC issues the subsequent renewed license, Monticello would be authorized to operate until September 8, 2050.

1.2 Purpose and Need for the Proposed Action

The purpose and need for the proposed action (subsequent renewal of the Monticello renewed operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by energy planning decision-makers, such as State regulators, utility owners, and, where authorized, Federal agencies other than the NRC. The definition of purpose and need reflects the Commission's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954, as amended, or in the NEPA environmental analysis, that would lead the NRC to reject a license renewal application, the NRC has no role in the energy planning decisions as to whether a nuclear power plant should continue to operate.

1.3 Major Environmental Review Milestones

Xcel Energy submitted an ER as an appendix to its SLR application on January 9, 2023 (Xcel 2023-TN9084). The NRC published a notice of the receipt of the application in the *Federal Register* (FR) on January 31, 2023 (Volume 88 of the FR, p. 6327 [88 FR 6327-TN9713]). After reviewing the SLR application and ER, the NRC staff accepted the application for a detailed technical review on February 23, 2023. The NRC staff published a FR notice of acceptability for docketing and opportunity for hearing on March 3, 2023 (88 FR 13474-TN9714). On March 10, 2023, the NRC published a notice in the FR (88 FR 15103-TN9715) informing the public of the staff's intent to conduct an environmental scoping process, which began a 30 day scoping comment period, and to prepare an environmental impact statement. The NRC staff held an in-person public scoping meeting on March 22, 2023, followed by a virtual public scoping meeting on March 29, 2023. In March 2024, the NRC issued a scoping summary report for Monticello SLR (NRC 2024-TN9817), which included the comments received during the 2023 scoping process (Appendix A of this EIS).

The NRC staff conducted a hybrid in-person and virtual environmental and severe accident mitigation alternatives (SAMAs) audit of Monticello during the week of August 7 and August 14, 2023, respectively, to independently verify information in Xcel Energy's ER. During the audit, the NRC staff held meetings with nuclear power plant personnel and reviewed site-specific documentation and photos. The NRC staff summarized the audit in a letter dated October 23, 2023 (NRC 2023-TN9723).

Figure 1-1 shows the major milestones of the NRC staff's environmental review of the Monticello SLR application. Following the publication of this EIS, the EIS public comment process provides a further opportunity for the incorporation of public comments and updating of the EIS, as appropriate.

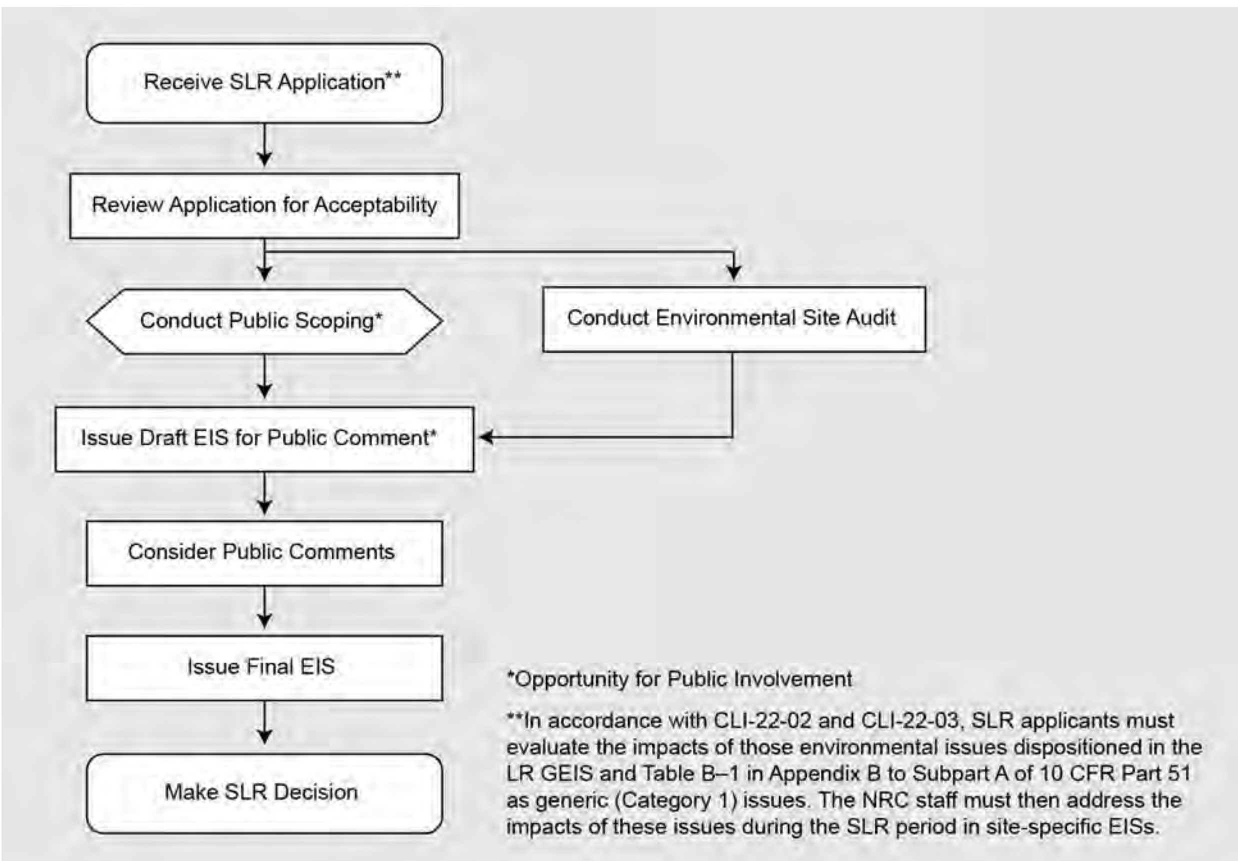


Figure 1-1 Environmental Review Process

The NRC has established a process that the NRC staff and LR applicants can complete in a reasonable period of time, that includes clear requirements to assure safe nuclear power plant operation for up to an additional 20 years of nuclear power plant life, pursuant to 10 CFR Part 54 (TN4878), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." This process consists of separate safety and environmental reviews, which the NRC staff conducts simultaneously and documents in two reports: (1) the safety evaluation report documents the safety review and (2) the EIS documents the environmental review. Both reports factor into the NRC's decision to issue or deny a renewed license.

1.4 Environmental Issues Evaluated in this EIS

In 1996, as supplemented in 1999, and revised in 2013, the NRC generically assessed the environmental impacts of license renewal of nuclear power plants in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (NRC 1996-TN288, NRC 1999-TN289, NRC 2013-TN2654). The NRC undertook this generic review to establish a systematic approach to evaluating the environmental consequences of renewing individual nuclear power plant operating licenses for up to a 20-year period.

The 2013 revision of the LR GEIS (NRC 2013-TN2654) established 78 environmental impact issues for LR. For each of these issues, the NRC determined whether the analysis of the environmental issue in the LR GEIS could be applied to all nuclear power plants seeking LR and whether additional mitigation measures would be warranted. Based on this determination, the NRC designated each environmental issue as Category 1 (generic to all or a distinct subset of nuclear power plants) or Category 2 (site-specific to certain nuclear power plants only). For initial LR applications, a site-specific supplement to the LR GEIS is developed that considers the applicable Category 1 and Category 2 issues for the site under review. For generic issues (Category 1), the staff can adopt the LR GEIS's analyses and conclusions unless new and significant information that invalidates the GEIS conclusion is identified during a site-specific review. For Category 2 issues, the staff performs a site-specific environmental review for each license renewal application. The NRC codified the conclusions in the LR GEIS in Appendix B to Subpart A of 10 CFR Part 51 (TN250), "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant."

As discussed above, on February 24, 2022, the Commission issued three decisions that addressed SLR proceedings for five operating nuclear power plants. Two of these orders, CLI-22-02 (NRC 2022-TN8182) and CLI-22-03 (NRC 2022-TN9844) are relevant to the Monticello SLR environmental review. In these orders, the Commission concluded that the LR GEIS and Table B-1 of Appendix B to 10 CFR Part 51 (TN250) did not consider the impacts from operations during the SLR period of extended operations. In CLI-22-03, the Commission directed the NRC staff to review and update the LR GEIS so that it covers nuclear power plant operation during the SLR period (NRC 2022-TN9844). However, the Commission allowed SLR applicants to submit a revised ER providing information on the environmental impacts during the SLR period, in which they must evaluate all such impacts on a site-specific basis. The NRC staff would then address the impacts of these issues during the SLR period in site-specific EISs.

The NRC staff prepared this site-specific EIS in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182; NRC 2022-TN9844) and requirements in 10 CFR 51.70 (TN250), "Draft Environmental Impact Statements – General Requirements." In this EIS, the impacts of all environmental issues applicable to Monticello SLR were considered on a site-specific basis. This EIS considers information in Xcel Energy's SLR application; the staff's consultation with

Federal, State, Tribal, and local government agencies; comments received during the scoping process, and other new information, as appropriate.

The NRC staff has also considered whether any additional environmental issues exist beyond the issues identified in the LR GEIS that would apply to Monticello during the SLR period of extended operations. The NRC staff identified no such issues during its review of Xcel Energy's ER, as supplemented, or as a result of the environmental scoping process, the environmental site audit, or consultations with Federal, State, and local agencies and American Indian Tribes. Generally, SLR would allow current operating conditions and environmental stressors to continue rather than introduce new environmental impacts that did not exist during the original license or the initial LR periods. Therefore, in this EIS, the NRC staff conducted a site-specific analysis using the structure of environmental issues established in the LR GEIS.

The NRC's standard of significance for impacts uses the Council on Environmental Quality (CEQ) terminology for "Determine the appropriate level of NEPA review" (40 CFR 1501.3(b)-TN4876). In considering whether the effects of the proposed action are significant, the NRC analyzes the potentially affected environment and degree of the effects of the proposed action (subsequent license renewal). The potentially affected environment consists of the affected area and its resources, such as listed species and designated critical habitat under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.-TN1010). For a site-specific analysis, significance would depend on the effects in the local area, including (1) both short- and long-term effects; (2) both beneficial and adverse effects; (3) effects on public health and safety; and (4) effects that would violate Federal, State, Tribal, or local law protecting the environment.

The NRC characterizes potential impacts according to three levels of significance for potential impacts—SMALL, MODERATE, and LARGE.

SMALL: indicates that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: indicates that the environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: indicates that the environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

1.5 Structure of this EIS

This site-specific EIS presents the analysis of the environmental effects of the continued operation of Monticello through the SLR term, reasonable alternatives to SLR, and mitigation measures for minimizing adverse environmental impacts. Chapter 3, "Affected Environment, Environmental Consequences, and Mitigating Actions," contains an analysis and comparison of the potential environmental impacts from SLR and alternatives to SLR. Chapter 4, "Conclusion," presents the NRC staff's preliminary recommendation on whether the environmental impacts of SLR are so great that preserving the option of SLR would be unreasonable. The NRC staff will consider public comments that it receives on this draft site-specific EIS and will then issue its final site-specific EIS. The NRC will make its final determination on Monticello's SLR in a record of decision to be issued following issuance of the final site-specific EIS.

In preparing this draft EIS, the NRC staff carried out the following activities:

- reviewed Xcel Energy's ER
- consulted with Federal agencies, State and local agencies, and American Indian Tribes
- conducted site-specific analysis of each environmental issue relevant to Monticello SLR
- performed environmental and SAMA site audits
- considered public comments received during the scoping comment period

New information can come from many sources, including the applicant, the NRC, other agencies, or public comments. If new information reveals a new issue that the NRC was not aware of, the staff will first analyze the issue to determine whether it is within the scope of the license renewal environmental review. If the NRC staff determines that the new issue bears on the proposed action or its impacts, the staff will then determine the significance of the issue for the plant and address the issue in the EIS, as appropriate.

1.6 Decision to Be Supported by the EIS

This site-specific EIS provides information and analyses to support the NRC's decision on whether to renew the Monticello operating licenses for an additional 20 years. The regulation at 10 CFR 51.103(a)(5) (TN250) specifies the NRC's decision standard as follows:

> In making a final decision on a license renewal action pursuant to [10 CFR] Part 54 of this chapter, the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

There are many factors that the NRC takes into consideration when deciding whether to renew the operating license of a nuclear power plant. The analysis of environmental impacts in this EIS will provide the NRC's decisionmakers (the Commission) with important environmental information for consideration in deciding whether to renew the Monticello operating license.

1.7 Cooperating Agencies

During the scoping process, the NRC staff did not identify any Federal, State, local, or Tribal agencies as cooperating agencies for this EIS.

1.8 Consultations

Certain Federal environmental statutes require Federal agencies to consult with other agencies, Tribes, and organizations before taking an action that may affect protected environmental resources, such as endangered species, habitat of managed fisheries, and historical and cultural resources. The ESA (16 U.S.C. 1531 et seq.-TN1010), the Magnuson–Stevens Fisheries Conservation and Management Act (MSA) of 1996, as amended (16 U.S.C. 1801 et seq.-TN7841); and the National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. 300101 et seq.-TN4157) require Federal agencies to consult with applicable State and Federal agencies and organizations before taking an action that may affect endangered species, fisheries, or historic and archaeological resources, respectively. See Appendix C for a list of the agencies and groups with which the NRC staff consulted.

1.9 Correspondence

During the review, the NRC staff contacted Federal, State, regional, local, and Tribal agencies listed in Appendix C, which chronologically lists all correspondence the NRC staff sent and received associated with the ESA, the MSA, and the NHPA. Appendix D chronologically lists all other correspondence.

1.10 Status of Compliance

Xcel Energy is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F, “Laws, Regulations, and Other Requirements,” of the LR GEIS, Revision 1, describes some of the major applicable Federal statutes. Numerous permits and licenses are issued by Federal, State, and local authorities for activities at Monticello. Appendix B of this EIS contains further information from the Monticello application about Xcel Energy’s status of compliance.

1.11 Related State and Federal Activities

The NRC staff reviewed the possibility that activities (projects) of other Federal agencies might impact the renewal of the operating licenses for Monticello. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparing this EIS. The NRC staff has determined that there are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this EIS (10 CFR 51.10(b)(2)-TN250). Section 3.14 identifies the activities (projects) including State activities that were considered during the cumulative environmental impacts review.

Section 102(2)(C) of NEPA (42 U.S.C. § 4332-TN4880) requires the NRC to consult with and obtain comments from any Federal agency or designated authority that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. For example, during the preparation of this site-specific EIS, the NRC consulted with the Minnesota State Historic Preservation Officer, among others. Appendix C provides a complete list of consultation correspondence.

The NRC staff reviewed the Monticello status of compliance in Chapter 3 and Appendix B and notes that some State or Federal permitting and certification activities could affect NRC license renewal. In appropriate circumstances (not present here), construction of water intake structures, access roads, or rail spurs may be required by other regulatory authorities. In such instances, some nuclear power plant construction activities may require a license amendment and an environmental review by the NRC. However, no such activities have been identified for Monticello SLR.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The NRC's decision-making authority in license renewal is limited to deciding whether to renew a nuclear power plant's operating license; the agency's implementation of the NEPA (42 U.S.C. 4321 et seq.; TN661), requires consideration of the environmental impacts of that action as well as the impacts of reasonable alternatives to renewing a nuclear power plant's operating license. Although the ultimate decision on which alternative (or the proposed action) to carry out falls to the nuclear plant owner, State, or other non-NRC Federal officials, comparing the impacts of renewing the operating license to the environmental impacts of alternatives allows the NRC to determine whether the environmental impacts of LR are so great that it would be unreasonable for the agency to preserve the option of LR for energy planning decision-makers (10 CFR Part 51.71(d) footnote 3; TN250).

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

This chapter describes (1) the Monticello Nuclear Generating Plant, Unit 1 (Monticello) site and its operation, (2) the proposed action (subsequent renewal of the current renewed Monticello operating license), (3) reasonable alternatives to the proposed action (including the no-action alternative), and (4) alternatives eliminated from detailed study.

2.1 Description of Nuclear Power Plant Facility and Operation

The physical presence of Monticello buildings and facilities, as well as the nuclear power plant's operations, are integral to creating the environment that currently exists at and around the site. This section describes certain nuclear power plant operating systems and certain nuclear power plant infrastructure, operations, and maintenance.

2.1.1 External Appearance and Setting

Monticello is located in the City of Monticello, Wright County, Minnesota, at 45° 20' N latitude and 93° 50' W longitude (Xcel 2023-TN9084). As shown in Figure2-1, Monticello is situated on the southern bank of the Mississippi River approximately 22 miles (mi) (35.4 kilometers [km]) southeast of St. Cloud and approximately 30 mi (48.2 km) northwest of the Twin Cities area of Minneapolis, St. Paul, and their surrounding suburbs.

As shown Figure2-2, the principal Monticello structures are the reactor building, a turbine building, a radioactive waste building and off-gas stack, and a diesel emergency generator building. Prominent features beyond the power block area include intake and discharge structures, two mechanical draft cooling towers (MDCTs), the Monticello training and conference center, technical and administrative support facilities, a firing range, meteorological towers, and the Monticello substation which includes 345, 230, 115, and 13.8 kilovolt (kV) switchyards (Xcel 2023-TN9084).

Figure 2-1 Monticello Nuclear Generating Plant Site 50 mi (80 km) Radius Map. Source: Xcel 2023-TN9084.

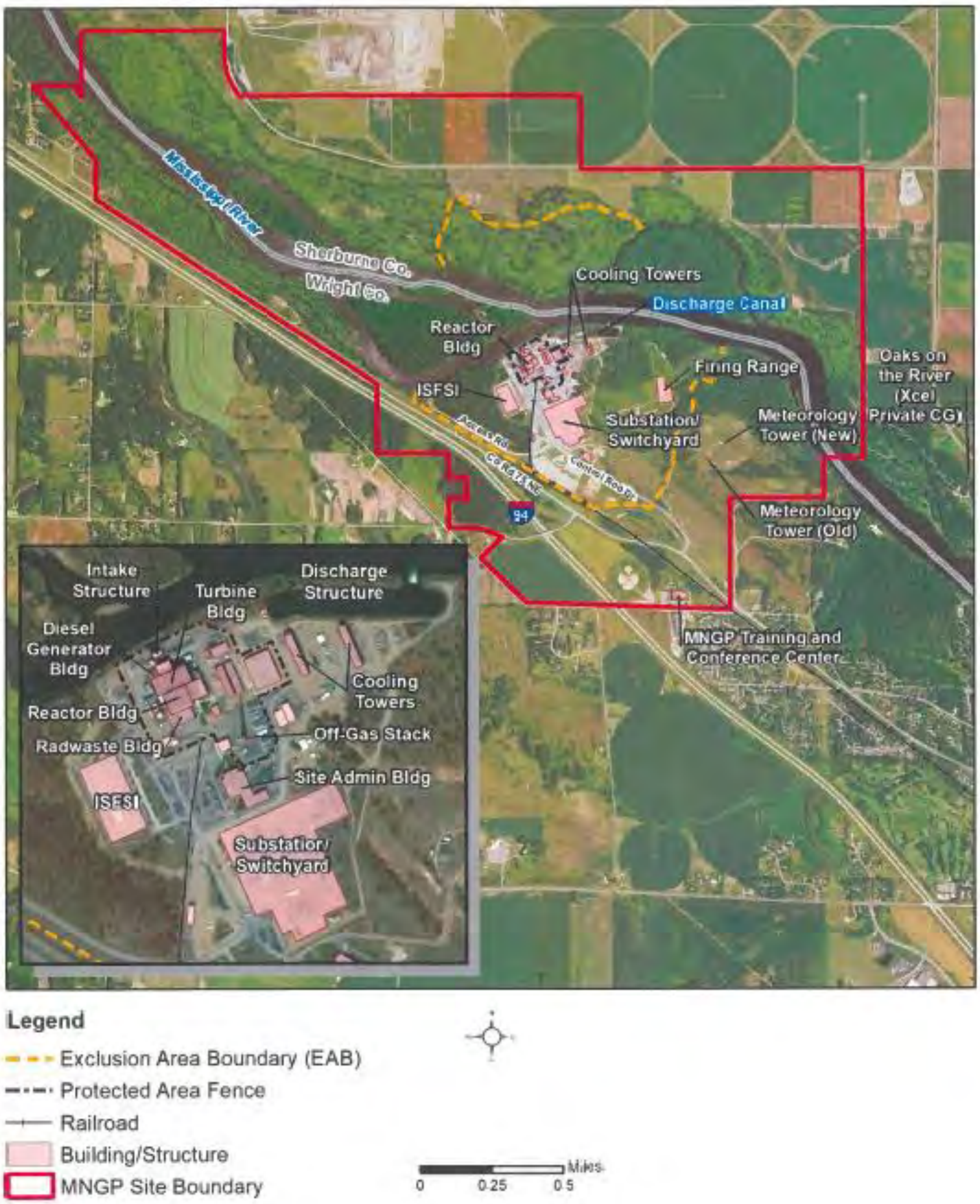


Figure 2-2 Monticello Nuclear Generating Plant Layout and Surrounding Features. Source: Xcel 2023-TN9084.

2.1.2 Nuclear Reactor Systems

Monticello is a single-unit electric generating plant consisting of a single-cycle, forced-circulation, General Electric boiling water reactor, BWR-3, that produces steam for direct use in a steam turbine. The NRC issued the original Monticello operating license on January 9, 1971. The first renewed license was issued on November 8, 2006.

The nuclear reactor was originally designed to produce up to 1,670 megawatts thermal (MWt) and 545 megawatts electric (MWe). An uprate license amendment increasing the power to 1,775 MWt/600 MWe was approved in 1998, and a subsequent extended power uprate (EPU) increasing the power up to 2,004 MWt/691 MWe was approved in 2013 (Xcel 2023-TN9084; NRC 2006-TN7315, NRC 2013-TN9799).

2.1.3 Cooling and Auxiliary Water Systems

There are numerous systems moving water through components at Monticello. Primary among them is the cooling system which consists of the circulating water system and the plant service water system. Both systems withdraw and use water from the Mississippi River. Auxiliary water systems include the domestic water system, which withdraws groundwater, and the fire protection system which utilizes water from the Mississippi River.

Monticello surface water and groundwater withdrawals are governed by water appropriation limits set by the Minnesota Department of Natural Resources (MDNR). Monticello is permitted to withdraw a maximum of 645 cubic feet per second (cfs) of water from the Mississippi River when the river flow is greater than 860 cfs. However, when the river flow is less than 860 cfs, special withdrawal restrictions on the permitted withdrawal volume are applicable. Further withdrawal restrictions apply if river flow is reduced to less than 240 cfs. Monticello may withdraw up to a total of 20 million gallons per year (an average of 38 gallons per minute [gpm]) of groundwater via two onsite wells that supply raw water to the reverse osmosis/make-up demineralizer system that is used to produce purified water for the plant primary systems (Xcel 2023-TN9084).

2.1.3.1 Circulation and Plant Water Systems

The function of the Monticello circulating water system is to remove heat from the main steam-cooling condenser. The circulating water system consists of two water pumps, each rated 140,000 gpm, mounted over each end of the intake structure connected to the Mississippi River. These pumps are designed to circulate 292,000 gpm of cooling water through the main condenser. The circulating water system operates under several modes based on prevailing river flow, river temperature, status of critical plant equipment, and compliance with State water use permits and National Pollutant Discharge Elimination System (NPDES) permit discharge limits. These modes include: (1) Open Cycle or Once-Through where water is withdrawn from and discharged directly to the Mississippi River, (2) Helper Cycle where two MDCTs are utilized and the cooled water is discharged from the towers to the Mississippi River, (3) Partial Recirculation where two MDCTs are utilized and the cooled water is recirculated to the intake while the remainder is discharged to the Mississippi, and (4) Closed Cycle where two MDCTs are utilized and all cooled water is recirculated to the intake except for cooling tower blowdown, evaporation, and drift.

The two MDCTs, which were replaced in 2021 and 2022, are supplied by pumps operating in series which deliver 151,000 gpm to each tower. The new cooling towers were equipped with drift eliminators. They have historically operated between May and September (when river temperatures exceed 68°F (20°C) and in recent years have operated between 129 to 179 days annually (Xcel 2023-TN9084).

The plant service water system provides strained (free of suspended solids) Mississippi River water to the reactor and turbine building to meet normal startup and shutdown requirements. It consists of three service water pumps each with 6,000 gpm capacity (NRC 2006-TN7315). The plant service water system supplies cooling water for several reactor related operations including the plant main generator, reactor and turbine building air conditioner units, turbine lube oil coolers, reactor building closed cooling water system heat exchangers, and reactor feedwater system pumps (Xcel 2023-TN9084).

Cooling Water Intake and Discharge

The intake structure that captures Mississippi River water used by the circulating water system, the plant service water system, and when needed, the fire protection system consists of an approach channel formed by sheet pile structures that are 98 ft (29.9 m) apart and extend 59 ft (17.9 m) into the river, angled at 81º to the shoreline. At the intake structure, the approach channel reduces to approximately 63 ft (19.2 m) wide. Water enters the intake structure over an approximately 63 ft (19.2 m) wide concrete sill that serves as a sediment barrier. At the center of the sill is a 12.5 ft (3.8 m) wide stop log section that can be removed during low river levels to allow water to flow unobstructed.

On the plant side of the sill is a concrete apron extending the width of the approach channel and 16 ft (4.9 m) upstream of the bar rack. The bar rack includes a motor-operated bar rack rake that both prevents large debris from entering the intake structure and lifts debris into a trash hopper to prevent the debris from re-entering the river. Following the bar rack, the water is divided into two separate streams that flows through two parallel traveling screens located 10 ft (3.05 m) behind the bar racks. The traveling screens have ⅜ in. (0.95 cm) mesh that removes fine debris. The traveling screens are rotated and rinsed every 12 hours when the river temperature is below 50°F (10°C). When the river temperature is above 50°F (10°C), certain game fish populations tend to increase (e.g., smallmouth bass, walleye, and northern pike), and the screens are continuously rotated to avoid fish being held against the screen for extended periods. The debris, as well as any impinged organisms, are rinsed from the traveling screens into a common sluiceway that extends back to the river downstream of the intake structures. From the traveling screens, water passes through the service water pump bay and two parallel motor-operated sluice gates before reaching the circulating water pumps (Xcel 2023-TN9084 and NRC 2006-TN7315)

In terms of discharge from the circulating water and plant service water systems, effluent is piped approximately 600 ft (182.9 m) through two 108 in. (274.3 cm) steel pipes to the discharge structure at the head of the discharge canal. The discharge structure is constructed of reinforced concrete and measures 50 ft by 54 ft by 38 ft (15.2 m by 16.5 m by 11.6 m), with the roof approximately 5 ft (1.5 m) above grade. The discharge structure includes two isolation and two sluice gates. The motor-operated sluice gates can isolate the discharge flow from the discharge canal. During open-cycle operation, the sluice gates are open, and the circulating water is returned to the Mississippi River through the discharge canal. The bottom of the discharge canal was constructed on a 0.25 percent slope in an easterly direction approximately 1000 ft (304.8 m) to where it enters the river. In 1980, an overflow weir was added to allow normal outflow of cooling water from the discharge canal, re-establishing the previously existing shoreline of the river. The weir inhibits fish from entering the canal. The discharge weir consists of an earth filled dike and a vertical sheet-pile overflow section (Xcel 2023-TN9084).

2.1.3.2 Domestic Water System

The domestic water system is an auxiliary system that provides water for drinking and sanitary use as well as supplying untreated water for the plant reverse osmosis/make-up demineralizer system and seal water to pumps located at the plant intake structure. Seven on-site groundwater wells are the source of water for the domestic water system. Two wells, which provide raw water to the demineralizer system and seal water, are each equipped with a 100 gpm capacity pump. These two wells, which are connected at a manifold, and provide raw water to the demineralizer system and seal water. The five other water supply wells provide additional domestic water as needed to a warehouse and site administration building (Xcel 2023-TN9084).

Fire Protection System

The Monticello fire protection system is an auxiliary system that uses the Mississippi River as its water source. In addition to its use in fire protection, this water system can provide water, when needed, to the service water system (administrative building computer room chillers), residual heat removal service water system, and make-up water to the spent fuel pool if additional makeup is needed. It consists of five pumps: a 1,500 gpm diesel-driven vertical centrifugal pump, two 1,500 gpm electrical motor-driven vertical centrifugal pumps (the fire pumps), and a 50 gpm electrical motor-driven horizontal jockey (pressure maintenance) pump. The fire protection system is a standby system during normal plant operations (Xcel 2023-TN9084).

2.1.4 Radioactive Waste Management Systems

The NRC licenses nuclear power plants with the expectation that they will release a limited amount of radioactive material to both the air and water during normal operations. Monticello uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of nuclear power plant operations. Section 2.2.6 of the Xcel Energy ER, submitted as part of its SLR application, provides an expanded description of Monticello’s radioactive waste management systems (Xcel 2023-TN9084: Appendix E, Section 2.2.6, E-2-16 to E-2-24). The NRC staff discusses the radioactive waste management systems in Section 3.13.1, “Radioactive Waste” of this EIS.

2.1.5 Nonradioactive Waste Management Systems

Monticello generates nonradioactive waste as a result of nuclear power plant maintenance, cleaning, and operational processes. Monticello manages nonradioactive wastes in accordance with applicable Federal and State regulations, as implemented through its corporate procedures. Section 2.2.7 of the Xcel Energy ER, submitted as part of its SLR application, provides an expanded description of Monticello’s nonradioactive waste management systems (Xcel 2023-TN9084: Appendix E, Section 2.2.7, E-2-24 to E-2-30). The NRC staff discusses the nonradioactive waste management systems in Section 3.13.2, “Nonradioactive Waste” of this EIS.

2.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at nuclear power plants typically interfaces with public infrastructure systems available in the region. Such infrastructure includes utilities, such as suppliers of electricity, fuel, and water, as well as roads and railroads that provide access to the site. The following sections briefly describe the existing utility and transportation infrastructure at Monticello. Site-specific information in this section is primarily derived from Xcel Energy's ER (Xcel 2023-TN9084), unless otherwise cited.

2.1.6.1 Electricity

Nuclear power plants generate electricity for other users; however, they also use electricity to operate. Offsite power sources provide power to engineered safety features and emergency equipment in the event of a malfunction or interruption of power generation at the nuclear power plant. Planned independent backup power sources provide power, if power from both the nuclear power plant itself and offsite power sources is interrupted.

2.1.6.2 Fuel

Monticello utilizes low-enriched uranium dioxide fuel with enrichments below 5.0 percent by weight uranium-235, with peak fuel-rod burn-up levels less than 62,000 megawatt-days per metric ton uranium (MWd/MTU). Refueling of the reactor is performed every 22 to 24 months with approximately 30 percent of the fuel being replaced during each refueling outage. Monticello stores spent fuel in the spent fuel pool located in the reactor building or in dry cask storage containers at the onsite independent spent fuel storage installation (ISFSI) (Xcel 2023-TN9084).

2.1.6.3 Water

Monticello withdraws Mississippi River water for condenser cooling, service water cooling, screen washing, and fire protection purposes. In addition, Monticello uses groundwater for nuclear power plant potable, sanitary, and everyday water use activities (e.g., drinking, showering, cleaning, doing laundry, operating toilets, and operating eye washes). In this EIS, Section 2.1.3, “Cooling and Auxiliary Water Systems,” describes the Monticello industrial water systems.

2.1.6.4 Transportation Systems

Nuclear power plants are served by controlled access roads that are connected to U.S. highways and Interstate highways. In addition to roads, many nuclear power plants also have railroad connections for moving heavy equipment and other materials. Nuclear power plants located on navigable waters may have facilities to receive and ship loads on barges. Section 3.10.6, “Local Transportation,” describes the Monticello transportation systems.

2.1.6.5 Power Transmission Systems

For LR and SLR actions, the NRC staff evaluates, as part of the proposed action, the continued operation of those Monticello power transmission lines that connect to the substation where it feeds electricity into the regional power distribution system. The transmission lines that are in scope for the Monticello SLR environmental review are onsite and are not accessible to the general public (Xcel 2023-TN9084). The NRC staff also considers, as part of the proposed action, the continued operation of the transmission lines that supply outside power to the nuclear plant from the grid. Section 3.11.4, “Electromagnetic Fields,” describes these transmission lines.

2.1.7 Nuclear Power Plant Operations and Maintenance

Maintenance activities conducted at Monticello include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements (Xcel 2023-TN9084). These activities include in-service inspections of safety-related structures, systems, and components; quality assurance and fire protection programs; and radioactive and nonradioactive water chemistry monitoring.

Additional programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications. Such additional programs include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Certain program activities are performed during the operation of the units, whereas others are performed during scheduled refueling outages (Xcel 2023-TN9084).

2.2 Proposed Action

As stated in Section 1.1, the proposed Federal action is to determine whether to renew the Monticello operating license for an additional 20 years. Section 2.2.1 describes normal nuclear power plant operations during the SLR term.

2.2.1 Nuclear Power Plant Operations during the Subsequent License Renewal Term

Nuclear power plant operation activities during the SLR term would be the same as, or similar to, those occurring during the current license term.

Section 2.1, “Description of Nuclear Power Plant Facility and Operation,” describes the general types of activities carried out during nuclear power plant operations. These include:

- reactor operation
- waste management
- cooling water intake and discharge
- nuclear fuel receipt and storage
- spent fuel storage security
- office and clerical work; possible laboratory analysis
- surveillance, monitoring, and maintenance
- refueling and other outages

As part of its SLR application, Xcel Energy submitted an ER stating that Monticello will continue to operate during the SLR term in the same manner as it would during the current license term except for additional aging management programs, as necessary (Xcel 2023-TN9084). Such programs would address structure and component aging in accordance with 10 CFR Part 54 (TN4878), “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.”

2.2.2 Refurbishment and Other Activities Associated with License Renewal

Refurbishment activities include replacement and repair of major structures, systems, and components. Most major refurbishment activities are actions that would typically take place only once in the life of a nuclear power plant, if at all. For example, reactor vessel head replacement is a refurbishment activity. Refurbishment activities may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the nuclear power plant-specific design.

In preparation for its license renewal application, Xcel Energy evaluated major structures, systems, and components in accordance with 10 CFR 54.21 (TN4878), "Contents of Application—Technical Information," to identify major refurbishment activities necessary for the continued operation of Monticello during the proposed 20-year period of extended operation (Xcel 2023-TN9084).

Xcel Energy did not identify any major refurbishment or replacement activities necessary for the continued operation of Monticello beyond the end of the current renewed operating license period (Xcel 2023-TN9084).

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

NUREG-0586, Supplement 1, Volumes 1 and 2, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors* (the decommissioning GEIS) (NRC 2002-TN665), describes the environmental impacts of decommissioning. The majority of nuclear power plant operation activities would cease with reactor shutdown. Some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management, administrative work, laboratory analysis, surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease. However, if these systems are not removed from the site after reactor shutdown, their physical presence may continue to impact the environment. Impacts associated with dedicated systems that remain in place, or with shared systems that continue to operate at normal capacities, could remain unchanged.

Decommissioning could occur whether Monticello is shut down at the end of its current renewed operating license or at the end of subsequent license renewal period of extended operation 20 years later.

2.3 <u>Alternatives</u>

As stated above, NEPA requires the NRC to consider reasonable alternatives to the proposed action of renewing the Monticello operating license. For a replacement energy alternative to be reasonable, it must be either (1) commercially viable on a utility scale and operational before the reactor's operating license expires or (2) expected to become commercially viable on a utility scale and operational before the reactor's operating license expires.

The first alternative to the proposed action (renewing the Monticello operating license), is for the NRC to not issue the license. This is called the no-action alternative and is described in Section 2.3.1. In addition to the no-action alternative, this section discusses three reasonable replacement energy alternatives. As described in Section 2.3.2, these alternatives would seek to replace Monticello's generating capacity by meeting the region's energy needs through other means or sources.

2.3.1 No-Action Alternative

At some point, all operating nuclear power plants will permanently cease operations and undergo decommissioning. Under the no-action alternative, the NRC would not renew the Monticello operating license, and the reactor unit would shut down at or before the expiration of the current renewed license on September 8, 2030. The NRC staff expects the impacts to be relatively similar, whether they occur at the end of the current renewed license term (i.e., after 60 years of operation) or at the end of a subsequent renewed license term (i.e., after 80 or more years of operation).

After permanent reactor shutdown, nuclear power plant operators will initiate decommissioning in accordance with 10 CFR 50.82, “Termination of License” (TN249). The decommissioning GEIS (NUREG-0586) (NRC 2002-TN665) describes the environmental impacts from decommissioning a nuclear power plant and related activities. The analysis in the decommissioning GEIS bounds the environmental impacts of decommissioning when Xcel Energy terminates reactor operations at Monticello. A licensee in decommissioning must assess in its post-shutdown decommissioning activities report submitted to the NRC, whether there are planned decommissioning activities with reasonably foreseeable environmental impacts that are not bounded in previous EISs. Section 2.2.3, “Termination of Nuclear Power Plant Operations and Decommissioning,” describes the incremental environmental impacts of SLR on decommissioning activities.

Termination of reactor operations would result in the total cessation of electrical power production at Monticello. Unlike the replacement energy alternatives described in Section 2.3.2, the no-action alternative does not meet the purpose and need of the proposed action, as described in Section 2.3.1, because the no-action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the electrical power generated by Monticello, the no-action alternative would likely create a need for replacement energy.

2.3.2 Replacement Power Alternatives

The following sections describe replacement power alternatives. The potential environmental impacts of these alternatives are described in Chapter 3 of this EIS. Although NRC’s authority only extends to deciding whether to renew the Monticello operating license, replacement energy alternatives represent possible options energy planning decisionmakers may need to consider if the Monticello operating license is not renewed. In evaluating replacement power alternatives, the NRC staff considered energy-generating technologies in commercial operation, as well as technologies likely to be commercially available by the time the current Monticello renewed operating license expires. Because energy-generating technologies continually evolve in capability and cost, and because regulatory structures change to either promote or impede the development of certain technologies, this evaluation considered which replacement power alternatives would be available and commercially viable when the Monticello current renewed operating license expires.

The Xcel Energy ER describes possible replacement power alternatives. In addition, information from the following sources were considered in the replacement power analysis:

- Energy Information Administration (EIA)
- other Department of Energy (DOE) offices

- the U.S. Environmental Protection Agency (EPA)
- industry sources and publications

In total, 14 of 17 alternatives were eliminated from detailed study, leaving three replacement power alternatives. The three replacement power alternatives and 14 eliminated alternatives include the following:

- Alternatives to the proposed action:
  - natural gas and renewables
  - renewables and storage
  - new nuclear small modular reactor
- Alternatives eliminated from detailed study:
  - solar power
  - wind power
  - biomass power
  - hydroelectric power
  - geothermal power
  - ocean wave, current, and tide energy
  - municipal solid waste-fired power
  - natural gas-fired power
  - petroleum-fired power
  - coal-fired power
  - fuel cells
  - purchased power
  - delayed retirement of other power-producing facilities
  - demand-side management/energy conservation/energy efficiency

The three replacement power alternatives are described in Sections 2.3.2.1 through 2.3.2.3. As part of its evaluation process to review replacement power alternatives, Xcel Energy established as a criterion the continued generation of approximately 640 MWe net baseload power, which is comparable to Monticello’s current generation of net baseload power. While these replacement alternatives do not directly match the 691 MWe maximum output of Monticello’s current generating capacity, the NRC staff considers them to be reasonably representative replacements for Monticello’s net baseload power for the period beyond Monticello’s current license term, to meet future system generating needs. Therefore, the NRC staff evaluated alternatives using this Xcel Energy criterion. Alternatives that could not provide the equivalent of Monticello’s current baseload generating capacity were eliminated from detailed study, as were alternatives whose costs or benefits could not justify inclusion in the range of reasonable alternatives. Alternatives not likely to be constructed and operational by the time the Monticello operating license expires were also eliminated from detailed study.

To ensure that alternatives are consistent with State or regional energy policies, the NRC staff reviewed energy-related statutes, regulations, and policies within the Monticello region. Accordingly, alternatives that would conflict with these requirements were eliminated from further consideration.

Section 2.4 briefly describes the 14 alternatives eliminated from detailed study and provides the basis for each elimination. Section 2.5 summarizes key characteristics of the replacement energy alternatives. The NRC assigns a significance level of SMALL, MODERATE, or LARGE for most site-specific issues. For ecological resources subject to the ESA (16 U.S.C. 1531 et seq.-TN1010) and the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.-TN7841); and historic and cultural resources subject to the NHPA (54 U.S.C. 300101 et seq.-TN4157), the impact significance determination language is specific to the authorizing legislation. The order in which this EIS presents the different alternatives does not imply increasing or decreasing level of impact; nor does the order imply that an energy planning decisionmaker would be more (or less) likely to select any given alternative.

2.3.2.1 Natural Gas and Renewables

This combination alternative involves the offsite construction and installation of a new 750 megawatt (MW) natural gas-fired, two-unit combustion turbine power plant, offsite installation of 750 MW wind turbines, and 200 MW of solar panels both on and offsite of Monticello (Xcel 2023-TN9084). Additional power generation would be provided by existing natural gas-fired power plants operated by Xcel Energy in the region of influence (ROI), as well as purchased power as needed.

Land Requirements: The natural-gas fired combustion turbine units would be co-located or installed separately at an existing power plant or a greenfield site. Depending on the location and design of the natural gas-fired power plant, cooling towers may or may not be necessary. Minnesota law (MN Stat. 216B-TN9184) requires that each electric utility must generate or procure sufficient energy generated from carbon-free sources to provide 100 percent of electricity from carbon-free energy technologies that is equivalent to the electric utility's total retail electric sales to retail customers in Minnesota by 2040 (MN Stat. 216B-TN9184, 2g). A natural-gas fired combustion turbine unit would not qualify as a carbon-free energy technology, but Xcel Energy may be able to meet the Minnesota carbon-free standard by generating sufficient carbon-free electricity in its service area, procuring carbon-free energy from other utilities, or purchasing renewable energy credits to satisfy the State carbon-free standard. The new natural gas-fired combustion turbine power plant would likely be sited near the area where its power could be sold without the need to purchase renewable energy credits to offset the generation, and therefore would probably not be sited in Minnesota. However, the natural-gas fired combustion turbine power plant could be sited in any of the States within the Xcel Energy service area. Based on the estimated amount of land needed for each combustion turbine unit (Leidos 2016-TN9183) up to 80 acres (ac) (32 hectares [ha]) of land would be needed for the natural gas-fired power plant. In addition, up to 25 mi (40 km) of two new 345 kV transmission lines in a 150 foot (ft) (45.7 meter [m]) wide corridor would be needed to transmit power from each combustion turbine to the electrical grid, or an additional 900 acres (ac) (364 hectares [ha]) of land.

The NRC staff notes that Xcel Energy has proposed to close fossil fuel-fired units to meet its 80 percent carbon reduction goal by 2030, This objective renders it unlikely that it would seek to build new natural gas-fired combustion turbine units. Nonetheless, the NRC staff included natural gas in this combination alternative, recognizing that Xcel Energy's stated goal could change in the future, potentially rendering this combination alternative more reasonable.

Wind energy generating turbines would be installed offsite within Minnesota or elsewhere in the Xcel Energy service area. Using DOE's estimates of land use for wind power projects (85 ac [34 ha] per MW for wind farms, 2.47 ac [1 ha] per MW for the construction footprint, and 0.74 ac [0.3 ha] per MW for permanent structures [DOE 2015-TN8757]), 750 MW of wind power generation would require approximately 66,000 ac (26,709 ha) of land. Xcel Energy estimates up to 150 mi (241 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 2,700 ac (1,093 ha) of land.

Solar panels would be installed at Monticello and Xcel Energy owned sites in the State of Minnesota, or at a location within the Xcel Energy service area. Xcel Energy estimates that the solar component of this alternative would be located at as many as three different project sites. Based on land requirements for a nearby solar facility, Xcel Energy estimates that the solar installations would require 7.6 ac (3 ha) of land per megawatt, or a combined total of approximately 1,500 ac (607 ha) of land for the 200 MW of solar power considered in this alternative. In addition, up to 25 mi (40 km) of one to three new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 1,450 ac (587 ha) of land.

2.3.2.2 Renewables and Storage

This alternative involves the offsite construction and installation of 950 MW of wind turbines, 700 MW of solar panels both on and offsite of Monticello, and 300 MW of offsite lithium-ion battery storage at existing solar facility locations. This alternative also would be supplemented by purchased power as needed, along with occasional and small amounts of additional power generation from existing natural gas-fired power plants operated by Xcel Energy.

Land Requirements: Xcel Energy estimates that solar panels would be installed at as many as three different project sites. Based on land requirements for a nearby solar facility, Xcel Energy estimates that the solar installations would require approximately 7.6 ac (3 ha) of land per megawatt, or a combined total of approximately 5,300 ac (2,145 ha) of land for the 700 MW of solar power considered in this alternative. In addition, up to 25 mi (40 km) of up to 10 new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 4,500 ac (1,821 ha) of land.

Wind energy generating turbines would be installed offsite within Minnesota or in the Xcel Energy service area. Using DOE's estimates of land use for wind power projects (85 ac [34 ha] per MW for wind farms, 2.47 ac [1 ha] per MW for construction footprint, and 0.74 ac [0.3 ha] per MW for permanent structures [DOE 2015-TN8757]), 950 MW of wind power generation would require approximately 84,000 ac (33,994 ha) of land. Xcel Energy estimates up to 150 mi (241 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be necessary to transmit power to the electrical grid, or an additional 2,700 ac (1,093 ha) of land. A small amount of additional land would be needed to support the battery storage system; no additional land would be required for any purchased power or the small amount of natural-gas fired power necessary to supplement the solar and wind generation.

2.3.2.3 New Nuclear (Small Modular Reactor)

Construction of a new small modular reactor (SMR) nuclear power plant would be a reasonable replacement energy alternative to Monticello's SLR. This alternative would involve the construction and installation of a 12 unit NuScale design SMR power plant generating approximately 880 MWe.

The SMR units would use a closed-cycle, MDCT cooling system. Surface water sources would be used at an estimated 740 gallons per megawatt-hour. Total annual water consumption would be approximately 5.7 billion gallons.

Minnesota Statute 216B.243, Subdivision 3b, prohibits the construction and operation of new nuclear power plants in Minnesota (MN Stat. 216B-TN9184). Therefore, the SMR plant would be constructed and installed outside of Minnesota in one of the other seven states in Xcel

Energy's service area, although, to date, there have been no discussions with energy planning decision-makers in these states regarding new nuclear power generation (Xcel 2023-TN9578). The new SMR power plant would be constructed within 25 mi (40 km) of a transmission grid with sufficient surface water to support the power plant cooling and water use.

Land Requirements: Xcel Energy assumes up to 130 ac (53 ha) of land would be needed to support the construction of the SMR power plant, with approximately 30 ac (12 ha) for the power plant footprint. Xcel Energy estimates up to 25 mi (40 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 450 ac (182 ha) of land.

2.4 Alternatives Considered but Eliminated

The NRC staff eliminated 14 alternatives from detailed study due to resource availability and commercial or regulatory limitations. Many of these limitations will likely still exist when the current renewed Monticello operating license expires. This section briefly describes these 14 alternatives as well as the reasons why they were eliminated from detailed study.

2.4.1 Solar Power

Solar power, including photovoltaic and concentrating solar power technologies, generates power from sunlight. Solar photovoltaic components convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam. Steam drives a turbine connected to a generator to produce electricity (NREL Undated-TN7710).

In May 2023, Xcel Energy broke ground on a new 460 MW solar facility north of Monticello on approximately 3,500 ac (1,416 ha) in Sherburne County, on agricultural land currently used for cultivated crops. When completed, the Sherco Solar Project will be the fifth largest solar facility in the nation. Xcel Energy recently proposed building another 250 MW solar farm adjacent to the one under construction, pending approval by State regulators. Combined, the project would total 710 megawatts (Marohn and Becker 2023-TN9857).

While Xcel Energy appears to be committed to the use of solar power to generate electricity, the use of solar power to replace Monticello's generating capacity would require a further commitment of resources to solar, including substantial additional land use. In addition, increased reliance on solar power to replace large amounts of baseload generating power may introduce unnecessary risks, as solar power is subject to intermittent unavailability. Solar generators are considered an intermittent electrical power resource because their availability depends on exposure to the sun, also known as solar insolation. Further, to be viable, a utility-scale solar alternative must replace the amount of electrical power that Monticello currently provides. Assuming a capacity factor of 25 percent (DOE/EIA 2023-TN8821), approximately 2,560 MW of additional solar energy capacity would need to be installed to replace 640 MW of electricity generated by Monticello. Based on Xcel Energy's estimate of 7.6 ac (3 ha) of land per MW, this would require approximately 19,500 ac (7,891 ha) of land.

If the Monticello operating license is not renewed, it is unlikely that Monticello's generating capacity would be replaced by a single type of intermittent electricity generation, including a non-baseload resource such as utility-scale solar. A combination of energy sources, including sources analyzed in Section 2.3.2 such as natural gas, wind, solar, and battery backup, would complement each other and reduce issues such as the intermittency of wind and utility-scale solar.

The impacts of utility-scale solar development are described in the two combination alternatives described in Section 2.3.2. The types of impacts of a standalone solar energy alternative would be similar to these alternatives, although the magnitude of such impacts may differ based on the amount of solar energy capacity to be constructed. Given the intermittency of solar power, a standalone solar alternative was considered but eliminated from detailed analysis. However, a limited amount of solar power generation, in combination with other energy generating technologies, could be a reasonable alternative to Monticello's SLR, as explained in Sections 2.3.2.1 and 2.3.2.2.

2.4.2 Wind Power

As is the case with other renewable energy sources, the feasibility of wind energy providing baseload power depends on the location (relative to electricity users), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is used, and there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources.

The American Clean Power Association reports a total of more than 122,000 MW of installed wind energy capacity nationwide as of December 31, 2020 (DOE Undated-TN8431). To be considered a reasonable replacement energy alternative to Monticello's SLR, a wind power alternative must replace the amount of electrical power that Monticello provides. Assuming a capacity factor of 41.4 percent for onshore wind facilities (Xcel 2023-TN9084), land-based wind energy facilities would need to generate approximately 1546 MW of electricity to replace 640 MWe of Monticello's generating capacity. Using DOE metrics of 0.74 ac/MW for permanent structures, 2.47 ac/MW for construction footprint, and 85 ac/MW for wind farm boundaries, onshore wind farms could require approximately 132,000 total ac (53,419 ha) of land (DOE 2015-TN8757). Additionally, because wind is an intermittent energy source, energy storage would be needed, increasing land requirements.

If the continued Monticello operating license were to be rejected, it is unlikely that Monticello's generating capacity would be replaced by a single type of intermittent electricity generation, including a non-baseload resource such as wind power. A combination of energy sources, including sources analyzed in Section 2.3.2 such as natural gas, wind, solar, and battery backup, would complement each other and reduce issues such as the intermittency of wind generation.

The impacts of utility-scale wind development are described in the two combination alternatives described in Section 2.3.2. The types of impacts of a standalone wind energy alternative would be similar to these alternatives, although the magnitude of such impacts may differ based on the amount of wind energy capacity to be constructed. Given the intermittency of wind power, a standalone wind alternative was considered but eliminated from detailed analysis. However, a limited amount of wind power generation, in combination with other power generating technologies, could be a reasonable alternative to Monticello's SLR, as explained in Sections 2.3.2.1 and 2.3.2.2.

2.4.3 Biomass Power

Biomass resources used for biomass fuel-fired power generation include agricultural residues, animal manure, wood wastes from forestry and industry, residues from food and paper industries, municipal green wastes, dedicated energy crops, and methane from landfills (IEA 2007-TN8436). Using biomass fuel-fired generation for baseload power depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. For this analysis, biomass fuel would be combusted for power generation in the electricity sector.

As of 2022, biomass in Minnesota powered approximately 2 percent of total State electricity, most of that from wood fuel (EIA 2023-TN9786). For utility-scale biomass fuel-fired electricity generation, technologies used for biomass energy conversion would be similar to the technology used in other fossil fuel-fired power plants, including the direct combustion of biomass fuel in a boiler to produce steam (NRC 2013-TN2654). Accordingly, biomass generation is considered a carbon-emitting technology.

Biomass energy generation is generally more cost effective when co-located with coal-fired power plants (IEA 2007-TN8436). However, most biomass fuel-fired power plants generally only reach capacities of 50 MWe, which means replacing Monticello’s generating capacity, using only biomass fuel, would require the construction of 13 new power plants.

Increasing biomass fuel-fired generation capacity by expanding existing or constructing new units by the time Monticello’s current renewed operating license expires is unlikely. For these reasons, biomass fuel-fired generation would not be a reasonable alternative to Monticello’s SLR.

2.4.4 Hydroelectric Power

There are about 2,000 hydroelectric facilities operate in the United States. Hydropower technologies capture flowing water and directs it to turbines and generators to produce electricity (NRC 2013-TN2654). There are three variants of hydroelectric power generation: (1) run of the river (diversion) facilities that redirect the natural flow of a river, stream, or canal through a hydroelectric power facility; (2) store and release facilities that block the flow of the river by using dams that cause water to accumulate in an upstream reservoir; and (3) pumped storage facilities that use electricity from other power sources to pump water to higher elevations during off-peak hours to be released during peak load periods to generate electricity (EIA 2020-TN8352, EIA 2021-TN8353).

Although EIA projects that hydropower will remain a leading source of renewable power generation in the United States through 2040, there is little expected growth in large-scale hydropower capacity (DOE/EIA 2013-TN2590). The potential construction of large new hydropower facilities has diminished because of public concern over flooding, habitat alteration and loss, and the impact on natural rivers (NRC 2013-TN2654).

Given the projected lack of growth in hydroelectric power, the competing demands for water resources, and public opposition to the environmental impacts from the construction of large hydroelectric power facilities, the use of hydroelectric power would not be a reasonable alternative to Monticello’s SLR.

2.4.5 Geothermal Power

Geothermal technologies extract heat from geologic formations to produce steam to drive steam turbine generators. Electricity production from geothermal energy have demonstrated 95 percent or greater capacity factors, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal power generation to provide baseload power depends on the regional quality and accessibility of geothermal resources.

Utility-scale power generation requires geothermal reservoirs with a temperature above 200°F (93°C). Such utility-scale geothermal resources are concentrated in the western United States, specifically Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming and most assessments of geothermal power generation resources have been conducted in these States (DOE Undated-TN7698; USGS 2008-TN7697). There is currently no utility-scale geothermal power production in the region. Given its low potential, geothermal power generation would not be a reasonable alternative to Monticello's SLR.

2.4.6 Wave and Ocean Energy

Ocean waves, currents, and tides are generally predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies can be used to harness wave energy: (1) terminator devices that range from 500 kilowatts (kW) to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM Undated-TN7696). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving generators to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves enter a tube and compress air that is then used to drive a generator producing electricity (NRC 2013-TN2654). Some of these technologies are undergoing demonstration testing at commercial scales, but none are currently used to provide baseload power (BOEM Undated-TN7696). In the United States, there are currently several projects licensed or seeking permits, the largest of which is 20 MW (Duke Energy 2021-TN8897).

While Minnesota borders Lake Superior and contains many thousands of smaller lakes, application of wave energy technologies probably would not be viable, as wave and ocean energy-generation technologies are still in their infancy and currently lack commercial application (EPRI 2011-TN8442). For these reasons, wave and ocean energy power generation would not be a reasonable alternative to Monticello's SLR.

2.4.7 Municipal Solid Waste-Fired Power

Energy recovery from municipal solid waste converts nonrecyclable waste materials into usable heat, electricity, or fuel through combustion. Three types of municipal solid waste combustion technologies include mass burning, modular systems, and refuse derived fuel systems. Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is then used to drive turbine generators to produce electricity. Ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2023-TN8443).

Currently, 75 waste-to-energy power plants are in operation in 21 States, processing approximately 29 million tons (26,308 kg) of waste per year. These waste-to-energy power plants have an aggregate capacity of 2,725 MWe (Michaels and Krishnan 2019-TN7700). Although some power plants have expanded to handle additional waste and to produce more energy, only one new municipal solid waste combustion power plant has been built in the United States since 1995 (Maize 2019-TN7699). The average waste-to-energy power plant produces about 50 MWe, which is a very small fraction of the energy produced by Monticello.

The decision to burn municipal solid waste to generate electricity is usually driven by the need for a waste disposal alternative to landfills, rather than a need to generate energy. Stable supplies of municipal solid waste would be needed to support new waste-to-energy power plants in the region. Based on this information, municipal solid waste-to-energy power plants would not be a reasonable alternative to Monticello's SLR.

2.4.8 Natural Gas-Fired Power

While a natural gas-fired combustion turbine was considered along with renewables as a reasonable replacement power alternative, it was eliminated as a utility-scale standalone replacement power alternative. Factors include Xcel Energy's proposal to close fossil fuel-fired units to meet its 80 percent carbon reduction goal by 2030 and stakeholder opposition (Xcel 2023-TN9578). Furthermore, a standalone natural-gas fired power plant would hinder Xcel Energy's ability to comply with the Minnesota Carbon-free standard which requires Xcel Energy to generate, procure sufficient electricity generated from carbon-free energy technology to provide 100 percent of the electric utility's total retail electric sales to retail customers in Minnesota by 2040, or purchase sufficient renewable energy credits to comply with this carbon-free standard.

Based on this information, utility-scale natural gas-fired power generation would not be a reasonable alternative to Monticello's SLR. However, natural gas-fired power generation, in combination with other carbon-free energy generating technologies, could be a reasonable alternative to Monticello's SLR, as explained in Section 2.3.2.1.

2.4.9 Petroleum-Fired Power

The variable costs and environmental impacts of petroleum-fired electrical power generation tend to be greater than those of natural gas-fired generation. The historically higher cost of oil also has resulted in a steady decline in its use for electricity generation, and the EIA forecasts no growth in capacity using petroleum-fired power plants through 2040 (DOE/EIA 2013-TN2590, DOE/EIA 2015-TN4585).

As stated in its ER, Xcel Energy is proposing to close fossil fuel-fired units to meet its 80 percent carbon reduction goal by 2030. Therefore, based on this information, petroleum-fired electricity generation would not be a reasonable alternative to Monticello's SLR.

2.4.10 Coal-Fired Power

Although coal has historically been the largest source of electricity in the United States, both natural gas generation and nuclear energy generation surpassed coal generation at the national level in 2020. Coal-fired electricity generation in the United States has continued to decrease as coal-fired units have been retired or converted to use other fuels and as the remaining units have been used less often (DOE/EIA 2021-TN7718).

Baseload coal-fired power units have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the available technologies, pulverized-coal boilers producing supercritical steam (supercritical pulverized-coal boilers) have become increasingly common, given their generally high thermal efficiencies and overall reliability.

Supercritical pulverized-coal facilities are more expensive to build than subcritical coal-fired power plants but consume less fuel per unit output. Integrated gasification combined cycle combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is cleaner than conventional pulverized-coal plants because some of the major pollutants are removed before combustion. Although several smaller, integrated gasification combined-cycle power plants have been in operation since the mid-1990s, large scale projects have experienced setbacks, and public opposition has hindered it from being fully integrated into the energy market.

As stated in its ER, Xcel Energy is proposing to close fossil fuel-fired units to meet its 80 percent carbon reduction goal by 2030. Based on these considerations, coal-fired power plants would not be a reasonable alternative to Monticello's SLR.

2.4.11 Fuel Cells

Fuel cells oxidize fuels without combustion and, therefore, without the environmental side effects of combustion. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts are heat, water, and carbon dioxide (depending on the hydrogen fuel type) (DOE Undated-TN7695). Hydrogen fuel can come from a variety of hydrocarbon resources, including natural gas. As of October 2020, the United States had only 250 MW of fuel cell power generation capacity (EIA 2022-TN8955).

Currently, fuel cells are not economically or technologically competitive with other electricity generating alternatives. The EIA estimates that fuel cells may cost $6,639 per installed kilowatt (total overnight capital costs in 2021 dollars), which is high compared to other replacement energy alternatives (DOE/EIA 2022-TN7694. In June 2021, DOE launched an initiative to reduce the cost of hydrogen production to spur fuel cell and energy storage development over the next decade (DOE 2021-TN7693). However, it is unclear whether or to what degree this initiative will lead to increased future development and deployment of fuel cell technologies.

More importantly, fuel cell units used for power production are likely to be small (approximately 10 MW). The world's largest industrial hydrogen fuel cell power plant is a 50 MWe plant in South Korea (Larson 2020-TN8401). Using fuel cells to replace the power that Monticello provides would require the construction of approximately 64 units. Given the limited deployment and high cost of fuel cell technology, fuel cells would not be a reasonable alternative to Monticello's SLR.

2.4.12 Purchased Power

Power may be purchased and imported from outside the region. Although purchased power would likely have little or no measurable impact, environmental impacts could occur where the power is being generated, depending on the technologies used to generate the power.

Purchased power is generally economically adverse because, historically, the cost of generating power has been less than the cost of purchasing the same amount of power from a third-party supplier (NRC 2013-TN2654). Purchased power agreements also carry the inherent risk that the supplier may not be able to deliver all the contracted power. Based on these considerations, purchased power would not provide a reasonable alternative to Monticello's SLR.

2.4.13 Delayed Retirement of Other Generating Facilities

Delaying the retirement of a power plant enables it to continue supplying electricity. Because some power generators are required to adhere to regulations requiring significant reductions in power plant emissions, some owners may opt to retire older, less efficient units rather than incur the cost for compliance. Retirements also may be driven by low competing commodity prices (such as low natural gas prices), slow growth in electricity demand, and EPA Mercury and Air Toxics Standards for fossil-fueled power plants (DOE/EIA 2015-TN4585; EPA 2020-TN8379).

Xcel Energy has an 80 percent carbon reduction goal by 2030 and has, therefore, proposed to close all coal-fired plants in its service area. Continuing to operate these coal-fired plants would result in increased air quality impacts. Because of these conditions, delayed retirement of older power generating units would not provide a reasonable alternative to the Monticello SLR.

2.4.14 Demand-Side Management

Demand-side management refers to energy conservation and efficiency programs that do not require the addition of new generating capacity. Demand-side management programs can include reducing energy demand through consumer behavioral changes or through altering the characteristics of the electrical load. These programs can be initiated by a utility, transmission operators, the State, or other load serving entities. In general, residential electricity consumers have been responsible for the majority of peak load reductions, and participation in most demand-side management programs is voluntary (NRC 2013-TN2654).

The existence of a demand-side management program does not guarantee that reductions in electricity demand will occur. The LR GEIS concludes that, although the energy conservation or energy efficiency potential in the United States is substantial, there have been no cases in which an energy efficiency or conservation program alone has been implemented expressly to replace or offset a large baseload generation station (NRC 2013-TN2654). Therefore, demand-side management programs alone would not be a reasonable alternative to the Monticello SLR. However, in combination with other power generating technologies, demand-side management could be a reasonable alternative to Monticello's SLR.

2.5 Comparison of Alternatives

This chapter presents the following three alternatives to the proposed action (Monticello's SLR): (1) natural gas and renewables, (2) renewables and storage, and (3) new nuclear (SMR). Chapter 3 describes the environmental impacts of the proposed action and the alternatives. Table 2-1 summarizes the environmental impacts of the proposed action (Xcel 2023-TN9084) and the alternatives to SLR considered in this EIS.

As discussed in detail in Chapter 3 of this EIS, the environmental impacts of the proposed action (subsequent renewal of the Monticello operating license) would be SMALL for all impact categories except groundwater resources has a SMALL to MODERATE impact. In comparison, each of the three replacement power alternatives has environmental impacts that are greater than the environmental impacts of the proposed subsequent license renewal action. In addition, the replacement energy alternatives would also result in construction impacts. If the NRC does not renew the Monticello operating license (no-action alternative), energy planning decision-makers would have to choose a replacement power alternative like the ones evaluated in this EIS. Based on the review of the replacement energy alternatives, the no-action alternative, and the proposed action, the NRC staff concludes that the environmentally preferred alternative is the proposed SLR action. Therefore, as discussed in Chapter 4 of this EIS, the NRC staff's preliminary recommendation is to renew the Monticello operating license.

1 **Table 2-1 Summary of Environmental Impacts of the Proposed Action and Alternatives**

Impact Area (Resource)	Monticello Subsequent License Renewal (Proposed Action)	No-Action Alternative	Natural Gas and Renewables Alternative	Renewables and Storage Alternative	New Nuclear Alternative (Small Modular Reactor) Alternative
Land Use	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE
Visual Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Air Quality	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL
Noise	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Geologic Environment	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Surface Water Resources	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Groundwater Resources	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL to MODERATE
Terrestrial Resources	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE
Aquatic Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Special Status Species and Habitats	SEE NOTE[(a)]	SEE NOTE[(b)]	SEE NOTE[(c)]	SEE NOTE[(c)]	SEE NOTE[(d)]
Historic and Cultural Resources	SEE NOTE[(e)]	SEE NOTE [(f)]	SEE NOTE[(g)]	SEE NOTE[(g)]	SEE NOTE[(g)]
Socioeconomics	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE
Transportation	SMALL	SMALL	SMALL	SMALL	MODERATE to LARGE
Human Health	SMALL[(h)]	SMALL[(h)]	SMALL[(h)]	SMALL[(h)]	SMALL[(h)]
Environmental Justice	SEE NOTE[(i)]	SEE NOTE[(j)]	SEE NOTE[(k)]	SEE NOTE[(k)]	SEE NOTE[(k)]
Waste Management	SMALL[(l)]	SMALL[(l)]	SMALL[(l)]	SMALL[(l)]	SMALL[(l)]

(a) May affect but is not likely to adversely affect northern long-eared bat, tricolored bat, whooping crane, and monarch butterfly. No effect on designated critical habitats or essential fish habitat (EFH) or sanctuary resources of National Marine Sanctuaries, because they do not occur within the action area.

(b) Overall, the effects on federally listed species would likely be smaller under the no action alternative than the effects under continued operation but would depend on the specific shutdown activities as well as the listed species present when the no-action alternative is implemented. No effect on designated critical habitats or EFH, because they do not occur within the action area.

Table 2-1 Summary of Environmental Impacts of the Proposed Action and Alternatives (Continued)

Impact Area (Resource)	Monticello Subsequent License Renewal (Proposed Action)	No-Action Alternative	Natural Gas and Renewables Alternative	Renewables and Storage Alternative	New Nuclear Alternative (Small Modular Reactor) Alternative

(c) The types and magnitudes of adverse impacts to species listed in the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.; TN1010), designated critical habitat, and EFH would depend on the proposed alternative site, as well as listed species and habitats present when the alternative is implemented. Therefore, the NRC staff cannot forecast a level of impact for this alternative.

(d) The types and magnitudes of adverse impacts to species listed in the ESA, as amended (16 U.S.C. 1531 et seq.; TN1010), designated critical habitat, and EFH would depend on the proposed alternative site, nuclear power plant design and operation, as well as listed species and habitats present when the alternative is implemented. Therefore, the NRC staff cannot forecast a level of impact for this alternative.

(e) Based on (1) the fact that Xcel Energy does not plan to alter operations, expand existing facilities, or disturb additional land during the subsequent license renewal period, (2) input from consulting parties, and (3) Xcel Energy's updates to procedures to identify, protect, and minimize the potential impact to cultural resources at Monticello, subsequent license renewal would not adversely affect historic properties or historic and cultural resources.

(f) No immediate effect on historic properties or historic and cultural resources.

(g) The potential for impacts on historic and cultural resources from construction and operation of the alternative would vary greatly depending on site locations and resources present.

(h) The chronic effects of electromagnetic fields on human health associated with operating nuclear power and other electricity generating plants are uncertain.

(i) Disproportionate and adverse human health and environmental effects to minority and low-income populations are not expected.

(j) Not renewing the operating licenses and terminating reactor operations could have a noticeable impact on socioeconomic conditions in communities near Monticello, and a reduction in tax revenue resulting from nuclear power plant shutdown could decrease the availability of public services. Minority and low-income populations dependent on these services could be disproportionately affected.

(k) The NRC staff identified common impacts from the construction and operation of replacement power facilities that could disproportionately affect minority and low-income populations. Construction and operations of replacement power alternatives would not likely have disproportionate or adverse human health and environmental effects on minority and low-income populations. However, this determination would depend on site location, nuclear power plant design, operational characteristics of the new facility, unique consumption practices and interactions with the environment of nearby populations, and the location of predominantly minority and low-income populations.

(l) NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (NRC 2014-TN4117), discusses the environmental impacts of spent fuel storage for the time frame beyond the licensed life for reactor operations.

3 AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES, AND MITIGATING ACTIONS

3.1 Introduction

In conducting its review of the environmental effects of renewing the Monticello operating license, the NRC staff describes the environment that could be affected by the proposed action (renewing the operating license authorizing an additional 20 years of reactor operation). The NRC staff also evaluates the environmental consequences of the proposed action as well as reasonable alternatives to the proposed action.

In this chapter, the affected environment is the environment that currently exists at and around the Monticello site. Because existing conditions are at least partially the result of past construction and nuclear power plant operations, this chapter considers the nature and impacts of past and ongoing operations and evaluates how, together, these actions have shaped the current environment. This chapter also describes reasonably foreseeable environmental trends. The effects of ongoing reactor operations at the site have become well established as environmental conditions have adjusted to the presence of the facility.[1]

Sections 3.2 through 3.13 describe the affected environment for each resource area, followed by the NRC staff's evaluation of the environmental consequences of the proposed action and alternatives to the proposed action. The NRC staff compares the environmental impacts of license renewal (LR) with those of the no-action alternative and replacement power alternatives to determine whether the adverse environmental impacts of LR are so great that it would be unreasonable to preserve the option for energy-planning decision-makers.

The evaluation of environmental consequences includes the following:

- impacts associated with continued operations during the period of extended operations
- impacts of the reasonable power replacement alternatives to the proposed action and the no-action alternative (not issuing the renewed licenses)
- impacts common to all alternatives: (1) fuel cycle including uranium fuel cycle, (2) terminating power plant operations and decommissioning, and (3) greenhouse gas emissions and climate change
- impacts associated with the uranium fuel cycle
- impacts of postulated accidents (design-basis accidents and severe accidents)
- cumulative impacts of the proposed action
- resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources
- new and potentially significant information about environmental issues related to the impacts of operation during the renewal term.

[1] Where appropriate, the NRC staff has summarized referenced information (incorporated information by reference) in this EIS. This allows the staff to focus on new and potentially significant information identified since the initial Monticello EIS was issued in 1990.

As stated in Section 1.4 the NRC staff evaluated environmental issues applicable to Monticello's SLR. Table 3-1 lists the Monticello SLR environmental issues and the impact findings related to these issues. This EIS considers the environmental impacts of each license renewal issue on a site-specific basis. Section 1.4 provides the definitions of SMALL, MODERATE, and LARGE impact significance.

Table 3-1 Summary of Site-Specific Conclusions Regarding Monticello Subsequent License Renewal

Resource Area	Environmental Issue	Impacts
Land Use	Onsite land use[(a)]	SMALL
Land Use	Offsite land use[(a)]	SMALL
Land Use	Offsite land use in transmission line right-of-ways (ROWs)[(a)]	SMALL
Visual Resources	Aesthetic impacts[(a)]	SMALL
Air Quality	Air quality impacts (all plants)[(a)]	SMALL
Air Quality	Air quality effects of transmission lines[(a)]	SMALL
Noise	Noise impacts[(a)]	SMALL
Geologic Environment	Geology and soils[(a)]	SMALL
Surface Water Resources	Surface water use and quality (non-cooling system impacts)[(a)]	SMALL
Surface Water Resources	Altered current patterns at intake and discharge structures[(a)]	SMALL
Surface Water Resources	Scouring caused by discharged cooling water[(a)]	SMALL
Surface Water Resources	Discharge of metals in cooling system effluent[(a)]	SMALL
Surface Water Resources	Discharge of biocides, sanitary wastes, and minor chemical spills[(a)]	SMALL
Surface Water Resources	Surface water use conflicts (plants with once-through cooling systems)[(a)]	SMALL
Surface Water Resources	Effects of dredging on surface water quality[(a)]	SMALL
Surface Water Resources	Temperature effects on sediment transport capacity[(a)]	SMALL
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)[(a)]	SMALL
Groundwater Resources	Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	SMALL
Groundwater Resources	Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	SMALL
Groundwater Resources	Radionuclides released to groundwater	SMALL to MODERATE
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides[(a)]	SMALL
Terrestrial Resources	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)[(a)]	SMALL

Table 3-1 Summary of Site-Specific Conclusions Regarding Monticello Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Terrestrial Resources	Cooling tower impacts on vegetation (plants with cooling towers)[(a)]	SMALL
Terrestrial Resources	Bird collisions with plant structures and transmission lines[(a)]	SMALL
Terrestrial Resources	Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL
Terrestrial Resources	Transmission line right-of-way (ROW) management impacts on terrestrial resources[(a)]	SMALL
Terrestrial Resources	Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)[(a)]	SMALL
Aquatic Resources	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)[(a)]	SMALL
Aquatic Resources	Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
Aquatic Resources	Infrequently reported thermal impacts (all plants)[(a)]	SMALL
Aquatic Resources	Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication[(a)]	SMALL
Aquatic Resources	Effects of nonradiological contaminants on aquatic organisms[(a)]	SMALL
Aquatic Resources	Exposure of aquatic organisms to radionuclides[(a)]	SMALL
Aquatic Resources	Effects of dredging on aquatic organisms[(a)]	SMALL
Aquatic Resources	Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL
Aquatic Resources	Effects on aquatic resources (non-cooling system impacts)[(a)]	SMALL
Aquatic Resources	Impacts of transmission line right-of-way (ROW) management on aquatic resources[(a)]	SMALL
Aquatic Resources	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses[(a)]	SMALL
Special Status Species and Habitats	Threatened, endangered, and protected species and essential fish habitat	May affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, whooping crane, and monarch butterfly; no effect on essential fish habitat; no effect on sanctuary resources of National Marine Sanctuaries

Table 3-1 Summary of Site-Specific Conclusions Regarding Monticello Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Historic and Cultural Resources	Historic and cultural resources	Would not adversely affect known historic properties or historic and cultural resources
Socioeconomics	Employment and income, recreation, and tourism[a]	SMALL
Socioeconomics	Tax revenues[a]	SMALL
Socioeconomics	Community services and education[a]	SMALL
Socioeconomics	Population and housing[a]	SMALL
Socioeconomics	Transportation[a]	SMALL
Human Health	Radiation exposures to the public[a]	SMALL
Human Health	Radiation exposures to plant workers[a]	SMALL
Human Health	Human health impact from chemicals[a]	SMALL
Human Health	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	SMALL
Human Health	Microbiological hazards to plant workers[a]	SMALL
Human Health	Chronic effects of electromagnetic fields (EMFs)	Uncertain impact
Human Health	Physical occupational hazards[a]	SMALL
Human Health	Electric shock hazards	SMALL
Postulated Accidents	Design-basis accidents[a]	SMALL
Postulated Accidents	Severe accidents	See EIS Appendix F
Environmental Justice	Minority and low-income populations	No disproportionate and adverse human health and environmental effects on minority and low-income populations
Waste Management	Low-level waste storage and disposal[a]	SMALL
Waste Management	Onsite storage of spent nuclear fuel[a]	SMALL
Waste Management	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal[a]	[b]
Waste Management	Mixed-waste storage and disposal[a]	SMALL
Waste Management	Nonradioactive waste storage and disposal[a]	SMALL
Cumulative Impacts	Cumulative impacts	See EIS Section 3.15
Uranium Fuel Cycle	Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste[a]	SMALL
Uranium Fuel Cycle	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste[a]	[c]
Uranium Fuel Cycle	Nonradiological impacts of the uranium fuel cycle[a]	SMALL
Uranium Fuel Cycle	Transportation[a]	SMALL

Table 3-1 Summary of Site-Specific Conclusions Regarding Monticello Subsequent License Renewal (Continued)

Resource Area	Environmental Issue	Impacts
Termination of Nuclear Power Plant Operations and Decommissioning	Termination of plant operations and decommissioning[(a)]	SMALL

EIS = environmental impact statement; EMF = electromagnetic fields; gpm = gallon(s) per minute; gps = gallon(s) per minute; ROW = right-of-way; SAMA = severe accident mitigation alternatives.

(a) Dispositioned as generic (Category 1) for initial license renewal of nuclear power plants in Table B–1 in Appendix B to Subpart A of Title 10 CFR Part 51 (TN250).

(b) The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants and does not warrant a site-specific analysis.

(c) 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. As stated in the 2013 LR GEIS, “The Commission concludes that these impacts 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 (TN4878) should be eliminated” (10 CFR Part 54-TN4878) (Section 3.13.3.3 of this EIS).

3.2 Land Use and Visual Resources

This section describes land use and visual resources in the vicinity of the Monticello site as well as the potential impacts from the proposed action of SLR and alternatives to the proposed action. Section E3.2 of Xcel Energy’s ER (Xcel 2023-TN9084) describes current Monticello onsite and offsite land use conditions as well as visual resources.

3.2.1 Land Use

The Monticello site is located in central Minnesota on approximately 2,000 ac (809 ha) divided by the Mississippi River. The part of the site on the south bank of the river lies in Wright County, Minnesota and the part of the site on the north bank lies in Sherburne County, Minnesota. The nearest community is the city of Monticello, Minnesota, which according to the 2020 census has a population of 14,455. Both Sherburne and Wright Counties lie within the Minneapolis-St. Paul-Bloomington metropolitan statistical area.

The sections below describe onsite and offsite land use within a 6 mi (10 km) radius and also describe the Minnesota coastal zone and the regulations that govern its use.

3.2.1.1 Onsite Land Use

Although the Monticello site occupies approximately 2,000 ac (809 ha), the nuclear power plant structures occupy only about 50 ac (20 ha) of the site and is entirely located within the city limits of Monticello, Minnesota. Much of the 2,000 ac (809 ha) Monticello site is undeveloped, but portions are leased for agricultural and recreational use. As shown in Table 3-2, the predominant land cover at the Monticello site is deciduous forest (35 percent), cultivated cropland (18 percent), pasture (13 percent), and open water (14 percent). Approximately 10.6 percent of the site is developed for industrial power plant use.

Table 3-2 Land Use/Land Cover, Monticello Nuclear Generating Plant Site

Category	Acres	Percentage
Open Water	284.4	13.9
Developed, Open Space	25.8	1.3
Developed, Low Intensity	58.9	2.9
Developed, Medium Intensity	77.4	3.8
Developed, High Intensity	54.3	2.6
Deciduous Forest	714.8	34.9
Evergreen Forest	16.9	0.8
Mixed Forest	2.7	0.1
Shrub/Scrub	8.2	0.4
Grassland/Herbaceous	32	1.6
Pasture/Hay	266	13
Cultivated Crops	373.6	18.2
Woody Wetlands	90.3	4.4
Emergent Herbaceous Wetlands	45.6	2.2
Total	**2,050.9**	**100**

Source: Xcel 2023-TN9084.

The City of Monticello has zoned the Monticello site as a “heavy industrial district (I-2)” for heavy industry and manufacturing away from residential or commercial land use. Access to the Monticello site is on County Road 75 NE, which runs parallel to Interstate 94 through the City of Monticello. The Monticello site also is served by a Burlington Northern Santa Fe railroad track spur that connects approximately 2,000 ft (610 m) south of the site. Although the site is located on the banks of the Mississippi River, the nearest navigable port is in Minneapolis, which is approximately 40 mi (64 km) to the southeast.

3.2.1.2 Coastal Zone

Section 307(c)(3)(A) of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)(3)(A)) (TN1243) requires that applicants for Federal licenses who conduct activities in a coastal zone provide a certification to the licensing agency (in this case the NRC) that the proposed activity complies with the enforceable policies of the State’s coastal zone program. The Federal regulations that implement the Coastal Zone Management Act indicate that this requirement is applicable to renewal of Federal licenses for actions not previously reviewed by the State (15 CFR 930.51(b)(1)) (TN4475).

The State of Minnesota’s Lake Superior Coastal Program was established in 1999 and comprises the counties in Minnesota’s Coastal Zone Management Program. It touches 189 mi (304 km) of shoreline along Minnesota’s north shore of Lake Superior and includes 31 local government units. Wright and Sherburne counties (which include the Monticello site are not within this area, and therefore, the Coastal Zone Management Act does not apply to the Monticello site or this SLR application.

3.2.1.3 Offsite Land Use

The Monticello site is in Wright and Sherburne counties, Minnesota. The predominant land covers within the 6 mi (9.7 km) radius of Monticello are cultivated crops (35 percent), deciduous forest (15 percent), pasture/hay (13 percent), wetlands (9 percent), and open water (6 percent) (NRC 2023-TN9084).

Wright County is approximately 423,000 ac (171,182 ha), of which 240,651 ac (97,388 ha) (57 percent) is farmland. Sherburne County is approximately 277,000 ac (112,097 ha), of which 102,544 ac (41498 ha) (37 percent) is farmland. Wright County has a total of 1,338 farms and Sherburne County has a total of 501 farms. Agricultural uses of farmland in these two counties include crop production, pastures, and rangeland for livestock.

Wright and Sherburne Counties, along with the City of Monticello, have comprehensive land use plans establishing "standards, regulations, and goals for future land development." The City of Monticello Comprehensive Plan was adopted on November 23, 2020, with a focus on providing a 20-year strategic land use approach. The Comprehensive Plan designates Monticello as a "special facility and land use with unique operational characteristics warranting a special designation for long-term planning purpose." This designation "is intended to safeguard the operation of the facility so that it continues to provide essential utility services that contribute to the local and regional economies." Wright County's comprehensive land use plan was adopted in 1988, and was updated by designating three different geographic areas within the county (Wright County Undated-TN9692). The Monticello site is located within the northeast quadrant of Wright County. The Northeast Quadrant adopted its own quadrant specific land use plan in 2007 (Wright County Office of Planning and Zoning 2007-TN9693). A primary focus of this land use plan includes urbanization, with substantial population growth. Sherburne County's latest comprehensive land use plan was adopted in 2011. A primary focus of the Sherburne County comprehensive plan includes growth management to promote development while preserving natural and agricultural resources.

In May 2023, Xcel Energy broke ground on a new 460 MW solar facility north of Monticello on approximately 3,500 ac (1,416 ha) in Sherburne County, on agricultural land currently used for cultivated crops. When completed, the Sherco Solar Project will be the fifth largest solar facility in the nation. Building the facility will create 900 temporary construction jobs.

3.2.2 Visual Resources

As noted in Section 3.2.1, the 2,000 ac (809 ha) Monticello site is located on the Mississippi River in central Minnesota. Visual features include the reactor, turbine, radiological waste building, and emergency diesel generator buildings; off-gas stack, MDCTs and the associated water vapor plume, and transmission lines. The tallest structure is the 328 ft (100 m) high off-gas stack. As only portions of the plant structures are visible from surrounding areas such as I-94, service roads, and the Mississippi River, the visual impacts of the Monticello site are minimal.

3.2.3 Proposed Action

The following sections address the site-specific environmental impacts of the Monticello SLR on environmental issues related to land use and visual resources.

3.2.3.1 Onsite Land Use

Operational activities during the SLR term would be similar to those already occurring at Monticello. Industrial land use conditions would continue unchanged. However, Xcel Energy has stated in its ER that Monticello will run out of dry storage capacity in 2030, therefore Xcel Energy must expand the dry storage capacity by constructing a second pad in the fenced ISFSI area to store spent nuclear fuel generated during SLR term. No new land would be needed or disturbed outside of the fenced ISFSI area for construction of the second pad

(Xcel 2023-TN9084). If the ISFSI pad needs to be expanded, previously disturbed land near the ISFSI is likely to be sufficient for the expansion with no significant environmental impact. Based on this information, the NRC staff concludes that the impact of continued nuclear power plant operations on onsite land use during the Monticello SLR term would be SMALL. In addition, the NRC staff did not identify any new onsite land use information that would alter this conclusion.

3.2.3.2 Offsite Land Use

License renewal and subsequent license renewal activities have little to no effect on offsite land use in communities near nuclear power plants. Operational activities during the SLR term, including periodic nuclear refueling outages requiring temporary staff, would be similar to those already occurring at the plant and would not affect offsite land use beyond what has already been affected. Based on this information, the NRC staff concludes that the impact of continued nuclear power plant operations on offsite land use during the Monticello SLR term would be SMALL. In addition, the NRC staff did not identify any new offsite land use information that would alter this conclusion.

3.2.3.3 Offsite Land Use in Transmission Line Right-of-Ways

Maintenance activities in transmission line rights-of-way (ROWs) during the subsequent license renewal term would be the same as or similar to those already occurring and would not affect offsite land use beyond what has already been affected. Transmission line ROWs do not preclude the use of the land for other purposes, such as agriculture and recreation. However, land use is limited to activities that do not endanger power line operation.

Based on this information, the NRC staff concludes that the impact of continued nuclear power plant operations during the Monticello SLR term on offsite land use in transmission line ROWs would be SMALL. In addition, the NRC staff did not identify any new land use information that would alter this conclusion.

3.2.3.4 Visual Resources

The visual appearance of the Monticello nuclear power plant structures and associated transmission lies has become well established over the plant’s operating history and is not likely to change during the SLR term. The NRC staff concludes that the visual impact of continued nuclear power plant operations at Monticello during the SLR term would be SMALL because the visual appearance of nuclear power plant structures, transmission lines, and vapor plume from the cooling towers will not change appreciably. In addition, the NRC staff did not identify any new information during the environmental review that would alter this conclusion.

3.2.4 No-Action Alternative

3.2.4.1 Land Use

Under the no-action alternative, the NRC would not issue a renewed Monticello operating license, and reactor power generating operations would cease on or before the expiration of the current renewed license. However, maintenance activities (e.g., maintaining, inspecting, and testing plant equipment) would continue before and after the expiration of the license. Decommissioning activities would begin after the expiration of the license. Under this alternative, onsite land use would remain similar to onsite land use under the proposed SLR.

Plant structures and other facilities would remain in place until decommissioning. Transmission lines and ROWs would remain in place after the cessation of reactor operations.

Shutdown of Monticello would not affect land use. Based on this information, the NRC staff concludes that land use impacts under the no-action alternative would be SMALL.

3.2.4.2 Visual Resources

Termination of reactor operations because the operating license is not renewed under the no-action alternative would not immediately change the visual appearance of the Monticello site. The most visible structures are the reactor containment and other buildings, and they would likely remain in place for some time during decommissioning until they are eventually dismantled. There would be no further operational impacts such as the vapor plumes associated with the cooling towers. As a result, the NRC staff concludes that the visual impacts from the no-action alternative would be SMALL.

3.2.5 Replacement Power Alternatives: Common Impacts

3.2.5.1 Land Use

Land use impacts are determined by the change in use and the amount of land affected by the construction and operation of a replacement power generating facility, infrastructure, and other installations. Table 3-3 summarizes land use impacts of replacement power alternatives. In addition, Minnesota Statute 216B.243, Subdivision 3b (TN9184), prohibits the construction and operation of new nuclear power plants in Minnesota. This means that new nuclear alternatives cannot be located on the Monticello site or in the State of Minnesota.

Table 3-3 Land Use Impacts of Replacement Power Alternatives

Alternative	Resource Requirements	Impacts	Discussion
Natural Gas and Renewables	Up to 80 ac (32.4 ha) for natural gas-fired power units. In addition, up to 25 mi (40.2 km) of two new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power from each combustion turbine unit to the electrical grid, or an additional 900 ac (364.2 ha).	MODERATE to LARGE	Natural gas-fired combustion turbine units could be co-located or installed separately at existing power plant or greenfield sites. The natural gas-fired combustion turbine power plant could be constructed onsite or offsite in the ROI for the Xcel Energy service area. Based on an estimate of 20-40 ac necessary for each combustion turbine unit (Leidos 2016-TN9183),
Natural Gas and Renewables	Approximately 1,500 ac (607 ha) for solar panels. In addition, up to 25 mi (40.2 km) of one to three new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 1,450 ac (586.8 ha).	MODERATE to LARGE	Solar panels could be installed both on the Monticello site and offsite either elsewhere in Minnesota or in the ROI. Xcel Energy estimates that the solar component would encompass as many as three different project sites. Based on land requirements for a nearby solar project, Xcel Energy estimates that solar installations would require 7.6 ac per MW.

Table 3-3 Land Use Impacts of Replacement Power Alternatives (Continued)

Alternative	Resource Requirements	Impacts	Discussion
Natural Gas and Renewables	Approximately 66,000 ac (26,709.3 ha) for wind turbines. Xcel Energy estimates up to 150 mi (241.4 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 2,700 ac (1,092.7 ha).	MODERATE to LARGE	Wind turbines would be installed offsite within Minnesota or the ROI. DOE estimates that wind power uses 85 ac per MW for wind farms, 2.47 ac (1 ha) per MW for construction footprint, and 0.74 ac (0.3 ha) per MW for permanent structures.
Renewables and Storage	Approximately 5,300 ac (2,144.8 ha) for solar panels. In addition, up to 25 mi (40.2 km) of one to ten new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 4,500 ac (1,821.1 ha).	MODERATE to LARGE	Xcel Energy estimates that solar panels would be installed at as many as three different project sites. Based on land requirements for a nearby solar project, Xcel Energy estimates that solar installations would require approximately 7.6 ac (3.1 ha) per MW.
Renewables and Storage	Approximately 84,000 ac (33,993.6 ha) for wind turbines. Xcel Energy estimates up to 150 mi (241.4 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be necessary to transmit power to the electrical grid, or an additional 2,700 ac (1,092.7 ha).	MODERATE to LARGE	Wind turbines would be installed offsite within Minnesota or the ROI. DOE estimates that wind power uses 85 ac (34.4 ha) per MW for wind farms, 2.47 ac (1 ha) per MW for construction footprint, and 0.74 ac (0.3 ha) per MW for permanent structures.
New Nuclear (SMR)	Up to 130 ac (52.6 ha) for a SMR nuclear power plant. Xcel Energy estimates up to 25 mi (40.2 km) of new 345 kV transmission lines in a 150 ft (45.7 m) wide corridor would be needed to transmit power to the electrical grid, or an additional 450 ac (182.1 ha).	SMALL to MODERATE	The SMR plant would be constructed and installed outside of Minnesota in one of the other seven states in the Xcel Energy's service area. The SMR power plant would be constructed within 25 mi (40.2 km) of a transmission grid with sufficient surface water to support the power plant cooling system and water use.

ac = acre(s); DOE = Department of Energy; ft = foot/feet; kV = kilovolt(s); mi = mile(s); MW = megawatt(s); ROI = region of influence; SMR = small modular reactor.

Construction

Construction of a replacement power facility would require the permanent commitment of land designated for industrial use and in addition, depending on the chosen site(s) of the replacement power alternatives, up to 150 mi (241.4 km) of new transmission lines in a 150 ft (0.3 m) wide transmission line corridor.

Operations

Operation of new power generating facilities would have no land use impacts beyond land committed for the permanent use of the replacement power plant. Additional land may be required to support power plant operations, including land for the mining, extraction, and waste disposal activities associated with each alternative.

3.2.5.2 Visual Resources

Visual impacts are determined by the degree of contrast between the replacement power generating facility and the surrounding landscape and the visibility of the new power plant.

Construction

Installation of power generating facilities and support structures at existing power plant sites would be consistent with visual character of the industrial site. Land for any replacement energy generating facility would require clearing, excavation, and the use of construction equipment. Temporary visual impacts may occur during construction because of the use of cranes and other construction equipment. If most of the components of this alternative are constructed at existing power plant sites, new visual impacts may be minimal. However, construction at greenfield sites may present new visual impacts. Construction of new wind turbines would likely be visible across a large area regardless of their location. The tallest structure associated with the SMR is the containment structure, up to 76 ft (23.2 m) in height. As such, the NRC staff concludes that construction and installation of each of the replacement power alternatives would have a SMALL to MODERATE visual impact.

Operations

Visual impacts during power plant operations of any of the replacement energy alternatives would be similar in type and magnitude. Combustion and wind turbines would be tall enough and solar panels could be seen off-site from a distance, depending on screening vegetation. Transmission lines would be visible, unless screened. Vapor plumes from alternatives using cooling towers would be the most noticeable visual impact and would likely be visible farther from the site than other buildings and infrastructure. Aircraft warning lights on power plant stacks, towers, or wind turbines would be visible at night. After completing construction and installation, the NRC staff concludes that power plant operations for each of the replacement power alternatives would have a SMALL visual impact.

3.3 Meteorology, Air Quality, and Noise

3.3.1 Meteorology and Climatology

Minnesota’s climate is continental characterized by humid summers and frigid winters, and large temperature variations across the seasons. The climate is influenced by cold air masses from the Artic in the winter, and humid air masses from the Gulf of Mexico in the summer. Winters are cold in the south and frigid in the north, and summers are mild to occasionally hot in the south and cool in the north. Minnesota’s location between the humid climate of the eastern United States and semiarid climate of the Great Plains creates large differences in average precipitation across the state. Annual average precipitation (from 1985 to 2020) ranges from 23 in. (58.4 cm) in the northwest to more than 35 in. (88.9 cm) in the southeast (NOAA 2022-TN9565).

The NRC staff obtained climatological data from the St. Cloud, Minnesota, weather station. This station is approximately 35 mi (56 km) from Monticello, and its data are used to characterize the region's climate because of its relative location and long period of record. Xcel Energy also maintains a meteorological monitoring system comprised of two meteorological towers. The primary tower is located southeast of Unit 1 and measures wind speed and direction, ambient air temperatures, precipitation, and dewpoint/relative humidity. The backup meteorological tower is located near the training center and measures wind speed and wind direction. In its ER, Xcel Energy provided meteorological observations from the meteorological monitoring system for the 1991–2020 period. However, due to data system issues, only 22 years of data for this 30-year period of record is complete and available.

The mean annual temperature for the 125-year period of record (1897–2022) at the St. Cloud weather station is 42°F (5.5°C), with mean monthly temperature ranging from a low of 10°F (-12.2°C) in January and a high of 70.8°F (21.5°C) in July (NOAA 2024-TN9623). The mean annual temperature from the Monticello onsite meteorological tower is 44.9°F (7.2°C) with a mean monthly ranging from a low of 15.2°F (-9.3°C) in January and a high of 71.8°F (22.1°C) in July (Xcel 2023-TN9084).

The average annual total precipitation for the 128-year period of record (1894–2022) at the St. Cloud weather station is 27.1 in (68.8 cm), with a mean monthly precipitation ranging from a low of 0.70 in (1.8 cm) in February and a high of 4.24 in (10.8 in) in June (NOAA 2024-TN9623). The mean annual total precipitation from Monticello's onsite meteorological tower is 31.2 in. (79.2 cm), with a mean monthly precipitation ranging from a low of 0.7 in (1.8 cm) in February and a high of 4.6 in (11.7 cm) in August (Xcel 2023-TN9084).

The mean annual wind speed for the 39-year period of record at the St. Cloud weather station is 8.2 mph (13.1 km/hr) with prevailing winds from the northwest (NOAA 2024-TN9623). The mean annual wind speed from Monticello's onsite meteorological tower is 6.1 mph (9.8 km/hr), with prevailing wind from the northwest (Xcel 2023-TN9084).

Minnesota is subject to extreme weather events. The following number of severe weather events have been reported in Wright and Sherburne County from January 1,1950 through May 31, 2023 (NOAA NCEI 2023-TN9566):

- tornados: 39 events
- floods: 10 events
- blizzards: 5 events

3.3.2 Air Quality

The EPA has set primary and secondary National Ambient Air Quality Standards (NAAQS 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards" TN1089) for six common criteria pollutants to protect sensitive populations and the environment. The NAAQS criteria pollutants include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). PM is further categorized by size—PM_{10} (diameter of 10 micrometers [µm] or less) and $PM_{2.5}$ (diameter of 2.5 µm or less).

The EPA designates areas of attainment and nonattainment with respect to meeting NAAQS. Areas for which there are insufficient data to determine attainment or nonattainment are designated as unclassifiable. Areas that were once in nonattainment, but are now in attainment, are called maintenance areas; these areas are under a 10-year monitoring plan to maintain their attainment designation status. States have primary responsibility for ensuring attainment and maintenance of the NAAQS. Under CAA Section 110 (42 U.S.C. 7410) (Clean Air Act-TN1141) and related provisions, States are to submit, for EPA approval, State implementation plans (SIPs) that provide for the timely attainment and maintenance of the NAAQS.

In Minnesota, air quality designations are made at the county level. For planning and maintaining ambient air quality with respect to NAAQS, EPA has developed air quality control regions (AQCRs). AQCRs are intrastate or interstate areas that share a common airshed. Monticello is located in Wright and Sherburne counties, which is part of the Central Minnesota AQCR (40 CFR 81.243 TN7226). With respect to NAAQS, EPA designates Wright County a maintenance area with respect to carbon monoxide and in attainment for other NAAQS; Sherburne County is in attainment for all NAAQS (EPA 2023-TN9567).

The Minnesota Pollution Control Agency (MPCA) regulates air emissions at Monticello under an air permit. MPCA issued its most recent air emissions permit, Permit No. 17100019-004, to Xcel Energy on November 15, 2013, authorizing the operation of air emissions sources at Monticello. Monticello's permitted air emissions are listed in Table 3-4. In addition to the permitted air emission sources listed in Table 3-4, Monticello also has two MDCTs onsite. However, there is no requirement to include particulate air emissions from the cooling towers in the site's air permit (Xcel 2023-TN9084). Monticello's air permit expired on November 15, 2018, however, Xcel Energy applied to renew the permit over 180 days prior to its expiration (Xcel 2023-TN9084). The air permit has been administratively extended and therefore remains in effect pending MPCA review and approval of the renewal application.

Table 3-4 Permitted Air Emission Sources at Monticello Nuclear Generating Plant

Emission Source	Permit Conditions
One heating boiler	Burn distillate fuel oil only. Fuel sulfur content less than or equal to 0.3 percent by weight Total particulate matter: less than or equal to 0.40 pounds/million British thermal units
Four diesel generators	Fuel type: Distillate fuel oil Sulfur content of fuel: less than or equal to 0.49 percent by weight
One fire pump diesel engine	Fuel type: Distillate fuel oil Sulfur content of fuel: less than or equal to 0.49 percent by weight
Three flexible diesel fired engine pumps	Fuel type: Distillate fuel CO: less than or equal to 5.0 grams/kilowatt-hour Total particulate matter: less than or equal 0.30 grams/kilowatt-hour NMHC + NO_X: less than or equal to 4.0 grams/kilowatt-hour. SO_2: less than or equal to 0.5 pounds/million British thermal units

NMHC = non-methane hydrocarbon(s); NO_X = nitrogen oxide(s).
Source: MPCA 2023-TN9624.

Xcel Energy reports that it has not received any notices of violation (NOV) of non-compliance associated with Monticello's air emissions permit between 2017–2022 (Xcel 2023-TN9084 and XCEL 2023- TN9578). The NRC staff's review of EPA's Enforcement and Compliance History Online system 3-year compliance history (October 2021–September 2023) revealed no NOVs (EPA ECHO 2022-TN9568).

The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze, which is caused by numerous, diverse air pollutant sources located across a broad region (40 CFR Part 51-TN1090). Specifically, 40 CFR 81 Subpart D (TN7226), "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important

Value," lists mandatory Federal areas where visibility is an important value. The Regional Haze Rule requires states to develop State Implementation Plans to reduce visibility impairment at Class I Federal Areas. There are no Class 1 Federal Areas within 100 mi (160 km) of the Monticello site.

3.3.3 Noise

Noise is unwanted sound and can be generated by many sources. Sound intensity is measured in logarithmic units called decibels (dB). A dB is the ratio of the measured sound pressure level to a reference level equal to a normal person's threshold of hearing. Most people barely notice a difference of 3 dB or less. Another characteristic of sound is frequency or pitch. Noise may be composed of many frequencies, but the human ear does not hear very low or very high frequencies. To represent noise as closely as possible to the noise levels people experience, sounds are measured using a frequency-weighting scheme known as the A-scale. Sound levels measured on this A-scale are given in units of A-weighted decibels (dBA). Levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each increase of 10 dBA sounds twice as loud (EPA 1981-TN7412).

Several different terms are commonly used to describe sounds that vary in intensity over time. The equivalent sound intensity level (Leq) represents the average sound intensity level over a specified interval, often 1 hour. The day-night sound intensity level (LDN) is a single value calculated from hourly Leq during a 24-hour period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. This addition accounts for the greater sensitivity of most people to nighttime noise. Statistical sound level (Ln) is the sound level that is exceeded n Percent of the time during a given period. For example, L90, is the sound level exceeded 90 percent of time and is considered the background level.

Primary offsite noise sources in the vicinity of Monticello are associated with vehicular traffic, boating access, and seasonal use of the river (Xcel 2023-TN9084). The nearest resident (measured from the reactor building) is located approximately 0.52 mi (0.83 km). Primary noise sources at Monticello include the firing range and emergency diesel generators. The emergency diesel generators are tested monthly and reach noise levels of 101–103 dBA. Between 2017 and 2022, Xcel Energy has not received noise complaints because of operation of Monticello (Xcel 2023-TN9084 and Xcel 2023-TN9578).

3.3.4 Proposed Action

3.3.4.1 Air Quality Impacts

The ambient air quality in the vicinity of Monticello is described in Section 3.3.2. Impacts on air quality during normal plant operations can result from operations of fossil-fuel fired equipment needed for various plant functions. Monticello's permitted air emission sources are presented in Table 3-4. Table 3-5 presents Monticello's annual air emissions from 2017–2021. Table 3-5 presents 2020 annual air emissions from Wright and Sherburne counties (EPA 2020-TN9569). The contributions of air emissions from sources at Monticello represent a fraction of the annual emissions from either Wright County or Sherburne County. Federal land management agencies that administer Federal Class I areas consider an air pollutant source that is located greater than 31 mi (50 km) from a Class I area to have negligible impacts with respect to Class I areas if the total SO_2, NO_2, PM_{10}, and sulfuric acid annual emissions from the source are less than 500 tons per year (70 FR 39104-TN8374; NPS 2010-TN7925). There are no Class 1 Federal Areas within 100 mi (160 km) of the Monticello site. Therefore, operation of Monticello has a negligible impact on Federal Class 1 areas.

Table 3-5 Monticello Nuclear Generating Plant Reported Annual Air Emissions (TPY) for years 2017–2021 and 2020 Annual Air Emissions for Wright and Sherburne County

Year	PM_{10}	$PM_{2.5}$	SO_2	NOx	CO
2017	0.31	0.22	1.27	11.99	2.84
2018	0.17	0.07	0.97	4.91	1.28
2019	0.15	0.08	0.7	5.38	1.41
2020	0.32	0.23	0.90	4.89	1.24
2021	0.28	0.20	0.76	4.80	1.23
Sherburne County (2020)	6,960	1,990	51	1,890	16,070
Wright County (2020)	9,860	3,000	77.5	2,790	25,105

CO= carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 µm; $PM_{2.5}$= particulate matter less than 2.5 µm; SO_2= sulfur dioxide; TPY = ton(s) per year.
Source for Monticello emissions: Xcel 2023-TN9084 and MPCA 2023-TN9625; Source for Sherburne and Wright County: EPA 2020-TN9569.

Xcel Energy does not anticipate future upgrades of air emission sources during the SLR term to support plant operations (Xcel 2023-TN9084). In Monticello's air permit renewal application, Xcel Energy requested that two existing onsite gasoline engines be included in the air permit and all non-road engines be removed, but no additional equipment or emission sources are included (Xcel 2023-TN9578). SLR would continue current operating conditions and therefore, the impacts of current operations and SLR would be similar. Given, Monticello's limited air emissions presented in Table 3-5, there is little likelihood that ongoing activities at Monticello during the SLR term would adversely affect air quality. Based on these considerations, the NRC staff concludes that the air quality impacts of continued nuclear plant operations at Monticello are SMALL.

3.3.4.2 Air Quality Effects of Transmissions Lines

Small amounts of ozone and substantially smaller amounts of oxides of nitrogen are produced during corona, a phenomenon that occurs when air ionizes near isolated irregularities on the conductor surface of transmission lines. During corona, ozone is approximately 90 percent of the oxidants generated, and 10 percent is NO_x (BLM 2010-TN9626). Xcel Energy has not conducted field tests of ozone or NO_x emissions generated by Monticello's 115 kV and 345 kV in-scope transmission lines (Xcel 2023-TN9578). Several studies have quantified the amount of ozone generated and concluded that the amount produced by even the largest lines in operation (765 kilovolt [kV]) is insignificant (SNYPSC 1978-TN7478; Scott-Walton et al. 1979-TN7480; Janes 1978-TN7479; Varfalvy et al. 1985-TN7364). Monitoring of ozone levels for 2 years near a Bonneville Power Administration 1,200 kV prototype line revealed no increase in ambient ozone levels caused by the line (Lee et al. 1989-TN7481). Similarly, field tests conducted over a 19-month period concerning ozone levels adjacent to Sequoyah Nuclear Plant transmission lines concluded that high-voltage lines up to 765 kV do not generate ozone concentrations above ambient measurements made at locations remote from transmission lines (TVA 2013-TN7899; NRC 2015-TN5842). The ozone concentrations generated by transmission lines are therefore too low to cause any significant effects. The minute amounts of NO_x produced are similarly insignificant. SLR would continue current operating conditions. Based on these considerations, the NRC staff concludes that the air quality impacts of transmission lines during the Monticello SLR term would be SMALL.

3.3.4.3 Noise Impacts

The ambient noise conditions in the vicinity of Monticello are described in Section 3.3.3. Xcel Energy does not anticipate refurbishment activities during the proposed SLR term. Therefore, there would be no noise generated by construction-related activities and equipment typically associated with refurbishment. Nuclear power plant operations would not change appreciably with time. The primary noise sources and levels currently at Monticello, as discussed in Section 3.3.3, would be the same during the SLR term. Noise from diesel generators and the firing range are intermittent. While noise levels from emergency diesel generators can reach 101–103 dBA, the noise levels from the generators are not expected to be noticeable after accounting for building walls (generators are housed inside a building) as noise barriers and dissipation given the distance to nearby residents (approximately 0.52 mi [0.83 km]). With each doubling of sound source distance, sound intensity decreases by 6 dB (Zahorik and Kelly 2007-TN9627). Xcel Energy does not anticipate any subsequent license related refurbishment and therefore, noise levels are anticipated to remain the same during the SLR term. Furthermore, as discussed in Section 3.3.3 of this EIS, Xcel Energy has not received noise complaints because of operations at Monticello. Based on these considerations, the NRC staff concludes that noise impacts from continued operations of Monticello during the SLR term would be SMALL.

3.3.5 No-Action Alternative

3.3.5.1 Air Quality

Under the no-action alternative, the permanent cessation of Monticello operations would reduce overall air emissions (e.g., from boiler, diesel generators, and vehicle traffic). Therefore, the NRC staff concludes that if emissions decrease, the impact on air quality from the shutdown of Monticello would be SMALL.

3.3.5.2 Noise

The permanent cessation of Monticello operations would result in a reduction in noise from the firing range, emergency diesel generators, and from vehicle traffic (e.g., workers, deliveries). As site activities are reduced, the NRC staff expects the impact on ambient noise levels to be lower than those from current plant operations; therefore, the NRC staff concludes that impacts on noise levels from the no-action alternative would be SMALL.

3.3.6 Replacement Power Alternatives: Common Impacts

3.3.6.1 Air Quality

Construction

Construction of a replacement power alternative and associated transmission lines would result in temporary impacts on local air quality. Air emissions include criteria air pollutants (PM, NO_x, CO, and SO_2), volatile organic compounds, hazardous air pollutants, and greenhouse gases (GHGs). Air emissions would be intermittent and would vary based on the level and duration of specific activities throughout the construction phase. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling to and from the facility as well as within the site. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicle traffic on unpaved surfaces, concrete batch plant operations, and wind erosion to a lesser extent.

Various mitigation techniques and best management practices (BMP) (e.g., watering disturbed areas, reducing equipment idle times, and using ultra-low sulfur diesel fuel) could be used to minimize air emissions and to reduce fugitive dust.

Operations

The impacts on air quality from operation of a facility for a replacement power alternative would depend on the energy technology (e.g., nuclear or renewable). Worker vehicles, auxiliary power equipment, and mechanical cooling towers will result in air emissions.

3.3.6.2 Noise

Construction

Construction of a replacement power facility and associated transmission lines would be similar to construction of any industrial facility in that they all involve many noise-generating activities. In general, noise emissions would vary during each phase of construction, depending on the level of activity, types of equipment and machinery used, and site-specific conditions. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities could take place. Other noise sources include construction worker vehicle and truck delivery traffic. However, noise from vehicular traffic would be intermittent. Noise impacts during construction would not be limited to the immediate vicinity of the sites where each alternative is located, since the construction of transmission corridors would be required for the replacement power alternatives considered.

Operations

Noise generated during operations could include noise from transformers, industrial equipment, speakers, and offsite sources, such as employees and delivery vehicular traffic. Noise generated by vehicles would be intermittent.

3.3.7 Natural Gas and Renewables Alternative

3.3.7.1 Air Quality

Air emissions and sources for construction of the natural gas portion of this alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1 of this EIS. Air emissions from construction of a new natural gas-fired, two-unit combustion turbine power plant would be intermittent, short-term, and temporary. The solar photovoltaic and wind portion of this alternative would not have a power block building. Accordingly, the number of heavy equipment and workforce, level of activities, and construction duration would be substantially lower than that for other alternatives and, consequently, less air emissions would result. Installation of wind turbines, however, require that a significant amount of land be disturbed (up to 66,000 ac [26,709 ha]), as well as a significant amount of land required for transmission lines (2,700 ac [1,093 ha]). These requirements can result in generation of significant amounts of PM. This alternative would also consist of additional generation from existing natural gas fired plants within Xcel Energy’s system and purchased power to meet energy demand. Air quality impacts can result from modifications needed at existing facilities. For instance, plant modifications at an existing facility to support additional generation or construction of new transmission lines would result in additional amounts of air emissions. Air emissions associated with the construction of transmission lines would be from operation of the earth-moving and material-handling equipment and exhaust emissions from worker vehicles and construction equipment. These emissions include criteria pollutants and GHGs. However, these impacts would be temporary and would not likely be high.

Operation of a 750 MW natural gas-fired, two-unit combustion turbine power plant would result in emissions of criteria pollutants and GHGs. Additionally, for this alternative, existing natural gas combustion turbines would be operated as a peaking plant to provide energy during occasional extended periods of low renewable output (Xcel 2023-TN9084). Projected generation for the existing combustion turbines would average 368,000 MWh annually (Xcel 2023-TN9084). The NRC staff estimated annual air emissions for the a 750 MW natural gas-fired, two-unit combustion turbine power plant and the operation of existing natural gas combustion turbines used as a peaking plant using emission factors for a gas turbine simple cycle plant developed by the U.S. Department of Energy's National Technology Laboratory (NETL 2014-TN9628):

- CO: 35 tons (32 metric tons [MT])
- NO_x: 340 tons (310 MT)
- SO_2: 9 tons (8.5 MT)
- PM_{10}: 8 tons (7 MT)

Emissions from nitrogen oxides would be significant. Operation of MDCTs of the natural gas component and up to 150 worker vehicles would result in additional air emissions. Two new natural gas fired units would need to secure a permit for air pollutants associated with its operation. Direct air emissions associated with operation of the solar photovoltaic and wind components of this combination alternative are negligible because no fossil fuels are burned to generate electricity. Emissions from wind turbine arrays and solar photovoltaic installations would include fugitive dust and engine exhaust from worker vehicles and heavy equipment associated with site inspections, maintenance activities, and wind erosion from cleared lands and access roads. Emissions would be localized and intermittent. Purchased power would result in emissions of criteria pollutants and GHGs. Power generation would be on a as needed basis and air quality impacts are expected to be negligible as there would be minimal change in existing plant operations and emissions.

Overall, the NRC staff concludes that the air quality impacts from construction and operation of the natural gas and renewable alternative is SMALL to MODERATE.

3.3.7.2 Noise

Sources of noise during the construction and operation of a natural gas and renewables alternative would include those discussed for all replacement power alternatives as discussed in Section 3.3.6.2. Construction of the natural gas fired power plants will require construction of a natural gas pipeline to support operation and would result in noise along the pipeline corridor. Noise generated during construction of the natural gas power plant, transmission lines, and natural gas pipeline may be noticeable depending on the location and distance of nearby noise sensitive receptors. The solar and wind portions of this alternative would have no power block buildings requiring construction. The number of heavy equipment and workforce, level of activities, and construction duration would be lower than for other alternatives. However, noise levels generated by construction activities of a solar facility can range from 70 to 80 dBA at 50 ft

(15 m) (BLM 2019-TN8386). Blasting may be required during construction for turbine foundations (WAPA/FWS 2015-TN8725; BLM 2013-TN8882). Noise levels during construction to nearby sensitive receptors of the solar and wind components of this alternative would depend on the distance from the site to nearby receptors and may be noticeable. Solar panels would be located both on and offsite of the Monticello site and wind turbines would be located offsite. At the Monticello site, the nearest nearby noise sensitive receptor is approximately 0.5 mi (0.8 km) from the site. Accounting for noise dissipation with distance, the NRC staff does not anticipate noise levels to be noticeable as result from construction of solar panels at the Monticello site. However, noise levels may be noticeable to nearby noise sensitive receptors because of construction of offsite solar panels and wind turbines and associated transmission lines. This alternative would also consist of additional generation from existing natural gas fired plants and purchased power. Noise impacts can result from necessary modifications at existing facilities to support additional generation. Noise impacts can result from additional noise sources associated with plant modifications at an existing facility or construction of new transmission lines. The increase in noise levels would be dependent on the distance of noise sensitive receptors to the noise sources.

Most of the noise-producing equipment (turbines, pumps, MDCTs) would be located inside the power block during operations of the natural gas-fired, two-unit combustion turbine power plant. However, offsite mechanical noise would result from compressor stations and pipeline blowdowns. The Federal Energy Regulatory Commission requires that any new compressor station or any modification, upgrade, or update of an existing station must not exceed day-night sound intensity level of 55 dBA at the closest noise sensitive area (18 CFR 157.206-TN7483). Day-night sound intensity level of 55 dBA was designated by the EPA as a noise level that is adequate to protect against outdoor activities (EPA 1974-TN3941). Noise generated by wind turbines would include aerodynamic noise from the blades and mechanical noise from turbine drivetrain components (generator, gearbox). Depending on the location, layout, and proximity of wind farms to noise sensitive receptors, noise associated with operation of the wind portion of the combination alternative could be noticeable. Because the solar portion with battery storage of this alternative would have no power block or cooling towers, a minimal number of noise sources, such as transformers and vehicular traffic, would be associated with maintenance and inspection activities. This alternative would be supplemented by purchased power (which could include a mix of fossil fuel and renewable sources) and existing natural gas-fired power plants. No significant changes in operation from these sources would occur. Therefore, noise levels would be the same from routine operations at the existing facilities.

Overall, the NRC staff concludes that the noise impacts from the natural gas and renewable combination alternative would be SMALL to MODERATE.

3.3.8 Renewables and Storage Alternative

3.3.8.1 Air Quality

Air emissions and sources for construction and operation of the renewable and storage alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1. The solar panels with battery storage and wind portions of this alternative would not have power block buildings. Accordingly, the number of heavy equipment and workforce, level of activities, and construction duration would be substantially lower than that for the other alternatives and consequently less air emissions would be generated. Installation of wind turbines, however, require that a significant amount of land be disturbed (up to 84,000 ac [33,994 ha]), as well as a significant amount of land requirements for transmission lines (2,700 ac [1,093 ha]). This can result in noticeable particulate air emissions during the construction phase. This alternative also would consist of additional generation from existing natural gas fired plants within Xcel Energy's system and purchased power to meet energy demand. Air quality impacts can result from necessary modifications at existing facilities. These emissions include criteria pollutants and GHGs. However, these impacts would be temporary and would not likely be significant.

Direct air emissions associated with operation of the solar with battery storage and wind portions of this alternative are negligible because no fossil fuels are burned to generate electricity. Emissions from wind turbine arrays and solar installations would include fugitive dust and engine exhaust from worker vehicles and heavy equipment associated with site inspections, maintenance activities, and wind erosion from cleared lands and access roads. Emissions would be localized and intermittent.

This alternative would include purchased power and additional generation from existing natural gas-fired power plants. Both purchased power and natural gas fired power plants would result in emissions of criteria pollutants and GHGs. For this alternative, Xcel Energy projected an annual peak of 204,000 MWh from natural gas fired generation. Purchased power would supplement renewable generation on an as-needed basis (Xcel 2023-TN9084). Therefore, for this alternative, emissions would primarily be from operation of existing natural gas fired plants. The NRC staff estimated the following maximum annual air emissions from an additional 204,000 MWh from existing natural gas fired power plants using emission factors by the U.S. Department of Energy's National Technology Laboratory (NETL 2014-TN9628):

- CO: 1.0 tons (0.9 MT)
- NO_x: 10 tons (9.1 MT)
- SO_2: 0.3 tons (0.2 MT)
- PM_{10}: 0.2 tons (0.2 MT)

Criteria air emissions from operation of the natural gas component of this alternative are comparable to those from operations at Monticello.

The NRC staff concludes that the overall air quality impacts from construction and operation of the renewables and storage alternative would be SMALL to MODERATE.

3.3.8.2 Noise

The renewable and storage alternative would consist of wind turbines, solar panels with battery storage, purchased power, and additional power generation from existing natural gas fired plants. Therefore, the noise impacts from construction and operation of a renewable and storage alternative would be similar to those discussed for the wind turbines, solar panels, purchased power, and additional power generation from existing natural-gas fired plants portions of the natural gas and renewable alternative in Section 3.3.6.2. Based on this information, the NRC staff concludes that the noise impacts construction and operation of the renewables and storage alternative would be SMALL to MODERATE.

3.3.9 New Nuclear (Small Modular Reactor) Alternative

3.3.9.1 Air Quality

Air emissions and sources associated with construction of the new nuclear alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1. Air emissions from construction of the new nuclear alternative would be intermittent, short term, and temporary (NRC 2019-TN6136).

Operation of the new nuclear alternative would result in air emissions similar to those from operation of Monticello. Sources of air emissions would include stationary combustion sources (e.g., diesel generators, auxiliary boilers, and gas turbines), MDCTs, and mobile sources (e.g., worker vehicles, onsite heavy equipment, and support vehicles). MDCTs could contribute to impacts associated with the formation of visible plumes, fogging, and subsequent icing downwind of the towers. In general, most stationary combustion sources at a nuclear power plant would operate only for limited periods, often during periodic maintenance testing. Additional air emissions would result from the approximately 600 employees commuting to and from the new nuclear facility. A new nuclear power plant would need to secure an air permit for air pollutants associated with its operations (e.g., criteria pollutants, volatile organic compounds, hazardous air pollutants).

In NUREG-2226 (NRC 2019-TN6136), the NRC staff conservatively estimated annual air emissions from cooling towers, auxiliary boilers, diesel generators, and gas turbines as a result of operating two or more small modular reactors with a maximum total electrical output of 800 MWe:

- NO_x: 37.6 ton (34 MT)
- CO: 4.8 ton (4.3 MT)
- SO_2: 20.8 ton (18.9 MT)
- PM_{10}: 7.4 ton (6.7 MT)

Given that the new nuclear alternative considered here consists of operation of a 12-unit small modular reactor power plant generating approximately 880 MWe, air emissions would be similar those estimated in NUREG-2226 and presented above. These air emissions are greater than annual emissions from operation of Monticello, but are relatively minor. The NRC staff does not expect air emissions from operation of a new nuclear alternative to contribute to NAAQS violations.

The NRC staff concludes that the overall impacts of construction and operation of a new nuclear alternative on air quality would be SMALL.

3.3.9.2 Noise

Sources of noise during the construction of a new nuclear power plant would include those discussed for all replacement power alternatives as discussed in Section 3.3.6.2. Noise levels generated by construction activities can reach 102 dBA measured 50 ft (0.3 m) from the source (NRC 2019-TN6136). The new nuclear alternative would be located outside of Minnesota but within Xcel Energy’s service area at an existing power plant site or greenfield site. Noise levels to nearby noise sensitive receptors (e.g., residence, school, park) would depend on the distance from the construction site (e.g., plant site, transmission line corridors) to the receptors, while short-term, noise can be noticeable.

Sources of noise during nuclear power plant operations would include those discussed for all replacement power alternatives in Section 3.3.6.2. Noise would be primarily limited to the immediate vicinity of the site. If the new nuclear alternative is located at an existing power plant site, noise would be compatible and like that being generated at the existing site. However, if the new nuclear alternative is located at a greenfield site, noise from cooling towers, turbines, and equipment may be noticeable and would depend on the distance to nearby noise sensitive receptors.

Overall, the NRC staff concludes that the noise impacts from construction and operation of a new nuclear alternatives would be SMALL to MODERATE.

3.4 Geologic Environment

EIS Section 3.4 describes the geologic environment of the Monticello site and vicinity, including the physiography, geology, geologic resources, soils, and seismic setting. The descriptions of these facets of the geologic environment are followed by the NRC staff's analysis of the potential site-specific environmental impacts on geology and soils from the proposed Monticello SLR action and alternatives to that proposed action.

3.4.1 Physiography and Geology

Section 3.5 of the Xcel Energy ER (Xcel 2023-TN9084) describes the geologic environment of the Monticello site and vicinity, including the regional geology, site geology, soils, and seismic history. Except as otherwise cited for clarity, the NRC staff summarizes this information in the following subsections. The staff did not identify any new and significant information regarding the geologic environment during the site audit and the scoping process or as the result of its review of available information as cited in this EIS.

Monticello is located in central Minnesota within the Central Lowlands physiographic province, which covers approximately 585,000 square miles (mi^2) (1,515,143 km^2), of generally low relief topography. Crystalline basement rocks in the region are Precambrian (>541 million years) in age. Monticello is located approximately 20 mi (32 km) northwest of the Midcontinent Rift. The Midcontinent Rift is a large (approximately 1,200 mi [2,000 km] in length) geologic feature that formed during Precambrian rifting and subsequent volcanic activity. The rift zone comprises dipping basins filled with old igneous (volcanic) rocks and younger sedimentary rocks (Stein et al. 2016-TN9868). The region was glaciated, and the underlying lithologies are largely Paleozoic age sandstones, shales, limestones, conglomerates, and coals (sedimentary rocks). The grade level elevation of the Monticello site is approximately 930 ft (283 m) above mean sea level MSL (Xcel 2023-TN9084).

The Monticello site is located on a bluff that forms the southwest bank of the Mississippi River. The bluff slopes gently downhill to the south away from the river. Six stratigraphic units are present at the site. Surficial deposits consist predominantly of fill (reworked natural material of gravels and silts), river terrace deposits (sand and gravelly sand), sandy till (sand with gravel), glacial outwash (sand with clay and trace gravel), and lower glacial till (clay with sand). The lower glacial till extends to the bedrock surface. Geologic logs indicate that the bedrock beneath the site is weathered sandstone at a depth of approximately 60 ft (18 m) below ground surface (bgs) and granite at a depth of approximately 70 to 122 ft (21 to 37 m) bgs. Soil and rock units at the site dip eastward.

3.4.2 Geologic Resources

Minnesota is the largest producer of iron ore (taconite) in the United States. However, current and future iron ore mining operations are located in northeast Minnesota (IMA 2022-TN9086). Sand and gravel deposits are quarried in Wright County (USGS 2023-TN9087). Nearby sites include the active Martin Marietta Monticello Pit 3.1 mi (5 km) northwest of the Monticello site and the Naaktgeboren Pit in Silver Creek 6.6 mi (10.6 km) southwest of the Monticello site. A new sand and gravel prospect has been proposed in Buffalo Township approximately 11.7 mi (18.8 km) south of the Monticello site (Knife River 2017-TN9088; Martin Marietta 2023-TN9089; WCPZ 2022-TN9090).

3.4.3 Soils

Natural soils and weathered rock material across the Monticello site were graded and disturbed during nuclear power plant construction. Where soils are present and undisturbed in the central portion of the Monticello site, mapping by the Natural Resources Conservation Service shows that they consist of loamy sand from the Hubbard–Mosford soil complex. Soils in the northeastern corner of the site extending eastward toward the Mississippi River, where present and undisturbed, consist of the fine sandy loam of the Elkriver complex. Before nuclear power plant construction, the soils formed on slopes ranging from 0 to 3 percent from parent material consisting of alluvium. Elkriver complex soils cover approximately 19 percent of the total site area (as presented in Figure 3.1-2 of Xcel 2023-TN9084) and are designated as prime farmland soils. Less than a quarter of the area of land indicated to contain Elkriver complex soils is developed; therefore, the undisturbed areas of this complex would still be classified as prime farmland.

Aside from areas of severe slopes, the Natural Resources Conservation Service rates the soils of the Hubbard–Mosford and Elkriver complexes as somewhat to very limited for site development with shallow excavations. The soils generally have slight erosion potential, except for a band of loamy outwash (Dorset Two Inlets Complex) that borders the Mississippi River west of the main site complex and has severe erosion potential. Stabilization measures have been in place since Monticello became operational to prevent erosion and sedimentation impacts. Additionally, as required by its State-issued NPDES general permit for stormwater discharges associated with industrial activity (No. MN00000868) for Monticello, Xcel Energy has also developed and implemented a stormwater pollution prevention plan (SWPPP). This plan identifies BMPs, including nonstructural preventive measures and source controls and structural (engineering) controls, to prevent erosion and to prevent or reduce pollutants, including total suspended solids, in stormwater discharges (Xcel 2023-TN9084).

3.4.4 Seismic Setting

Earthquake activity in Minnesota has historically been low. The main mechanism for earthquake activity in the region is interpreted to be the reactivation of ancient Precambrian faults as the North American plate drifts westward away from the Mid-Atlantic ridge. Several of these ancient fault zones cross the State in largely southwest to northeast orientations, including the Great Lakes Tectonic Zone and the Leech Lake Structural Discontinuity. The nearest mapped fault to the Monticello site is an unnamed feature of unknown displacement located approximately 2.9 mi (4.7 km) northwest of the site’s northern boundary (USGS 2023-TN9261). Between 1970 and October 1, 2023, five earthquakes with a magnitude equal to or greater than 3.0 have been recorded within a 200 mi (322 km) radius of the Monticello site (USGS 2023-TN9263). Between 2014 and January 2023, 102 mining explosions have been recorded with a magnitude equal to or greater than 3.0 within 200 mi (322 km) of the Monticello site (USGS 2023-TN9263).

The NRC evaluates the potential effects of natural hazards, including seismic events, on nuclear power plants on an ongoing basis that is separate from the LR process. All nuclear power plants in the United States are designed and built to withstand strong earthquakes based on their location and nearby earthquake activity. The NRC’s understanding of seismic hazards for a given nuclear power plant may change as the methods of assessing seismic hazards evolve and the scientific understanding of earthquake hazards improves (NRC 2014-TN8997, NRC 2018-TN8998). In 2018, the U.S. Geological Survey published updated seismic hazard maps that included the region encompassing the Monticello site (Petersen et al. 2020-TN7281). Based on the 2018 seismic hazard maps, the Monticello site is in an area with a predicted peak horizonal acceleration between 0.02–0.04 g (10–20 percent of standard gravity) for a 2 percent probability of exceedance in 50 years (i.e., corresponding to a return time of about 2,500 years). Previous peak horizontal acceleration estimates for the site were 0.04–0.08 g (USGS 2014-TN6177).

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established the Near-Term Task Force to review regulatory insights from the Fukushima Dai-ichi accident as directed by the Commission on March 21, 2011, in COMGBJ-11-0002 (NRC 2011-TN7448). The Near-Term Task Force assessment resulted in the NRC issuing order EA-12-049 (NRC 2012-TN7947) on March 12, 2012 to nuclear power plant licensees requiring them to mitigate beyond-design-basis external events, and issuing 10 CFR 50.54(f) (TN249) letters directing licensees to conduct seismic and flooding reevaluations (NRC 2012-TN2198). In November 2020, the NRC staff issued its determination that Xcel Energy had completed its response to the order and the 10 CFR 50.54(f) letter (NRC 2020-TN9695) for Monticello.

The impacts of natural phenomena, including geologic hazards, on nuclear power plant systems, structures, and components are outside the scope of the NRC's license renewal (LR) environmental review. Monticello was originally sited, designed, and licensed in consideration of applicable geological and seismic criteria, and seismic issues are assessed as part of the nuclear power plant safety review. Further, the NRC requires all licensees to take seismic activity into account in order to maintain safe operating conditions at all nuclear power plants. When new seismic hazard information becomes available, the NRC evaluates the new information to determine if any changes are needed at existing nuclear power plants. This reactor oversight process, which considers seismic safety, is separate and distinct from the NRC staff's LR environmental review.

3.4.5 Proposed Action

This section addresses the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 that relate to geology and soils. Below, the NRC staff analyzes the impacts at the Monticello site for the SLR term.

The impact of continued operation and any refurbishment associated with SLR at the Monticello site on geologic and soil resources would consist of soil disturbance and potential excavations for the anticipated ISFSI expansion and other projects (if any), such as replacing or adding buildings, roads, parking lots, and belowground and aboveground utility structures. For such projects, the licensee may also need to obtain geologic materials (e.g., soil or sand borrow or backfill material, aggregate for road building or concrete production) from locations on the nuclear power plant site or from offsite borrow areas or quarries. However, it is more likely that these materials would be obtained from commercial vendors. Regardless, stabilization measures to prevent erosion and sedimentation impacts on the Monticello site and surrounding area have been in place since construction began in the early 1970s. In addition, the site maintains an SWPPP (Xcel 2023-TN9084) that identifies BMPs to prevent or reduce soil erosion and the subsequent impacts on surface water quality. These include nonstructural preventative measures and structural controls to prevent erosion or treat stormwater impacted by potential pollutants caused by erosion. Any construction activities at the Monticello site would be subject to and managed by the current SWPPP, and any ground disturbance of one or more acres (or less than one acre if the activity is scoped within a larger development plan of more than one acre) would require a construction stormwater permit be obtained from the MPCA (MPCA 2023-TN9266).

The Farmland Protection Policy Act of 1981 (FPPA; 7 U.S.C. 4201 et seq.-TN708) requires Federal agencies to take into account agency actions affecting the preservation of farmland, including prime and other important farmland soils, as described in Section 3.4.3. However, the site is not subject to the FPPA because the FPPA does not apply to Federal permitting or licensing for activities on private or nonfederal lands.

Based on the site-specific environmental review conducted by the NRC staff, to date, no significant impact issues related to continued operations and refurbishment activities on geology and soils have been identified.

The geologic and soil conditions at Monticello and the associated transmission lines have been well established during the current licensing term. These conditions are expected to remain unchanged during the 20-year SLR term. SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. For these reasons, the effects of continued operations on geologic and soil resources would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts of SLR on geology and soils during the Monticello SLR term would be SMALL.

3.4.6 No-Action Alternative

Under the no-action alternative, there would be few or no incremental impacts on site geology and soils associated with the shutdown of Monticello. In this case, before beginning decommissioning activities, little or no new ground disturbance would occur at the plant site while operational activities were being reduced and eventually terminated. Therefore, the NRC staff concludes that the impact of the no-action alternative on geology and soils would be SMALL.

3.4.7 Replacement Power Alternatives: Common Impacts

Construction

During facility construction for the replacement power alternatives and associated components, aggregate material (e.g., crushed stone, riprap, sand, and gravel) would be required to construct buildings, foundations, roads, parking lots, pad sites, transmission lines, and other supporting infrastructure, as applicable. The NRC staff considers that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing, grading, and excavation work expose soils to erosion and alter surface drainage. The staff also expects that BMPs would be implemented in accordance with applicable State and local permitting requirements to reduce soil erosion and the associated offsite impacts. These practices would include such measures as the use of sediment fencing, staked hay bales, check dams, sediment ponds, riprap aprons at construction and laydown yard entrances, mulching and geotextile matting of disturbed areas, and rapid reseeding of temporarily disturbed areas as applicable. Standard construction practice dictates that the topsoil removed during construction and any suitable excavated materials would be stored onsite for redistribution, e.g., as backfill, at the end of construction.

Operations

Replacement power facilities would be built in accordance with applicable State and local building codes and would consider such siting and design factors to mitigate potential impacts from natural phenomena. Once facility construction is completed, the areas disturbed during construction, whether on land or offshore, would be within the footprint of the completed facilities, overlain by other impervious surfaces (such as roadways and parking lots), or revegetated or stabilized as appropriate. Therefore, there would be no additional land disturbance and no direct operational impacts on geology and soils. The consumption of aggregate materials or topsoil for maintenance purposes during operations would be negligible.

3.4.8 Natural Gas and Renewables Alternative

The impacts on geologic and soil resources from construction and the operations associated with the natural gas and renewables alternative would likely be similar to, but of lesser intensity, than those described and assumed as common to all alternatives in Section 3.4.7. The impacts are expected to be less than those associated with the new nuclear alternative. However, the potential construction impacts of this alternative to soil resources at the Monticello site are expected to be greater than those associated with the SMR component of the new nuclear alternative because a larger area of land would be disturbed and converted to industrial use (see Section 3.2.5.1 for more detail on land use for replacement power alternatives) Total land use for the natural gas and renewables alternative is about 72,630 ac (29,392 ha), including transmission lines and corridors (see Section 3.2.5.1). However, the intensity of the excavation work for the power block of the natural-gas-fired combustion turbine power plant and the wind turbine and solar panel foundations would be less under this alternative than for the new nuclear alternative. In summary, the NRC staff concludes that the impacts on geology and soil resources from the natural gas and renewables alternative would be SMALL to MODERATE.

3.4.9 Renewables and Storage Alternative

The impacts on geologic and soil resources from construction and the operations associated with the renewables and storage alternative would likely be similar to those described and assumed as common to all alternatives in Section 3.4.7 and those described in Section 3.4.8 for the natural gas and renewables alternative. Total land use under this alternative is 96,500 ac [39,052 ha], including transmission lines and corridors (see Section 3.2.5.1 for more detail on land use for replacement power alternatives). While the construction impacts on surface soils are likely to be elevated due to the large land-use requirement, the intensity of the excavation work would be much less compared to that of the SMR. The NRC staff concludes that the impacts on geology and soil resources from this alternative would be SMALL to MODERATE.

3.4.10 New Nuclear (Small Modular Reactor) Alternative

The impacts on geologic and soil resources from construction and the operations associated with the new nuclear alternative would likely be similar to those described and assumed as common to all alternatives in Section 3.4.7. Minnesota Statute 216B.243, Subdivision 3b, prohibits the construction and operation of new nuclear power plants in Minnesota. Therefore, without legislative change, the SMR plant would be constructed and installed outside Minnesota, and the existing infrastructure at the Monticello site could not be used. Therefore, the construction of the SMR plant could potentially increase the consumption of geologic resources for new facility construction. However, total land use needed to support the construction of the new SME power plant and transmission lines would be two orders of magnitude less than that of the natural gas and renewables and the renewables and storage alternatives (see Section 3.2.5.1 for more detail on land use for replacement power alternatives).

Disturbance to geologic strata and soil erosion and loss under this alternative would generally be localized to the construction sites, and offsite soil erosion impacts would be mitigated by using BMPs. However, excavation work for the nuclear power block associated with the SMR modules may extend to a depth of approximately 140 ft (43 m) below grade (NRC 2018-TN7244). This would likely require excavation in weathered and sound rock and the application of methods (e.g., grouting and dewatering) to stabilize the deep excavation during construction. Because this alternative would require multiple excavations, including a deep excavation for the SMR, and substantial soil disturbance, the NRC staff concludes that the overall impacts on geology and soil resources from the new nuclear alternative would be SMALL to MODERATE.

3.5 Water Resources

This section describes surface water and groundwater resources at and around the Monticello site. The description of the resources is followed by the staff's analysis of the potential impacts on surface water and groundwater resources from the proposed action (SLR) and alternatives to the proposed action.

3.5.1 Surface Water Resources

Surface water encompasses all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and manmade reservoirs or impoundments.

3.5.1.1 Surface Water Hydrology

The NRC staff previously considered the interaction of Monticello's cooling and auxiliary water systems with the hydrologic environment in Sections 2.1.3, 2.2.2, and 2.2.3, of NUREG-1437, Supplement 26 for initial license renewal of the nuclear power plant (NRC 2006-TN7315).

In Sections 2.2.3, 3.6.1 and 3.7.1 of its ER, Xcel Energy provides a detailed description of the surface water environment of the Monticello site including the Mississippi River system, flooding potential, and related operational interactions between the Monticello nuclear power plant and surface water resources. The NRC staff incorporates this information here by reference. Except as otherwise cited for clarity, the staff summarizes this information here and in the following subsections. The NRC staff did not identify any new and significant information regarding the surface water affected environment during the site audit, the scoping process, or as the result of its review of available information as cited in this EIS.

Local and Regional Hydrology

The Mississippi River basin covers more than 1,245,000 mi^2 (3,224,535.2 km^2) and includes all or parts of 31 States and two Canadian provinces (USACE Undated-TN9629). The U.S. Geological Survey (USGS) has divided the Mississippi River into six sub-basins: the Upper Mississippi River, Lower Mississippi River, Arkansas Red-White River, Ohio River, Missouri River, and Tennessee River sub-basins. Monticello is located in the Upper Mississippi River drainage basin. The Mississippi River is the second longest river in North America, flowing approximately 2,300 mi (3,701.5 km) from its source at Lake Itasca in northern Minnesota through the center of the continental United States to the Gulf of Mexico (NPS 2022-TN9630). The Monticello site is located in the City of Monticello, Wright County, Minnesota, on the southern bank of the Mississippi River (River Mile [RM] 900) (NRC 2006-TN7315]). Figure 3-1 depicts the surface water features of the region in relation to Monticello. Near Monticello, the Mississippi River is broad and turbulent. The main channel is approximately 980 ft (298.7 m) wide, 6.2 ft (1.9 m) deep and river velocities can exceed 4.9 fps (Xcel 2023-TN9084).

The reach of the Mississippi River within the project area serves a variety of uses including recreation and domestic water supply. St. Cloud, located approximately 30 mi (48.2 km) upstream of Monticello, is the first city along the Mississippi River to obtain its drinking water from the river. The Minneapolis Water Works Reservoir also is supplied from the Mississippi River with its intake located approximately 37 mi (59.5 km) downstream of Monticello (Xcel 2023-TN9084). All portions of the Mississippi River within 6 mi (9.7 km) of Monticello are classified as "Recreational" (Xcel 2023-TN9084).

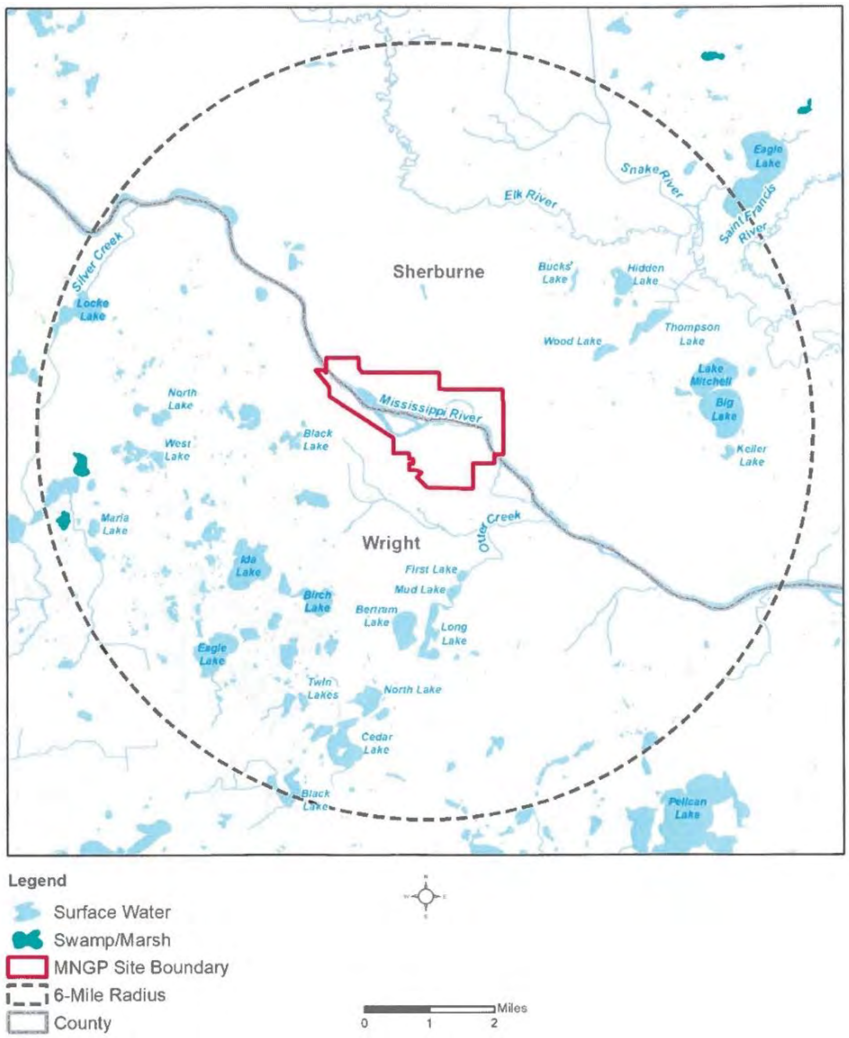


Figure 3-1 Regional Surface Water Features Associated with the Monticello Nuclear Generating Plant Site. Source: Xcel 2023-TN9084.

Hydrological conditions (e.g., river stage, discharge, depth, surface area, temperature, turbidity) of the Mississippi River near the Monticello site are subject to considerable seasonal variations. As shown in Table 3-6, the average daily discharges during spring run-off (April–May) are approximately 3 times higher than during the lower flow months (e.g., August–September). Table 3-6 contains monthly summaries of daily mean discharge data for the period between 1988 and 2023 from the USGS station (#05270700; St. Cloud) located 26 mi (41.8 km) upriver of the Monticello site (Xcel 2023-TN9084). The minimum daily flow recorded at this station of 553 cfs occurred on August 19, 2021. As discussed further in Section 3.5.3.1 of this EIS, this flow was part of a 6-day low flow event.

Table 3-6 Mississippi River Daily Water Discharges Near the Monticello Nuclear Generating Plant by Month from 1988–2023

Month	Avg. (cfs)	Max. (cfs)	Min. (cfs)	Avg. (m^3/s)	Max. (m^3/s)	Min. (m^3/s)
Jan	3,946	8,350	1,430	112	236	40
Feb	3,788	14,500	1,250	107	411	35
Mar	6,290	33,900	1,320	178	960	37
Apr	13,193	45,100	3,210	374	1,277	91
May	12,097	32,700	3,180	343	926	90
Jun	9,260	30,500	1,780	262	864	50
Jul	7,576	23,900	915	215	677	26
Aug	4,603	13,000	553	130	368	16
Sep	4,415	15,400	964	125	436	27
Oct	5,879	21,400	1,290	166	606	37
Nov	5,914	17,900	1,320	167	507	37
Dec	4,514	14,600	1,110	128	413	31

cfs = cubic feet per second; m^3/s = cubic meters per second.
Source: USGS 2024-TN9631, USGS 2024-TN9632, USGS 2024-TN9634.

3.5.1.2 Surface Water Use in the Last 5 Years

The Mississippi River supports a variety of commercial–industrial, public, and recreational uses. These uses include thermoelectric power production, irrigation, mining, water-based recreation, and public water supply.

Monticello withdraws Mississippi River water through its intake canal and intake structure for condenser cooling, service water cooling, screen washing, and fire protection, and returns the noncontact cooling water and permitted effluents to the river through the plant's discharge structure (see Section 2.1.3 and Figure2-2) (Xcel 2023-TN9084). Surface water withdrawals are governed by water appropriation limits set by the MDNR under Permit No. 66-1172.

Under typical river conditions, the circulating water system removes heat from the Monticello condenser by the once-through circulating water system. Under certain discharge canal temperature, river temperature, and river flow conditions, the circulating water system can use two mechanical draft cooling towers for partial or complete recirculation of the cooling water in compliance with permit limits. The operating modes for the circulating water system are required by the NPDES permit discharge limits and the Surface Water Appropriations Permit. The Surface Water Appropriations Permit allows Monticello to withdraw up to 645 cfs (or 290,000 gpm) of water from the Mississippi River, with special operating conditions if the river flow is less than 860 cfs, and further restrictions if river flow is 240 cfs or less.

Xcel Energy estimates a worst-case maximum total water consumption of up to 12 cfs assuming 150 days per year of cooling tower operation (Xcel Energy 2008-TN9536). Table 3-7 summarizes Monticello's actual annual surface water withdrawals from 2018 to 2022. Xcel Energy monitors Monticello's surface water withdrawals from the Mississippi River and submits annual reports to the MDNR. The data for 2021 and 2022 reflect withdrawals after the installation of new cooling towers. Xcel Energy determined that cooling tower use has an insignificant effect on the total consumptive use of surface water at Monticello (Xcel 2023-TN9084).The Water Appropriation Permit Program requires all users withdrawing more than 10,000 gallons (gal) of water per day or 1 million gallons per year (3.8 million liters per year) to have a water appropriation (water use) permit, and to submit annual water use reports to the MDNR.

Table 3-7 Surface Water Withdrawals, Monticello Nuclear Generating Plant, 2018–2022

Year	Average Withdrawal Rate (MGD)
2018	346.7
2019	333.6
2020	357.4
2021	290.2
2022	339.8
2018–2022	333.5

MGD = million gallons per day.
Source: Xcel 2023-TN9084, Xcel 2023-TN9578.

3.5.1.3 Surface Water Quality and Effluents

Water Quality Assessment and Regulation

In accordance with Section 303(c) of the Federal Water Pollution Control Act (i.e., Clean Water Act of 1972, as amended [CWA; 33 U.S.C. 1251-1387 TN662]), States have the primary responsibility for establishing, reviewing, and revising water quality standards for U.S. navigable waters. Such standards include the designated uses of a water body or water body segment, water quality criteria necessary to protect those designated uses, and an anti-degradation policy with respect to ambient water quality. As established under Section 101(a) of the CWA, water quality standards are intended to restore and maintain the chemical, physical, and biological integrity of the U.S. waters and to attain a level of water quality that provides for designated uses. The EPA reviews each State's water quality standards to ensure they meet the goals of the CWA and Federal water quality standards regulations (40 CFR Part 131-TN4814).

Section 303(d) of the CWA requires states to identify all "impaired" waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards in such waters. Similarly, CWA Section 305(b) requires states to assess and report on the overall quality of waters in their state. States prepare a CWA Section 303(d) list that identifies the water quality limited stream segments that require the development of total maximum daily loads (TMDLs) to assure future compliance with water quality standards. The list also identifies the pollutant or stressor causing the impairment and establishes a priority for developing a control plan to address the impairment. The TMDLs specify the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Once established, TMDLs often are implemented through watershed-based programs administered by the State, primarily through permits issued under the NPDES permit program, pursuant to Section 402 of the CWA, and associated point and nonpoint source water quality improvement plans and associated BMPs. States are required to update and resubmit their impaired waters list every 2 years, which ensures that impaired waters continue to be monitored and assessed by the State until applicable water quality standards are met.

Beginning in 2004, the MPCA began providing the Water Quality Integrated Report to the EPA. This report is intended to combine the requirements of CWA Sections 305(b) and 303(d) through a biennial abbreviated narrative report (MPCA 2021-TN9537).

The reach of the Mississippi River (between the Clearwater and Crow Rivers) where Monticello is located is classified as an "outstanding resource value water – restricted." This classification is assigned to high-quality waters and waters that have exceptional recreation, cultural, aesthetic, or scientific value for which new or expanded waste discharges are restricted (Xcel 2023-TN9084). The designated beneficial uses of this reach of the river are as follows (MPCA 2020-TN9538):

- domestic consumption (requires heavy treatment)
- aquatic life and recreation also protected as a source of drinking water – general warm water habitat (lakes and streams)
- industrial consumption (heavy treatment)
- agriculture and wildlife (irrigation)
- agriculture and wildlife (livestock and wildlife)
- aesthetic enjoyment and navigation
- other uses

In addition, this reach is listed by the MPCA as impaired for fish consumption due to polychlorinated biphenyls (PCBs) and mercury in fish tissue and impaired for aquatic recreation due to the presence of fecal coliform bacteria (MPCA 2022-TN9539).

Flooding

The Monticello site is located on the southern bank of the Mississippi River within the Upper Mississippi River drainage basin. Two types of flooding can occur within this drainage basin: open-water flooding and backwater flooding. When open-water conditions prevail, flooding is caused by runoff-producing rains or by melting snow, or by a combination of both. Backwater flooding usually is caused by ice jams in the river. The most serious flooding throughout the basin has been associated with excessive snowmelt and rainfall (Xcel 2021-TN9633).

As shown in Figure 3-2, the Federal Emergency Management Agency has delineated flood hazard areas in the vicinity of the Monticello site. Federal Emergency Management Agency has mapped most of the nuclear power plant site, including the entire main nuclear power plant complex encompassing the nuclear island as Uncus X (unshaded), which represents areas of minimal flood hazard and lies outside the 0.2 percent annual chance flood (500 year flood level). The discharge canal area, the shoreline of the Mississippi River, and some areas to the southeast of the Monticello complex are mapped as Zone AE (i.e., within the base floodplain, 1 percent annual chance flood). The finished plant grade (930 Mean Sea Level [MSL]) is about 25 ft (7.6 m) above the normal river level, 14 ft (4.3 m) above the highest recorded flood level, which occurred in the spring of 1965, and 10 ft (3 m) above the predicted 1,000 year flood (Xcel 2023-TN9084).

In accordance with the NRC's general design criteria (Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 , "Domestic Licensing of Production and Utilization Facilities"), nuclear power plant structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions.

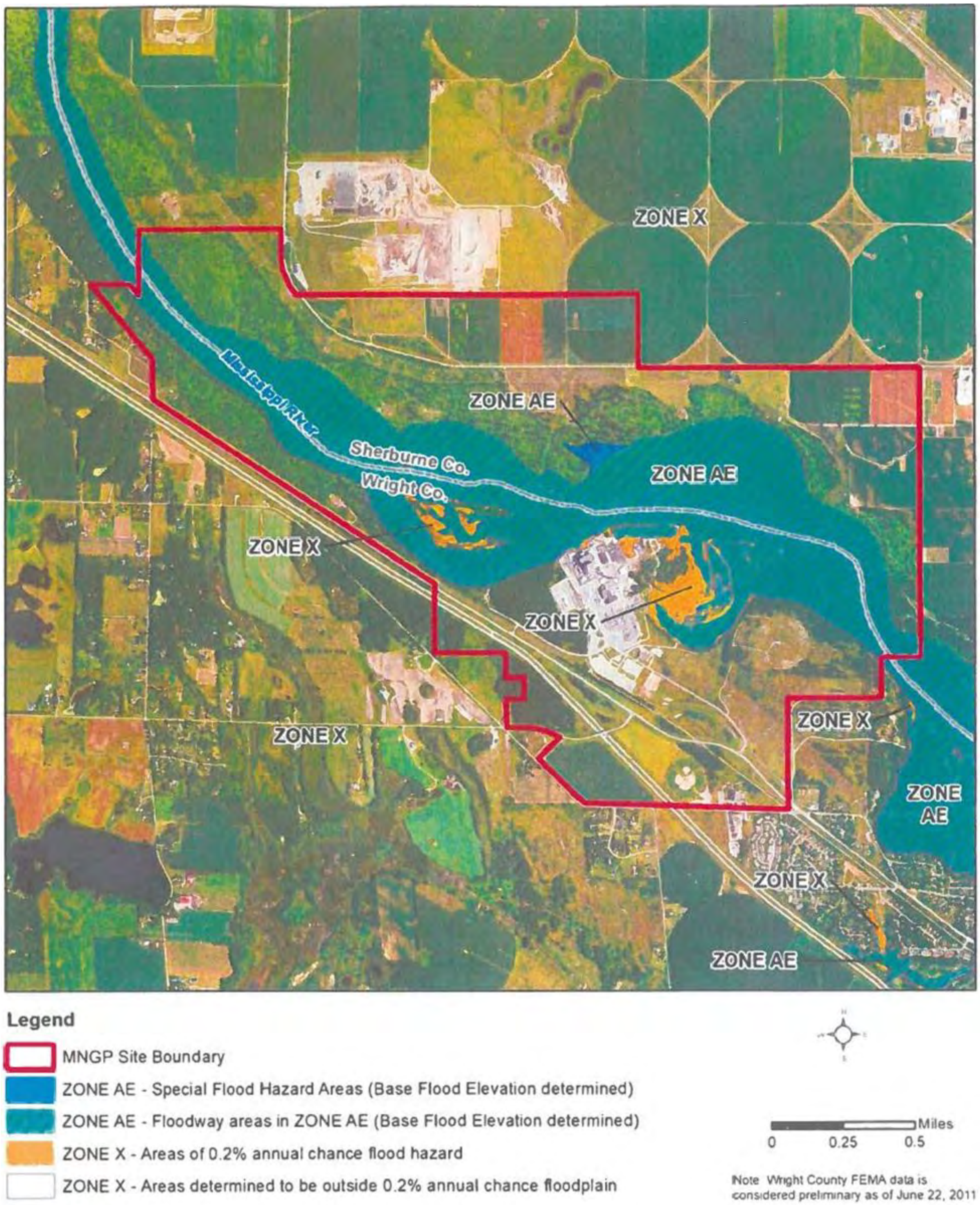


Figure 3-2 Federal Emergency Management Agency Floodplain Zones at Monticello. Source: Xcel 2023-TN9084.

Additionally, the NRC staff evaluates nuclear power plant operating conditions and physical infrastructure to ensure ongoing safe operations through its Reactor Oversight Process, which is separate from the NRC's license renewal review process. If new information about changing environmental conditions becomes available, the NRC will evaluate the new information to determine if any safety-related changes are needed. The NRC also evaluates new information important to flood projections and independently confirms that a licensee's actions appropriately consider potential changes in flooding hazards at the site.

To operate a nuclear power plant, NRC licensees must comply with provisions of the CWA, including associated requirements imposed by the EPA or the State, as part of the NPDES permitting system under Section 402 of the CWA. The Federal NPDES permit program addresses water pollution by regulating point sources (i.e., pipes, ditches) that discharge pollutants to waters of the United States. NRC licensees must also meet State water quality certification requirements under Section 401 of the CWA. The EPA or the State, not the NRC, sets the limits for effluents and operational parameters in plant-specific NPDES permits. Nuclear power plants cannot operate without a valid NPDES permit and a current Section 401 Water Quality Certification. The EPA authorized the State of Minnesota to administer the NPDES program in 1974.

Xcel Energy's NPDES permit (No. MN0000868) (Xcel 2023-TN9084, Xcel 2023-TN9578) provides a detailed description of the MPCA-permitted outfalls, effluent (water quality) monitoring requirements and a description of the main processes that contribute flow to each outfall. The NRC staff incorporates this information here by reference. NPDES permits are normally issued on a 5-year cycle. MPCA reissued Monticello's NPDES permit in May 2023. During its review of Monticello's application, MPCA determined that locations previously identified as surface discharge stations SD 003, SD 004, and SD 006 are better represented by designating these flows as internal waste streams WS 004, WS 005, and WS 006, respectively (Xcel 2023-TN9578). Based on its review, NRC staff did not identify any substantial changes in the 2023 permit conditions as compared to the previous issuance.

Surface discharge station SD 001 (see Figure 3-3) is an external outfall that represents the plant discharge out of the discharge canal to the Mississippi River and contains combined waste streams represented by monitoring stations WS 001, WS 002, WS 003, WS 004, and WS 006. Monticello's NPDES monitoring stations are summarized in Table 3-8. Depending on the station, Xcel Energy is required to monitor flow rate, pH, total suspended solids, oil and grease, total residual chlorine, cooling water intake and discharge temperatures, and other specified parameters. Xcel Energy's NPDES permit specifies the pollutant-specific discharge limitations and monitoring requirements for effluents discharged through each outfall/monitoring station to ensure that discharges from Monticello comply with applicable water quality standards. Xcel Energy must notify and seek approval from the MPCA before using any new water maintenance chemicals or to increase quantities used, because such changes could alter Monticello permitted effluent quality. Over the period of 2016 to August 2022, there have been no NOV or non-compliances associated with Monticello wastewater discharges to receiving surface waters (Xcel 2023-TN9084).

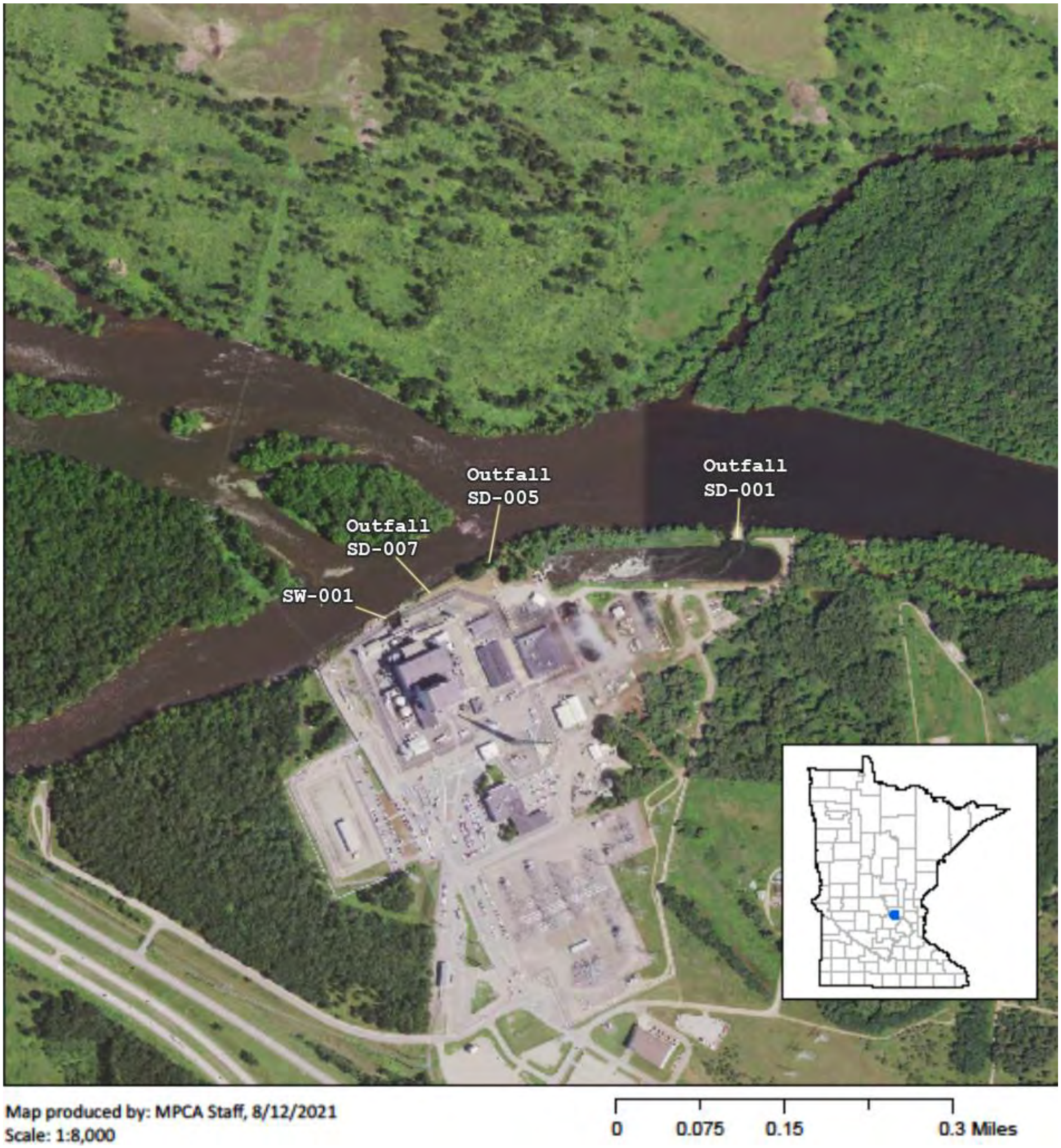


Figure 3-3 Monticello Nuclear Generating Plant External National Pollutant Discharge Elimination System Monitoring Locations. Adapted from: Xcel 2023-TN9084, Fig 3.6-3.

Table 3-8 Monticello Nuclear Generating Plant's National Pollutant Discharge Elimination System Monitoring Stations

Station	Type of Station	Local Name
SD 001	Effluent To Surface Water (Mississippi River)	Plant Cooling Water Discharge
SD 005	Effluent To Surface Water (Mississippi River)	Screen Backwash Discharge
SD 007	Stormwater, Non-specific Runoff	Plant Yard (Intake)
SW 001	Stream/River/Ditch, Upstream	Plant Cooling Water Intake
WS 001	Internal Waste Stream	Mid-downstream Discharge Canal
WS 002	Internal Waste Stream	Condenser Cooling Water
WS 003	Internal Waste Stream	Service Water
WS 004	Internal Waste Stream	Retention Pond Effluent Discharge
WS 005	Internal Waste Stream	Turbine Building Sump and Miscellaneous Discharge
WS 006	Internal Waste Stream	Screen Backwash and Stormwater Roof/Yard Drain

Source: May 2023 NDPES permit (Xcel 2023-TN9578).

Other Surface Water Resources Permits and Approvals

An applicant (in this case, Xcel Energy) for a Federal license to conduct activities that may cause a discharge of regulated pollutants into navigable waters of the United States is required by CWA Section 401 to provide the Federal licensing agency (in this case, the NRC) with water quality certification from the certifying authority (in this case, the State of Minnesota). This certification denotes that discharges from the project or facility to be licensed will comply with CWA requirements and will not cause or contribute to a violation of State water quality standards. If the applicant has not received Section 401 certification, the NRC cannot issue a renewed license, unless the State has otherwise waived the requirement.

In its ER, Xcel Energy provided copies of MPCA letters from 1973 and 1977 regarding CWA Section 401 certification. The 1973 MPCA letter issued the initial Section 401 certification to Monticello. The 1977 MPCA letter explicitly acknowledges that issuance of the NPDES permit by the State and compliance with that permit and any other applicable agreements by Monticello constitutes Section 401 certification. In a May 16, 2023, letter from MPCA to Xcel Energy, MPCA waived its Section 401 certification authority with respect to continued operations at Monticello during the SLR term; this letter also confirmed that the 1973 Section 401 certification remains valid for continued operations during the proposed SLR term (MPCA 2023-TN9835).

CWA Section 404 governs the discharge of dredge and fill materials to navigable waters, including wetlands, primarily through permits issued by the U.S. Army Corps of Engineers (USACE) and applicable state-level permitting programs. Monticello holds both a USACE regional general permit (RGP-003-MN) and a MDNR State dredge permit (1967-0743) to conduct maintenance dredging activities in the intake canal and Mississippi River. Monticello's NPDES/SDS permit contains reporting requirements and additional details related to dredged material management.

3.5.2 Groundwater Resources

This section describes the groundwater flow systems (aquifers) and groundwater quality in and around Monticello. Aquifers are a geologic formation, group of formations, or part of a formation that contain sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

3.5.2.1 Local and Regional Groundwater Resources

Sections 3.5.2 and 3.6.2 of the Xcel Energy ER (Xcel 2023-TN9084) describe the geology and groundwater resources, respectively, in the vicinity of Monticello. The NRC staff also evaluated information related to the groundwater resources during the site audit, the scoping process, and during its review of other available information as cited in this EIS.

Monticello, located in Wright County, is in the central groundwater province of Minnesota (MnDNR 2021-TN9636). The region was subject to multiple advances of continental glaciers over the past 2.6 million years (USGS 1992-TN9637). The glacially deposited sediments comprise the surficial aquifer system, which includes permeable layers of sands and gravels that are the primary supply of groundwater in the region (Xcel 2023-TN9084). In this region of Minnesota, glacial sediments are underlain by the Cambrian-Ordovician aquifer system (consisting of one or more hydraulically connected aquifers) that regionally consists of a sandstone and dolomite aquifer and two sandstone aquifers interbedded by less permeable units (USGS 1992-TN9637). The Cambrian-Ordovician aquifer system is a major source of groundwater in southeastern Minnesota for public, domestic, agriculture, and industrial uses (USGS 1992-TN9637). The Cambrian-Ordovician aquifer system overlies a crystalline-rock aquifer of low water-bearing capacity (USGS 1992-TN9637).

As described in Section 3.4.1 of this EIS, Monticello is underlain by unconsolidated sediments of fill, river terrace deposits, an upper sandy till, glacial outwash, and a lower clay till. These sediments range in depth from 40 to 110 ft bgs (12.2 to 33.5 m bgs) (Xcel 2023-TN9084). Groundwater in the surficial aquifer occurs at a depth from 10–40 ft bgs (3.0–12.2 m bgs) at the site and is typically found in the terrace or outwash sediments (Xcel 2021-TN9633).The saturated thickness of the surficial aquifer is approximately 15 ft (4.6 m), terminating in the lower clay till layer (Xcel 2023-TN9084). The low-permeability lower clay till confines the underlying Mount Simon-Hinckley sandstone bedrock aquifer onsite (the lower most unit of the Cambrian-Ordovician aquifer system). The sandstone aquifer ranges in thickness between 10 and 25 ft (3.0–7.6 m) at the site (thickening to the east) and has been eroded variably, with some areas completely eroded to the underlying granitic crystalline-rock aquifer (Xcel 2023-TN9084).

The outwash sediments (predominantly sands and gravels) that form the surficial aquifer in the region of Monticello can yield up to 1,000 gpm with sufficient saturated thickness (Lindholm 1980-TN9703). Tests performed by the USGS in Benton, Sherburne, Stearns, and Wright counties resulted in specific yield values ranging from 0.01–0.32 within the unconfined sediments. The average specific yield of these tests was 0.17 and the nearest well tested to Monticello (4 mi [6.4 km] northwest) resulted in a high specific yield of 0.29. The range of specific yields for water table aquifers is expected to be 0.05–0.30 (Lindholm 1980-TN9703).

Within Wright County, spring snowmelt and precipitation are the primary sources of groundwater recharge (Barry 2018-TN9638). Water generally flows toward the Mississippi River in the surficial aquifers, while deeper bedrock groundwater flow tends to be to the southeast regionally (Xcel 2021-TN9633). At Monticello, a similar trend in groundwater flow is observed with some variation due to interference from plant structure foundations (Xcel 2023-TN9084). Typical groundwater flow within the unconsolidated sediments is north toward the Mississippi River in the western area of the site. In the central to eastern areas of the site, several factors cause groundwater to flow in a more north-easterly direction, including shallow groundwater intersecting the reactor and turbine buildings, the geologic transition from glacial outwash to clayey till, and the natural curvature of the river (Xcel 2023-TN9084). Figure 3-4 depicts groundwater contours and flow direction in June and December 2020.

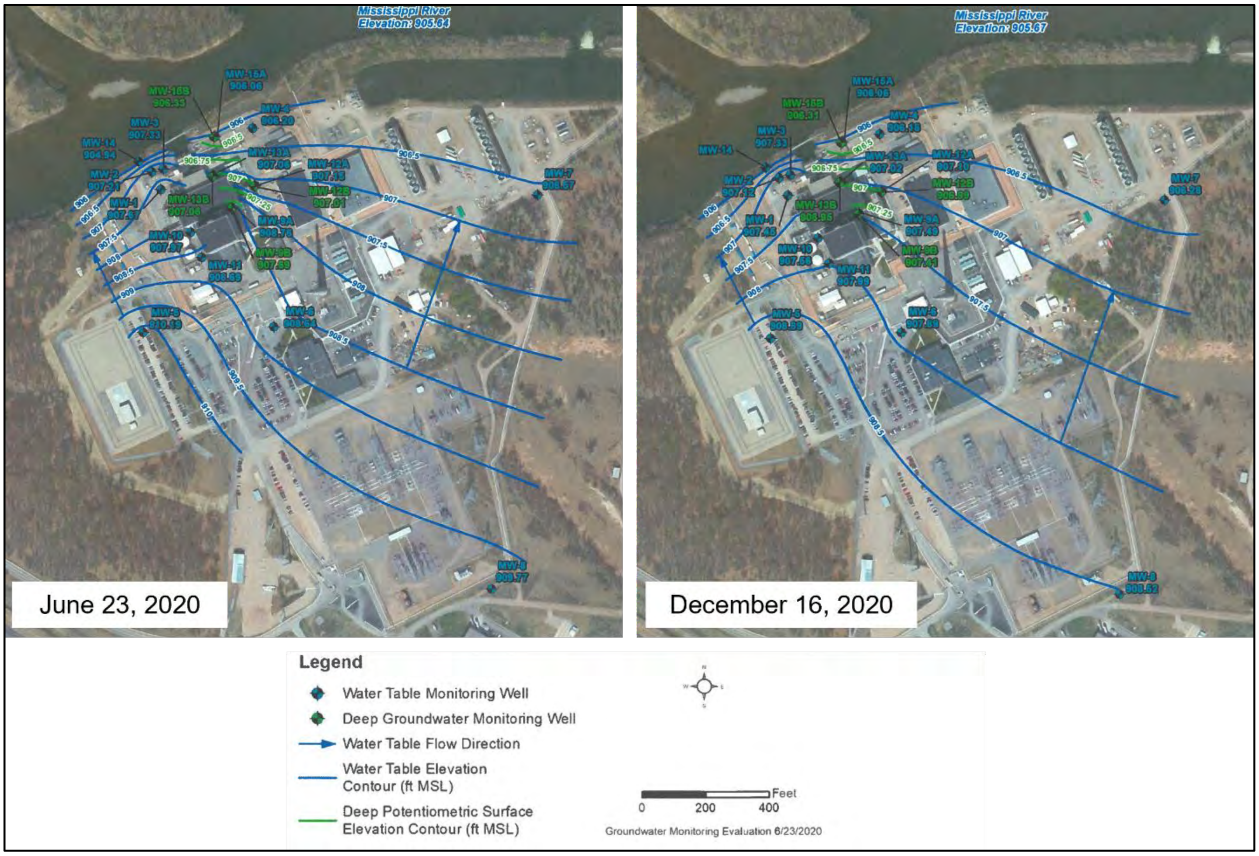


Figure 3-4 Groundwater Elevation Contours and General Groundwater Flow Direction in Shallow and Deep Aquifers in June and December 2020. Source: (Xcel 2023-TN9084).

Monitoring wells are screened in the unconsolidated sediments except for the deep (B-series) wells, which are screened in the upper weathered bedrock (Xcel 2023-TN9084). During high river stage periods, the direction of groundwater flow in the surficial aquifer near the river may reverse as river water flows into the shallow sediments (Xcel 2023-TN9084).

Hydraulic property data were collected in 14 Monticello monitoring wells and used to calculate groundwater flow velocities that ranged from 0.12–0.71 ft/day (0.037–0.22 m/day) in the surficial aquifer near the main plant structures and from 0.82–1.06 ft/day (0.25–0.32 m/day) in the deeper bedrock aquifer (Xcel 2023-TN9084: Table 3.6-2). These groundwater velocities were estimated using an average groundwater elevation gradient of 0.003. Based on the groundwater elevations shown in Figure 3-4, the average gradient between the main plant buildings and the river could be larger than 0.003, which would result in larger groundwater velocities. Estimated groundwater velocity in the bedrock aquifer is larger than in the surficial aquifer because the porosity of the sandstone is lower than that of the unconsolidated sediments comprising the surficial aquifer.

Monticello is not situated within the boundary of an EPA-designated sole source aquifer, the nearest of which is approximately 49 mi (78.9 km) to the north (EPA 2023-TN9841).

3.5.2.2 Local and Regional Water Consumption

The surficial aquifer system supplies the majority of groundwater (72 percent) in Wright County (Barry 2018-TN9638). Potential well yields of the surficial aquifer system range from 10 to 500 gpm (38–1,900 Lpm) in the region depending on local saturated thickness and sand content of the aquifer (USGS 1992). Bedrock aquifers provide the remaining groundwater use in Wright County. Wells finished in the sandstone aquifer have been rated to pump up to 2,000 gpm (7571 Lpm) (Xcel 2021-TN9633). Municipal/public water supply is the predominant use of groundwater in Wright County, followed by irrigation (Barry 2018-TN9638). The public supply well nearest to Monticello is registered to the River Terrace Mobile Home Park, which serves approximately 250 people and is approximately 2 mi (3.2 km) southeast of the plant, (MnDH 2018-TN9640). The City of Monticello uses groundwater from the surficial aquifer system and sandstone aquifer for public water supply (Barry 2018-TN9638).

There are approximately 178 registered groundwater wells within a 2 mi (3.2 km) radius of the Monticello power block area, not including the onsite groundwater monitoring and supply wells (Figure 3-5) (MnDH 2022-TN9641). The nearest registered well to Monticello is a domestic water well, 0.6 mi (1 km) southwest of the center of the site, completed to a depth of 28 ft (85 m) below ground level in fine sand (Xcel 2023-TN9084: Table 3-6.9). Most registered wells are completed within the surficial aquifer system for domestic use. Shallow (less than 30 ft [9.1 m]) unregistered wells completed in the surficial aquifer and used for small amounts of domestic water supply may be present within Wright County (Barry 2018-TN9638).

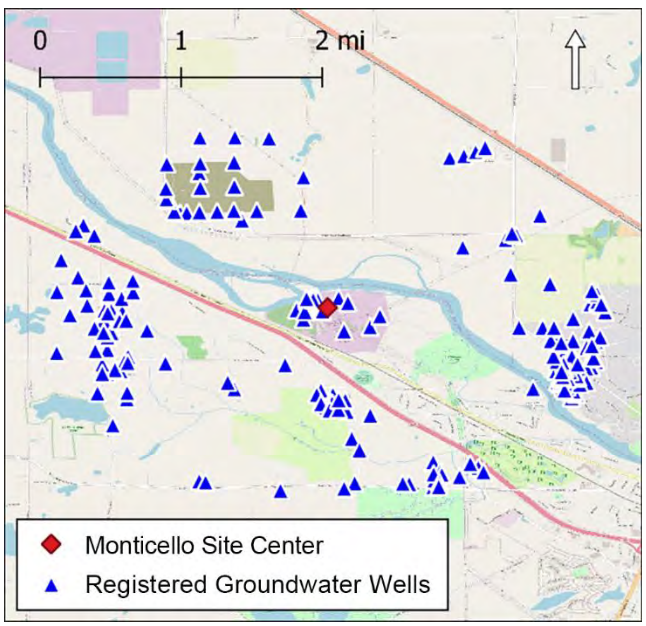


Figure 3-5 Registered Groundwater Wells within 2 mi (3.2 km) Radius of the Monticello power block area. Adapted from MnDH 2022-TN9641.

Monticello withdraws onsite groundwater to provide water for potable use, purified water production, and other plant system requirements (Xcel 2023-TN9084). Groundwater withdrawals are regulated under MDNR water appropriations permit No. 67-0083 (Xcel 2023-TN9084). The groundwater supply system is composed of two onsite wells, Well numbers 2 and 4 (alternate designations of Well #11 and Well #12, respectively), that are permitted to withdraw up to 20 million gallons per year (75.7 million liters per year) at a maximum combined total rate of 200 gpm (378.5 Lpm). From 2016–2022, withdrawals from the two onsite supply wells averaged approximately 11.2 million gallons per year (42.4 million liters per year), or 21.3 gpm (80.6 Lpm) total (Xcel 2023-TN9578). These wells withdraw water from the sandstone aquifer.

An additional five onsite groundwater wells actively supply domestic water, as needed, to a site warehouse and administration building. These wells each use less than 1 million gallons per year (3.8 million liters per year) and are not required to be permitted. Except for Well #3, which withdraws water from the sandstone aquifer, these wells access the surficial aquifer system. Locations of Monticello onsite water supply wells are shown in Figure 3-6.

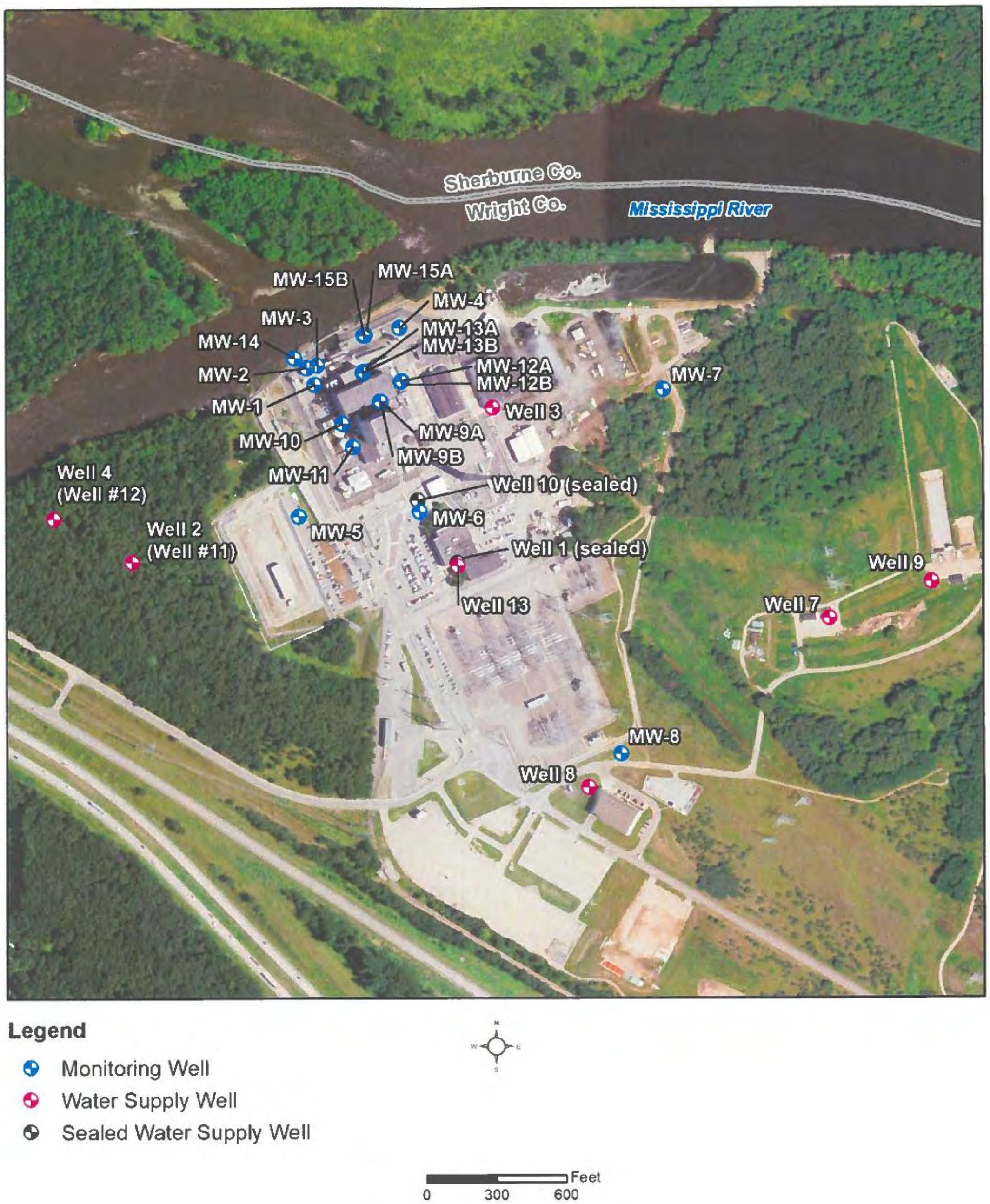


Figure 3-6 Monticello Nuclear Generating Plant Onsite Supply Wells, 2020 (Xcel 2023-TN9084). Note: Monitoring Wells Have Been Updated in 2022 and 2023.

3.5.2.3 Groundwater Quality

Groundwater in unconsolidated glacial deposits and the Mt. Simon-Hinckley Aquifer is typically rich in calcium, magnesium, and bicarbonate. The dissolved solids concentration increases with depth but is usually less than 500 mg/L (Albin and Bruemmer 1987-TN9643). Groundwater in Minnesota is impacted locally by the predominant land use type. Urban areas are affected by chloride, volatile organic carbon compounds, and emerging contaminants of concern (e.g., persistent contaminants), while elevated nitrate concentrations are found in agricultural areas (Kroening, and Vaughan 2019-TN9644).

Nonradiological Releases

Xcel Energy controls the use and storage of chemicals at Monticello in accordance with site-specific spill prevention plans and best management practices in accordance with its NPDES permit (No. MN0000868) (Xcel 2023-TN9578). From 2016 to July 18, 2023, Xcel Energy reported two inadvertent nonradioactive releases (Xcel 2023-TN9578, Xcel 2023-TN9084). On August 4, 2016, the Minnesota Department of Health issued an NOV for sampled carbon tetrachloride concentrations (13.5 micrograms per liter [µg/L]) that exceed the maximum contaminant level for drinking water (5 µg/L) (Xcel 2023-TN9084). The elevated carbon tetrachloride levels were detected in Well #10, which supplied water to the security access facility at Monticello. In response, a new connection to Well #1 was installed to replace the water supply for the security access facility. Following a site investigation in 2018, no known source of carbon tetrachloride was identified, and the impacted area was determined to be limited to the vicinity of Well #10. In 2020, Well #10 was sealed, and Xcel Energy committed to preventing the installation of new water supply wells in the vicinity of Well #10 (Xcel 2023-TN9084). Well #1 was also sealed in 2020 due to low productivity, unrelated to the elevated carbon tetrachloride levels detected in Well #10 (Xcel 2024-TN9860). Well #1 was replaced with Well #13, which was installed in December 2020 (Figure 3-6)(Xcel 2023-TN9084).

On July 16, 2019, a flange between two valves in the service water sodium hypochlorite injection system leaked approximately 300 gal (1136 L) of water into the building containing the injection system. While most of the spill volume was contained within the building by a berm, approximately 0.5 gal (1.9 L) drained to Outfall SD001, which returns to the Mississippi River. A release sampling report was submitted to the MPCA. No further action was required by the MPCA (Xcel 2023-TN9084).

Groundwater Protection Program

Based on the Industry Groundwater Protection Initiative (NEI 2019-TN6775), a Groundwater Protection Program (GWPP) was implemented at Monticello in 2008 to ensure timely and effective management of situations involving inadvertent releases of licensed material to groundwater (Xcel 2023-TN9084). As part of the GWPP, Monticello monitors groundwater via onsite monitoring wells for tritium, gamma-emitting nuclides, difficult to detect radionuclides, environmental conditions, and groundwater elevation in accordance with their site-specific procedures. Under normal conditions, monitoring locations are sampled monthly, quarterly, or annually, with tritium and gamma-emitting nuclides tested quarterly at locations more prone to leak or spill detection. Locations near to higher-risk systems, structures, and components are monitored monthly for tritium and quarterly for gamma-emitting nuclides (Xcel 2023-TN9084: Table 3.6-10). Results of the GWPP monitoring are submitted to the NRC in annual monitoring reports and are discussed in the sections below.

Radiological Releases

The GWPP at Monticello established a baseline threshold for measured tritium concentrations based on historical precedent. At monitoring locations where tritium is consistently measured below limits of detection, the baseline threshold for a determination that tritium is above background levels is set at 400 pCi/L. If concentrations meet or exceed 1,200 pCi/L (three times the baseline) in these wells, additional action is taken to identify the source of the change in activity and any corrective actions necessary (Xcel 2023-TN9084). By comparison, the EPA's maximum contaminant level (the highest level of a contaminant that is allowed in drinking water) for tritium is 20,000 pCi/L. As part of the GWPP, Monticello considers six monitoring wells (MW-2, MW-3, MW-4, MW-14, MW-15A, and MW-15B) as "sentinel" wells that would act as a first indication of radioactive material migrating offsite to the Mississippi River (Xcel 2023-TN9596)

Annual Radiological Effluent Release Reports are submitted to the NRC (per 10 CFR 50.36a) to report the quantities of radionuclides released from liquid and gaseous effluents and the results of groundwater monitoring under the GWPP (Xcel 2023-TN9596, Xcel 2022-TN9595, Xcel 2021-TN9597, Xcel 2020-TN9598, Xcel 2019-TN9599). The NRC staff reviewed 5 years of available radiological release reports (2018–2022 monitoring results). While no radioactive materials due to plant operations were detected in offsite samples from 2018–2022, elevated tritium concentrations have been measured on site at well MW-9A since 2009 (Xcel Energy, 2019 - 2023 ARERRs). An additional release of effluent containing elevated tritium activity was reported in November 2022. Incidents are summarized below.

Historical Tritium Detection in Well MW-9A

Monitoring well MW-9A was installed in September 2009, and initial sample results indicated elevated tritium levels (average of 9,117 pCi/L, maximum of 21,727 pCi/L in 2009), see Figure 3-7 (Certrec 2009-TN9840). Investigations into the source of the elevated activity identified tritiated process water from the Turbine Building that likely migrated through the building's concrete basemat into the groundwater (Xcel 2023-TN9084). Corrective actions were taken in 2011, including installing sump linings and discontinuing the use of embedded piping. After those corrective actions were completed, average tritium activity at MW-9A from 2012–2021 ranged between 306 and 4,147 pCi/L (Figure 3-7).

Prior to 2022, the plume of tritiated groundwater in the vicinity of MW-9A was considered to be located under the turbine building and predominantly stagnant, evidenced by the lack of tritium measured in down-gradient wells (Xcel 2023-TN9084). The hydraulic setting of Monticello along the Mississippi River results in changes in hydraulic gradient depending on seasonal fluctuations in groundwater and river stage, thus resulting in periods of groundwater flow reversal that could cause fluctuations in the tritium activity measured in well MW-9A (Xcel 2023-TN9084). As described in Section 3.5.2.1 of this EIS, groundwater flow patterns are affected by building foundations that may affect the movement of tritium in the vicinity of MW-9A toward the Mississippi River.

2022 Tritium Release to Groundwater

On November 23, 2022, Monticello notified the State of Minnesota and the NRC that a sample result for tritium from an onsite monitoring well was above the ODCM and GWPP reporting levels (NRC 2022-TN9600). As part of the environmental audit process, Xcel Energy provided a timeline of events, including corrective actions taken and groundwater sample data covering the interval from the initial identification of the leak to August 2023 (Xcel 2023-TN9609). The NRC staff analyzed the provided information and publicly available information.

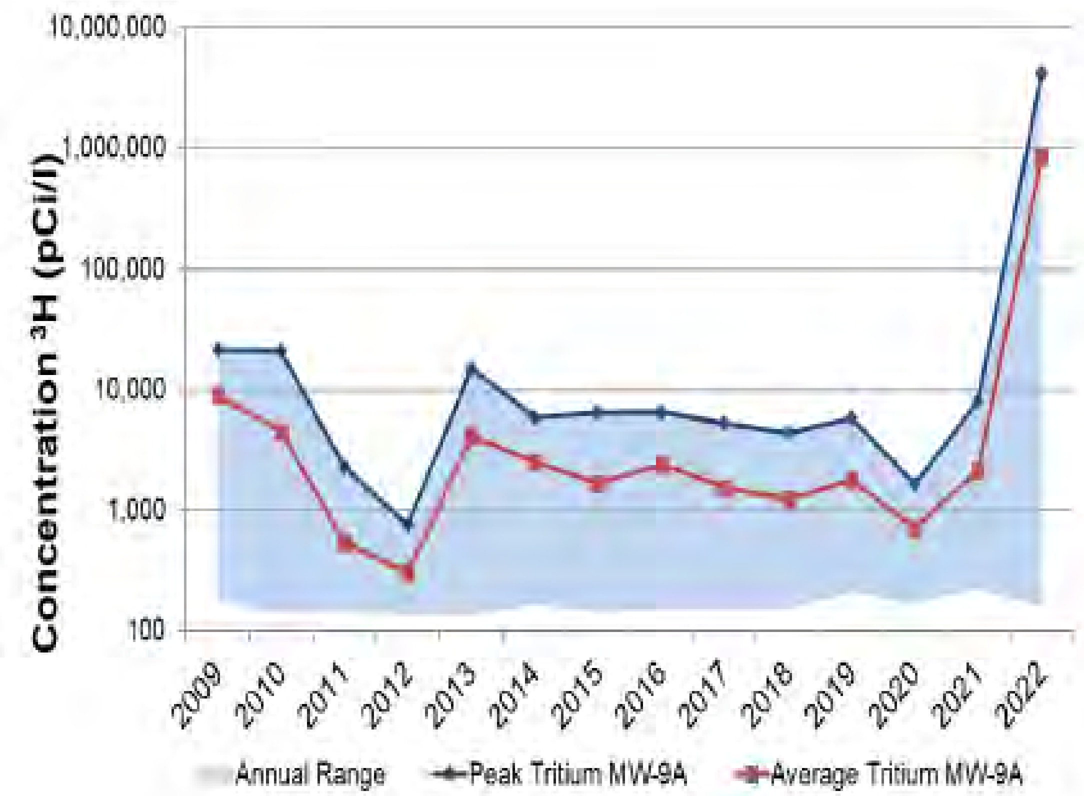


Figure 3-7 Tritium Concentrations at Well MW-9A between 2009–2022 from the 2022 Monticello Annual Radioactive Effluent Release Report (Xcel 2023-TN9596)

On November 21, 2022, a sample from MW-9A recorded a tritium concentration of 5,020,000 pCi/L (Xcel 2023-TN9609). Additional sampling the following day confirmed the elevated tritium level at MW-9A, and a voluntary notification was sent to the State of Minnesota and the NRC on November 22, 2023 (NRC 2022-TN9600). The notice states no impact to the health and safety of the public or plant personnel was identified. Samples from MW-9A were also analyzed for I-131, I-133, I-135, Xe-133, and Xe-135 (Xcel 2023-TN9609). The maximum non-tritium isotope activity recorded was 147 pCi/L for I-133. Additional groundwater sample results from March 28 to September 18, 2023, did not detect non-tritium radionuclides in groundwater.

On December 21, 2022, Xcel Energy identified the leak location as a 3 in. (7.62 cm) condensate to control rod drive (CRD) suction line pipe between the reactor building and the turbine building. Diversion of the leak effluent using a catchment system coupled with a groundwater recovery system (0.5–2 gpm) at wells MW-9A, MW-9B, and MW-12A was initiated in January 2023. The effluent was directed to holding tanks, waste process systems, and/or reused onsite (Xcel 2024-TN9645). On March 23, 2023, sampling results indicated the effluent was no longer contained within the catchment system. The plant was fully shut down, and on March 25, 2023, the CRD suction pipe was removed and replaced (Xcel 2023-TN9609). Additionally, beginning in December 2022, Monticello expanded the network of onsite monitoring wells to better assess the extent of the tritium plume. As of August 2023, there were 55 onsite monitoring wells.

On May 23, 2023, Xcel Energy provided an additional notice to the State of Minnesota and the NRC to report a release of 300–600 gal of water with a tritium activity of 194,000 pCi/L from a holding tank associated with the ongoing remediation efforts (NRC 2023-TN9610; Xcel 2023-TN9609). The water was released back to the area from which it was pumped, and no impact to the health and safety of public or plant personnel was identified.

Corrective action measures are ongoing to recover the tritium plume in onsite groundwater and minimize the discharge of tritiated groundwater to the Mississippi River. Eight pumping wells for tritium extraction have been installed since the detection of the leak, two of which were monitoring wells that were over-drilled and converted to pumping wells (Xcel 2023-TN9609). A storage pond was constructed for managing recovered groundwater with elevated tritium activity. A water balance analysis estimated the volume of water released into the subsurface from the initial leak to be 829,000 ±68,100 gal (3,138,106 ± 257,786 L), with a total activity of 14.0 ±1.2 Ci (99 percent of the activity from tritium) (Xcel 2023-TN9609). As of October 2023, approximately 6.6 million gal (25 million L) of tritium-contaminated groundwater had been pumped from onsite wells (Xcel 2023-TN9609) (see Figure 3-8). The overall average pumping rate across all wells from January–October 2023 was 1.3 gpm (4.9 Lpm). Monthly average pumping rates at individual wells did not exceed 16 gpm (60.6 Lpm) (Xcel 2023-TN9609).

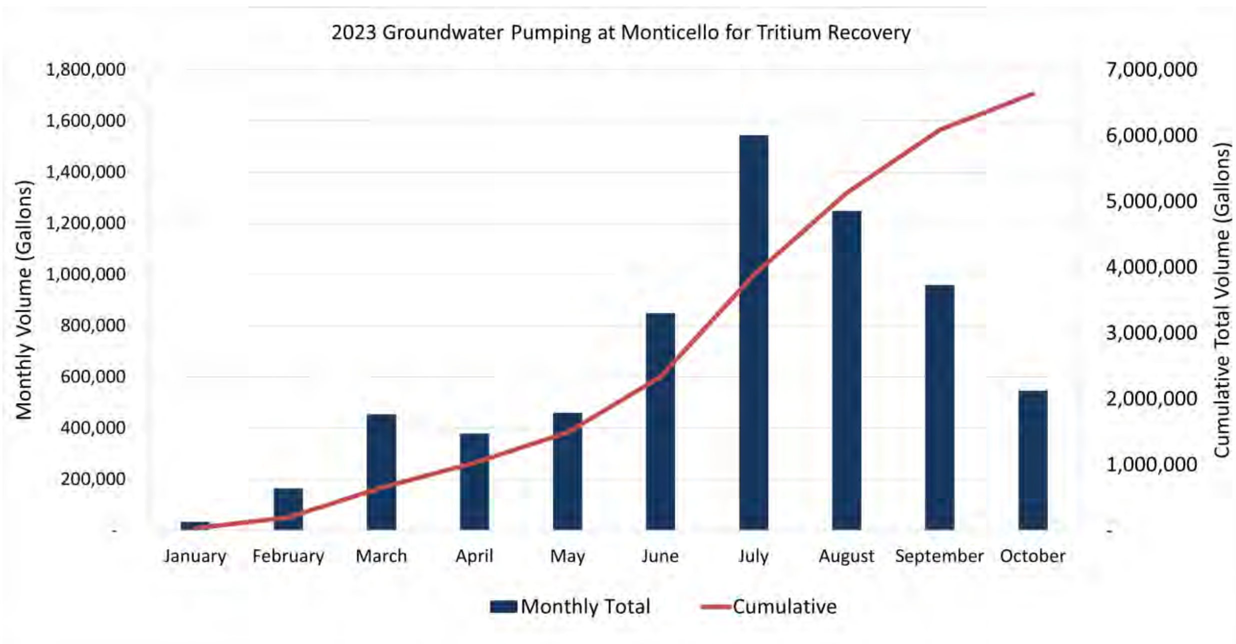


Figure 3-8 Monthly and Total Cumulative Volume of Groundwater Pumped during January–October 2023 for Tritium Recovery. Based on Data From (Xcel 2023-TN9609).

Figure 3-9 depicts the monitoring and pumping wells on site at Monticello as of August 18, 2023, as well as the storage pond location. Figure 3-10 shows the locations of wells in greater detail along with the estimated extent of tritium-impacted groundwater as of August 2023.

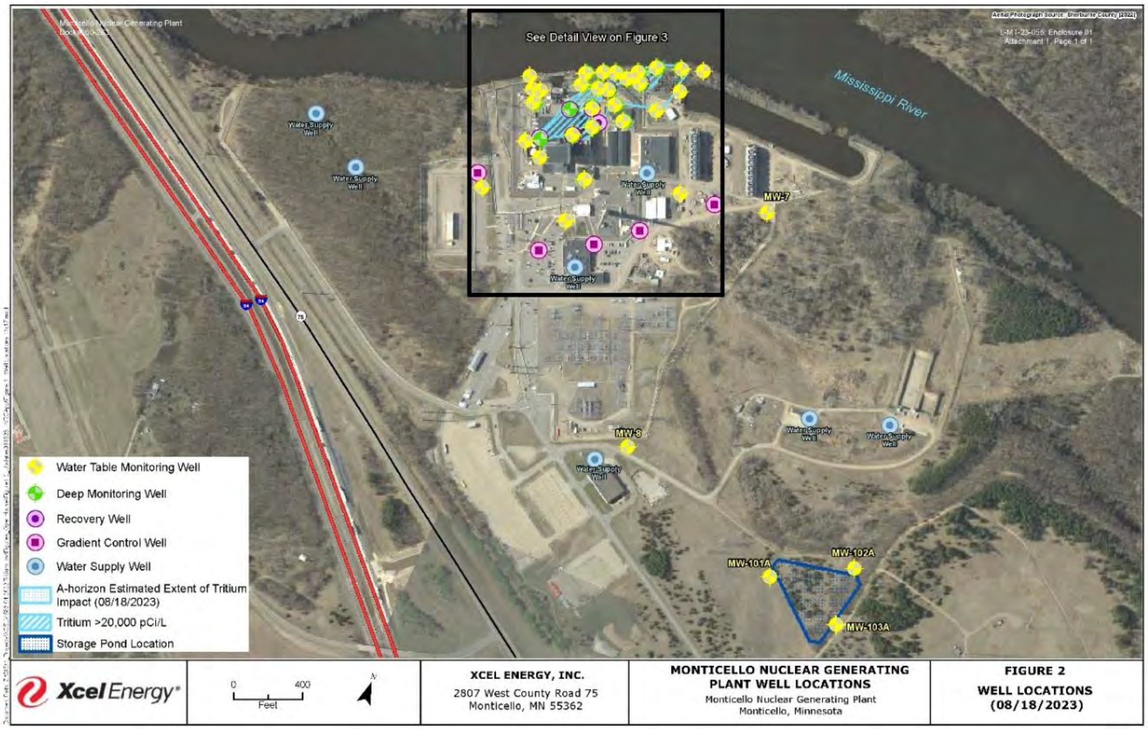


Figure 3-9 Updated Monticello Well Locations and Location of Storage Pond (Xcel 2023-TN9609)

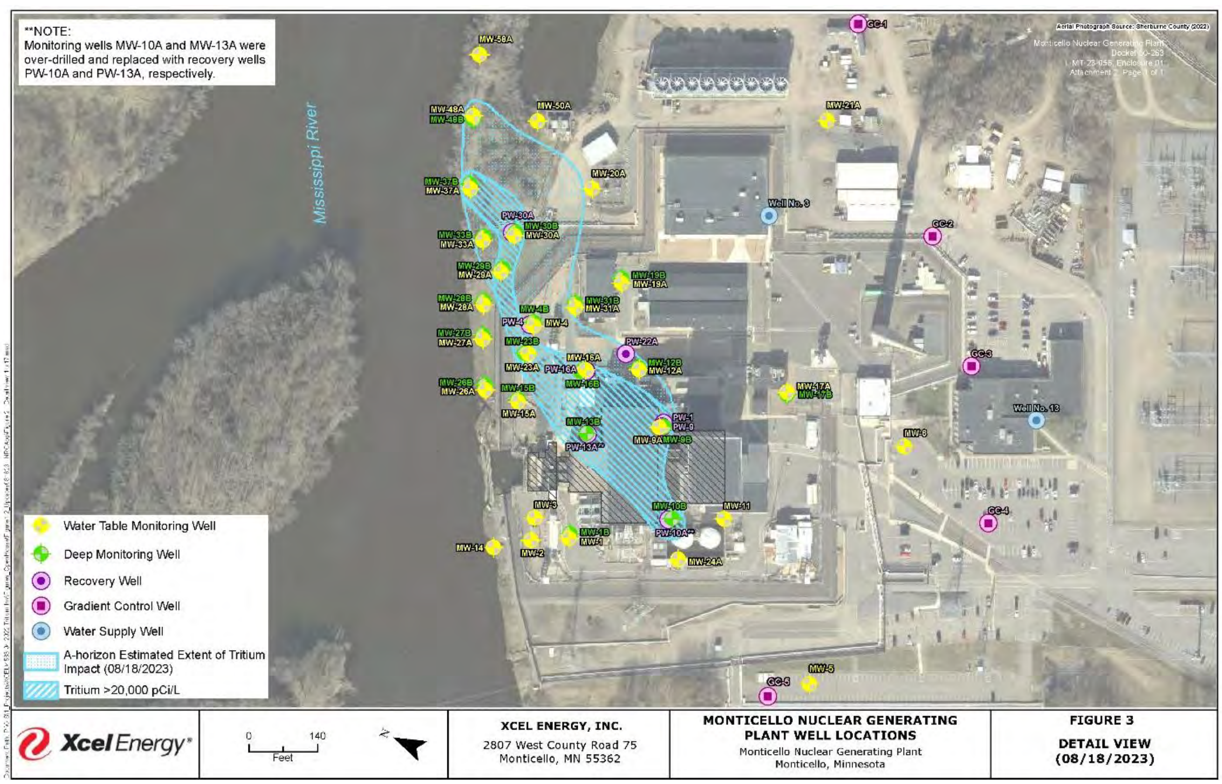


Figure 3-10 Extent of Tritium-impacted Groundwater and Locations of Monticello Wells as of August 2023 (Xcel 2023-TN9609)

In addition to extracting tritiated groundwater, a sheet pile wall was constructed at Monticello near the Mississippi riverbank to minimize tritium discharge from groundwater into the river (Xcel 2024-TN9645). The sheet pile wall extends from the southern end of the discharge structure to the intake canal. As of August 30, 2023, five gradient control wells have been installed on the eastern boundary of the site (Figure 3-9). These wells are intended to intercept clean, inflowing groundwater and maintain the onsite groundwater levels below the top of the sheet pile wall to help contain tritium-contaminated water to the Monticello site. Pumping is not intended to permanently draw down groundwater levels (Xcel 2024-TN9859) but is anticipated to be needed only during those times when the groundwater levels are relatively high. The rate of pumping from the gradient control wells will depend onsite groundwater levels, which are expected to vary between 50 and 150 gpm (189–568 Lpm) at each well (Xcel 2024-TN9859). Well GC-5 did not yield sufficient water during a pump test and was determined to be infeasible for gradient control use (Xcel 2024-TN9859). Water Appropriation Permit No. 2023-2958 specifies maximum withdrawal limits and monitoring and reporting requirements Xcel 2024-TN9859. Water pumped from the gradient control wells must be discharged to the intake canal, or temporarily to the plant discharge canal.

Monitoring data from the initial leak detection on November 11, 2022, to August 2023 indicates a downward trend in tritium activity for the groundwater most impacted by the release. Figure 3-11 presents measured tritium concentrations at monitoring wells MW-9A (more shallow groundwater) and MW-9B (deeper groundwater). Groundwater recovery pumping began at both wells in January 2023. Pumping ceased first at MW-9B in April, followed by MW-9A in June. By mid-May, tritium concentrations in MW-9B were consistently measured to be below 20,000 pCi/L (the drinking water standard) but have not returned to background levels. Concentrations at MW-9A have decreased overall, but remain elevated well above 20,000 pCi/L.

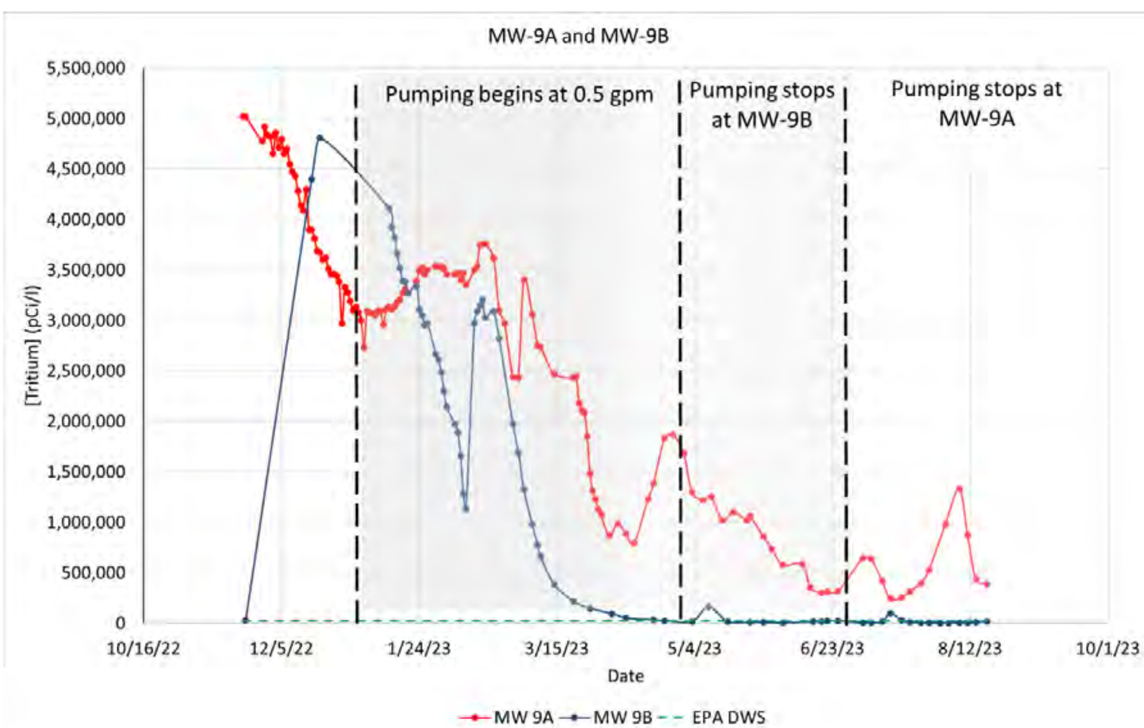
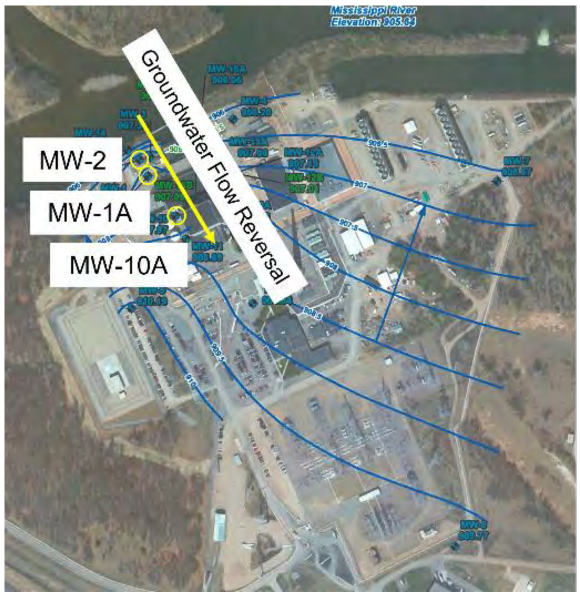


Figure 3-11 Measured Tritium Activities at Groundwater Monitoring Wells MW-9A and MW-9B. Based on Data from Xcel 2023-TN9609.

Under normal site hydraulic conditions, groundwater flow is toward the Mississippi river, as described in Section 3.5.2.1. Onsite groundwater is hydraulically connected to the river; therefore, groundwater flow reversal can occur due to changes in hydraulic gradient during periods of high river stage. Hydraulic gradient reverses onsite when the river level rises above the groundwater table and river water flows into the aquifer. A period of groundwater reversal is highlighted in Figure 3-12. River stage rose 7.57 ft (2.3 m) between April 2 and April 10, 2023. As shown in Figure 3-12, groundwater levels in monitoring wells closer to the river (MW-2 and MW-1A) are more responsive to rising river levels than wells further away from the river (MW-10A). This indicates groundwater flow is temporarily occurring from the river toward the plant buildings. As the river level rapidly declines, the hydraulic gradient reverses back toward the river, resuming normal groundwater flow conditions from the plant towards the river.



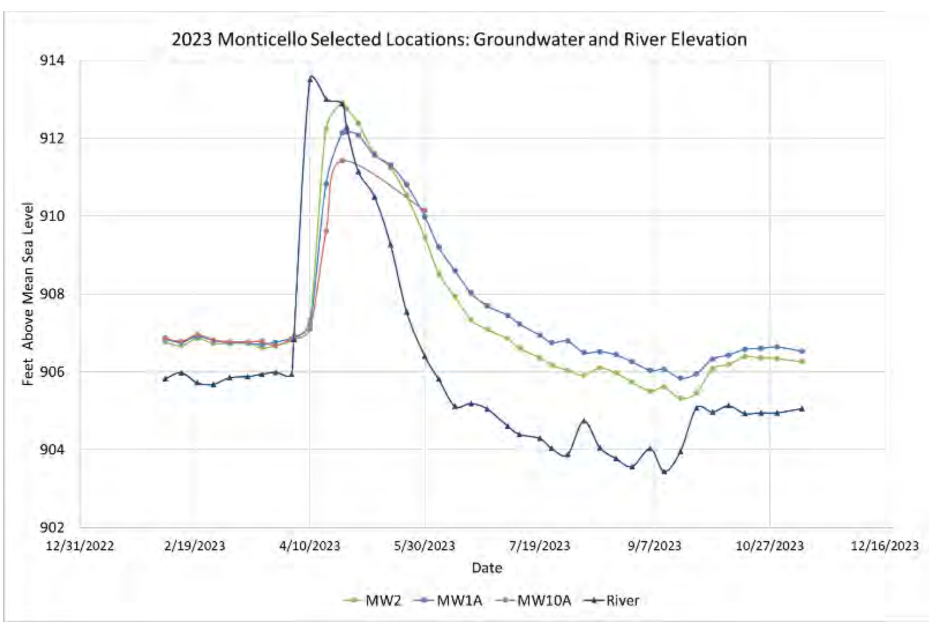


Figure 3-12 Groundwater Elevations in Response to Changes in River Stage (Xcel 2023-TN9084; Xcel 2023-TN9609)

The period of groundwater flow reversal in April and May 2023 helps explain some of the observed changes in tritium activities, like the explanation of the historical behavior of measured tritium concentrations at MW-9A from 2009–2021. During a groundwater flow reversal, tritium concentrations may increase in wells that are normally upgradient from the tritium plume. Figure 3-13 depicts the behavior of tritium concentrations at MW-10A, which is upgradient of the November 2022 tritium release location under normal groundwater flow conditions, in response to a groundwater gradient reversal. Tritium activity at MW-10A rapidly increased during the groundwater flow reversal and began to decline once normal flow was restored. As shown in Figure 3-10, the tritium plume does not extend further upgradient of MW-10A (i.e., no elevated tritium activity has been measured at MW-11).

Figure 3-10 depicts the area of tritium-impacted groundwater in August 2023. Following the initial release near MW-9A, impacted groundwater flowed to the northeast. Figure 3-14 presents tritium activities at monitoring wells in the impacted area where activities have been measured above background levels but below 120,000 pCi/L (as of August 2023). Tritium detections in wells near the Mississippi Riverbank (i.e., MW-29A, MW-33A, MW-37A, and MW-48A) in 2023 indicate tritium-impacted groundwater likely discharged to the river. Minor levels (<100 pCi/L) of tritium were measured in river samples in March and April 2023. Further sampling, up to August 2023, did not record tritium above detection limits in the river. From available sampling data (Xcel 2023-TN9609), tritium activity in wells MW-29A and MW-37A, which are near the river, were above the 20,000 pCi/L drinking water standard and trending in an upward direction as of August 2023 (see Figure 3-14). As described above, Monticello is pumping groundwater at eight wells for tritium recovery and has installed a sheet pile wall along the riverbank to minimize discharges of tritium-impacted water to the Mississippi River.

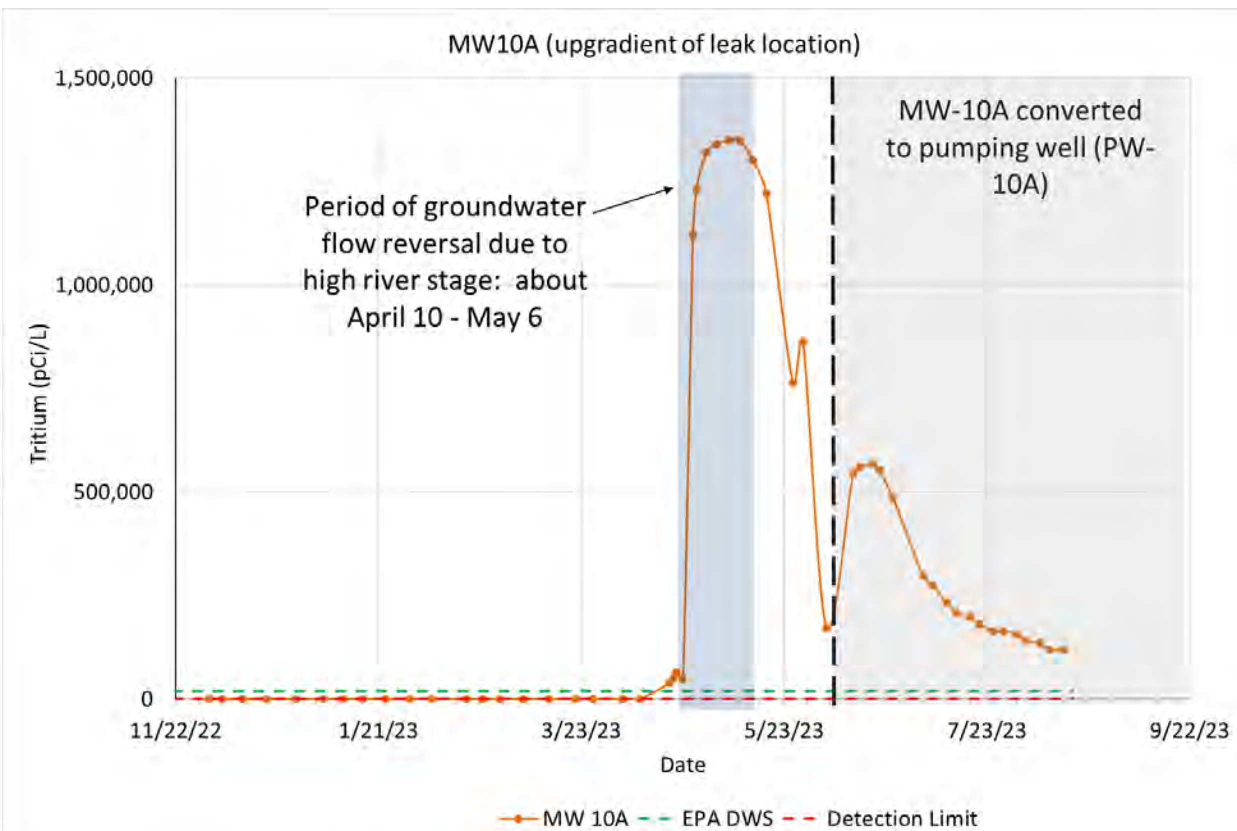


Figure 3-13 Measured Tritium Activities at MW-10A (Xcel 2023-TN9609)

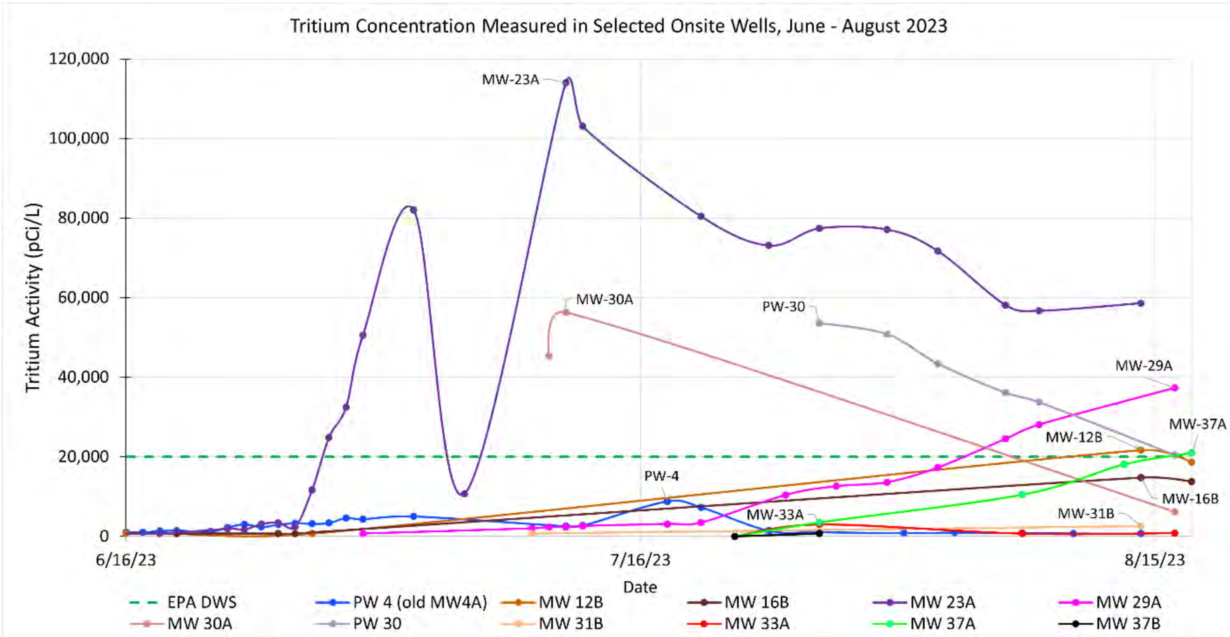


Figure 3-14 Measured Tritium Activities in Selected Onsite Well (Xcel 2023-TN9609)

3.5.3 Proposed Action

3.5.3.1 Surface Water Resources

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 that relate to surface water resources.
Surface water use and quality (non-cooling system impacts)
During the SLR term, surface water may be used at a nuclear power plant for non-cooling systems (e.g., during refurbishment activities for concrete preparation, dust suppression, washing equipment, facility cleaning). Surface water quality could be degraded by stormwater runoff that may entrain pollutants from refurbishment-related land-disturbing activities or chemical and fuel spills.

Surface water use and quality are discussed and evaluated in Sections 3.6.3.1 and 3.6.4.1, respectively, of Xcel Energy's Xcel 2023-TN9084. Instead of relying on surface water, Monticello uses onsite groundwater wells to meet its potable and sanitary water demand, which reduces non-cooling water consumption at the plant. Surface water withdrawn from the Mississippi River is used at Monticello for condenser cooling, service water cooling, screen wash, and fire protection. Because onsite groundwater wells are used to meet domestic water demands, the volume of surface water used for non-cooling purposes is negligible compared to the volume used for cooling purposes.

Monticello discharges non-cooling water to the Mississippi River in accordance with its NPDES permit, which was re-issued in May 2023 (Xcel 2023-TN9578). To prevent and mitigate surface water impacts from pollutants in stormwater, and spills of oil and hazardous materials, Monticello has several plans and programs in place, including a SWPPP, an SPCC plan, a hazardous substance spill contingency plan, and a chemical control program. Additionally, Monticello identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges. All stormwater management issues, and corrective measures taken throughout the reporting period are documented in an annual report. Monticello has not proposed any refurbishment activities related to SLR (Xcel 2023-TN9084).

As discussed in Section 3.5.2.3 of this EIS, on May 21, 2023, approximately 300–600 gal of water, with an estimated tritium concentration of 1.94×10^5 pCi/L, overflowed a holding tank associated with groundwater remediation efforts (Xcel 2023-TN9578). The overflow seeped into the ground near the tank and did not discharge to surface water (Xcel 2023-TN9578).

The NRC staff has not identified new and significant information related to surface water use and quality (non-cooling system impacts) during the audit, scoping process, or review of available information cited in this EIS. Continued compliance with the NPDES permit and stormwater regulatory requirements and permit conditions, implementation of the SWPPP, the SPCC plan, and using BMPs, will minimize impacts on water quality. The NRC staff concludes that the impacts on surface water use and quality from non-cooling water systems during the proposed SLR term would be SMALL.

Altered Current Patterns at Intake and Discharge Structures

The intake and discharge of cooling system water has the potential to alter current patterns in a surface water body. The degree of alteration depends on flow rates, characteristics of the surface water body, and the design of the intake and discharge structures.

Cooling system water at Monticello is withdrawn from the Mississippi River through an approach channel formed by sheet pile structures that extend approximately 59 ft (18 m) into the river. The width of the approach is reduced from approximately 98 ft to 63 ft (29.9 m to 19.2 m), where the water enters the intake over a concrete sill.

Cooling system water is returned to the Mississippi River through an approximately 1000 ft (304.8 m) long discharge canal. The discharge canal has an easterly horizontal alignment, with a bottom slope of approximately 0.25 percent. A 54 ft (16.5 m) wide weir structure is located at the end of the discharge canal. Concrete and rip-rap aprons are located downstream of the weir are to prevent scour.

Xcel Energy anticipates no modifications to the operation of the plant's cooling system associated with the proposed SLR term that may change the existing current pattens at the intake and discharge structures (Xcel 2023-TN9084). The NRC staff has not identified any new information related to altered current patterns. The NRC staff expects that the effect on currents near the intake and discharge structures are localized and would remain the same during the proposed SLR term. The NRC staff concludes that the impacts on altered current patterns at intake and discharge structures for the proposed SLR term would be SMALL.

Scouring Caused By Discharged Cooling Water

The high flow rate of water from a cooling system discharge structure has the potential to scour sediments and redeposit them elsewhere. The degree of scouring depends on the design of the discharge structure, the discharge flow rate, and the sediment characteristics. Scouring is expected to occur only in the vicinity of the discharge structures where flow rates may be high. While scouring is possible during reactor startup, operational periods would typically have negligible scouring.

Withdrawal and discharge of water to and from the Mississippi River are discussed in Section 2.2.3 of Xcel Energy's ER (Xcel 2023-TN9084). Cooling system water is returned to the Mississippi river via a 54 ft (16.5 m) wide weir structure located at the end of the discharge canal. A 20 ft (6.1 m) long concrete apron with a downstream 50 ft (15.2 m) long rip-rap apron is located downstream of the weir to prevent scour. No plant operations or modifications are planned for the Monticello cooling system that would alter discharge patterns during the SLR term (Xcel 2023-TN9084). Because no changes in existing current patterns are expected, changes in scouring impacts are also not anticipated.

The NRC staff identified no new information related to the Monticello's cooling system discharge to the Mississippi River. The NRC staff concludes that the impacts on surface water quality due to scouring caused by discharged cooling system water would be SMALL for the proposed SLR term.

Discharge of Metals in Cooling System Effluent

Circulating cooling water can leach heavy metals such as copper, zinc, and chromium from condenser tubing and other components of the heat exchange system. These metals are normally addressed in NPDES permits because their presence in high concentrations can be toxic to aquatic organisms.

The chemical additives approved by the MPCA to control microbiological activity and scale at Monticello are described in Section 3.6.1.2.1 of Xcel Energy's ER (Xcel 2023-TN9084). The Monticello NPDES permit does not have a metals limit or require monitoring for metals at the circulating condenser cooling water outfall. The Monticello condenser tubes are made of stainless steel and therefore would not contribute leached metals to the cooling water discharge (Xcel 2023-TN9084).

The NRC staff has not identified any new and significant information related to discharge of metals in cooling system effluent during the audit, scoping process, or review of available information cited in this EIS. Based on compliance with current and future NPDES regulatory requirements, permit conditions, and BMPs, the NRC staff concludes that the potential impacts of metal discharge in the cooling system effluent for the proposed SLR term would be SMALL.

Discharge of biocides, sanitary wastes, and minor chemical spills

Biocides and other water treatment chemicals are commonly used in plant cooling systems to control biofouling and nuisance organisms. The types of chemicals, concentrations, and frequency of their use, however, are specific to each plant. Treated sanitary waste may be released via onsite wastewater treatment facilities, a septic field, or through a connection to a municipal sewage system. Minor chemical spills may be collected in floor drains. Each of these activities or events has the potential to affect surface water quality.

Chemical additives and biocides are used to control scale, corrosion, and biofouling of Monticello plant equipment. Monticello's NPDES permit governs the use of these chemical additives and biocides. New chemical additives or dosage changes must be approved by MPCA in accordance with Monticello's NPDES permit. Monticello has not been issued any NOVs related to their NPDES permit in the past 5 years (Xcel 2023-TN9084, Xcel 2023-TN9578).

To prevent and mitigate surface water impacts from pollutants in stormwater, and spills of oil and hazardous materials, Monticello has several plans and programs in place, including a SWPPP, an SPCC plan, a hazardous substance spill contingency plan, and a chemical control program. Monticello sanitary wastewater is discharged to the City of Monticello sanitary sewage disposal system under an agreement with the City of Monticello. (Xcel 2023-TN9084).

Based on a review of site records over the last 5 years, there have been no releases at Monticello that have triggered notification to the National Response Center and one release that triggered notification to MPCA based on Minnesota Statute 115.061 (Xcel 2023-TN9084, Xcel 2023-TN9578).

A leak of approximately 300 gal of water from the service water sodium hypochlorite injection system discovered on July 16, 2019, required notification to MPCA. The leak was contained within a building berm except for approximately ½ gal of water that reached a floor drain that returns to the Mississippi River through NPDES permitted Outfall SD 001 (Xcel 2023-TN9084). MPCA did not provide any comment or requirements concerning the incident, and no recordable spills or violations were reported in the NPDES permit compliance summary (Xcel 2023-TN9084).

The NRC staff has not identified any new and significant information related to discharge of biocides, sanitary wastes, and minor chemical spills. The NRC staff concludes that compliance with current NPDES regulatory requirements and permit conditions along with the implementation of SPCC, SWPPP, and BMPs will mitigate impacts from wastewater and stormwater discharges. The NRC staff concludes that impacts from discharges of biocides, sanitary wastes, and minor chemical spills would be SMALL during the SLR term.

<u>Surface Water Use Conflicts</u>

Nuclear power plant cooling systems may compete with other users relying on surface water resources, including downstream municipal, agricultural, or industrial users. Once-through and closed-cycle cooling systems have different water consumption rates. Once-through cooling systems return most of their withdrawn water to the same surface water body, with evaporative losses approximately 1 to 3 percent (Dieter et al. 2018-TN6681 and Solley et al. 1998-TN7508). Plants using cooling towers need to replenish the consumptive loss of water to evaporation, which can be 60 percent or more of the condenser flow rate by Solley et al. (1998-TN7508).

The typical water balance at Monticello is presented in ER Figure 2.2-1 (Xcel 2023-TN9084) and is incorporated here by reference. Surface water withdrawn from the Mississippi River is used at Monticello for service water cooling, screen washing, fire protection, and condenser cooling (Xcel 2023-TN9084).

The Monticello cooling water system employs a flexible multicycle system with the capability of once-through circulation of river water, recirculation in a closed cycle with two MDCTs, and several variations of these basic modes. Given that Monticello operates in various modes, both the Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River) and Surface Water Use Conflicts (Plants with Once-Through Cooling Systems) issues are addressed jointly in this section.

Monticello has a surface water appropriation permit, No. 66-1172, that authorizes it to pump water from the Mississippi River at a rate varying up to 645 cfs with a maximum total annual appropriation of 467,000-acre feet. Monticello does not anticipate the need for an increased surface water allocation during the SLR term (Xcel 2023-TN9084). The operating modes for the circulating water system are specified by the NPDES permit (Xcel 2023-TN9578) discharge limits and the surface water appropriations permit; these conditions are as follows (NMC 2005-TN9345):

- A maximum of 645 cfs may be appropriated for cooling in an “open cycle” or “once through” mode when river flows exceed 860 cfs and cooling of circulating water meets NPDES permit limits.
- A maximum of 645 cfs may be appropriated for a “helper” cycle mode of operation that utilizes cooling towers when river flow at the site exceeds 860 cfs and river temperatures approach permit limits.
- A “partial recirculation” mode of operation recirculates cooling tower water to the intake, and the appropriated flow shall not exceed 75 percent of the river flow when the river flow is less than 860 cfs but greater than 240 cfs.
- A “closed cycle” mode of operation is authorized whenever the river flow is equal to or greater than 240 cfs.
- At river flows less than 240 cfs, Monticello shall comply with special operating conditions which the Commissioner of the MDNR may prescribe.

The NPDES permit requires Monticello to notify the MPCA if Monticello is required to operate in partial recirculation or closed-cycle mode. To date, Monticello has not needed to operate in closed cycle mode and has needed to operate in partial recirculation mode on only two occasions (Xcel 2023-TN9578).

The thermal discharge limits vary by season as presented in the NPDES permit. Under typical river conditions, the Monticello circulating water system operates in once-through mode. The cooling towers are used as needed, approximately 130–150 days per year (Xcel 2023-TN9084). Xcel Energy estimates a worst-case annual average water consumption of up to 12 cfs assuming 150 days per year of cooling tower operation (Xcel 2008-TN9536). The new cooling towers installed in 2021 and 2022 were equipped with drift eliminators to reduce consumptive use (Xcel 2023-TN9578). As discussed below, this level of water consumption represents a small fraction (less than 1 percent) of the annual average river flows.

The St. Cloud USGS gage station (Station 05270700, Mississippi River) is located approximately 26 mi upstream from the Monticello site. This gage station has data available since October 1988 and represents a conservative estimate of flow at Monticello because it does not consider additional flow inputs between the gage station and the Monticello site. Furthermore, there are no significant surface water withdrawals between the measuring station and the intake at Monticello (MnDNR 2023-TN9863).

The annual average flow (1989–2022) recorded at USGS St. Cloud gage station 05270700 is approximately 6,800 cfs (USGS 2024-TN9646).

From October 1988 through July 2023, the maximum and minimum daily flows at the St. Cloud gage station were 45,100 cfs and 553 cfs, occurring on April 9, 1997, and August 19, 2021, respectively (USGS 2024-TN9647).

During the period of record, only 6 days had measured flows of less than 860 cfs. These flows were recorded on consecutive days from August 15 through August 20, 2021. Under these conditions, Monticello is only allowed to withdraw 75 percent of the river flow. Conservatively assuming a closed cycle mode of operation was used during this historic low-flow event, the consumptive water use for makeup water would represent less than 10 percent of the 6-day average river flow of approximately 650 cfs (Xcel 2023-TN9084). Under certain low-flow conditions, the DNR is required by Minnesota law (Minnesota statutes 103G.285 -TN9648) to limit consumptive appropriations of surface water to protect the environment and downstream water users (MnDNR 2019-TN9650).

As discussed in Section 3.6.3.1 of the Xcel Energy ER, MDNR has issued 26 water appropriation permits between Monticello and Minneapolis. The nearest permitted intake downstream of Monticello that has actively been appropriating water over the last 10 years is located approximately 20 miles downstream of Monticello and supports agricultural use.

The NRC staff has not identified any new and significant information related to surface water conflicts during the audit, scoping process, or review of available information cited in this EIS. Moreover, continued compliance with the surface water allocation and NPDES permits mitigates water use impacts by protecting downstream users and ecological communities. Hence, the NRC staff concludes that the surface water use conflicts for the proposed SLR term would be SMALL.

Effects of Dredging on Surface Water Quality

Dredging in the vicinity of surface water intakes, canals, and discharge structures is undertaken by some nuclear power plant licensees to remove deposited sediment and maintain the function of plant cooling systems. Dredging also may be needed to maintain barge shipping lanes. Whether accomplished by mechanical, suction, or other methods, dredging disturbs sediments in the surface water body and affects surface water quality by temporarily increasing the turbidity of the water column. In areas affected by industries, dredging also can mobilize heavy metals, PCBs, or other contaminants in the sediments.
Monticello periodically conducts mechanical or hydraulic maintenance dredging in the area in front of the plant’s concrete intake apron and the Mississippi River. The material removed consists primarily of silt, sand, and rocks.

Typically, a maximum of 600 cubic yards (yd^3) of sediment from the intake bay is removed approximately every 2 years, and a maximum of 350 yd^3 of sediment is removed from the traveling screen bay/service water bay area approximately every 12–18 months (Xcel 2023-TN9084). Monticello holds both a USACE regional general permit (RGP-003-MN) and a MDNR State dredge permit (1967-0743).

Once removed, the dredge material is dewatered and evaluated for possible contamination. Water removed from the dredge material is routed to NPDES outfall SD 001. To date, dredged material has met the criteria listed in Monticello’s NPDES/SDS permit for beneficial reuse and has been transported offsite (Xcel 2023-TN9084).

With Monticello’s continued compliance with State and regional permits, the NRC staff concludes that the impacts of dredging on surface water quality for the proposed SLR term would be localized and temporary, and therefore SMALL.
Temperature Effects on Sediment Transport Capacity

Increased temperature and the resulting decreased viscosity have been hypothesized to change the sediment transport capacity of water, leading to potential sedimentation problems, altered turbidity of rivers, and changes in riverbed configuration.

Cooling system water at Monticello is returned to the Mississippi River via a 54 ft (16.5 m) wide weir structure located at the end of the discharge canal. A 20 ft (6.1 m) long concrete apron with a downstream 50 ft (15.2 m) long rip-rap apron is located downstream of the weir. Studies conducted in 2009 for the extended power uprate indicate rapid mixing of thermal effluent within the river, decreasing the temperature differential between the discharge location and the ambient river (Xcel 2023-TN9084). Temperature discharge limits are established in Monticello's NPDES permit. There have been no NOVs related to the NPDES permit in the past 5 years (Xcel 2023-TN9084).

There are no planned changes or modifications for Monticello that would alter discharge patterns for the proposed SLR term (Xcel 2023-TN9084). Because no change in operation of the cooling system is expected during the proposed SLR term, no change in effects of sediment transport capacity is anticipated. The NRC staff has not identified any new information related to temperature effects on sediment transport capacity. The NRC staff concludes that, with continued temperature discharge limit compliance, the temperature effects on sediment transport capacity for the proposed SLR term would be SMALL.

3.5.3.2 Groundwater Resources

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 that relate to groundwater resources.

<u>Groundwater Contamination and Use (Non-Cooling System Impacts)</u>

This issue concerns the potential impacts on groundwater availability from dewatering a shallow aquifer during continued operations and plant refurbishment activities, including operational dewatering for control of contaminated groundwater. In addition, this issue concerns impacts on groundwater quality that may occur from the release of contaminants to soil and groundwater during general industrial activities at the plant, including the storage and use of solvents, hydrocarbon fuels (diesel and gasoline), heavy metals, or other chemicals and operation of wastewater treatment/disposal ponds or lagoons. Materials released from these activities all have the potential to affect soils, sediments, and groundwater, and the contaminants that migrate into the subsurface environment can cause a long-term impact on underlying groundwater resources depending on the contaminant, quantity of the release, and site hydrogeological conditions. This issue was expanded for consideration as part of the groundwater review for license renewal in the 2013 GEIS revision (NRC 2013-TN2654) and was not assessed in the 2006 supplemental environmental impact statement (SEIS) for Monticello (NRC 2006-TN7315).

Onsite groundwater use is discussed and evaluated in Section 3.6.3.2 of the Xcel Energy ER (Xcel 2023-TN9084), and no dewatering for refurbishment activities or continued operations is described therein. New information regarding groundwater withdrawals for tritium plume recovery and gradient control was identified during the audit, scoping, and review process and is described in Section 3.5.2.3 of this EIS. In October 2023, Monticello pumped groundwater at a rate of about 12 gpm (45 lpm) from eight onsite wells for tritium recovery and had extracted approximately 6.6 million gal (25 million L) of groundwater in total in response to the November 2022 release. As part of the tritium release response, uncontaminated water from the surficial aquifer is expected to be pumped from five gradient control wells to intercept inflowing groundwater and maintain the onsite groundwater levels below the top of the sheet pile wall. Groundwater withdrawals for gradient control could be a much as 150 gpm (568 Lpm) from each of four wells (Xcel 2024-TN9859).

Because the combined rate of tritium recovery and gradient control pumping is expected to exceed 100 gpm (378.5 lpm), the NRC staff evaluated the potential effects of these groundwater withdrawals on other water users/uses. As discussed in Section 3.5.2.1 of this EIS, groundwater flow in the surficial aquifer tends to be toward the Mississippi River. As a result, the groundwater pumped for gradient control would otherwise naturally discharge into the Mississippi River. Groundwater pumped for gradient control will be discharged to the intake structure for the plant (Xcel 2024-TN9859), which would mitigate the effects of the reduced groundwater discharge to the river resulting from the gradient control pumping.

The NRC staff considered the hydrogeological setting of the site when evaluating the potential impacts to offsite groundwater users from groundwater withdrawals at Monticello for tritium recovery and gradient control. The site is bounded to the north by the Mississippi River, which limits the impacts of pumping to areas south of the river. The nearest offsite, registered water wells are upgradient of ongoing and planned groundwater extractions (Figure 3-5), with the closest well about 0.6 mi (1 km) from the center of the site. In evaluating the water appropriation permit application, the Minnesota DNR determined that the gradient control withdrawals would be unlikely to adversely affect the groundwater resource, and drawdowns in groundwater levels resulting from the pumping would not affect offsite domestic wells (Xcel 2024-TN9859). The NRC staff conducted an independent confirmatory analysis and determined that 2 months of continuous gradient control pumping at the maximum rate would be likely to cause less than 1 ft (0.3 m) of groundwater drawdown at the site boundary. Furthermore, the water appropriation permit specifies that the withdrawals must cease if a water use conflict arises (Xcel 2024-TN9859). The NRC staff assumes that gradient control pumping is temporary and will cease once the tritium remediation is complete. Xcel Energy has stated that it will continue tritium recovery until tritium in all onsite groundwater monitoring wells is below the EPA’s maximum contaminant level (20,000 pCi/L) (Xcel 2024-TN9645). The total duration of gradient control pumping is thus unknown. However, the pumping is not intended to occur year-round, which will allow affected groundwater levels to recover. Because gradient control pumping would be discontinuous and temporary and offsite wells are located a significant distance from the site, the NRC staff concludes that the onsite groundwater withdrawals for tritium recovery and gradient control would not significantly affect groundwater levels in offsite wells.

The NRC staff also determined that the onsite drinking water supply wells are not likely to be affected by the tritium recovery and gradient control pumping from the overlying surficial aquifer because the water supply wells withdraw water from the sandstone aquifer, which is separated from the surficial aquifer by the low-permeability sediments of the lower till. In addition, the principal water supply wells for Monticello (Well numbers 2 and 4: alternate designations of Well #11 and Well #12, respectively) and located more than 500 ft (150 m) from the nearest gradient control well and are outside the gradient control area.

According to Section 3.6.4.2 of the Xcel Energy ER, industrial practices at the site generally involve the use of chemicals associated with maintenance activities for plant, equipment, buildings, and water treatment. Management of the chemicals is governed by Xcel Energy procedures and site-specific spill prevention plans (Xcel 2023-TN9084).

The NRC staff has concluded that, over the SLR period of extended operation, potential groundwater contamination would likely remain onsite, and no offsite wells are expected be affected by onsite tritium recovery and gradient control groundwater pumping. Monticello adheres to the appropriate State pollution prevention permits and maintains a robust monitoring strategy to readily detect potential future releases of contamination to groundwater. Gradient control withdrawals are regulated by the State water appropriation permit and are not expected to affect groundwater availability for offsite users or receptors. Therefore, the NRC staff concludes that the non-cooling system impacts on groundwater contamination and use during the SLR term would be SMALL.

Groundwater Use Conflicts (Nuclear Power Plants that Withdraw More Than 100 gpm)

This issue addresses groundwater use conflicts that may occur due to plant potable and service water and dewatering withdrawal. Historically, Monticello has withdrawn groundwater at a rate less than 100 gpm, which has been determined by the NRC staff to be unlikely to result in water use conflicts for offsite groundwater users (NRC 1996-TN288). Therefore, this issue was not assessed in the 2006 SEIS (NRC 2006-TN7315). As presented in Section 3.5.2.3 of this EIS, the response to a 2022 release of tritium resulted in new groundwater withdrawals for tritium recovery and gradient control that could continue into the SLR term, depending on the duration of tritium remediation activities. The maximum pumping rate for the gradient control wells is 150 gpm (568 Lpm), with rates adjusted based on the hydraulic conditions of the site (Xcel 2024-TN9859). Rates of pumping for tritium recovery averaged 15.2 gpm (57.5 Lpm) in 2023. Pumping rates for tritium recovery are expected to decrease as tritium activity in groundwater decreases. The impacts of tritium recovery and gradient control pumping were evaluated in the Groundwater Contamination and Use (non-cooling system impacts) issue above and were found to be SMALL. The combined impact of all onsite pumping is assessed here.

As discussed in Section 3.5.2.2, seven onsite wells provide water for potable use, purified water production, and other plant system requirements. The average total withdrawal is 23.2 gpm (87.8 Lpm), but the majority of water use (92 percent) is from Well numbers 2 and 4 (alternate designations of Well #11 and Well #12, respectively). Well numbers 2, 4, and 3 withdraw water from the sandstone aquifer, which is separated from the surficial aquifer by a layer of low-permeability clay till. Withdrawals from the sandstone aquifer are expected to continue to be less than 100 gpm in the SLR term. Groundwater pumping for tritium recovery and gradient control withdraws water from the surficial aquifer. Because the water supply and tritium remediation wells withdraw from different aquifers that are hydraulically separated by an intervening layer of low permeability sediments, the effects on offsite groundwater users from tritium remediation withdrawals would not contribute to the effects resulting from water supply withdrawals.

When evaluating the potential impacts resulting from groundwater use conflicts associated with SLR, the NRC staff considers the existing groundwater resource conditions described in Section 3.5.2 of this site-specific EIS as its baseline. These baseline conditions encompass the existing hydrogeologic framework and conditions (including aquifers) potentially affected by continued operations, as well as the nature and magnitude of groundwater withdrawals compared to relevant appropriation and permitting standards. The baseline also considers other potentially affected uses and users of the groundwater resources affected by the continued operation of the nuclear power plant. Potential impacts to offsite groundwater users from tritium recovery and gradient control withdrawals were assessed in Groundwater Contamination and Use (non-cooling system impacts) and were determined to be SMALL. Water supply withdrawals related to SLR at Monticello are expected to be much less than 100 gpm (380 lpm) and are not expected to lower groundwater levels beyond the site boundary nor contribute to the impacts from tritium plume remediation withdrawals. Therefore, the NRC staff concludes that groundwater use impacts during the SLR term would be SMALL.

Groundwater Use Conflicts (Plants with Closed-Cycle Cooling Systems That Withdraw Makeup Water from a River)

This issue addresses plants with cooling towers or cooling ponds that rely on a river for cooling water makeup. Consumptive use of the river water, if significant enough to lower the river's water level, would also influence water levels in an adjacent, connected aquifer, which could reduce water levels in the wells of nearby groundwater users. The potential for groundwater use conflicts is dependent on the site's hydrogeology, the decrease in river levels caused by the consumptive water use of the plant, and on the locations, depths, and pumping rates of affected wells.

As discussed in Section 3.5.3.1 of this EIS, the Monticello cooling water system uses a flexible, multicycle system that is typically operated in once-through mode, but can also be operated in partial recirculation and closed cycle modes that utilize the two MDCTs. The partial recirculation and closed cycle modes of operation would be used when river flow is relatively low, as specified by the Monticello surface water appropriations permit and NPDES permit discharge limits. Since the plant began operation, the partial recirculation mode has only been used on two occasions and the closed cycle mode has never been used (Xcel 2023-TN9578). In Section 3.5.3.1 of this EIS, the NRC staff conservatively estimated that consumptive water use for closed cycle operation would be less than 10 percent of the river's flow during a historic low-flow event. This small reduction in the river's flow, occurring only rarely, would be unlikely to cause a significant groundwater use conflict. In addition, the majority of registered groundwater wells within 2 mi of Monticello are distant from the river, which would reduce the impact of river water use on these wells. Accordingly, the NRC staff concludes that groundwater use conflicts from water withdrawals for closed-cycle cooling at Monticello would have a SMALL impact during the SLR term.

<u>Radionuclides Released to Groundwater</u>

This issue was added for consideration as part of the groundwater review for license renewal in the 2013 LR GEIS revision (NRC 2013-TN2654) because of the accidental releases of liquids containing radioactive material into the groundwater at a number of nuclear power plants. In 2006, the NRC released a report documenting lessons learned from a review of these incidents that ultimately concluded that these releases had not adversely affected public health and safety (*Liquid Radioactive Release Lessons Learned Task Force Report*; NRC 2006-TN1000). This report concluded, in general, that affected groundwater is expected to remain onsite, but instances of offsite migration have occurred. The LR GEIS (NRC 2013-TN2654) determined that the impacts on groundwater quality from the release of radionuclides could be SMALL or MODERATE, depending on the magnitude of the leak, the radionuclides involved, hydrogeologic factors, distance to receptors, and response time of nuclear power plant personnel to identify and stop the leak in a timely fashion.

This issue was discussed and evaluated in Sections 3.6.4.2 and 4.5.4 of the Xcel Energy ER (Xcel 2023-TN9084). Additional details are provided in Section 3.5.2.3 of this EIS. Monticello personnel monitor groundwater for inadvertent releases as part of its groundwater protection program, which was implemented in 2008 under NEI 07-07. Tritium is the only radionuclide that has been historically detected in the surficial aquifer onsite due to unplanned releases. Prior to November 2022, average tritium activity in onsite groundwater had not been detected above the drinking water standard of 20,000 pCi/L. A release of tritium was detected on November 21, 2022, due to a failed CRD suction line pipe between the reactor and turbine buildings. As discussed in Section 3.5.2.3, peak tritium activity in groundwater was 5,020,000 pCi/L following this release, and corrective actions have been taken to address affected groundwater. These actions include groundwater pumping for tritium recovery; as described in Section 3.13 of this EIS, the tritium-affected groundwater is stored onsite in above-ground tanks and in an in-ground, lined pond. Remediation activities also include gradient control pumping and installation of a cutoff wall to reduce the volume of contaminated groundwater reaching the river.

Ongoing monitoring indicates the tritium plume is migrating to the northeast, away from onsite water supply wells, and overall concentrations are decreasing in the vicinity of the initial release due to the tritium recovery activities. River samples collected upstream and downstream of the site from May to August 2023 indicated tritium concentrations were below detection limits.

While tritium continues to be detected in onsite groundwater at levels that exceed the EPA's maximum contaminant level for tritium, ongoing monitoring, tritium recovery pumping, and hydraulic controls (i.e., gradient control groundwater pumping and the cutoff wall) reduce the potential for offsite migration. Additionally, the nearest registered water wells are hydraulically isolated from the site since there are either upgradient of groundwater flow to the site or are buffered by the hydraulic boundary created by the Mississippi River. This isolates these wells from the site groundwater contamination. Based on the information presented in Section 3.5.2 of this EIS, the NRC staff concludes that inadvertent releases of tritium have moderately impaired site groundwater quality but have not substantially affected offsite groundwater quality or affected groundwater use near Monticello. The NRC staff expects that, with Xcel Energy's continuation of the current remediation efforts, tritium levels in onsite groundwater will be reduced below the EPA standard for drinking water. Because of uncertainty in the duration required to complete the groundwater remediation, the NRC staff concludes that groundwater quality impacts due to the release of radionuclides would be SMALL to MODERATE during the SLR term.

3.5.4 No-Action Alternative

3.5.4.1 Surface Water Resources

Under the no-action alternative, surface water withdrawals would greatly decrease and eventually cease. Stormwater would continue to be discharged from the site, but wastewater discharges would be reduced considerably. As a result, shutdown of Monticello would reduce the overall impacts on surface water use and quality. Therefore, the impact of the no-action alternative on surface water resources would be SMALL.

3.5.4.2 Groundwater Resources

With the cessation of operations, there would be little or no additional impact on groundwater quality. Water pumped for supply would be reduced, which would reduce impacts from onsite water use. Contamination in onsite soil and groundwater, including tritium, would be assessed during decommissioning, whether the plant is decommissioned at the end of the current licensing period or at the end of the SLR period. A license termination plan will describe actions needed for site remediation to meet NRC criteria for radiologic dose, and site specific clean up criteria to be met before the release of the site. Therefore, dewatering for tritium and gradient control would likely continue at current rates or be reduced as tritium contamination is removed from the site groundwater. Therefore, the impact of the no-action alternative on groundwater resources would be SMALL.

3.5.5 Replacement Power Alternatives: Common Impacts

3.5.5.1 Surface Water Resources

<u>Construction</u>

Construction activities associated with replacement power alternatives may cause temporary impacts on surface water quality by increasing sediment loading to waterways. Construction activities also may impact surface water quality by introducing pollutants in stormwater runoff from disturbed areas and excavations, spills and leaks from construction equipment, and any dredge and fill activities. These sources could potentially affect downstream surface water quality.

Facility construction activities might alter surface water drainage features within the construction footprints of replacement power facilities, including any wetland areas. Potential hydrologic impacts would vary depending on the nature and acreage of land area disturbed and the intensity of excavation work. Land disturbance may reduce infiltration and increase the potential for greater and quicker surface runoff. Changes in stormwater runoff volume, timing, and quality are typically controlled and managed with applicable Federal, State, and local permits and implementation of BMPs.

The NRC staff assumes that construction contractors would implement BMPs for soil erosion and sediment control to minimize water quality impacts in accordance with applicable Federal, State, and local permitting requirements. These measures would also include spill prevention and response procedures to avoid and respond to spills and leaks of fuels and other materials from construction equipment and activities.

Surface water use during construction is generally related to concrete preparation, dust suppression, and potable and sanitary water for the workforce and is limited to the construction duration. These construction-related water needs are usually small compared to cooling water needs during thermoelectric plant operation. Based on this analysis, the NRC staff concludes that the impact from construction of replacement power alternative on surface water resources would be SMALL.

Operation

Thermoelectric generation may require varying amounts of surface water for cooling plant components depending on the selected cooling technology and, therefore, may require new water use permits from and agreements with State and local agencies. Potable and sanitary water use for the plant would depend on the workforce size and, therefore, also may require new potable water use permits from and sanitary water disposal agreements with local agencies or municipalities. Discharge of effluents including cooling system discharges would require permits from Federal, State, and local agencies, including a certification that the discharges are consistent with State water quality standards. Effluent discharges would be subject to treatment and monitoring and reporting requirements of relevant permitting agencies. The NRC staff assumes that plant operations would follow the requirements of any applicable Federal, State, and local permits.

During operation of renewable energy facilities, only small amounts of water normally would be needed by facility personnel to periodically clean solar panels and turbine blades and motors, as part of routine servicing. Some water also may be used for dust control. The NRC staff assumes that water for this use would be supplied from a municipal utility, onsite groundwater, or trucked to the point of use and procured from nearby sources. The NRC staff assumes that all thermoelectric and renewable energy sites would be designed and constructed with appropriate drainage and stormwater management controls and implement an SWPPP, associated BMPs, and procedures to minimize offsite water quality impacts in accordance with applicable State and local regulations. Based on this analysis, the NRC staff concludes that the impact from operation of a replacement power alternative on surface water resources would be SMALL to MODERATE.

3.5.5.2 Groundwater Resources

<u>Construction</u>

Excavation dewatering for foundations and substructures during construction of replacement power generation facilities, as applicable, may be required to stabilize slopes and permit placement of foundations and substructures below the water table. Groundwater levels in the immediate area surrounding an excavation may be temporarily affected, depending on the duration of dewatering and the methods (e.g., cofferdams, sheet piling, sumps, and dewatering wells) used for dewatering. The NRC staff expects that any impacts on groundwater flow and quality caused by dewatering would be highly localized, of short duration, and would not affect other groundwater users. Discharges resulting from dewatering operations would be released in accordance with applicable State and local permits, as described above.

Although foundations, substructures, and backfill may alter onsite groundwater flow patterns, local and regional trends would remain unaffected. Construction of replacement power generating facilities may contribute to onsite changes in groundwater infiltration and quality due to removal of vegetation and construction of buildings, parking lots, and other impervious surfaces. The potential impacts of increased runoff and subsurface pollutant infiltration or discharge to nearby water bodies would be prevented or mitigated through implementation of BMPs and an SWPPP.

In addition to construction dewatering, onsite groundwater could be used to support construction activities (e.g., dust abatement, soil compaction, and water for concrete batch plants). Groundwater withdrawal during construction could temporarily affect local water tables or groundwater flow, and these withdrawals and resulting discharges would be subject to applicable permitting requirements. The NRC staff concludes that the impacts on groundwater resources from construction and operation of a replacement power alternative would be SMALL.

<u>Operation</u>

Dewatering for building foundations and substructures may be required during the operational life of the replacement power facility. Operational dewatering rates, if required, would likely be lower than the rates required for construction and be managed subject to applicable permitting requirements. Dewatering discharges and treatment would be properly managed in accordance with applicable NPDES permitting requirements. The NRC staff expects that any impacts on groundwater flow and quality affected by dewatering would be highly localized, and that there would be no effects on other groundwater users due to the site location.

Effluent discharges (e.g., cooling water, sanitary wastewater, and stormwater) from a facility are subject to applicable Federal, State, and other permits specifying discharge standards and monitoring requirements. Adherence to proper procedures by replacement power facility operators during all material, chemical, and waste handling and conveyance activities would reduce the potential for any releases to the environment, including releases to the subsurface and groundwater.

For replacement power alternatives, groundwater use during operation is assumed to be similar to or less than current nuclear power plant use, where a water supply system, tritium recovery, and gradient control withdrawals exceed 100 gpm (380 lpm). Site groundwater use was determined to have a minimal impact on surrounding groundwater use or quality. Therefore, the NRC staff concludes that the groundwater use during operation of a replacement power alternative would result in a SMALL impact. Onsite groundwater withdrawals would be subject to applicable State water appropriation, permitting, and registration requirements.

3.5.6 Natural Gas and Renewables Alternative

3.5.6.1 Surface Water Resources

This alternative includes 750 MW from new, offsite natural gas-fired generation; 750 MW from new, offsite wind turbines; and 200 MW from new onsite and offsite solar panels. The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.1 of this EIS as common to all replacement power alternatives also apply to this alternative.

The natural gas combustion turbine units (with MDCTs) use of water resources for cooling tower makeup and blowdown would be required to comply with appropriate NPDES permits. Because natural gas units would be operated to provide energy during occasional extended periods of low renewable output, it is anticipated that they would require a smaller volume of cooling water (Xcel 2023-TN9084).

Construction of the solar and wind installations and their supporting transmission lines would require water for dust suppression, equipment washing, and sanitary systems. The solar and wind installations do not require a cooling system or process water for operation. Some water would be needed for periodically washing the solar panels. Depending on the site locations, construction and operational water demands could be met by municipal supply, trucked in potable water, or onsite or nearby surface or groundwater resources.

Some water quality impacts could result from erosion and runoff associated with construction and operations but should be controlled by implementation of BMPs and compliance with stormwater permits and applicable regulations.

Based on this analysis, the NRC staff concludes that the overall impacts on surface water resources from construction and operations under the natural gas and renewables alternative would be SMALL.

3.5.6.2 Groundwater Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.2 as being common to all replacement power alternatives also apply to this alternative. The NRC staff did not identify any impacts on groundwater resources for this alternative beyond those discussed above as being common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operations under the natural gas and renewables alternative would be SMALL.

3.5.7 Renewables and Storage Alternative

3.5.7.1 Surface Water Resources

This alternative is a mix of new construction and the use of existing generation and power purchases. This alternative includes 950 MW from new wind turbines, 700 MW from new solar panels, and 300 MW of new lithium-ion battery storage located at the solar locations. The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.1 of this EIS as common to all replacement power alternatives also apply to this alternative.

Construction of the solar and wind installations and their supporting transmission lines would require water for dust suppression, equipment washing, and sanitary systems. The solar and wind installations do not require a cooling system or process water for operation. Some water would be needed for periodically washing the solar panels. Depending on the site locations, construction and operational water demands could be met by municipal supply, trucked in potable water, or onsite or nearby surface or groundwater resources.

Some water quality impacts could result from erosion and runoff associated with construction and operations but should be controlled by implementation of BMPs and compliance with stormwater permits and applicable regulations.

Based on this analysis, the NRC staff concludes that the overall impacts on surface water resources from construction and operations under the renewables and storage alternative would be SMALL.

3.5.7.2 Groundwater Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.2 as being common to all replacement power alternatives also apply to this alternative. The NRC staff did not identify any impacts on groundwater resources for this alternative beyond those discussed above as being common to all replacement power alternatives. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operations under the renewables and storage alternative would be SMALL.

3.5.8 New Nuclear (Small Modular Reactor) Alternative

3.5.8.1 Surface Water Resources

This alternative is a SMR plant based on the NuScale design. The plant would be sited outside Minnesota because new nuclear power plants are prohibited by Minnesota State law. The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.1 of this EIS as common to all replacement power alternatives also apply to this alternative. Additionally, deep excavation work required to construct the nuclear island could require groundwater dewatering (see Section 3.4.10 of this EIS). Water pumped from excavations would be managed and discharged in accordance with NPDES permit requirements. As a result, the NRC staff expects that dewatering would not impact surface water quality.

The SMR plant would use a closed-cycle cooling system with MDCTs using a surface water source for makeup water. The plant would be sited at a location with adequate inflow to accommodate the plant’s cooling system and water consumption (Xcel 2023-TN9084). When operated with wet cooling, which provides direct contact between the cooling water and the air passing through the tower, the annual water consumption rate for a 12-module SMR plant would be approximately 24 cfs, or roughly twice the worst-case annual rate (12 cfs) of the currently operating plant (Xcel 2023-TN9084).

The NRC staff assumes that the SMR plant would operate in compliance with a State issued NPDES permit, any applicable industrial stormwater permit, State, and local surface withdrawal requirements, and would have spill prevention and response procedures in place to minimize impacts on surface water quality.

Given that the location of a potential new SMR is unknown, the impacts from this alternative are uncertain prior to the selection of the site for the facility. However, based on the above analysis, the NRC staff concludes that the overall impacts on surface water resources from construction and operations under the new nuclear alternative would likely be SMALL to MODERATE.

3.5.9 Groundwater Resources

The hydrologic and water quality assumptions and implications for construction described in Section 3.5.5.2 of this EIS as being common to all replacement power alternatives also apply to this alternative. However, given that the location of a potential SMR is unknown, the impacts from operation of this alternative are uncertain prior to the selection of a site for the facility. Groundwater use for the operation of a SMR could be greater than or less than current operational groundwater use rates depending on the hydraulic setting of the chosen site. Operational dewatering rates, if required, would be managed subject to applicable permitting requirements. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operation of a new SMR nuclear power plant complex would likely be SMALL to MODERATE.

3.6 Terrestrial Resources

This section describes the terrestrial resources of the Monticello site and the surrounding landscape. Following the description, NRC staff analyzes the potential impacts on terrestrial resources from the proposed action of subsequent license renewal and alternatives to the proposed action. Information here is based on the initial Monticello LR SEIS (NRC 2006 TN7315), the applicant’s ER, and other publicly available information.

3.6.1 Ecoregion

The Monticello site lies within the North Central Hardwood Forests Ecoregion (Xcel 2023-TN9084: Section 3.7.2.2). The EPA (White 2020-TN9281) characterizes this ecoregion (Level III Ecoregion 51) as transitional between northern forests and lakes to the north, the agriculture-dominated plains to the west, and the Lake Agassiz Plain to the south. Topography ranges from nearly level to rolling glacial till plains, lake basins, outwash plains, and rolling or hilly moraines. In addition to urban land covers concentrated in Minneapolis and St. Paul, current land use and land covers are a mosaic of deciduous forests, wetlands and lakes, cropland, pasture, and dairies. Two Level IV ecoregions occur within 6 mi (10 km) of Monticello site: (1) Anoka Sand Plain and Mississippi Valley Outwash and (2) Big Woods. Pre-settlement vegetation of the Big Woods was oak openings and savannas, prairies, and wet prairies; for the Anoka Sand Plain and Mississippi Valley Outwash, pre-settlement vegetation was oak, maple, basswood, and other hardwoods surrounded by prairie and savanna.

The U.S. Army Corps of Engineers defines wetlands as areas either 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. In its environmental report, Xcel Energy (Xcel 2023-TN9084) characterizes the National Wetlands Inventory features in the vicinity surrounding the Monticello site as follows:

- freshwater emergent wetlands—4,253.76 ac (1,721.44 ha)
- freshwater forested/shrub wetlands—2,730.70 ac (1,105.08 ha)
- freshwater ponds—1,031.91 ac (417.60 ha)

- lakes—2,983.92 ac (1,207.55 ha)
- riverine waters—1,299.49 ac (525.88 ha)

3.6.2 Monticello Site

The Monticello site consists of about 2,000 ac (809 ha) of land along both banks off the Mississippi River in Wright County (south bank) and Sherburne County (north bank) in central Minnesota (Xcel 2023-TN9084). The Monticello site lies within the Anoka Sand Plain and Mississippi Valley Outwash (Level IV Ecoregion 51h). This ecoregion is dominated by a sandy lake plain and terraces along the Mississippi River.

Within the approximately 2,000 ac (809 ha) Monticello site, the Monticello plant and supporting facilities are located on about a 50 ac (20.2 ha) industrial area along the southern bank of the Mississippi River in Wright County, Minnesota. Because these facilities are mostly located on previously cultivated areas, existing vegetation in the 50 ac (20.2 ha) industrial area around the plant is mainly early successional grasses and forbs.

About 11 percent of the approximately 2,000 ac (809 ha) Monticello site consists of developed land cover types, 14 percent is open water, and the remaining 75 percent of the site is vegetated (Xcel 2023-TN9084: Table 3.2-1). Forests and agriculture are the dominant vegetation types, covering about 36 percent and 31 percent of the site, respectively. Most of the forest is deciduous forest (35 percent). Minor forest types (<1 percent each) are evergreen forest and mixed forest. About 18 percent of the site consists of cultivated crops, and another 13 percent is pasture hay. Other minor vegetation types (<5 percent each) are woody wetlands (4.4 percent), emergent herbaceous wetlands (2.2 percent), grassland/herbaceous (1.6 percent), and shrub/scrub (0.4 percent).

The descriptions, presented in Xcel Energy's ER (Xcel 2023-TN9084: Section 3.7.2.3), characterize the terrestrial habitats within the site boundary. Habitat descriptions of the associated tree, shrub, and herbaceous strata are incorporated here by reference:

- upland forests
- forested wetlands
- floodplain forest
- silver maple–Virginia creeper floodplain forest
- bur oak woodland
- oak woodland–brushland
- willow swamp
- dry oak savanna
- dry prairie

Monticello site boundaries contain a total of 45.6 ac (18.45 ha) of wetlands, lakes, ponds, and riverine waters (Xcel 2023-TN9084: Section 3.7.2.4). Table 3-9 summarizes the area and percentage of wetlands and surface water features on the Monticello site as documented in the National Wetlands Inventory. Figure 3-15 shows the location of National Wetlands Inventory wetlands on a map of the Monticello site.

Table 3-9 Wetlands and Surface Water Features on the Monticello Nuclear Generating Plant Site

Wetland or Water Feature	Area	Percent of Onsite Wetland Habitat
Freshwater Forested/Shrub Wetlands	16.17 ac (6.54 ha)	35.46
Riverine Waters	27.58 ac (11.16 ha)	60.48
Freshwater Ponds	0.48 ac (0.19 ha)	1.05
Freshwater Emergent Wetlands	1.37 ac (0.55 ha)	3.01
Total	45.6 ac (18.45 ha)	100.00

Wildlife species occurring on the Monticello site consist of those species typically found in central Minnesota forests, croplands, developed areas, and riparian areas. Table 3.7-4 in the ER presents a list of the terrestrial wildlife species likely to occur in Wright or Sherburne counties; this list includes 23 mammals, 36 birds, 5 amphibians, and 5 reptiles. Common mammals include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), squirrels (*Tamiasciurus hudsonicus, Sciurus carolinensis, S. niger, and Ictidomys tridecemlineatus*), whitetailed jack rabbit (*Lepus townsendii*), coyote (*Canis latrans*), red and grey foxes (*Vulpes vulpes* and *Urocyon cinereoargenteus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), striped skunk (*Mephitis mephitis*), several weasel species (*Mustela ermina, M. vision, M. frenata, M. nivals*), and many small mammals.

Birds on the Monticello site include a mix of resident bird species that may breed or overwinter, onsite seasonal residents, and birds that stop briefly during migration. The Monticello site is located within the Mississippi flyway, an important bird migration route which extends from the Gulf Coast to the Arctic Circle. Migrant birds often fly at night, landing to rest early in the morning. Suitable habitats that allow migratory birds to feed, rest, and avoid predators are called stopovers. Large natural barriers may create crowded stopover locations because flights over the barriers mean long stretches without opportunities to rest or feed. Along the Mississippi flyway, Hudson Bay and the Great Lakes are major barriers. Many species of migratory birds likely use the Monticello site and vicinity during the spring and fall migrations.

Important terrestrial species discussed further in this section include those protected by State and Federal laws, those that are culturally important, and those that are particularly affected by the continued operation of the nuclear power plant. In particular, peregrine falcons (*Falco peregrinus*) are known to nest on the Monticello off-gas stack (Xcel 2023-TN9084: Attachment B), and trumpeter swans (*Cygnus buccinator*) use the waters downstream of the concrete discharge structure as an important winter habitat. Section 3.6.3.4 discusses peregrine falcons and trumpeter swans in more detail. Section 3.6.3.7 describes culturally important species such as wild rice and red cedar.

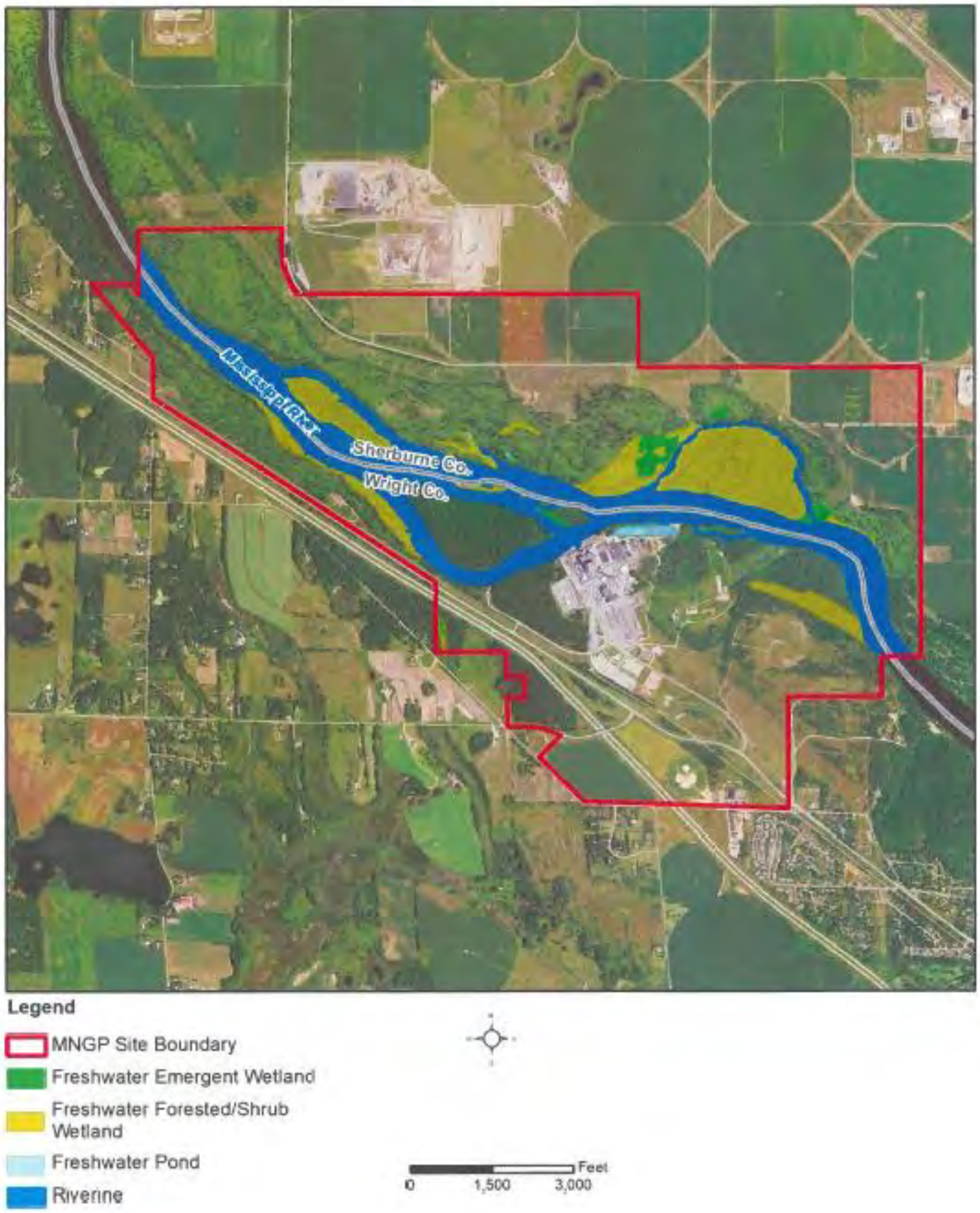


Figure 3-15 Wetlands Located Within the Monticello Nuclear Generating Plant Site as Mapped in National Wetlands Inventory. Source: Xcel 2023-TN9084, Figure 3.7-2.

3.6.3 Important Species and Habitats

3.6.3.1 Federally Listed Species

For a discussion of terrestrial species and habitats that are federally protected under the Endangered Species Act of 1973, as amended, see Section 3.7, “Federally Protected Ecological Resources,” of this document.

3.6.3.2 State-Listed Species

Xcel Energy (Xcel 2023-TN9084: Table 3.7-5) provided a list of species that the State of Minnesota has listed as threatened or endangered and that are known to occur or potentially occur in Wright or Sherburne counties. Of these State-listed species, three are also federally listed by the U.S. Fish and Wildlife Service as endangered, threatened, or candidates for Federal listing, and two are aquatic species. The NRC addresses all federally-listed species in Section 3.7 of this document and addresses State-listed aquatic species in Section 3.7. Table 3-10 summarizes the 20 terrestrial species that are State-listed as threatened or endangered (but not also federally listed) and are known to occur in Wright and Sherburne counties.

Table 3-10 State-Listed Species (That Are Not Also Federally Listed) for Wright or Sherburne Counties, Potentially Occurring in the Vicinity of Monticello Nuclear Generating Plant

Common Name	Scientific Name	Class	State Legal Status
Common Tern	*Sterna hirundo*	Bird	Endangered
Horned Grebe[a, b]	*Podiceps auratus*	Bird	Endangered
Loggerhead Shrike[a, b]	*Lanius ludovicianus*	Bird	Endangered
Eastern Spotted Skunk[a]	*Spilogale putorius*	Mammal	Threatened
Blanding’s Turtle[a, b]	*Emydoidea blandingii*	Reptile	Threatened
Uncus Skipper	*Hesparia uncas*	Insect	Endangered
Annual Skeletonweed	*Shinnersoseris rostrata*	Plant	Threatened
Beach Heather	*Hudsonia tomentosa*	Plant	Threatened
Blunt-Lobed Grapefern[a]	*Botrychium oneidense*	Plant	Threatened
Butternut[a]	*Juglans cinerea*	Plant	Endangered
Clinton’s Bulrush[a]	*Trichophorum clintonii*	Plant	Threatened
Cross-Leaved Milkwort[a]	*Polygala cruciata*	Plant	Endangered
Hooded Arrowhead	*Sagittaria calcyina var. calycina*	Plant	Threatened
Lance-Leaf Violet[a]	*Viola lanceolata var. lanceolata*	Plant	Threatened
Ram’s Head Orchid[a]	*Cypripedium arietinum*	Plant	Threatened
Rock Sandwort[a, b]	*Minuartia dawsonensis*	Plant	Threatened
Seaside Three-Awn[b]	*Aristida tuberculosa*	Plant	Threatened
Swamp Blackberry[a]	*Rubus semisetosus*	Plant	Threatened
Tall Nutrush[a]	*Scleria triglomerata*	Plant	Endangered
Tubercled Rein Orchid[a]	*Platanthera flava var. herbiola*	Plant	Threatened

(a) Species with potential habitat on the Monticello Nuclear Generating Plant Site.
(b) Species known within 6 mi (9.7 km) of Monticello site (Xcel 2023-TN9084: Section 3.7.8.2).

For all species in Table 3-10, Xcel Energy’s ER contains full species descriptions and occurrence information (Xcel 2023-TN9084: Section 3.7.8.2) which the NRC incorporates here by reference. Of the 20 State-listed terrestrial species that are not also federally listed (Table 3-10), three are birds, one is a mammal, one is a reptile, one is an insect, and 14 are plants. None of the 20 State-listed terrestrial species (Table 3-10) are known to occur on the Monticello site. However, 14 of these species do have potential habitat on the Monticello site. Below, the NRC staff describes these 14 species. All species information is from Xcel Energy’s ER unless otherwise specified:

- Potential habitat for two of the three State-listed endangered bird species (horned grebe and loggerhead shrike) exists within the Monticello site. These species, like most native birds, are also protected under the Migratory Bird Treaty Act (TN3331; 50 CFR Part 10-TN5490). According to the ER (Xcel 2023-TN9084), one occurrence of horned grebes and 12 occurrences of loggerhead shrikes are known from within 6 miles of the Monticello site. However, neither species is known to occur on the Monticello site. Horned grebes are a common migrant, but no persistent breeding populations are known in Minnesota. Horned grebes could use marsh habitats on the Monticello site during migration. Loggerhead shrikes use open habitats with short vegetation intermixed with shrubs or low trees, particularly those with spines or thorns (FWS 2023-TN9571). Potential open habitat for loggerhead shrikes occurs in the undeveloped parts of the Monticello site and along roadsides.
- Eastern spotted skunk (also known as the civet cat) is a State-listed threatened mammal that has experience rapid population decline with no more than a few sightings in Minnesota over the last several decades (MnDNR 2024-TN9710). Eastern spotted skunks generally occur in open habits with cover, including thickets, brush, riparian woodlands, and fencerows. Xcel Energy reported no occurrences of the eastern spotted skunk onsite or within 6 mi (10 km) of the site. Riparian woodlands and brush habitat on the Monticello site could provide habitat for the eastern spotted skunk.
- Blanding’s turtle is State listed as threatened. The Mississippi River and wetlands on the Monticello site and in the vicinity provide suitable habitat for this turtle. Twenty observations of Blanding’s turtle have occurred within 6 mi (10 km) of the Monticello site.
- Rock sandwort, a State-listed threatened plant, has one occurrence within the vicinity of the Monticello site. The species typically occurs in open, dry, sparsely vegetated sites. This perennial plant with small white flowers establishes itself in the shallow cracks and crevices of dry, sedimentary rock outcrops or occasionally in dry prairie sandy soils. Such habitat could be present on the Monticello site.
- Wetland habitats for the following six State-listed plants are present within the vicinity and the Monticello site boundary: Clinton’s bulrush, cross-leaved milkwort, lance-leaved violet, swamp blackberry, tall nutrush, and tubercled rein orchid. Xcel Energy reported no occurrences of these species onsite or within 6 mi (10 km) of the site.
- Forest habitats for the following three State-listed plants occurs within the vicinity and the Monticello site boundary: blunt nosed grapefern, butternut, and ram’s head orchid. Xcel Energy reported no occurrences of these species onsite or within 6 mi (10 km) of the site.

3.6.3.3 Species Protected under the Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA; 16 U.S.C. 668 and 668c-TN1447) extends regulatory protections to the bald eagle and golden eagle. The Act prohibits anyone without a permit from the U.S. Secretary of the Interior from "taking" bald eagles or golden eagles, including their parts, nests, or eggs.

Xcel Energy summarizes eagle occurrences and nesting in the vicinity and on the Monticello site (Xcel 2023-TN9084: Section 3.7.8.3). Bald eagles are known to nest on the Monticello site and in the vicinity. Although one bald eagle nest was known to occur on Cedar Island, upstream from the power block, recent information about that individual's nesting or nesting success is unknown. Although golden eagles occur in Minnesota, they are not known to nest within the State and do not have any known occurrences within 6 mi (10 km) of the Monticello site. No surveys for eagles or eagle nests have been conducted on the Monticello site since the initial license renewal (Xcel 2023-TN9084). Xcel Energy reports no eagle take permitting requirements associated with Monticello site operations or in-scope transmission lines.

3.6.3.4 Species Protected under the Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale any migratory bird or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued under Federal regulations. Xcel Energy has a memorandum of understanding with U.S. Fish and Wildlife Service (FWS) and MDNR to address migratory birds that may be present, injured, or killed on Xcel Energy property (Xcel 2023-TN9084: Section 2.2.5.3).

Northern States Power - Minnesota (NSPM) maintains a Federal Migratory Bird Special Purpose Utility Permit from the FWS (Xcel 2023-TN9084: Section 3.7.2.6). This permit can only be issued to utility companies to collect, transport, and temporarily possess migratory birds found dead on utility properties, structures, and rights-of-way (FWS Undated-TN9282). In emergency circumstances, permit holders may relocate or destroy active nests.

In its ER, Xcel Energy lists 36 bird species that are likely to be observed in Wright and Sherburne counties (Xcel 2023-TN9084: Table 3.7-4). Of these 36 bird species, 33 species are protected by the MBTA (50 CFR Part 10-TN5490). One species, the cerulean warbler (*Dendroica cerulea*), is also a Bird of Conservation Concern, an FWS designation for species of highest conservation priority that are not already federally listed as threatened or endangered (FWS 2021-TN8740). FWS (FWS 2023-TN9083) provided a list of 12 migratory birds that could occur within the Monticello site and are of particular concern for the project because they are an eagle or on the Bird of Conservation Concern list: bald eagle, black tern (*Chlidonias niger*), Canada warbler (*Cardellina canadensis*), cerulean warbler, chimney swift (*Chaetura pelagica*), golden-winged warbler (*Vermivora chrysoptera*), lesser yellowlegs (*Tringa flavipes*), long-eared owl (*Asio otus*), red-headed woodpecker (*Melanerpes erythrocephalus*), rusty blackbird (*Euphagus carolinus*), western grebe (*Aechmophorus occidentalis*), and wood thrush (*Hylocichla mustelina*).

Another important bird species protected under the MBTA is the trumpeter swan (*Cygnus buccinator*, also called *waabiziwag* in the Ojibwe language, Mille Lacs Band of Ojibwe 2023-TN9666). Heat discharges into the Mississippi River from Monticello operations have warmed the water near the plant and created an important winter habitat for Minnesota trumpeter swans (Xcel 2023-TN9084: Section 3.7.2.5). The information described here comes from the following sources: MNBBA 2023-TN9572, MnDNR 2023-TN9573, Moriarty 2020-TN9574, Partridge and Steigauf 2020-TN9575.

Trumpeter swans are large, wetland-dependent birds, with a length of 4.8–5.4 ft (1.5–1.6 m) and a wingspan of 6–8 ft (1.8–2.4 m). During the breeding season, they select nesting sites in smaller wetlands and with extensive forest cover along the shoreline. Occasionally, they select sites along slow-moving rivers. After being overhunted in the late 1800s, trumpeter swans were extirpated from Minnesota by the mid-1900s. Reintroduction in Minnesota began in 1966 and continued up to 2012. The current breeding population in Minnesota is at least 25,000 birds.

In the winter, most of Minnesota's breeding population of trumpeter swans migrate to locations in central and southern Minnesota with warm open water and abundant food. Monticello provides an important site with reliably warm water in the winter. Soon after Monticello's operations began, five trumpeter swans did not migrate south, but instead over-wintered downstream of the plant in the City of Monticello (Partridge and Steigauf 2020-TN9575). Local community members began feeding overwintering swans in Monticello, which attracted even more swans to overwinter in subsequent years. Currently, more than 1,000 Asia overwinter in Monticello. These swans have become a major tourist attraction (Partridge and Steigauf 2020-TN9575).

Minnesota lists the peregrine falcon as a species of special concern (MnDNR 2024-TN9743). According to the initial LR (NRC 2006-TN7315), peregrine falcons have nested at the site since 1995, and the MDNR notes this in its letter about relicensing (Xcel 2023-TN9084: Attachment B). The State notes that about 70 percent of breeding peregrine falcons nest on tall buildings, bridges, and smokestacks, while about 30 percent nest on cliffs. Threats to peregrine falcons include human related factors (e.g., collisions with buildings and infrastructure, pollutants, nesting habitat loss) and environmental factors (e.g., disease, predation).

3.6.3.5 Invasive Species

Invasive species are identified as non-native organisms whose introduction causes or is likely to cause economic or environmental harm or to cause harm to human, animal, or plant health (EO 13751, 81 FR 88609-TN8375). Executive Order (EO) 13112 (64 FR 6183-TN4477), as amended by EO 13751, directs Federal agencies to not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species unless they determine that the benefits of the action clearly outweigh the harm from invasive species and that all feasible and prudent measures to minimize risk of harm are taken (64 FR 6183-TN4477: Section 2). Minnesota lists 16 species of plants as noxious weeds (MnDA 2023-TN9344).

Xcel Energy noted important invasive species in the vicinity of the Monticello site (Xcel 2023-TN9084: Section 3.7.5). Of these, none are terrestrial animals. The aquatic plant, Eurasian milfoil, is covered in Section 3.7.1 of this document). The remaining invasive plant species (Xcel 2023-TN9084: Section 3.7.5.1 and Section 3.7.5.3) have the potential to occur within the site and are addressed here as terrestrial species, with full species biology and occurrence information incorporated by reference from the applicant's ER. Only the following three invasive terrestrial species are reported to occur onsite, as documented in records from MDNR (MnDNR 2023-TN9576, MnDNR 2023-TN9577):

- Common buckthorn (*Rhamnus cathartica*) is a tree or shrub that occurs in forests, wetlands, prairies, and other natural habitats. This species is present within the site boundaries, on islands in the Mississippi River.

- Bell's honeysuckle (*Lonicera* x *bella*) is a shrub that grows in disturbed areas with full sun or partial shade. This species is present within the site boundaries, on islands in the Mississippi River.
- Purple loosestrife (*Lythrum salicaria*) is a tall herbaceous perennial that grows in open wetlands. This species is known to occur in the vicinity and on site. Minnesota aquatic species data (MnDNR 2023-TN9576) show one location on the south of the meteorological towers (MET) on the west side of the road.

3.6.3.6 Important Habitats

Important habitats include any wildlife sanctuaries, refuges, preserves, or habitats identified by State or Federal agencies as unique, rare, prioritized for protection, wetlands and floodplains, and land areas identified as critical habitat for species listed by the FWS as threatened or endangered. Important habitats on and around the Monticello site include the wetlands discussed above in Sections 3.6.1 and 3.6.2. In particular, the Mississippi River riparian habitats provide important habitat, especially during very cold winters when heat released by station operations maintains an ice-free body of water. In addition, nearby Federal lands provide important terrestrial habitats (Xcel 2023-TN9084: Sections 3.7.4). Sherburne National Wildlife Refuge provides mating and nesting habitat for bald eagles. The wildlife refuge also provides overnight roosting for many migrating birds including up to 14,000 greater sandhill cranes (*Grus canadensis tabida*) in October and November (FWS Undated-TN9744). State lands such as Sand Dunes State Forest and Lake Maria State Park also provide important habitats.

3.6.3.7 Culturally Important Species

Two culturally important plant species, eastern red cedar (*Juniperus virginiana*) and wild rice (*Zizania* spp.), occur in the vicinity of the Monticello site (iNaturalist 2023-TN9655). See Section 3.9 in this EIS for more information about these culturally important species.

Eastern red cedar is an evergreen tree in the cypress family which grows well in rocky dry soils and river bluffs and occurs on the Monticello site (Xcel 2024-TN9859). According to a letter from the Mille Lacs Band of Ojibwe Department of Natural Resources to the NRC, rich red cedar forests once lined the banks of the Mississippi River on what is now the Monticello site (Mille Lacs Band of Ojibwe 2023-TN9666). The red cedar is an important cultural resource to the Ojibwe who hewed dugout canoes from the tree trunks. These canoes were traditionally used to harvest another culturally important plant species, natural wild rice (Milgroom 2023-TN9745).

Called *manoomin* in the Ojibwe language, wild rice is an aquatic grass that naturally occurs in wetlands of Minnesota, Wisconsin, and parts of Canada. This food source is essential to the creation story of the Ojibwe. It grows in shallow water (1 to 3 ft; 0.3 to 0.9 m) deep. In order to germinate, the seeds require near freezing temperatures over 3–4 months on the bottom of shallow lake beds (MnDNR 2008-TN9711). Warm water temperatures from climate change or from thermal discharge can impact wild rice habitat. Wild rice beds are also very attractive to migrating waterfowl (MnDNR 2024-TN9712). The applicant plans to conduct an onsite survey for wild rice onsite in the summer of 2024 and will submit the results to the NRC (Xcel 2024-TN9859).

3.6.4 Proposed Action

The following sections address the site-specific environmental impacts of the Monticello SLR on the environmental issues related to terrestrial resources.

3.6.4.1 Effects on Terrestrial Resources (Non-cooling System Impacts)

According to the LR GEIS, non-cooling system impacts on terrestrial resources can include impacts that result from site and landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the LR period on and near a plant site. The NRC staff based its analysis in this section on information derived from Xcel Energy's ER (Xcel 2023-TN9084) unless otherwise cited. Xcel Energy has not identified any refurbishment activities during the proposed relicensing term (Xcel 2023-TN9084). No further analysis of potential impacts from refurbishment activities is therefore necessary.

In its ER (Xcel 2023-TN9084), Xcel Energy states that it will conduct ongoing operational and maintenance activities at Monticello throughout the SLR term, including landscape maintenance activities, stormwater management, piping installation, and fencing. The NRC staff expects that physical disturbances would be limited to paved or disturbed areas or to areas of mowed grass or early successional vegetation and not encroach into wetlands or into the remaining areas of mixed forest. Xcel Energy maintains a special use permit from FWS and has procedures to protect nests and nesting birds on the Monticello site. The NRC staff concludes that the anticipated activities would have only minimal effects on terrestrial resources, based on information presented in the ER and the staff's independent analysis.

Xcel Energy (Xcel 2023-TN9084) states that it has administrative controls in place at Monticello to ensure that it reviews operational changes or construction activities and minimizes environmental impacts through BMPs, permit modifications, or new permits, as needed. Xcel Energy (Xcel 2023-TN9084) further states that regulatory programs for issues like stormwater management, spill prevention, dredging, and herbicides further minimize impacts on terrestrial resources. The NRC staff concludes that continued adherence to environmental management practices and BMPs already established for Monticello would continue to protect terrestrial resources during the SLR operational period.

Operational noise from the Monticello site facilities extends into the remaining natural areas on the site. However, Monticello has exposed these habitats to similar operational noise levels since it began operation in 1970. The NRC staff therefore expects that wildlife in the affected habitats have long ago acclimated to the noise and human activity of Monticello operations and adjusted their behavior patterns accordingly. Extending the same level of operational noise levels during the 20-year SLR period is therefore unlikely to noticeably change the patterns of wildlife movement and habitat use.

Based on its independent review, the NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that Xcel Energy might undertake during the SLR term would primarily be confined to already disturbed areas of the Monticello site. These activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the site. The NRC staff expects that Xcel Energy would continue to comply with the applicable requirements of Federal and State regulatory programs and obtain any needed permits. Accordingly, the NRC staff concludes that non-cooling system impacts on terrestrial resources during the SLR term would be SMALL.

3.6.4.2 Exposure of Terrestrial Organisms to Radionuclides

This issue concerns the potential impacts on terrestrial organisms from exposure to radionuclides from routine radiological effluent releases. The NRC staff will first summarize how this issue has been addressed historically, and then provide a site-specific evaluation of the issue for the Monticello SLR term.

Radionuclides may be released from nuclear power plants into the environment through several pathways. During normal operations, nuclear power plants can release gaseous emissions that deposit small amounts of radioactive particulates in the surrounding environment. Gaseous emissions typically include krypton, xenon, and argon (which may or may not be radioactive), tritium, isotopes of iodine, and cesium. Emissions may also include strontium, cobalt, and chromium. Nuclear power plants can also release radionuclides as liquid effluents into water. From there, terrestrial plant roots can absorb radionuclides from shallow groundwater or surface waters. Animals may experience exposure to ionizing radiation through inhalation, direct contact (with air, water, or other media), inhalation, or ingestion (of contaminated food, water, or soil).

The 1996 LR GEIS (NRC 1996-TN288) did not address the impacts of the exposure of terrestrial organisms to radionuclides released from routine plant operations during license renewal. In 2007, the International Commission on Radiation Protection (ICRP) issued revised recommendations for a system of protection to control exposure from radiation sources (ICRP 2007-TN422). The recommendations included a section about the protection of the environment in which the ICRP found that a clearer framework for assessing the impact of radionuclide exposure on non-human organisms was warranted. The ICRP indicated that it would develop a set of reference animals and plants as the basis for relating exposure to dose, and dose to radiation effects. This information would then provide a basis from which agencies and responsible organizations could make policy and management decisions. Subsequently, the ICRP developed and published a set of 12 reference animals and plants that included a large and a small terrestrial mammal, an aquatic bird, a large and a small terrestrial plant, and several other species. (ICRP 2008-TN7530, ICRP 2009-TN7531). The ICRP also issues publications and information related to radiological effects and radiosensitivity in non-human biota (Adam-Guillermin et al. 2018-TN7972).

In 2009, after the NRC staff conducted a review of the ICRP’s 2007 recommendations, the Commission found no evidence that the NRC’s current (as of 2009) radiation protection controls was not protective of the environment (NRC 2009-TN6651). For this reason, the Commission determined that the NRC staff should not develop separate radiation protection regulations for plant and animal species (NRC 2009-TN6651). Instead, the Commission charged the NRC staff to monitor international developments on this issue and to keep the Commission informed. Nonetheless, when preparing the 2013 LR GEIS, the NRC decided to address the radiological exposure of non-human organisms after considering public concern about these impacts at some nuclear power plants (NRC 2013-TN2654).

In the 2013 LR GEIS (NRC 2013-TN2654), the NRC staff adopted the U.S. Department of Energy (DOE) standard for a graded approach for evaluating radiation doses to terrestrial and aquatic biota (DOE 2019-TN6817). This DOE standard provides methods, models, and guidance that can be used to characterize radiation doses to terrestrial and aquatic biota exposed to radioactive material (DOE 2019-TN6817). The following DOE guidance dose rates are the levels below which no adverse effects to resident populations are expected:

- riparian animal: 0.1 radiation-absorbed dose per day (rad/day) (0.001 Gray per day (Gy/day))
- terrestrial animal: 0.1 rad/day (0.001 Gy/day)
- terrestrial plant: 1 rad/day (0.01 Gy/day)
- aquatic animal: 1 rad/day (0.01 Gy/day)

The NRC staff notes that in 1992, the International Atomic Energy Agency (IAEA 1992-TN712) had concluded that chronic dose rates of 0.1 rad/day (0.001 Gy/day) or less do not appear to cause observable changes in terrestrial animal populations. The United Nations Scientific Committee on the Effects of Atomic Radiation concluded in 1996 and reaffirmed in 2008 that chronic dose rates of less than 0.1 mGy/hr (0.24 rad/day or 0.0024 Gy/day) to the most highly exposed individuals would be unlikely to have significant effects on most terrestrial communities (UNSCEAR 2010-TN7974).

In the 2013 LR GEIS (NRC 2013-TN2654), the NRC estimated the total radiological dose that four non-human receptors (riparian animal, terrestrial animal, terrestrial plant, and aquatic animal) would be expected to receive during normal nuclear power plant operations based on plant-specific radionuclide concentrations in water, sediment, and soils at 15 operating nuclear power plants. The NRC found that total calculated dose rates for all terrestrial receptors at all 15 plants were significantly less than the DOE guideline values. As a result, the NRC anticipated in the 2013 LR GEIS that normal operations of these facilities would not result in negative effects on terrestrial organisms from radionuclide release. The 2013 LR GEIS concluded that this is a Category 1 issue and that the impact of radionuclides on terrestrial biota from past operations would be SMALL for all nuclear plants and would not be expected to change appreciably during the initial license renewal period.

In the following discussion, the NRC staff analyzes the impact of radionuclides on terrestrial organisms on a site-specific basis for the Monticello SLR term, in accordance with CLI-22-03, that references CLI-22-02 (NRC 2022-TN8182, NRC 2022-TN9844).

As discussed in Section 2.1.4 of this site-specific EIS, the NRC requires nuclear power plants to maintain a radiological environmental monitoring program (REMP) in accordance with NRC regulations at 10 CFR Part 50, Appendix I (TN249); 10 CFR Part 20 (TN283); and 10 CFR Part 72 (TN4884); through plant-specific technical specifications, and through the guidance in Regulatory Guide 4.1 (NRC 2009-TN3802). These collectively require that licensees establish and implement a REMP to obtain data on measurable levels of radiation and radioactive material. REMP monitoring confirms that radiation is below regulatory limits and any increases are detected and addressed, as appropriate.

As part of its environmental review, the NRC staff reviewed the past 5 years (2018–2022) of REMP reports (Xcel 2019-TN9621, Xcel 2020-TN9612, Xcel 2021-TN9613, Xcel 2022-TN9614, Xcel 2023-TN9615). The NRC staff assumed that a 5-year period provides adequate coverage to evaluate a broad range of Monticello operational and maintenance activities that could influence the generation and release of radionuclides. The NRC staff looked for indications of adverse trends (i.e., increasing radioactivity levels) over the 5-year review period.

Xcel Energy's REMP measures the terrestrial, aquatic, and atmospheric environment for ambient radiation and radioactivity. Xcel Energy conducts monitoring for the following: direct radiation, air, precipitation, well water, river water, surface water, food products and vegetation (such as edible broad leaf vegetation), fish, silt, and shoreline sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon).

For this issue, NRC staff evaluated REMP and groundwater monitoring data. As discussed in Section 2.1.4 of this site-specific EIS, over the 5-year review period, NRC staff found no apparent evidence in the REMP data showing an increasing trend in concentration or pattern of radionuclide concentrations that would indicate potential ongoing inadvertent releases from Monticello. However, the NRC staff's review of Monticello groundwater monitoring data did show elevated levels of tritium concentration onsite at well MW-9A since 2009. The applicant also reported an additional release of liquid effluent containing elevated tritium in November 2022 (Xcel 2023-TN9084: ER Section 3.6.3.2). See Section 3.5.2.3 of this EIS for new information regarding tritium plume recovery and gradient control identified during the environmental review process. Additional sampling until August 2023 has not identified tritium above detection levels in the Mississippi River. The NRC staff does not expect these below-detectable levels of tritium in the river to negatively impact terrestrial resources, nor does the staff expect them to negatively impact aquatic resources (Section 3.7.2.7 of this document). If such a spill were to occur during the SLR term, the NRC staff expects that Xcel Energy would take appropriate actions, as it has in this case, to mitigate and resolve the issue in accordance with all relevant State and Federal requirements.

Plant operations during the SLR term would continue current operating conditions, site management controls, and environmental stressors rather than introduce wholly new conditions and stressors. Therefore, the impacts of radionuclide exposure on terrestrial biota during the SLR term would likely be similar to impacts during current operations. For these reasons, the effects of radionuclide exposure would be minor and would neither destabilize nor noticeably alter any important attribute of this resource during the SLR term. The NRC staff concludes that the impacts of exposure to radionuclides on terrestrial resources during the Monticello SLR term would be SMALL.

3.6.4.3 Cooling System Impacts on Terrestrial Resources (Plants with Once-Through Cooling Systems or Cooling Ponds)

This issue concerns the potential impacts of once-through cooling systems and cooling ponds at nuclear power plants on terrestrial resources. Cooling system operation can alter the ecological environment in a manner that affects terrestrial resources. Such alterations may include thermal effluent additions to receiving water bodies, chemical effluent additions to surface water or groundwater, impingement of waterfowl, disturbance of terrestrial plants and wetlands associated with maintenance dredging, disposal of dredged material, and erosion of shoreline habitat. In the following discussion, the NRC staff summarizes how this issue has been addressed historically, and then presents a site-specific evaluation of the issue for Monticello SLR.

The 2013 LR GEIS (NRC 2013-TN2654) states that many of the effects of cooling system operations on terrestrial resources have only been identified at a small number of nuclear power plants, and these plants have since modified their operations to reduce or eliminate the effects. For instance, in a study of eight nuclear power plants with copper alloys in their cooling systems, elevated concentrations of copper were discharged into the cooling systems from condenser tubing. At one plant, copper released from the cooling system increased deformities and reduced reproductive capacity in the resident bluegill sunfish population (*Lepomis macrochirus*) (Harrison 1985-TN7579); At another plant, abalone (*Haliotis* spp.) mortality was attributed to copper exposure in plant effluents (NRC 1996-TN288). Terrestrial wildlife such as migratory birds that feed on these aquatic organisms could have also been exposed to elevated copper levels and could have also experienced adverse effects. However, these eight nuclear power plants subsequently replaced their copper alloy condenser tubes with tubes made of different materials (e.g., titanium), which eliminated these impacts. This issue has not since been reported at any other nuclear power plants. The 2013 LR GEIS identified this as a Category 1 issue with a determination of SMALL impact.

In the following discussion, the NRC staff analyzes the effects of cooling system operations on terrestrial resources on a site-specific basis for the Monticello SLR term, in accordance with CLI-22-03, that references CLI-22-02 (NRC 2022-TN8182, NRC 2022-TN9844).

Section 3.5.3.1 of this document describes Monticello surface water withdrawals and plant discharges. The cooling water source for the plant is the Mississippi River, and Monticello's surface water withdrawal permit (MDNR permit 66-1172) establishes limits on withdrawals under low-flow conditions. Xcel Energy's NPDES permit (MN0000868) authorizes discharge of non-contact cooling water, stormwater, and other operations-related waters into the Mississippi River. Xcel Energy reports no notices of violation relating to the NPDES permit over the last 5 years regarding increased water temperatures or contaminants in the surface water (Xcel 2023-TN9084: ER Section 4.6.8.2).

Between 2014 and 2023, Xcel Energy recorded 10 onsite bird deaths and injuries. None of these bird deaths were attributed to impingement on intake screens (Xcel 2023-TN9578: Enclosure 31). Xcel Energy states that it routinely maintains intake screens to remove biofouling, which likely reduces the potential for avian foraging from organisms caught on the intake screens. Discharges would continue to provide overwintering habitat for trumpeter swans downstream of the Monticello plant.

Xcel Energy manages wetland and riparian areas for conservation by using BMPs to protect streams from stormwater runoff and erosion. Maintenance dredging at the intake occurs for plant operations as warranted (Xcel 2023-TN9084: Section 3.7.3). All dredging is conducted in accordance with NPDES, USACE, and MDNR permits. The NRC staff assumes that periodic dredging will be necessary during SLR term at similar frequencies, material volumes, and permit requirements. Each permit-granting agency would conduct their own environmental reviews prior to permitting dredging. The NRC staff further assumes that Xcel Energy would continue to abide by all dredging permit requirements in order to minimize adverse impacts on the terrestrial environment.

Xcel Energy has not identified any construction or change in cooling system operations during the SLR period. Therefore, the impacts for continued cooling system operations would be similar to current operating conditions. Xcel Energy plans to continue operating cooling water systems as currently configured and authorized through its withdrawal permit and its NPDES permit. The NRC staff concludes that the potential for cooling system impacts to terrestrial organisms during the Monticello SLR term would be SMALL.

3.6.4.4 Cooling tower impacts on vegetation (plants with cooling towers)

The issue concerns the impact of nuclear power plant cooling towers on terrestrial vegetation. In the following discussion, the NRC staff explains how this issue has been addressed historically and then provides a site-specific evaluation for the Monticello SLR term.

The 1996 LR GEIS (NRC 1996-TN288) evaluated two cooling tower impacts on vegetation: (1) impacts on crops and ornamental vegetation and (2) impacts on native plants. The 2013 LR GEIS (NRC 2013-TN2654) combined these two issues into one issue: cooling tower impacts on vegetation. Both the 1996 and 2013 LR GEIS identified this as a Category 1 issue and concluded that cooling impacts on vegetation would be SMALL during the initial LR. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL impacts for Monticello initial license renewal.

Terrestrial vegetation in the vicinity of nuclear power plant cooling towers can be exposed to increased humidity and have a higher risk of structural damage from freezing vapor plumes or exposure to deposition of drift particulate and water droplets. However, most of the deposition from cooling towers occurs in terrestrial vegetation located in relatively close proximity to the towers. Generally, deposition rates from these cooling towers have been below those that are known to result in measurable adverse impacts on terrestrial vegetation, and no deposition effects on agricultural crops or other terrestrial vegetation communities have been observed at most nuclear power plants. Terrestrial vegetation communities in the vicinity of cooling towers that have been exposed to many years of cooling tower operations are unlikely to change during the SLR term. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

Xcel Energy operates two MDCTs at Monticello under certain conditions (Xcel 2023-TN9084: Section 4.5). The cooling towers are located at the northeast corner of the plant's developed industrial area just south of the Mississippi River (see Figure 3-15). In 2021 and 2022, Xcel Energy replaced these cooling towers (Xcel 2023-TN9084: Attachment D). The new towers have slightly greater cooling capacity. According to Xcel Energy, use of the new cooling towers in the summer will result in lower discharge temperatures than the old cooling towers (Xcel 2023-TN9084: Section 3.10.1). The new cooling towers are also equipped with drift eliminators. Xcel Energy stated that the design drift loss limit is 0.0005 percent (Xcel 2023-TN9578: Enclosure 10). Because the source of water is the freshwater from Mississippi River, salt deposition is not a potential impact from operating these cooling towers.

In its ER, Xcel Energy states that the new cooling towers use the same footprint as the existing plant facility (Xcel 2023-TN9084: Section 3.1.4). The NRC staff compared Monticello plant site images in Google Earth Pro (GEP 2024-TN9858) from 2011 to 2023 to confirm that the old and new cooling towers generally occupy the same footprint in the plant industrial area; therefore, potentially exposed, vegetation should be similar to as before tower replacement. Potentially exposed vegetation occurs within a 6 mi (9.7 km) radius of the Monticello site (Xcel 2023-TN9084 ER: Table 3.2-2). The most abundant vegetated land covers within the 6 mi (9.7 km) radius of Monticello are cultivated crops (35 percent), deciduous forest (15 percent), pasture/hay (13 percent), and wetlands (9 percent). Section 3.6.2 describes the terrestrial habitats and dominant vegetation within the site boundaries; with about 75 percent of the approximately 2,000 ac (809 ha) site being covered with terrestrial vegetation. Deciduous forests (36 percent of site), cultivated crops (18 percent), and pasture/hay (13 percent) are the main vegetation types. About 45.6 ac (18.4 ha; 2.2 percent) of the site is wetlands (Figure 3-15).

Because the new towers are equipped with drift eliminators, vegetation should be exposed to less humidity and vapor plumes than before the towers were replaced. Particulate deposition should be similar as before tower replacement. With the installation of drift eliminators, the amount of particulates deposited on terrestrial vegetation is expected to be less than before the towers were replaced.

Other than temporary ground disturbance in the already disturbed area, Xcel Energy has not identified any impacts from replacing the cooling towers in 2021 and 2022, and it does not plan any construction or change in nuclear plant cooling operations during the SLR period. Therefore, the impacts of continued cooling system operations at Monticello would be less than operational impacts prior to tower replacement, and the NRC staff concludes that the potential for cooling system impacts on terrestrial vegetation during the Monticello SLR term would be SMALL.

3.6.4.5 Bird Collisions with Plant Structures and Transmission Lines

Bird collisions and the potential for mortality are associated with tall structures such as cooling towers, transmission structures, meteorological towers (MET), and other nuclear power plant infrastructure. Bird mortality is of concern if the resulting reduction in population numbers threatens the stability of the species or significantly impairs its function within the ecosystem. The 2013 LR GEIS (NRC 2013-TN2654) identified this as a Category 1 issue with a determination of SMALL impact. The NRC staff found that the available data on bird collision mortality associated with nuclear power plant cooling towers and other structures suggest that the number of bird mortality collisions is small and primarily occur during the spring and fall migration of songbirds at night. In the following discussion, the NRC staff analyzes the impact of bird collisions on a site-specific basis for the Monticello SLR term in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

In its ER, Xcel Energy states that it plans no new construction of tall structures such as buildings or transmission lines during the Monticello SLR term. Therefore, this analysis addresses potential impacts of bird collisions with existing structures and transmission lines during the SLR term. The tallest structures on the Monticello site are the off-gas stack and primary MET, both of which are 328 ft (100 m) above ground level (Xcel 2023-TN9084: Sections 2.2.4 and 3.2.3). The primary MET is guyed and lit with red flashing lights (FAA 2013-TN9579). Xcel Energy states that swan diverters are installed on transmission lines in areas where incidents of bird collisions have occurred to reduce the likelihood of collision (Xcel 2023-TN9084: Section 2.2.5.3). However, in-scope transmission lines on the Monticello site do not have swan diverters (Xcel 2023-TN9578: Enclosure 14) because avian mortality on the Monticello site from all causes, including in-scope transmission lines, is low. From 2014–2023, Xcel Energy reported 10 avian deaths on the Monticello site (10 individuals; Xcel 2023-TN9578: Enclosure 31); only one of these was determined to be a collision (with a building). This low number over a nearly 10-year period suggests that avian mortality at the Monticello site is generally low and does not have the potential to adversely affect bird populations.

Xcel Energy has an aviation protection plan detailing policies and procedures to avoid and minimize risks of avian collision on its sites and infrastructure (Xcel 2023-TN9084: Sections 2.5.6.3 and 3.7.2.6). Furthermore, NSPM holds a migratory bird special purpose utility permit from FWS authorizing the permittee to carry out utility-specific management actions (Xcel 2023-TN9084: Section 2.5.6.3).

Under the proposed SLR, current operating conditions and environmental stressors would continue to exist; no new impacts would be expected to occur. Therefore, the impacts of current operations and SLR on bird collisions would be similar. For these reasons, the effects of bird collisions with plant structures and transmission lines would likely be minor and would neither destabilize nor noticeably alter any important attribute of bird populations during the SLR term. The NRC staff concludes that the impacts of bird collisions with plant structures or transmission lines during the Monticello SLR term would be SMALL.

3.6.4.6 *Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)*

Water use conflicts occur when the amount of water needed to support riparian communities is diminished as a result of demand for agricultural, municipal, or industrial use or decreased water availability due to droughts, or a combination of these factors. The NRC staff describes how this issue has been addressed historically, and then provides a site-specific evaluation for the Monticello SLR term.

In the 1996 LR GEIS (NRC 1996-TN288), the NRC evaluated water use conflicts as a surface water quality issue and included all ecological impacts within this surface water quality issue. The NRC rated water use conflicts as SMALL. The 2013 LR GEIS (NRC 2013-TN2654) separated surface water quality issues from ecological water use conflicts. For terrestrial resources, the NRC created a new issue of water use conflicts for plants with cooling ponds or cooling towers using makeup water from a river, reasoning that riparian communities could be impacted by reduced flows if the makeup water is from a river. For the Wolf Creek Generating Station in Coffey County, Kansas, which withdraws makeup water from a small river with especially low flow during drought conditions, the NRC staff concluded that the water use conflict impacts on terrestrial resources were SMALL to MODERATE. For other plants, the NRC staff concluded that the impact of water use conflicts with riparian communities is a plant-specific issue and that the range of impacts at plants with cooling ponds or cooling towers using make up water from a river could not be determined generically. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue and adopted the 1996 LR GEIS's conclusion of SMALL for Monticello initial license renewal. In this EIS, the NRC staff analyzes surface water resource use conflicts in Section 3.5.3.1 and water use conflicts regarding aquatic resources in Section 3.7.2.9. Below, the NRC staff analyzes this site-specific issue for the SLR term.

Monticello's cooling water intake system has the flexibility to operate in one of four modes: open-cycle (i.e., once-through), closed cycle using cooling towers, and two combinations of these modes referred to as helper cycle mode and partial recirculation mode, respectively. Xcel Energy chooses the mode in which to operate, based on water temperature and river flow requirements specified in Monticello's NPDES permit (MN0000868) and Water Appropriation Permit (#66-1172; MPCA 2023-TN9401; MnDNR 2023-TN9402).

Terrestrial riparian communities that could be impacted by diminished water availability are the terrestrial resources associated with the wetlands and surface water habitats on the Monticello site (Table 3-9, Figure 3-15). These riparian habitats total about 45.6 ac (18.4 ha) and consist mostly of riverine wetlands (60 percent of onsite wetland habitats) and freshwater forested/shrub wetlands (35 percent of onsite wetland habitats) along the channel and on oxbow islands. Many of the important terrestrial biota (Section 3.6.3) onsite are associated with riparian habitats.

In the NRC staff's analysis of surface water conflicts (Section 3.5.3.1), the staff estimated that less than 1 percent of the Mississippi River flows are permanently removed by Monticello in an average year. The NRC staff did identify one period of extreme low flows in the Mississippi River during the past 25 years of record (1998–2023). The extreme low river flows occurred over six consecutive days from August 15 to August 20, 2021, during which time the average Mississippi River flow was 650 cfs (18.4 m^3/s). This was the only period where Mississippi River flows dropped below Monticello's Surface Water Appropriation Permit river-flow threshold of 860 cfs (24.4 m^3/s) and triggered restrictive water appropriations (i.e., appropriations shall not exceed 75 percent of flows). The water withdrawals during this 6-day period of extreme low river flows resulted in the permanent removal of approximately 8 percent of the Mississippi River flows.

In Section 3.5.3.1, the NRC staff concluded that surface water use conflicts would be SMALL due to the Surface Water Appropriation Permit which contains conditions that control water withdraws from the Mississippi River and can require use of cooling towers to stay within the water appropriations. Additionally, Monticello’s operations permanently remove only a small portion of Mississippi River flows during an average year (less than 1 percent) and during extreme lows (approximately 8 percent). Thus, a high percentage (92 to 99 percent) of Mississippi River flows would remain in the river even during extreme low flows, which would preserve terrestrial riparian habitats and resources.

The proposed SLR for Monticello would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on terrestrial resources would be similar. For the reasons explained above, water use conflicts with terrestrial resources from SLR either would not occur or would be so minor that the effects on terrestrial resources would be undetectable. The NRC staff concludes that water use conflicts with terrestrial resources during the Monticello SLR term would be SMALL.

3.6.4.7 Transmission Line Right-of-Way Management Impacts on Terrestrial Resources

This issue concerns the effects of transmission line ROW management on terrestrial plants and animals. Utilities maintain transmission line ROWs so that the ground cover is composed of low-growing herbaceous or shrubby vegetation and grasses. Generally, ROWs are initially established by clear-cutting during transmission line construction and are subsequently maintained by physical (e.g., mowing and cutting) and chemical (e.g., herbicides or pesticides) means. These activities alter the composition and diversity of plant communities and generally result in lower-quality habitat for wildlife. Heavy equipment used for ROW maintenance can crush vegetation and compact soils, which can affect soil quality and reduce infiltration to shallow groundwater. This is especially of concern in sensitive habitats, such as wetlands. Chemical herbicides can be transported to neighboring undisturbed habitats through precipitation and runoff. Disturbed habitats often favor non-native or nuisance species and can lead to their proliferation. Noise and general human disturbance during ROW management can temporarily disturb wildlife and affect their behaviors, and the presence of ROWs can favor wildlife species that prefer edge or early successional habitats.

Both the 1996 LR GEIS (NRC 1996) and the 2013 LR GEIS (NRC 2013) identified this as a Category 1 issue and concluded that the impacts of transmission line ROW management on terrestrial resources would be SMALL during the initial license renewal term. In the 2006 Monticello LR (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue and adopted the 1996 LR GEIS’s conclusion of SMALL impacts.

In the following discussion, the NRC staff analyzes the issue of transmission line ROW management impacts on terrestrial resources on a site-specifical basis for the Monticello SLR term, in accordance with CLI-22-03 and CLI-22-02 (NRC 2022-TN8182, NRC 2022-TN9844).

Xcel Energy proposes no additional transmission line expansion or construction under the proposed action of subsequent license renewal. Therefore, during the SLR term, in-scope transmission line ROWs would be the same as the current ROWs connecting turbine building to switch yards. The current in-scope transmission lines mostly cross developed industrial land covers such as parking lots, switchyards, and substations (Xcel 2023-TN9084: Section 3.7.2.6), which are not vegetated. However, the ROWs also do cross some landscaped areas that contain vegetation. Control measures to limit or discourage vegetation growth incompatible with in-scope transmission lines include mowing, pruning, removal, and herbicide application. Although Xcel Energy does not have site-specific procedures for herbicide application, the Xcel Energy chemical control program is applicable to herbicide application.

During the SLR term, Xcel Energy's facility department would continue to maintain onsite transmission line ROWs with current control measures. The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new conditions and impacts. Therefore, the impacts of current operations and the impacts of the proposed SLR on transmission line ROW maintenance impacts on terrestrial resources would be similar. For these reasons, the effects of transmission line ROW maintenance would likely be minor and would neither destabilize nor noticeably alter any important attribute of terrestrial resources during the SLR term. The NRC staff concludes that the impacts of transmission line ROW maintenance on terrestrial resources during the Monticello SLR term would be SMALL.

3.6.4.8 Electromagnetic Field [Impacts] on Flora and Fauna (Plants, Agricultural Crops, Honeybees, Wildlife, and Livestock)

This issue concerns the effects of electromagnetic fields (EMFs) on terrestrial plants and animals, including agricultural crops, honeybees, wildlife, and livestock. Operating transmission lines produce electric and magnetic fields, collectively referred to as EMFs. EMF strength at the ground level varies greatly but is generally stronger for higher-voltage lines. Corona is the electrical discharge occurring in air from EMFs; it can be detected adjacent to phase conductors. Corona is generally not an issue for transmission lines of 345 kV or less. Corona results in audible noise, radio and television interference, energy losses, and ozone and nitrogen oxide production. For the purpose of license renewal, in-scope transmission lines include lines that connect the plant to the first substation that feeds into the regional power distribution system. The first substation is usually (but not always) on plant property.

In the LR GEIS (2013-TN2654), the NRC staff found that with the exception of honeybee hives, terrestrial biota located under and near the in-scope transmission lines do not experience biologically or economically (in the case of agriculture) significant adverse effects from EMFs during license renewal. Plant foliage and buds can sustain minor damage that reduces upward and outward growth, but the damage does not interfere with overall plant growth or the health of the lower parts of the plant (Miller 1983-TN1328). Studies on crop plants grown in electric fields have shown either no effect or small reductions in germination or yield (2013-TN2654). Adverse effects to honeybee hives under transmission lines include reduced growth, greater irritability, increased production of propolis (a resin compound used as a sealant), and increased mortality. These adverse effects can be reduced by shielding hives with a grounded metal screen or moving hives so that they are no longer near transmission lines.

In the following discussion, the NRC staff analyzes the issue of EMF impacts on flora and fauna on a site-specific basis for the Monticello SLR term, in accordance with CLI-22-03, and referencing CLI-22-02 (NRC 2022-TN8182, NRC 2022-TN9844).

As stated earlier in this section (Section 3.6.4.5), Xcel Energy has planned no additional transmission lines under the proposed SLR. Therefore, in-scope transmission lines and rights-of-way in the SLR term would be the same as those that currently connect the Monticello turbine building to the switchyards (Xcel 2023-TN9084: Figure 2.2-3). The current transmission line ROWs mostly cross impervious surfaces or land with sparse vegetation; they do not cross agricultural fields, pastures, or other habitats important for native wildlife or livestock. Therefore, exposure of terrestrial flora and fauna to EMFs are minimal under current operating conditions.

During the SLR term, Xcel Energy would continue current operating conditions, site management controls, and environmental stressors rather than introduce wholly new conditions. Therefore, the EMF impacts of operations during the SLR period on flora and fauna would be similar to current impacts, which are minor. The NRC staff concludes that the impacts of EMFs on flora and fauna during the SLR term would be SMALL.

3.6.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and Monticello would shut down on or before the expiration of the current operating licenses. Much of the operational noise and human activity at Monticello would cease, thereby reducing disturbances to wildlife in forest cover and other natural vegetation on and near the site. However, some continued maintenance of Monticello would still be necessary. Human activity, noise, and herbicide application would continue at the site with possible impacts resembling, but perhaps of a lower magnitude than, those described for the proposed action of subsequent license renewal. Shutdown itself is unlikely to noticeably alter terrestrial resources. Reducing human activity and frequency of operational noise may constitute minor beneficial effects on wildlife inhabiting nearby natural habitats.

If Monticello were to cease operating, some withdrawal of water from the Mississippi River would continue during the shutdown period to provide cooling to spent fuel in the spent fuel pool until that fuel could be transferred to dry storage. However, the amount of water withdrawn for these purposes would be a small fraction of water withdrawals used during current operations. Eventually, the amount of cooling water returned to the river would decrease over time and would end within the first several years following shutdown. The expected decrease in the amount of cooling water would lower the temperature of the river below the concrete discharge. Eventually, the water in the river would return to pre-plant winter temperatures when discharges completely end. As described earlier in this section (Section 3.6.3.4), a group of about 1,000 trumpeter swans stop migrating south during the winter and instead depend on the warm, open water winter habitat produced by the Monticello plant. If the Monticello plant were to cease operations under the no-action alternative, trumpeter swans (a species protected under the Migratory Bird Treaty Act) that winter at Monticello would lose an important overwintering habitat in central Minnesota (MNBBA 2023-TN9572). If the release of heated water were reduced in the winter months, many of the overwintering trumpeter swans would probably migrate elsewhere; however, some could die. The NRC staff concludes that the impacts of the no-action alternative on terrestrial resources during the proposed SLR term would be SMALL.

3.6.6 Replacement Power Alternatives: Common Impacts

Under all the replacement power alternatives that the NRC staff seriously considered, additional land would likely be temporarily disturbed for construction and laydown areas. If not already previously disturbed, the licensee could mitigate the impact by later revegetating temporarily disturbed land. All replacement power alternatives would also involve construction on developed or undeveloped lands outside the vicinity of the Monticello site with indeterminate loss of offsite forest, grasslands, desert, or wetlands.

Loss of habitat and increased noise generation during construction and operation of the new facilities could cause terrestrial wildlife to move into other habitats in the surrounding landscape, increasing demands on those habitats and competing with other wildlife. Erosion and sedimentation from clearing, leveling, and excavating land could affect adjacent riparian and wetland habitats. However, implementation of appropriate BMPs and the revegetation of temporarily disturbed lands would minimize impacts. The operator of the natural gas plant would develop and adhere to environmental management practices and BMPs protect terrestrial resources for the generation facilities and associated transmission corridors.

All of the power replacement alternatives assume the construction and maintenance of new transmission line corridors. Loss of habitat, habitat fragmentation, and increased noise generation during construction and operation of the new transmission line corridor could cause terrestrial wildlife to move into other habitats in the surrounding landscape, increasing demands on those habitats and competing with other wildlife. As the corridor revegetates and routine maintenance occurs, species favoring differing habitats could avoid or prefer the open habitat of the corridor. Invasive plants may also colonize the newly created corridors. In a review of bird mortality literature, Loss et al. (2014-TN9396) estimated that the median annual collision mortality for birds is 23.2–29.6 birds/km of powerline. Biological, environmental, location, and design factors influence the likelihood of collisions (APLIC 2012-TN6779; Bevanger 1994-TN9619).

The MBTA makes it illegal to take any migratory bird (or parts, nests, or eggs), except under a valid permit issued under Federal regulations. The utility may need to commission avian impact studies and obtain a Federal migratory bird special purpose utility permit for take of MBTA-protected bird species, in order to collect, transport, and temporarily possess migratory birds found on utility property or to handle active nest (FWS Undated-TN9282).

3.6.7 Natural Gas and Renewables (Solar and Wind) Alternative

Xcel Energy's ROI includes Minnesota and seven other states: Colorado, Michigan, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin. This analysis assumes that the natural gas-fired power plant would be constructed either onsite or offsite in one of the states within Xcel Energy's ROI. Solar panels could be installed on the Monticello site, offsite within Minnesota, or elsewhere within the ROI. Wind turbines would be installed offsite within Minnesota or elsewhere within the ROI.

This alternative would require 72,630 ac (29,393 ha) of land within the ROI: 67,580 ac (27,349 ha) for power generation facilities and an additional 5,050 ac (2,044 ha) of land for transmission line corridors.

Natural Gas Generation

The LR GEIS (NRC 2013-TN2654, page 4-119) concludes that many of the impacts on terrestrial resources from the operation of fossil-fuel energy alternatives would be essentially similar to those from the continued operation of a nuclear power plant. These similar impacts include cooling tower salt drift, noise, bird collisions with plant structures and transmission lines, the impacts connected with herbicide application and landscape management, and the potential water use conflicts connected with cooling water withdrawals. However, some impacts particular to a natural gas plant would be from air emissions of GHGs such as nitrogen oxide, carbon dioxide, and methane. Such GHGs can lead to consequences like climate change.

For the natural gas portion of the alternative, about 980 ac (396 ha) of land would be needed. About 80 ac (32 ha) would be needed for the 750 MW natural-gas-fired plant, assuming 20–40 ac (8–16 ha) per combustion unit (Leidos 2016-TN9183). About 900 ac (364 ha) would be needed for two new 345 kV transmission lines; each corridor would be 25 mi (45.7 km) long and 150 ft (40.2 m) wide. The natural gas facility could be constructed on the Monticello site, offsite in Minnesota, or offsite in another state in the ROI.

If the lands chosen for the plant to be built offsite were previously cleared and used for industrial activity, the impacts on terrestrial resources would be less significant than if the lands were virgin forest, grasslands, or desert containing important species and habitats. Vegetation clearing, tree removal, and construction noise would displace wildlife to nearby habitats, but some species would return at the end of construction when temporarily disturbed land is restored.

Operation of the offsite natural gas facility would have similar impacts to the proposed action regarding cooling tower salt drift, noise, bird collisions with plant structures and transmission lines, potential water use conflicts connected with cooling water withdrawals, and management of site and transmission corridors. Section 3.14.3.1 in this report discusses the effects of climate change on terrestrial resources. Despite these impacts, operating the natural gas alternative power plant would not likely destabilize any important attribute of the terrestrial environment.

The land requirement for construction of generation facilities and transmission corridors would not necessarily lead to moderate amounts of habitat loss, depending on whether or not those facilities and corridors are placed on already developed lands. Construction of new transmission lines would cause of loss of vegetation, change in habitats and wildlife habitat use, and would pose an increased risk of bird collisions and mortality. The NRC staff concludes that the impacts on terrestrial resources from the natural gas portion of this alternative would be SMALL to MODERATE.

Solar Photovoltaic

About 2,950 ac (1,194 ha) of land would be needed for the solar portion of this alternative. DOE estimates that the solar installation could occur on as many as three project sites and that they require about 7.6 ac (3.1 ha)/MW. Because this alternative proposes to install 200 MW of solar photovoltaic (PV), solar installations would require about 1,500 ac (607 ha). An additional 1,450 ac (587 ha) would be needed for one to three new 345 kV transmission lines; each corridor would be 25 mi (45.7 km) long and 150 ft (40.2 m) wide. A small amount of additional land would be needed to support the battery storage system at each site.

Impacts on terrestrial habitats and biota from the construction and operation of solar PV plants would depend largely on the amount of land required and its location. The NRC staff assumes that one of the solar plants would be located on the Monticello site, and the other two would be located offsite. If the lands chosen for the plants offsite were previously cleared and used for industrial activity, the impacts on terrestrial resources would be less significant than if the lands were forest, grasslands, wetlands, or desert containing important species and habitats. Vegetation clearing and tree removal would displace wildlife to nearby habitats, but some species would return at the end of construction when temporarily disturbed land is restored. Once in operation, solar plants pose special hazards to birds through collisions with PV equipment and transmission lines, electrocution by substation and distribution lines, and predation when injured and stunned on the ground after collision (Hathcock 2019-TN8470). Another less understood cause of bird collisions is known as the lake effect theory. Birds, especially migrating waterfowl and shorebirds, perceive the horizontally polarized light of PV solar panels as bodies of water and are injured or killed when they attempt to land on the panels as if they were water (Horvath et al. 2009-TN897). Water-seeking insects can also collide with the panels for the same reasons. In large enough numbers, such insect deaths may affect food webs. The Multiagency Avian-Solar Collaborative Working Group is a collection of Federal and State agencies identifying information needs and best practices for reducing the avian impacts of solar energy. Collaboration with government agencies on best practices in the construction and siting of the solar installations can mitigate their impacts on birds.

The NRC staff concludes that the impacts on terrestrial resources from the solar portion of this alternative would be MODERATE to LARGE based on the land requirement for solar generation facilities and transmission corridors, resulting in the significant loss of wildlife, habitats, and vegetation and the increased mortality risk to birds from collisions with solar PVs and new transmission lines.

Wind

About 68,700 ac (27,812 ha) of land would be needed for the wind portion of this alternative. DOE estimates that wind power generation disturbs up to 88.21 ac (35.70 ha)/MW. Because this alternative proposes to install 750 MW of wind power, wind turbine installation would require about 66,000 ac (26,709 ha). An additional 2,700 ac (1,093 ha) would be needed for 150 mi (241.4 km) of new 345 kV transmission lines; each corridor would be 150 ft (40.2 m) wide. Wind facilities could be located onshore or offshore (Section 2.4.2).

Impacts on terrestrial habitats and biota from the construction and operation of wind farms as part of the combination alternative would depend largely on the amount of land required, location of the land, and whether the facility is onshore or offshore. The NRC staff assumes that the onshore wind portion of the alternative would be in the Xcel Energy ROI. If the lands chosen for the plants were previously cleared and used for industrial activity, the impacts on terrestrial resources would be less significant than if the lands were forests or grasslands containing important species and habitats. Vegetation clearing and tree removal would displace wildlife to nearby habitats, though some species would return at the end of construction when temporarily disturbed land is restored.

Operation of wind farms would likely cause the injury and/or death of bats and birds that collide with wind turbines (Allison et al. 2019-TN8847), with onshore collisions thought to be more common than offshore collisions. However, accurately estimating collision fatalities requires accounting for differences in search effort and area, scavenger removals, and searcher efficiency.

For onshore wind turbine locations, species composition of deaths varies regionally for bats and birds (Allison et al. 2019-TN8847, Thompson et al. 2017-TN8746). In some regions, bat mortalities are greater than those of birds. Bat collision mortality appears to be lowest in areas with the greatest grassland cover around the onshore wind farm. Three migratory tree roosting bat species account for 72 percent of reported mortalities: hoary bat, eastern red bat, and silver-haired bat. Most of the observed bird deaths at onshore wind farms are small songbirds (57 percent of deaths) or diurnal raptors (9 percent), which include eagles and hawks.

For offshore wind turbine locations, collision impacts are difficult to accurately quantify because of challenges in bird and bat fatality monitoring in the offshore environments (Allison et al. 2019-TN8847). Offshore wind farms tend to use much larger turbines, include larger numbers of turbines, and operate in areas where the background noise from wind and waves hamper bird acoustic perceptions (Exo et al. 2003-TN8488). Lack of assessment tools, environmental differences, and infrastructure make it difficult to use onshore wind turbine mortality rates as the starting point for estimating offshore wind turbine bat or bird mortality rates.

Based on the preceding analysis, the NRC staff concludes that impacts on terrestrial resources from construction and operation of the wind portion of this alternative would be MODERATE to LARGE. Although construction of the wind farms would result in the alteration and loss of vegetation and wildlife habitats, sites could be revegetated. Some species and habitats would reestablish after the construction disturbance ends. Operational impacts would negatively impact bird and bat populations.

<u>Natural Gas and Renewables (Solar and Wind) Conclusion</u>

The NRC staff concludes that the overall impacts on terrestrial resources for the Natural Gas and Renewables (Solar and Wind) combination alternative could range from MODERATE to LARGE. The NRC staff's conclusion is based primarily on the large area of land required for all of the plants and the transmission corridors, the types of land that could permanently disturbed for the solar PV portion, the operational impacts of the wind portion of the alternative on birds and bats, and the increased likelihood of bird mortality from collisions with the new transmission lines.

3.6.8 Renewables (Solar and Wind) and Storage Alternative

Under this alternative, 950 MW of wind turbines, 700 MW of solar panels both on and offsite of Monticello, and 300 MW of offsite lithium-ion battery storage would be constructed. Xcel Energy estimates that solar panels would be installed at as many as three different project sites within the Xcel Energy ROI. Wind turbines would be installed offsite within Minnesota or the ROI. Types of impacts to terrestrial species from the solar and wind energy facilities would be similar to those described for the solar and wind portions of the previous alternative (Section 3.6.7) as would permitting requirements from regulatory agencies. However, because the land requirements are larger overall (96,500 ac; 39053 ha), he likelihood of negative impacts on terrestrial species increases. Solar PV generation is 750 MW, which is estimated to require (5,300 ac (2,145 ha). Wind power generation is 950 MW, which is estimated to require (84,000 ac [33,994 ha]). These new generation facilities are estimated to require 400 mi of new transmission corridors (7,200 ac [2,914 ha]). Operational impacts would be greater to birds and bats, because more solar panels and wind turbines would be operational, and because more transmission lines increase the likelihood of bird collisions. A small amount of additional land would be needed to support the battery storage system at each site.

Under this alternative, construction would result in the significant loss of vegetation and wildlife habitat, and operational impacts would negatively affect bird and bat populations. Based on the preceding analysis, the NRC staff concludes that impacts on terrestrial resources from construction and operation of solar PV and wind generation facilities as part of this alternative would be MODERATE to LARGE.

3.6.9 New Nuclear (Small Modular Reactor) Alternative

For the new nuclear alternative, the NRC staff assumes that the applicant would replace Monticello with a 12-unit NuScale design SMR power plant generating 880 MWe. Because Minnesota prohibits the construction and operation of new nuclear power plants within the State, the NRC staff assumes that the replacement plant would be constructed in one of the other seven states within Xcel Energy's service area (i.e., Colorado, Michigan, New Mexico, North Dakota, South Dakota, Texas, or Wisconsin).

The 12-unit SMR facility would be sited and constructed on about 130 ac (53 ha) of land that is within 25 mi of an existing transmission grid with sufficient surface water to support a plant cooling system and water use. An additional 450 ac (182 ha) would be needed to construct a 25 mi-long, 150 ft-wide transmission corridor to transmit power to the electrical grid. The SMR cluster will require the addition of new, tall structures to the landscape, including MDCTs, a power block, and one or two meteorological towers less than 200 ft (61 m) tall. The construction of tall structures may result in increased bird and bat mortality or injury from collisions. However, the NRC staff expects that over time, bird and bat populations would become accustomed to the presence of the new towers and avoid them.

Project construction would require clearing approximately 580 ac (235 ha) for the facility, auxiliary structures, and new transmission corridor. Once the SMR and associated facilities are built, the operational impacts on terrestrial resources would likely remain as expected for the proposed action.

For the Monticello plant site, impacts to terrestrial resources are the same as the No-Action alternative, because the site will be shut down. Because no nuclear facilities can be built in the State of Minnesota, the new nuclear alternative would result in the eventual loss of the existing overwintering swan habitat downstream of the Monticello plant on the Mississippi River in Minnesota as described above in the No-Action alternative.

Based on the preceding analysis, the NRC staff concludes that the impacts on terrestrial resources from the new nuclear option would be MODERATE for construction and SMALL for operations.

3.7 Aquatic Resources

This section describes the aquatic resources of the affected environment, which is the stretch of the Mississippi River by Monticello. The NRC staff previously characterized these resources in Section 2.2.5 of the 2006 Monticello LR SEIS, which analyzed the environmental impacts of initial license renewal (NRC 2006-TN7315). Section 3.7 of Xcel Energy's 2023 Environmental Report also contains a description of the aquatic environment (Xcel 2023-TN9084). This information is incorporated herein by reference, with key and updated information summarized below in the following subsections. Following the description of the aquatic environment, the staff analyzes the potential impacts on these resources that would occur from the proposed action (SLR) and alternatives.

3.7.1 Mississippi River

Monticello lies in central Minnesota along the southern bank of the Mississippi River at RM 900 (river kilometer [RKM] 1,448). Monticello withdraws cooling water from and discharges thermal effluent to the Mississippi River. The reach of the Mississippi River in the vicinity of Monticello is free flowing, shallow, and has swift currents and rapids (Xcel 2023-TN9084). The currents are swift because the river loses approximately 10 ft (3.1 m) of elevation in the stretch that is 1.5 mi (2.4 km) upstream and downstream of Monticello. The water velocity averages 1.5 to 2.5 fps (0.46 to 0.76 m/s) and can exceed 4.9 fps (1.49 m/s) during high flows. The main channel is approximately 980 ft (299 m) wide with an average depth of 6.2 ft (1.9 m). This region has mixed riverbed substrate consisting of gravel, rubble, boulder, and sand. The backwaters and shoreline areas are shallower with an average depth of 2 ft (0.6 m). These areas have finer substrates of mixed silt and mud. Section 3.5.1 contains additional information on the hydrological characteristics of the river.

The reach of the Mississippi River in the vicinity of Monticello is included in the Minnesota State Wild and Scenic River System Program, and it is designated as a “restricted” Outstanding Resource Value Water by the MPCA (see Section 3.7.1.2). While the portion of the Mississippi River near Monticello is free-flowing, it lies between the Sartell Dam upriver in Saint Croix, Minnesota, and the Coons Rapid Dam (a low sill dam) and the Lower Saint Anthony Falls Dam (the last dam with a lock for barged transport) downstream. The Coon Rapids Dam (RM 866; RKM 1,394) bars upstream fish migration, but fish can sometimes circumvent the dam during floods (Hatch et al. 2003-TN9330). These dams prevent species below the dams, such as lake sturgeon (*Acipenser fulvescens*) and paddlefish (*Polyodon spathula*), from accessing the reach of the Mississippi River by Monticello (NRC 2006-TN7315); however, fish can migrate downstream past the dams via spillways or powerhouses.

3.7.1.1 Biological Communities of Mississippi River

The local biological communities are those associated with riverine and backwater habitats (Xcel 2023-TN9084). The trophic structure consists of primary producers that process organic compounds from solar energy, which in turn feed primary and secondary consumers across the other trophic levels (Figure 3-16). Even though the main primary producer is periphyton (a mix of algae, diatoms, other microbes attached to the river bottom), floating phytoplankton (floating algae) and macrophytes (aquatic plants) also contribute to primary production. Detritus, which includes leaves, sticks, and other organic debris from the terrestrial environment, is another important energy source in river systems.

Primary consumers mainly include benthic invertebrates (e.g., insects, snails, mussels, crustaceans), along with zooplankton. Primary consumers support a diverse array of secondary and tertiary consumers, such as forage fish and predatory fish, including species that are popular in recreational fisheries. Primary consumers also provide food for aquatic snakes, salamanders, and turtles.

Studies characterizing primary producers and primary consumers near Monticello were last conducted between 1940 and 1976 (Xcel 2023-TN9084), which means that the discussions of these organisms in the 2006 Monticello LR SEIS remain the best available information (NRC 2006-TN7315). With respect to fish in the higher tropic levels, Xcel Energy conducts annual electrofishing and seining surveys to evaluate local fishery health. The most recently available survey report includes data gathered in 2020 and 2021[2] (Xcel 2023-TN9578: Enclosure 24).

[2] Xcel Energy 2022. Monticello Nuclear Generating Plant Environmental Monitoring and Ecological Studies Program, 2020–2021 Biennial Report. Enclosure 24 Attachment 1 of Xcel 2023-TN9578.

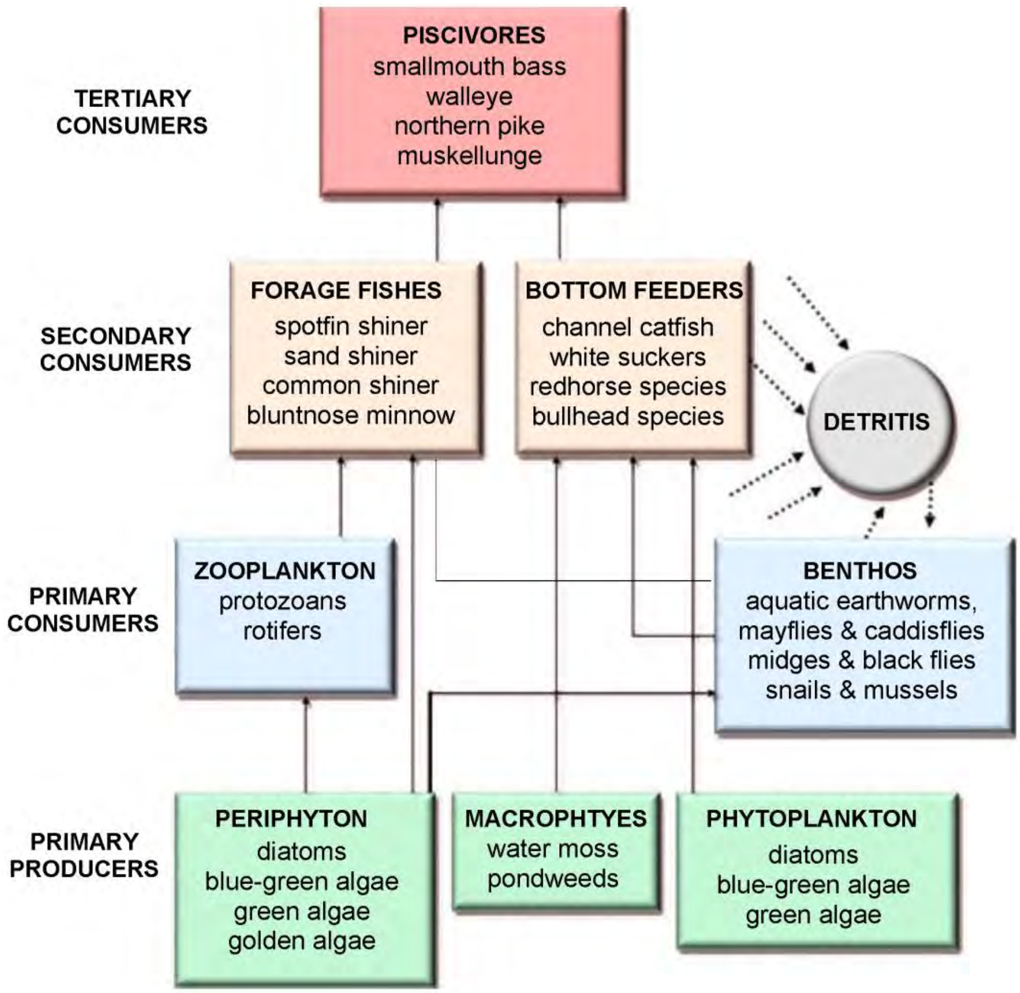


Figure 3-16 Aquatic Communities of the Mississippi River by the Monticello Nuclear Generating Plant

Periphyton and Other Plankton

Periphyton is typically the main primary producer in river systems and serves as a main energy source. Periphyton is comprised of mixed groups of algae, diatoms (that conduct photosynthesis) and cyanobacteria that attach to a variety of substrates in the river systems.

In studies conducted in the Mississippi River near Monticello in the 1970s, researchers estimated that 60 to 82 percent of the total primary production of the Mississippi River that flows past Monticello is attributed to periphyton (Amish et al. 1978-TN9580). Analysis of plankton collections identified 149 taxa of algae. The diatom *Gomphonema olivaceum* dominated winter and spring collections. Other dominant spring diatoms included *Diatoma vulgare*, *Synedra ulna*, and *Navicula gracilis*. Diatoms such as *Cocconeis placentula* and *Cocconeis pediculus* dominated fall collections (see Table 3.7-1 in Xcel 2023-TN9084). Periphyton production was highest in the summer, since these organisms rely on sunlight, and was dominated by the diatoms listed above along with blue-green algae. In its LR SEIS (NRC 2006-TN7315), the NRC staff found that periphyton species composition was similar in preoperational and post-operational collections.

The same species of periphyton algae can also occur in rivers as “floating phytoplankton,” but at a lower prevalence. Floating phytoplankton can be washed into rivers from reservoirs or standing backwater areas. Floating plankton can also occur as pieces of periphyton that break off and float to the surface. Researchers estimated that 18 to 40 percent of the primary production in the aquatic ecosystem by Monticello is attributed to floating phytoplankton based on surveys conducted from 1968 to 1970 (Amish et al. 1978-TN9580); however, the main source was probably from fragments of periphyton (NRC 2006-TN7315; NMC 2005-TN9345).

Zooplankton are microscopic animals that drift in the open water and prey upon floating phytoplankton. While zooplankton are an important contributor to aquatic ecosystems in oceans and lakes, they are not prominent components of the riverine ecosystems since they are not well adapted to fast currents. Zooplankton are present near Monticello but contribute a negligible amount to the energy flow (NRC 2006-TN7315; NMC 2005-TN9345).

Macrophytes

Aquatic vascular plants (macrophytes) can also be important contributors to riverine habitats; however, they are not abundant near Monticello because of the swift currents, shifting sands, and gravel to rocky bottoms that make it difficult for macrophytes to anchor roots and take hold (NRC 2006-TN7315; NMC 2005-TN9345). The three species of macrophytes found at low abundances during early surveys near Monticello include: (1) water moss (*Fontinalis antipyretica*); (2) American pondweed (*Potamogeton nodosus)*; and (3) sago pondweed (*Stuckenia pectinata)* (NRC 2006-TN7315; Amish et al. 1978-TN9580).

Benthic Invertebrates

Benthic invertebrates inhabit the bottom of rivers and mainly consume periphyton. They include certain zooplankton and macroinvertebrates such as insects, mussels, crayfish, snails, clams, and polychaetes. Benthic invertebrates are primary consumers and are an important indicator of the health of an aquatic system. Table 3.7-2 of Xcel Energy’s 2023 Environmental Report (Xcel 2023-TN9084) contains a summary of benthic invertebrates found near Monticello.

Moyle (NMC 2005-TN9399) and students from Saint Cloud State University (Amish et al. 1978-TN9580) conducted studies of invertebrates near Monticello in 1940 and 1968, respectively. Researchers recorded over 100 taxa of benthic invertebrates during these surveys. Collections were dominated by the following groups: (1) aquatic earthworms (oligochaetes); (2) insect larvae (mayflies, beetles, caddisflies, midges, and blackflies) (3) snails (gastropods*)*; and (4) fingernail clams (*Sphaeriida* spp.*).* Freshwater insects are an abundant and important food source for fish with millions passing a single sampling point in a single 24-hour period (Amish et al. 1978-TN9580).

Freshwater Mussels

The upper portion of the Mississippi River (including the area by Monticello) once supported a substantial mussel fishery, but the mussels were rapidly overfished by the 1930s and many populations have struggled to recover (FWS 2003-TN9346). Mussels may be negatively affected by riverbed disturbance, changes in water flow, and deterioration in water quality including sedimentation/siltation, nutrient loading, and possibly temperature alterations.

In early surveys of the region, Moyle (NMC 2005-TN9399) and Saint Cloud State University (Amish et al. 1978-TN9580) collected five species of mussels above Saint Anthony Falls:

(1) mucket (identified as *Actinonaias carinata* in early Monticello studies, although now known *as Actinonaias ligamentina*); (2) giant floater (*Anodonta grandis plana*); (3) black sandshell (*Ligumia recta*); (4) fatmucket (*Lampsilis siliquoidea*); and (5) plain pocketbook mussel (identified as *Lampsilis ventricose* in early Monticello studies, although now regarded as being the same species *Lampsilis caridium*) (NMC 2005-TN9399; Amish et al. 1978-TN9580). The MDNR Natural Heritage Review Team has indicated that black sandshell is a State-listed mussel species of special concern (MnDNR 2023-TN9338) that may continue to occur near Monticello.

<u>Finfish</u>

The Mississippi River near Monticello is home to approximately 50 fish species (Table 3-11) based on electrofishing, seining, and trotline surveys conducted by Xcel Energy, MDNR, and Saint Cloud State University. Students from Saint Cloud State University conducted electrofishing surveys in 1968 before Monticello began operating (Amish et al. 1978-TN9580). Xcel Energy has also conducted annual electrofishing and seining surveys since Monticello operations began (Xcel 2004-TN9581, Xcel 2023-TN9578). Xcel Energy's survey reports contain species compositions, length compositions, catch-per-unit-effort by year, and weight trends for areas upriver and downriver of Monticello. Electrofishing surveys are better at capturing larger fish and seine surveys are better at capturing small fish, which is why both survey types are often used to evaluate fish populations. The most abundant species captured in Xcel Energy's electrofishing surveys include shorthead redhorse (*Moxostoma macrolepidotum*), silver redhorse (*M. anisurum*), common carp (*Cyprinus carpio)*, smallmouth bass (*Micropterus dolomieu*), northern hog sucker (*Hypentelium nigricans*), white sucker (*Catostomus commersoni*), channel catfish (*Ictalurus punctatus*), and walleye (*Sander vitreus*). The main species captured in Xcel Energy's seining surveys include spotfin shiner (*Cyprinella spiloptera*), sand shiner (*Notropis stramineus*), common shiner (*Luxilus cornutus*), bluntnose minnow (*Pimephales notatus*), and other forage fishes (Table 3-11). In 2007, the MDNR conducted an electrofishing and trotline survey that compares catch-per-unit-efforts for areas upriver and downriver of Monticello (Stewig and Chapman 2009-TN9337). Section 3.8.1.2 discusses the results of this survey.

Table 3-11 Fish Species That Occur in the Mississippi River Near Monticello Nuclear Generating Plant

Family	Species	Common Name
Amiidae	*Amia calva*	bowfin
Antherinidae	*Labidesthes sicculus*	brook silverside
Catostomidae	*Catostomus commersoni*	white sucker
Catostomidae	*Hypentelium nigficans*	northern hogsucker
Catostomidae	*Ictiobus cyprinellus*	bigmouth buffalo
Catostomidae	*Moxostoma anisurum*	silver redhorse
Catostomidae	*Moxostoma macrolepidotum*	shorthead redhorse
Catostomidae	*Moxostoma valenciennesi*	greater redhorse
Centrarchidae	*Ambloplites rupestrus*	rockbass
Centrarchidae	*Lepomis cyanellus*	green sunfish
Centrarchidae	*Lepomis gibbosus*	pumpkinseed
Centrarchidae	*Lepomis macrochirus*	bluegill
Centrarchidae	*Micropterus dolomieu*	smallmouth bass

Table 3-11 Fish Species That Occur in the Mississippi River Near Monticello Nuclear Generating Plant (Continued)

Family	Species	Common Name
Centrarchidae	*Micropterus salmoides*	largemouth bass
Centrarchidae	*Pomoxis annularis*	white crappie
Centrarchidae	*Pomoxis nigromaculatus*	black crappie
Cyprinidae	*Campostoma anomalum*	central stoneroller
Cyprinidae	*Cyprinella spiloptera*	spotfin shiner
Cyprinidae	*Cyprinus carpio*	common carp
Cyprinidae	*Hybognathus hankinsoni*	brassy minnow
Cyprinidae	*Nocomis biguttus*	hornyhead chub
Cyprinidae	*Notemigonus crysoleucas*	golden shiner
Cyprinidae	*Notropis blennius*	river shiner
Cyprinidae	*Notropis dorsalis*	bigmouth shiner
Cyprinidae	*Notropis hudsonius*	spottail shiner
Cyprinidae	*Notropis stramineus*	sand shiner
Cyprinidae	*Notropis voluceltus*	mimic shiner
Cyprinidae	*Pimephales nofatus*	bluntnose minnow
Cyprinidae	*Pimephales promefas*	fathead minnow
Cyprinidae	*Puoxinus eos*	redbelly dace
Cyprinidae	*Rhinichthys atralus*	blacknose dace
Cyprinidae	*Rhinichthys cataractae*	longnose dace
Cyprinidae	*Semotilus atromaculatus*	creek chub
Esocidae	*Esox lucius*	northern pike
Esocidae	*Esox masquinongy*	muskellunge
Fundulidae	*Fundulus diaphanus*	banded killifish
Gasterosteidae	*Culaea inconstans*	brook stickleback
Ictaluridae	*Amerius melas*	black bullhead
Ictaluridae	*Amerius natalis*	yellow bullhead
Ictaluridae	*Amerius nebulosus*	brown bullhead
Ictaluridae	*Ictalurus punctatus*	channel catfish
Ictaluridae	*Pylodictis olivaris*	flathead catfish
Lotidae	*Lota Iota*	burbot
Percidae	*Etheostoma nigrum*	johnny darter
Percidae	*Perca flavescens*	yellow perch
Percidae	*Percina caprodes*	logperch
Percidae	*Percina maculata*	blackside darter
Percidae	*Sander vitreus*	walleye
Percopsidae	*Percopsis omiscomaycus*	trout-perch
Salmonidae	*Coregonus artedi*	cisco

Sources: Amish et al. 1978-TN9580; Xcel 2023-TN9578[3]; Xcel 2004-TN9581; Stewig and Chapman 2009-TN9337.

[3] Xcel Energy 2023. Enclosure 24 RAI AQ-4 through AQ-7 Aquatic Resources Documents. Enclosure 24 in Xcel 2023-TN9578, page 59.

3.7.1.2 Important Species and Habitats of Mississippi River

This section summarizes State river designations, important fisheries, State-protected species, and other special status species. Section 3.8.1 discusses federally listed species separately; however, no federally protected aquatic species occur in the action area.

State River Designations

The reach of the Mississippi River by Monticello is included in the Minnesota State Wild and Scenic River System Program due to an abundance of aquatic wildlife, a high-quality smallmouth bass fishery, a series of unique bluffs and islands, and an area of high-quality canoeing and kayaking (MnDNR 2023-TN9339, MnDNR 2004-TN9340). The MDNR classifies this reach as "recreational" since it has been impacted by impoundment or other considerable human activity. The MDNR manages this reach to preserve and protect its scenic, recreational, natural, historical, and scientific values (MnDNR 2023-TN9341). This stretch of the river is not included in the Federal National Wild and Scenic Rivers Act (National Wild and Scenic Rivers System 2023-TN9342).

Tribal Fishing Rights

Under the 1837 treaty of St. Peters, 11 Ojibwe Tribes in Minnesota, Wisconsin, and Michigan have reserved fishing rights in ceded Mississippi River tributaries (Minnesota Indian Affairs Council-TN9662). Section 3.9 of this EIS discusses cultural and historic resources, including Tribal treaty rights, in more detail.

Commercially Important Fisheries

There are no commercial fisheries in the reach of the Mississippi River by Monticello (NMC 2006-TN9677; Stewig and Chapman 2009-TN9337).

Recreationally Important Fisheries

The Mississippi River near Monticello is a popular angling destination that is supported by natural production (i.e., fish species are not stocked). From May 12, 2007, through September 30, 2007, the MDNR conducted a fishery creel survey of the entire reach of the river from Saint Cloud to Coon Rapids (i.e., upriver and downriver of Monticello (Altena 2008-TN9350). This survey collected information from an estimated 67,685 angler trips from a boat and 50,783 angler trips from the shore. Nearby boat ramps include Ellison Park, Mississippi Park, and Kadler Park (Stewig and Chapman 2009-TN9337). From data it collected, MDNR estimated that a total of 80,650 fish were caught (harvested and released) during the survey period. These included 57,809 smallmouth bass, 7,631 channel catfish, 6,142 carp, 2,792 northern pike, 1,477 walleye, and the remainder included black crappie, bowfin, rock bass, sunfish, bullhead, and sucker species (Altena 2008-TN9350). The survey results also provided other information about the health of the fisheries in the region (Altena 2008-TN9350). For instance, length-frequency data (Table 9 in Altena 2008-TN9350) show that anglers caught a diversity of larger spawners and younger recruitment classes that will populate future fisheries.

The Minnesota Department of Health has issued a consumption advisory for channel catfish due to PCBs and mercury in a 40 mi (64 km) stretch of the Mississippi River that includes the approximately 3 mi (5 km) reach of the Mississippi River by Monticello. This advisory is unrelated to Monticello operations as it is a regional problem, and Monticello operations do not release these chemicals (Xcel 2023-TN9084). This river reach is also under a recreational advisory for fecal coliform. Monticello operations do not contribute to this issue since Monticello's sanitary waste is discharged to the City of Monticello sanitary sewage disposal system (Xcel 2023-TN9084).

State-Protected and Other Special Status Species

Minnesota's Endangered Species Statute (MN Stat. 084.0895; TN9583) authorizes the MDNR to adopt regulations to protect endangered or threatened species. The MDNR also designates species of special concern; however, this status does not afford species legal protections (MnDNR 2023-TN9351).

The MDNR has not identified any State-endangered or threatened aquatic species in the Mississippi River near Monticello[4] (Xcel 2023-TN9084). The MDNR identified one species of special concern, the black sandshell mussel *(Ligumia recta),* as possibly residing in the area. The MDNR stated that the black sandshell is sensitive to habitat disturbance, changes in water flow and temperature, and water quality deterioration, such as increases in sedimentation or siltation and nutrient loading.

3.7.1.3 Invasive and Nuisance Species of Mississippi River

Nonnative species are those species that are present only because of introduction and that would not naturally occur either currently or historically in an ecosystem. Invasive species are nonnative organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health (81 FR 88609-TN8375). For purposes of this discussion, nuisance species are nonnative species that alter the environment but do not rise to the level of invasive.

Zebra mussels (*Dreissena polymorpha*) are the main invasive species of concern at Monticello because a bed of mussels can clog water intake system pipes (Xcel 2023-TN9084). Xcel Energy regularly monitors for zebra mussels at Monticello. Xcel Energy has observed only 11 individuals through 2021 (Xcel 2023-TN9084). Xcel Energy plans to continue monitoring zebra mussels during the SLR term. If zebra mussels pose a potential problem in the future, Xcel Energy could seek authorization from the MPCA to use biocides through the NPDES permitting process. Currently, the MPCA authorizes biocides (e.g., sodium hypochlorite and sodium bromide) to prevent fouling of the cooling water intake system from microbiological organisms in the NPDES permit.

Asian clams (*Corbicula fluminea*) are an invasive species that is now widespread throughout the United States. Like zebra mussels, Asian clams clog intake system pipes. Xcel Energy reports infrequently capturing Asian clams in the Monticello traveling screen forebays. Xcel Energy has not instituted any specific control measures. The warm effluent of Monticello is conducive to the survival of localized populations of Asian clams which would otherwise be prone to mass die-offs during winter months when the water temperature drops to less than 35.6°F (2°C) (Xcel 2023-TN9084). Localized populations of Asian clams are also found near other power plants in Minnesota for the same reason. The population of Asian clams at Monticello is not likely to spread because they need the warm water of the Monticello discharge to survive the winters (Xcel 2023-TN9084).

[4] Minnesota Department of Natural Resources. 2023. Natural Heritage Review of the proposed Monticello Nuclear Generating Plant SLR, T33N R28W Sections 17-21, 28, T122N R25W Sections 30, 32–34, and T121N R25W Sections 4–5; Sherburne and Wright Counties. Correspondence # MCR 2022-00475. Attachment B in Xcel 2023-TN9084. p. 2181.

Common carp (*Cyprinus carpio*), a species from Europe in the 1880s, is also found near Monticello. Common carp negatively impacts aquatic habitats by uprooting aquatic vegetation and disturbing sediment. Fisheries survey data show that common carp abundances have been stable throughout time and have been similar upstream and downstream of Monticello (see surveys discussed in Section 3.7.1.1; Xcel 2023-TN9578[3]).

During the public scoping process, the Mille Lacs Band of the Ojibwe expressed concern that the invasive bighead carp (*Hypophthalmichthys nobilis*) could spread to the Mississippi River near Monticello. Bighead carp, silver carp (*Hypophthalmichthys molitrix*), and black carp (*Mylopharyngodon piceus*) are referred to as “Asian carp” and are invasive species of high concern throughout the entire Mississippi River watershed including Minnesota (MnDNR 2023-TN9352). The Asian carp can radically alter local ecosystems by outcompeting native planktivores (e.g., larval fish of all species, paddlefish, shad, buffalos) and are rapidly spreading (MnDNR 2023-TN9352). Asian carp are also a safety hazard to boaters since they are large (up to 70 lb; 32 kg), jump into the air when frightened, and can strike boaters. While Asian carp have not been detected near Monticello and have only been found downriver of Minneapolis, the MDNR is concerned they could spread upriver. Accordingly, the Minnesota Invasive Carp Action plan was created to better evaluate and minimize the spread of Asian Carp via a partnership with State and Federal agencies, conservation groups, and universities (MnDNR 2014-TN9584).

3.7.2 Proposed Action

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 that relate to aquatic resources.

3.7.2.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

This section evaluates the impacts of impingement and entrainment during the Monticello SLR period on aquatic organisms. In 2006, the NRC staff evaluated the impacts of the initial Monticello license renewal on aquatic organisms as two issues: “impingement of fish and shellfish” and “entrainment of fish and shellfish in early life stages.” For both issues, the NRC staff determined that the impacts of continued operation of Monticello would be SMALL during the initial license renewal term (i.e., 2010–2030) (NRC 2006-TN7315). In 2013, the NRC staff issued Revision 1 of the LR GEIS. In the revised LR GEIS, the staff combined the two aquatic issues into a single site-specific issue: “impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).” This section evaluates this consolidated issue as it applies to the continued operation of Monticello during the proposed SLR term (i.e., 2030–2050).

Impingement occurs when organisms are trapped against the outer part of an intake structure’s screening device (79 FR 48300-TN4488). The force of the intake water traps the organisms against the screen, and individuals are unable to escape. Impingement can kill organisms immediately or cause exhaustion, suffocation, injury, and other physical stresses that contribute to mortality later. The potential for injury or death is generally related to the amount of time an organism is impinged, its fragility (susceptibility to injury), and the physical characteristics of the screen wash and fish return systems of the intake structure. The EPA has found that impingement mortality is typically less than 100 percent if the cooling water intake system includes fish return or backwash systems (79 FR 48300-TN4488). Because impingeable organisms are typically fish with fully formed scales and skeletal structures and well-developed survival traits, such as behavioral responses to avoid danger, many impinged organisms can survive under proper conditions (79 FR 48300-TN4488).

Entrainment occurs when organisms pass through the screening device and travel through the entire cooling system, including the pumps, condenser or heat exchanger tubes, and discharge pipes (79 FR 48300-TN4488). Organisms susceptible to entrainment are of smaller size, such as ichthyoplankton, larval stages of shellfish and other macroinvertebrates, zooplankton, and phytoplankton. During travel through the cooling system, entrained organisms experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals (Mayhew et al. 2000-TN8458). Because organisms that get entrained generally possess fragile life stages (e.g., eggs, which exhibit poor survival after interaction with cooling water intake structure; or early larvae, which lack a skeletal structure and swimming ability), the EPA has concluded that for purposes of assessing the impacts of a cooling water intake system on the aquatic environment, all entrained organisms are assumed to die (79 FR 48300-TN4488).

Entrainment susceptibility is highly dependent on life history characteristics. For example, broadcast spawners with non-adhesive, free-floating eggs that drift with the water current may become entrained in a cooling water intake system. Nest-building species or species with adhesive, demersal eggs are less likely to be entrained in early life stages. Susceptibility of larval life stages to entrainment depends on body morphology and swimming ability.

A species can be susceptible to both impingement and entrainment if several life stages of the species occupy the same source water. For instance, adults and juveniles of a given species of fish may be impinged against the intake screens, while larvae and eggs may pass through the screening device and be entrained through the cooling system. The susceptibility to either impingement or entrainment relates to the size of the individual relative to the size of the mesh on the screening device. The EPA considers aquatic organisms that can be collected or retained on a sieve with 0.56 in. (1.4 cm) diagonal openings to be susceptible to impingement (79 FR 48300-TN4488). This equates to screen device mesh openings of 0.5 in. × 0.25 in. (1.3 cm × 0.635 cm), which is slightly larger than the openings on the typical 0.375 in. (0.95 cm) square mesh found at many nuclear power plants. Organisms smaller than the 0.56 in. (1.4 cm) mesh are considered susceptible to entrainment.

The magnitude of the impact that impingement and entrainment create on the aquatic environment depends on the plant-specific characteristics of the cooling system as well as the local aquatic community. Relevant nuclear power plant-based characteristics include location of the cooling water intake structure, intake velocities, withdrawal volumes, screening device technologies, and the presence or absence of a fish return system. Relevant characteristics of the aquatic community include species present in the environment, life history characteristics, population abundances and distributions, special species statuses and designations, and regional management objectives.

Monticello Cooling Water Intake System

Monticello’s cooling water intake system is a flexible system that can operate in four modes: open-cycle (i.e., once-through), closed cycle using cooling towers, and two combinations of these modes referred to as helper cycle mode and partial recirculation mode. Xcel Energy chooses the mode in which to operate based on water temperature and river flow requirements specified in Monticello’s NPDES permit (MN0000868) and Water Appropriation Permit (#66-1172) (MPCA 2023-TN9401; MnDNR 2023-TN9402). Table 3-12 summarizes these modes and the conditions under which Xcel Energy is required to operate in each mode. Features relevant to the impingement and entrainment analysis are summarized below. Section 2.1.3 of this EIS describes the Monticello cooling and auxiliary water systems in detail.

Table 3-12 Monticello Nuclear Generating Plant Cooling Modes

Mode	Conditions[a]
Open Cycle Mode: • Water withdrawn from intake canal • Once-through cooling occurs (no cooling towers) • Water discharged into the discharge canal • Gate at discharge weir is open to allow effluents to flow into Mississippi River	#1: When river flow exceeds 860 cfs (24 m^3/s), a maximum of 645 cfs (18.2 m^3/s) may be appropriated for cooling #2: Ambient river temperature is below 68°F (20°C) #3: Cooling towers are not needed to keep the temperatures in the drainage canal are lower NPDES daily maximums: – 95°F (35°C) between April and October – 85°F (29.4°C) for November and March – 80°F (26.6°C) between December and February
Helper Cycle Mode: • Water withdrawn from the intake canal • Heated water routed to the discharge structure • A portion of the heated water is routed to the cooling towers before being discharged into the drainage canal • The remaining portion is discharged directly into the drainage canal • Gate at discharge weir is open to allow effluents to flow into Mississippi River	#1: When river flow is above 860 cfs (24 m^3/s), a maximum of 645 cfs (18.2 m^3/s) may be appropriated for cooling #2: Ambient river temperatures start to consistently reach 68°F (20°C) or #3: Discharge temperatures are starting to approach the NPDES limits
Partial Recirculation Mode: • Similar to helper cycle mode except water that passes through cooling towers is routed back to the intake so it can be recirculated more than once • Gate at discharge weir is open to allow effluents to flow into Mississippi River	#1: Ambient river temperatures start to consistently reach 68°F (20°C) #2: When river flow is between 240–860 cfs (6.8–24 m^3/s), 75 percent of river flow may be appropriated for Monticello; partial recirculation mode may be used to help comply with that restriction
Closed Cycle Mode: • All cooling water recirculated through cooling towers • Gates at intake and discharge channel closed to Mississippi River • Make-up water drawn from intake structure due to evaporative water loss	#1: Authorized when river flow is equal to or greater than 240 cfs (6.8 m^3/s) Note: If river flows drop below 240 cfs (6.8 m^3/s), the State of Minnesota would prescribe special operating conditions

(a) Conditions for operating each cooling mode are derived from the NPDES permit and Surface Water Appropriations permit, as cited below.
Sources: Xcel 2023-TN9084; MPCA 2023-TN9401; Water Appropriations Permit #No. 66-1172; Xcel 2023-TN9084.

In open cycle, helper, and partial recirculation modes, Monticello withdraws water from the Mississippi River via an approach channel located upstream of the plant. The approach channel is constructed of sheet pile structures and extends 59 ft (0.3 m) into the river and narrows to approximately 63 ft (19.2 m) wide. Water that enters the approach channel passes over a concrete sill that is designed to prevent sediment buildup during low flows. The concrete sill also contains a removable log stop that captures and removes logs.

Water then passes through a bar rack that prevents large debris from entering the intake structure; a motorized rake removes the large debris from the bar rack, deposits it into a trash hopper, and prevents it from re-entering the river (Xcel 2023-TN9084, Xcel 2023-TN9578[3]). The trash racks are made of steel bars that are 0.75 in. (0.95 cm) wide and are spaced 3 in. (7.6 cm) apart at the center.

Traveling screens, which have mesh openings of 0.375 in^2 (2.4 cm^2), and a width of 10 ft (3.05 m), are located approximately 10 ft (3.05 m) behind the bar racks (Xcel 2023-TN9084, Xcel 2023-TN9578[5]). Xcel Energy normally operates the traveling screens continuously when the river temperature is above 50°F (10°C) to limit the duration that fish are impinged on the screen, and otherwise rotates and rinses the screens every 12 hours. Debris and aquatic organisms that are rinsed off the traveling screens enter a sluiceway that returns debris and organisms back to the Mississippi River downstream of the intake structures.

Organisms small enough to pass through the traveling screen mesh, such as fish eggs, larvae, and other zooplankton, are entrained into the cooling water system. Entrained organisms pass through the entire cooling system, enter the discharge channel, and can either become stranded in the discharge channel or pass through it and re-enter the Mississippi River. During this process, entrained organisms are subject to mechanical, thermal, and toxic stresses.

Clean Water Act Section 316(b) Requirements for Existing Facilities

Section 316(b) of the CWA addresses the adverse environmental impacts caused by the intake of cooling water from waters of the United States. This section of the CWA grants the EPA the authority to regulate cooling water intake structures to minimize adverse impacts on the aquatic environment. Under CWA Section 316(b), the EPA has issued regulations for existing facilities, such as Monticello, at 40 CFR Part 122 (TN2769) and 40 CFR Part 125 (TN254), Subpart J. Existing facilities include power generation and manufacturing facilities that are not new facilities as defined at 40 CFR 125.83 (TN254) and that withdraw more than 2 mgd (7.6 million liters per day) of water from waters of the United States and use at least 25 percent of the water they withdraw exclusively for cooling purposes.

Under the CWA Section 316(b) regulations, the location, design, construction, and capacity of cooling water intake structures of regulated facilities must reflect the best technology available (BTA) for minimizing impingement mortality and entrainment. The EPA, or authorized States and Tribes, impose BTA requirements through NPDES permitting programs. In Minnesota, the MPCA administers the NPDES program and issues NPDES permits to regulated facilities.

With respect to impingement mortality, the BTA standard requires that existing facilities comply with one of the following seven alternatives per the rule that was adopted on October 14, 2014 (TN254):

1. operate a closed-cycle recirculating system, as defined at 40 CFR 125.92(c) (TN254)
2. operate a cooling water intake structure that has a maximum through-screen design intake velocity of 0.5 fps (0.15 m/s)
3. operate a cooling water intake structure that has a maximum design through-screen intake velocity of 0.5 fps (0.15 m/s)

[5] Xcel Energy 2023. Monticello Nuclear Power Station 316(b) Impingement and Entrainment Characterization Study Report, January 14, 2007. Enclosure 24 Attachment 2 of Xcel 2023-TN9578.

4. operate an offshore velocity cap, as defined at 40 CFR 125.92(v) (TN254) that was installed on or before October 14, 2014

5. operate a modified traveling screen that the NPDES Permit Director determines meets the definition at 40 CFR 125.92(s) (TN254) and that the NPDES Permit Director determines is the BTA for impingement reduction at the site

6. operate any other combination of technologies, management practices, and operational measures that the NPDES Permit Director determines is the BTA for impingement reduction

7. achieve the specified impingement mortality performance standard

Options (1), (2), and (4) above are essentially preapproved technologies requiring either no demonstration or only a minimal demonstration that the flow reduction and control measures are functioning as the EPA envisioned. Options (3), (5), and (6) require more detailed information to be submitted to the permitting authority before the permitting authority may specify it as BTA for a given facility. Under Option (7), the permitting authority may also review site-specific data and conclude that a de minimis rate of impingement exists; and, therefore, no additional controls are warranted to meet the BTA impingement mortality standard.

With respect to entrainment, the CWA Section 316(b) regulations do not prescribe a single nationally applicable entrainment performance standard, because the EPA did not identify a technology for reducing entrainment that is effective, widely available, feasible, and does not lead to unacceptable non-water-quality impacts (79 FR 48300-TN4488). Instead, the permitting authority must establish the BTA entrainment requirement for each facility on a site-specific basis. In establishing site-specific requirements, the regulations direct the permitting authority to consider the following factors (40 CFR Part 125-TN254):

i. numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of federally listed, threatened and endangered species, and designated critical habitat (e.g., prey base),

ii. impact of changes in particulate emissions or other pollutants associated with entrainment technologies,

iii. land availability inasmuch as it relates to the feasibility of entrainment technology,

iv. remaining useful plant life, and

v. quantified and qualitative social benefits and costs of available entrainment technologies when information on both benefits and costs is of sufficient rigor to make a decision.

In support of entrainment BTA determinations, facilities must conduct site-specific studies and provide data to the permitting authority to aid in its determination of if site-specific controls would be required to reduce entrainment and which controls, if any, would be necessary.

<u>Analysis Approach</u>

When available, the NRC staff relies on the expertise and authority of the NPDES permitting authority with respect to the impacts of impingement and entrainment. Therefore, if the NPDES permitting authority has made BTA determinations for a facility pursuant to CWA Section 316(b) in accordance with the current regulations specified in 40 CFR Part 122-TN2769 and 40 CFR

Part 125-TN254, which were promulgated in 2014 (79 FR 48300-TN4488), and that facility has implemented any associated requirements or those requirements would be implemented before the proposed SLR period; then, the NRC staff assumes that adverse impacts on the aquatic environment will be minimized. In such cases, the NRC staff concludes that the impacts of either impingement, entrainment, or both would be SMALL for the proposed SLR term.

In cases in which the NPDES permitting authority has not made BTA determinations, the NRC staff analyzes the potential impacts of impingement, entrainment, or both using a weight-of-evidence approach. In this approach, the staff considers multiple lines of evidence to assess the presence or absence of ecological impairment (i.e., noticeable or detectable impact) on the aquatic environment. For instance, as its lines of evidence, the NRC staff might consider characteristics of the cooling water intake system design, the results of impingement and entrainment studies performed at the facility, and trends in fish and shellfish population abundance indices. The NRC staff then considers these lines of evidence together to predict the level of impact (SMALL, MODERATE, or LARGE) that the aquatic environment is likely to experience during the proposed SLR term.

Baseline Condition of the Resource

For the purposes of this analysis, the NRC staff assumes that the baseline condition of the resource is the aquatic community of the Mississippi River by Monticello as it occurs today, which is described in Section 3.7.1 of this EIS. All fish and benthic invertebrate populations are self-sustaining. Electrofishing and seining sampling indicate no major upward or downward trends in juvenile or adult fish populations. While species richness, evenness, and diversity within the community may change or shift between now and when the proposed SLR period would begin, the NRC staff finds the present aquatic community to be a reasonable surrogate in the absence of fishery and species-specific projections.

3.7.2.1.1 Impingement

Impingement Mortality BTA

The MPCA has not made an impingement mortality or entrainment BTA determination for Monticello. The current NPDES permit (MN0000868, MPCA 2023-TN9401), which was issued on May 1, 2023, with an expiration date of April 30, 2028, was based on a permit renewal application that Xcel Energy submitted in 2012 before the EPA issued the 2014 CWA Section 316(b) final rule concerning existing facilities.

Xcel Energy has not submitted an updated CWA Section 316(b) for compliance for impingement mortality BTA since 2019[6] (Xcel 2023-TN9578). Instead, Xcel Energy has chosen to defer the method of compliance for impingement mortality BTA until after the MPCA makes an entrainment BTA determination (40 CFR 129.94(b)(1)-TN6409; Xcel 2023-TN9578).

The MPCA could determine that Monticello operations meet one of the impingement mortality compliance alternatives listed previously in this section without Xcel Energy needing to modify or upgrade any components of the cooling water intake system. When the MPCA makes the impingement mortality BTA determination, it may also impose additional requirements to reduce

[6] Xcel Energy 2023. Monticello Nuclear Generating Plant § 316(b) 40 CFR § 122.21(r)(2)-(r)(8) Information. Enclosure 24 Attachment 6 of Xcel 2023-TN9578.

or mitigate the effects of impingement mortality at Monticello. Such requirements would be incorporated as conditions of a future renewed NPDES permit.

The NRC staff assumes that any additional requirements that the MPCA imposes would minimize the impacts of impingement mortality over the course of the proposed SLR term in accordance with CWA Section 316(b) requirements. However, because the MPCA has not made an impingement mortality BTA determination at this time, the NRC staff also considers other lines of evidence below, including the hydraulic zone of influence (HZI) and results of impingement mortality studies, to more fully evaluate the magnitude of impact that impingement would represent during the proposed SLR period.

Hydraulic Zone of Influence

MACTEC Engineering and Consulting, Inc (MACTEC) evaluated the Hydraulic Zone of Influence (HZI) for the Monticello cooling water intake system, and the results appear in the Monticello 2019 CWA Section 316(b) demonstration report (Xcel 2023-TN9578). The HZI is defined as the portion of the source waterbody that is hydraulically affected by the cooling water intake structure water withdrawal (40 CFR 125.83-TN254).

MACTEC (Xcel 2023-TN9578) determined the size of the HZI by reviewing hydrological data. The Mississippi River near Monticello has two main channels that are separated by an island. MACTEC focused its HZI analysis on the main channel that passes by the cooling water intake canal, which contains 58 percent of the total river flow on average. The HZI extends beyond the intake canal and into this main channel. During average flows, the HZI extends into one-quarter of the width of the main channel and two-thirds of main channel under low conditions.

MACTEC also computed the average monthly volume of the Mississippi River that is affected by the HZI from 2014–2018 (Table 3-13). The average percentage of the Mississippi River flow that was affected by the HZI and was used for the Monticello cooling water intake system during that time period was lowest during April and May (about 4.5 to 4.6) and was highest during August (11.4 percent) and September (10.3 percent). The HZI and the cooling water intake system influences a relatively small portion of the Mississippi River even during low flow months (Xcel 2023-TN9578: Attachment 6 of Enclosure 24 of Request for Additional Information [RAI]/RCI).

Within the HZI, fish and other aquatic organisms are only subject to impingement within a smaller region of the HZI where the intake water velocity exceeds those individuals’ ability to swim against the draw of water into the cooling water intake system to escape impingement. While Xcel Energy has not specifically evaluated this area, the NRC staff concludes that this area is limited to the intake canal and not the Mississippi River because most impinged fish (e.g., bluegills and black crappies) are associated with backwater habitats (not the river channel).

Xcel Energy proposes no changes or modifications to the cooling water intake system as part of the proposed SLR, therefore, this area would remain the same during the SLR term, and it is considered further below as one component affecting the NRC staff’s conclusion on impingement mortality.

Table 3-13 Average Monthly Volume of the Mississippi River Drawn into the Monticello Cooling Water Intake System and Affected by the Hydraulic Zone of Influence, 2014–2018

Month	Monthly River Flow (cfs)	Design Intake (cfs)	Percent of River (Design)	Actual Intake (cfs)	Percent of River (Actual)
January	4,276.8	707.4	16.5	415.2	9.7
February	4,307.5	707.4	16.4	459.4	10.7
March	5,753.2	707.4	12.3	501.7	8.7
April	9,462.1	707.4	7.5	434.6	4.6
May	11,245.7	707.4	6.3	508.9	4.5
June	9,968.0	707.4	7.1	611.7	6.1
July	7,852.4	707.4	9.0	615.6	7.8
August	5,321.9	707.4	13.3	607.6	11.4
September	5,561.3	707.4	12.7	570.4	10.3
October	7,064.7	707.4	10.0	528.3	7.5
November	6,010.0	707.4	11.8	492.4	8.2
December	5,375.1	707.4	13.2	458.0	8.5

Source: Xcel 2023-TN9578.

Impingement Studies

2005–2006 Impingement Characterization Study

MACTEC conducted an impingement characterization study by Monticello from August 2005 to July 2006 (Xcel 2023-TN9578). The researchers conducted 48 sampling events, 4 per month, at a frequency to ensure sampling took place during the evening, morning, day, and night.

The researchers caught 31 fish species during the 2005–2006 impingement study (Table 3-14). The highest percentage of the total impingement catch was from bluegill (28.2 percent), channel catfish (21.1 percent), black crappie (19.2 percent), black bullhead (6.5 percent), with the rest of the species accounting for less than 3 percent. The size of these impinged fish corresponded with ages 0–2 years (Xcel 2023-TN9578).

The researchers did not find a correlation between the abundance of species in impingement samples compared to the abundance in electrofishing or seining surveys. For example, researchers found that bluegills accounted for 28.2 percent of impinged fish and 0.3 percent of fish collected in abundance surveys, as was the case for black crappie which represented 19 percent of impinged fish and 0.02 percent of abundance in surveys (Xcel 2023-TN9578).

MACTEC estimated annual impingement at Monticello by applying catch rates during sampling (number per million gallons) to total water intake. The researchers estimated that the total impingement was 15,027 finfish per year, which mainly included bluegill (5,392 fish; 35.8 percent), channel catfish (2,811 fish; 18.7 percent), and black bullhead (1,064 fish; 7.1 percent) (Table 3-14). The remaining finfish species contributed no more than 3 percent each to the total catch of finfish. The researchers also estimated that the annual shellfish impingement was 1,950 crayfish, 41 freshwater mussels, and 6 Asian clams (Xcel 2023-TN9578).

Researchers found that approximately 63 percent of impinged fish were alive at the collection site in the sluiceway, which provides fish passage back to the Mississippi River.

Table 3-14 Estimated Annual Impingement from the Monticello Cooling Water Intake System from August 2005 to July 2006

Scientific Name	Common Name	Fish Collected	Percent of Total Fish Collected	Estimated Fish Impinged Per Year	Percent[(a)] of Estimated Total
Lepomis macrochirus	bluegill	216	28.2	5,392	35.88
Ictalurus punctatus	channel catfish	162	21.1	2,811	18.71
Pomoxis nigromaculatus	black crappie	147	19.2	2,086	13.88
Ameiurus melas	black bullhead	50	6.5	1,064	7.08
Micropterus dolomieu	smallmouth bass	19	2.5	431	2.87
Ameiurus natalis	yellow bullhead	18	2.3	194	1.29
Moxostoma macrolepidotum	shorthead redhorse	13	1.7	187	1.25
Percina maculate	blackside darter	13	1.7	249	1.66
Cyprinus carpio	common carp	12	1.6	258	1.72
Cyprinella spiloptera	spotfin shiner	12	1.6	238	1.58
Percopsis omiscomaycus	trout perch	11	1.4	271	1.80
Ameiurus nebulosus	brown bullhead	10	1.3	106	0.70
Micropterus salmoides	largemouth bass	9	1.2	150	1.00
Notropis ludibundus	sand shiner	8	1.0	179	1.19
Stizostedion vitreum	walleye	8	1.0	145	0.96
Perca flavescens	yellow perch	7	0.9	149	0.99
Notropis hudsonius	spottail shiner	7	0.9	152	1.01
Noturus gyrinus	tadpole madtom	7	0.9	157	1.04
Pimephales promelas	fathead minnow	5	0.7	109	0.73
Rhinichthys cataractae	longnose dace	5	0.7	101	0.67
N/A	Unidentifiable fish	4	0.5	134	0.89
Catostomus commersoni	white sucker	4	0.5	73	0.49
Percina caprodes	log perch	3	0.4	61	0.40
Lepomis cyanellus	green sunfish	2	0.3	44	0.29
Nocomis biguttatus	hornyhead chub	2	0.3	50	0.33
Shiner spp.	shiner species	2	0.3	0	0.00
Ambloplites rupestris	rock bass	2	0.3	45	0.30
Ictalurid spp.	several species of catfish	2	0.3	42	0.28
Pomoxis sp.	crappie species	1	0.1	10	0.07
Labidesthes sicculus	brook silverside	1	0.1	21	0.14
Moxostoma spp.	several species of redhorse	1	0.1	22	0.15
Culaea iconstans	brook stickleback	-	-	21	0.14
Moxostoma anisurum	silver redhorse	1	0.1	9	0.06
Campostoma pullum	central stoneroller	1	0.1	21	0.14
Notemigonus crysoleucas	golden shiner	1	0.1	21	0.14
Luxilus cornutus	common shiner	1	0.1	23	0.15
Total[(a)]	**-**	**767**	**100**	**15,027**	**100**

N/A = not applicable.
No table entry has been denoted by "-"
(a) Totals and percents may not equate due to rounding.
Source: Xcel 2023-TN9578[6]: Attachment 2 of Enclosure 24 of the RAIs/RCIs, Tables 5-3 and 5-5.

Historical Impingement Studies

NUS Corporation Inc. (NUS) conducted impingement mortality studies in the 1970s shortly after Monticello began operating (Amish et al. 1978-TN9580). As summarized in the 2006 Monticello LR SEIS, the species, length, and age compositions in these studies were similar to the 2005 to 2006 study (NRC 2006-TN7315). Specifically, NUS estimated impingement to be:

- 2,952 fish between June and September 1972
- 18,030 fish between July and December 1973
- 16,343 fish in 1974
- 34,157 fish in 1975

Impingement Conclusion

Based on the NRC staff's review of the available information, the staff finds that impingement from the Monticello cooling water intake system would have minor effects on aquatic resources for several reasons: (1) the HZI is a relatively small area of the Mississippi River and impingement appears to be mainly impacting species in the intake canal (Xcel 2023-TN9578: Enclosure 24); (2) the majority of impingement is limited to bluegill, black crappie, channel catfish, and black bullhead that are highly fecund species and are not species of concern per the MDNR (MnDNR 2023-TN9585, MdDNR Undated-TN9588; Pauly and Froese 2023-TN9590); (3) Xcel Energy and MDNR surveys indicate stable and diverse populations of fish in the Mississippi River near Monticello (see Section 3.7.1.1); and (4) shellfish have a relatively low vulnerability to impingement compared to finfish, and the majority of shellfish impingement is attributed to crayfish, which are not a species of concern.

The NRC staff anticipates that impacts during the proposed SLR period would be similar because water withdrawals, and the associated risk of impingement, would remain the same under the proposed action. Further, the MPCA will make an impingement mortality BTA determination as part of issuing a renewed NPDES permit. If the MPCA imposes any additional requirements beyond those contained in the current permit, those requirements would likely further reduce the impacts of impingement mortality during the proposed SLR term, in accordance with CWA Section 316(b) requirements. For the reasons described above, the NRC staff finds that the impacts of impingement mortality on aquatic resources during the proposed SLR term would be SMALL.

3.7.2.1.2 Entrainment

Entrainment BTA

The MPCA has not made an entrainment BTA determination for Monticello. As explained in Section 3.7.2.1.1, Xcel Energy submitted information concerning CWA Section 316(b) entrainment BTA to the MPCA on January 9, 2023 (Xcel 2023-TN9578: Enclosure 24). MPCA will make an entrainment BTA determination as one component of issuing a renewed NPDES permit. When the MPCA makes its BTA determination, it could impose additional requirements to reduce or mitigate the effects of entrainment at Monticello.

Such requirements would be incorporated as conditions of the renewed NPDES permit. The NRC staff assumes that any additional requirements that MPCA may impose would minimize the impacts of entrainment over the course of the proposed license renewal term in accordance with CWA Section 316(b) requirements. However, because the MPCA has not made an entrainment BTA determination at this time, the NRC staff also consider other lines of evidence below, including the HZI and results of entrainment characterization studies, to more fully evaluate the magnitude of impacts that entrainment would represent during the proposed SLR period.

Hydraulic Zone of Influence

The HZI is described in the impingement mortality section above. As evaluated by MACTEC, the HZI only affects that portion of the Mississippi River that flows past Monticello and not the main channel that is separated by an island. The HZI is the area within which an organism may be drawn to the intake rather than transported away in the ambient flow. For an organism to become entrained, it must enter the HZI of the cooling water intake system. Organisms within the HZI have a high probability of being withdrawn by the intake, but not all organisms within the HZI will be entrained (Xcel 2023-TN9578). Entrainment studies are described in detail below.

Entrainment Studies

Xcel Energy’s 2023 316(b) demonstration report summarizes entrainment performance studies conducted at Monticello during 2017–2018, 2006, 1976, and 1973–1974 in accordance with 40 CFR 122.21(r)(7) (TN2769) requirements. The results of these entrainment studies are described below.

2017–2018 Entrainment Characterization Study

Xcel Energy Environmental Services performed an entrainment characterization study from March 2017 to December 2018 that evaluated the numbers and types of ichthyoplankton entrained by the Monticello cooling water intake system (Xcel 2023-TN9578: Attachment 3 of Enclosure 24).

Researchers collected entrainment samples by pumping water samples through an ichthyoplankton net at three locations: (1) at the sluice gate area of the discharge structure; (2) at the cooling tower discharge area; and (3) the cooling water system intake. Samples taken from the intake area were used to assist with identification of organisms collected from the discharge structure and cooling tower discharge. For samples from the discharge structure, researchers mechanically pumped discharged water from the two outlet bays at two different water depths. Water was pumped from the outlet bays to sampling containers with ichthyoplankton nets with 500 µm mesh openings and transported back to a laboratory for processing. Sampling was performed twice a month during the peak spawning months (April to September) and once a month for the rest of the year. One exception to this sampling schedule occurred over 30 days between April and May in 2017 when the circulating water pumps were not in service due to a refueling outage. Sampling was performed at four 6-hour intervals but was reduced to two 6-hour intervals in the fall/winter months. For the cooling tower discharge, 1.6 ft (0.5 m) diameter ichthyoplankton nets with 300–500 µm mesh openings were deployed at two different locations at two depths (surface and mid-water column) within the cooling tower discharge area then samples were taken back to a laboratory for processing. Sampling occurred twice a month from June to September in 2017 and from May to September in 2018 to correspond when cooling towers were in service. Sampling was performed at four 6-hour intervals. Although the cooling towers were replaced in 2021-2022, this replacement did not change cooling tower operation in a manner that would appreciably affect the results of this study. To estimate the total entrainment due to Monticello operations, data from the discharge structure and cooling towers were combined and adjusted based on sample volumes and intake flows.

Researchers collected a total of 2,022 fish eggs and larvae from 23 distinct taxa; 786 eggs and larvae in 2017, and 1,236 eggs and larvae in 2018 (Xcel 2023-TN9578: Attachment 3 of Enclosure 24). Based on actual intake flows, the researchers estimated that annual entrainment of ichthyoplankton at Monticello was 19,616,797 fish and eggs in 2017, and 26,377,802 fish and eggs in 2018. May and June had the highest estimated entrainment rates, which corresponds with peak spawning months. Table 3-15 shows the breakdown of estimates by species, and results are summarized as follows.

- The majority of the entrainment samples were larvae (2017: 69.0 percent; 2018: 99.3 percent).
- The highest amount of larvae from entrainment samples were from unidentified species (2017: 33.7 precent; 2018: 42.7 percent).
- Cyprinidae species (2017: 5.8 percent; 2018: 26.0 percent) and white sucker (*Catostomus commersonii*) (2017: 23.2 percent; 2018: 17.6 precent) were the most abundant identified fish larvae in both 2017 and 2018, and no other species exceeded 4 percent.

With respect to different life stages, researchers were able to distinguish life stage for 49.9 percent of the larvae. Of the distinguishable life stages, the majority (57.1 percent) were post-yolk sac larvae. No juvenile or adult life stages were collected, and no shellfish eggs or larvae were identified.

Xcel Energy Environmental Services evaluated entrainment densities by sample depth strata (i.e., surface and mid-column) and by time of day (i.e., daytime [0600–1800] and nighttime [1800–0600]). Although densities were slightly higher in the mid-column samples, researchers postulated that this may be attributable to ichthyoplankton sinking after passing through the cooling water intake system. With respect to diel variation, entrainment densities were highest in the daytime for 2017 and similar between the daytime and nighttime for 2018. However, due to only 4 of the 34 sampling events exhibiting this relationship, Xcel Energy Environmental Services concluded that there were no significant diel patterns for entrained organisms. Xcel Energy Environmental Services did not draw any overall conclusions with respect to impacts of entrainment on Mississippi River finfish populations.

<u>2006 Entrainment Study</u>

MACTEC conducted an entrainment study from April 2006 to September 2006 (Xcel 2023-TN9578[5]: Attachment 2 of Enclosure 24). Researchers collected entrainment samples 1 day a week at four diel periods by mechanically pumping water from the discharge pump well through a sampling apparatus consisting of a 2 in. (5 cm) flex hose and pipe system with a flow control valve and flow meter. Water moved through the sampling apparatus to a centralized sampling container with an ichthyoplankton net with 300 µm mesh openings. All samples were collected and preserved and then later processed in a laboratory. Results of this study are summarized in an impingement and entrainment characterization report (Xcel 2023-TN9578[5]: Attachment 2 of Enclosure 24). The information in this section is summarized from that report unless otherwise indicated.

Researchers collected a total of 225 larvae and eggs during the study representing six taxa. Overall, sucker larvae dominated collections (77.3 percent). Entrainment densities peaked in mid to late May and in August. With respect to collection densities, collections peaked in May with catostomid larvae and in August with eggs and unidentified larvae. MACTEC noted that very few representative important species, as defined by prior electrofishing and seining surveys conducted in the Mississippi River near Monticello, were collected during the entrainment sampling, suggesting that they are not commonly entrained.

Table 3-15 Estimated Annual Ichthyoplankton Entrainment Based on Actual Intake Flows at Monticello in 2017 and 2018

Taxa	2017 Total[(a)]	2017 Percent[(a)] of Total	2018 Total[(a)]	2018 Percent[(a)] of Total
Larvae — Unidentified	6,613,282	33.7	11,272,683	42.7
Cyprinidae	1,143,103	5.8	6,859,904	26.0
Catostomus commersonii	4,545,318	23.2	4,642,779	17.6
Lota lota	-	-	1,022,231	3.9
Micropterus dolomieu	135,092	0.7	391,353	1.5
Moxostoma spp.	503,598	2.6	288,110	1.1
Lepomis spp.	29,498	0.2	266,212	1.0
Sander vitreus	-	-	248,801	0.9
Lepomis macrochirus	-	-	236,931	0.9
Eggs — Unidentified	6,080,666	31.0	183,706	0.7
Percina caprodes	-	-	147,190	0.6
Etheostoma spp.	275,958	1.4	143,555	0.5
Ictalurus punctatus	68,398	0.3	109,300	0.4
Esox spp.	-	-	101,579	0.4
Percopsis omiscomaycus	-	-	91,205	0.3
Pomoxis spp.	-	-	85,022	0.3
Micropterus salmoides	-	-	77,739	0.3
Percidae spp.	88,580	0.5	63,214	0.2
Lepomis cyanellus	88,772	0.5	59,063	0.2
Catostomidae	-	-	27,547	0.1
Centrarchidae	-	-	27,547	0.1
Cottus bairdi	-	-	16,583	0.1
Cyprinella spiloptera	-	-	15,548	0.1
Notropis spp.	14,539	0.1	-	-
Perca flavescens	29,992	0.2	-	-
Total	**19,616,797**	**100.0**	**26,377,801**	**100.0**

No table entry has been denoted by "-".
(a) Totals and percents may not equate to 100 percent due to rounding.
Source: Xcel 2023-TN9578[6]: Attachment 3 of Enclosure 24.

MACTEC used sample results and intake flows to estimate total entrainment for each entrained species. Table 3-16 provides the monthly intake flow-adjusted total entrainment by taxa. MACTEC estimated total entrainment to be 5,702,590 individuals comprised primarily of fish larvae (95 percent) with a small amount (5 percent) of fish eggs. Peak ichthyoplankton densities occurred in May (73.77 percent), August (11.39 percent), and June (7.38 percent). Suckers accounted for the majority of ichthyoplankton (73.83 percent), followed by unidentified larvae (11.65 percent). The dominate life stage for collected organisms varied by species. Only two adult sticklebacks were collected. With respect to diel patterns, MACTEC found no clear pattern or seasonal trend; however, in May with the peak entrainment density, densities were slightly higher in the morning and afternoon.

Table 3-16 Flow-Adjusted Ichthyoplankton Entrainment at Monticello, 2006

Species Grouping/ Taxa	April	May	June	July	August	September	Total(a)	Percent(a)
Cyprinidae	0	0	0	24,525	98,914	75,999	199,438	3.50
Cyprinidae/ flattened eye	0	24,059	0	0	0	0	24,059	0.42
Cyprinidae group/ mid-ventral stripe	0	0	123,637	0	0	41,237	164,874	2.89
Cyprinidae group/ outlined gut	0	0	0	0	24,654	20,658	45,312	0.79
suckers	0	4,061,326	148,904	0	0	0	4,210,230	73.83
brook stickleback	0	0	49,366	0	0	0	49,366	0.87
walleye	0	46,432	0	0	0	0	46,432	0.81
Eggs-fish other	0	0	0	75,047	223,209	0	298,256	5.23
Unidentified larvae	67,942	75,107	99,004	24,928	302,933	94,709	664,623	11.65
Total(a)	67,942	4,206,924	420,911	124,500	649,710	232,604	5,702,590	-
Percentage	1.19	73.77	7.38	2.18	11.39	4.08	-	100

"-" denotes no entry.
(a) Totals and percents may not equate due to rounding.
Source: Xcel 2023-TN9578[5]: Attachment 2 of Enclosure 24.

In addition, MACTEC also collected samples from the intake forebay to compare with entrainment samples. Researchers conducted sampling from the intake forebay once a month at four diel periods using a 1.6 ft (0.5 m), 300 µm mech conical net that was deployed at two locations at mid-water depth. All samples were collected and preserved and later processed in a laboratory. A total of 217 larvae were collected. Overall, cyprinids dominated collections (89 percent). In all sampled months except May total density was higher for the intake forebay samples than the entrainment samples. MACTEC postulated that these differences may be due to seasonal variation and the sampling regime missing the peak densities for entrained samples. Alternatively, MACTEC speculated that samples collected in the forebay could be residents and less vulnerable to entrainment.

Overall, MACTEC found that the estimated entrainment during the 2006 study was lower than but comparable to estimates made by NUS (1978-TN9580) and they postulated that differences may have in part been attributed to differences in Mississippi River flow rates. In addition, MACTEC noted that representative important species, including spotfin shiner, shorthead redhorse, black bullhead, channel catfish, bluegill, smallmouth bass, and black crappie were not commonly entrained. In addition, MACTEC concluded that based on historical annual electrofishing and seining surveys and the entrainment data, that there is no indication that entrainment due to Monticello operations is having a major impact on fish species composition or abundance.

Historical Entrainment Studies

Entrainment studies conducted by Knutson et al. (1976) and Amish et al. (1978-TN9580) are described in Section 4.1.2 of the 2006 Monticello LR SEIS and are summarized here (NRC

2006-TN7315). Knutson et al. (1976) collected entrainment samples at Monticello from September 1973 to August 1974 (NRC 2006-TN7315). The researchers estimated that entrainment rates for young-of-the-year fish to be 1,617/hr or 38,805/day for all fish. Entrainment losses consisted of 23 species or species groups, which comprised of 96.5 percent catostomids (suckers), 1.3 percent black crappie, 0.8 percent cyprinids, and 0.5 percent walleye. Based on this data and data from regular fish surveys, the researchers concluded that entrainment is not having an impact on sucker species.

NUS Corporation conducted entrainment monitoring in support of a CWA Section 316(b) Demonstration. The monitoring was conducted from April to September 1976, which was a low-flow year for the Mississippi River (Amish et al. 1978-TN9580). NUS Corporation estimated the number of entrained organisms to be 1,076,000 eggs and 2,827,000 fish (less than one year old). The primary entrained species were logperch (31.8 percent), shorthead redhorse (22.4 percent), unidentified darters (13.7 percent), unidentified minnows (10.9 percent), white sucker (5.3 percent), and several other species (16.7 percent) that individually constituted less than 4 percent of total entrainment. NUS Corporation concluded that, similar to the 1974 study, nearly all fish were entrained between May and August. Researchers estimated that the number of equivalent adult fish lost due to entrainment was 250,124 fish which consisted of 218,000 logperch, 9,230 shorthead redhorse, 1,410 darters, and 13,600 minnows.

Entrainment Reduction Methods

As explained previously, the CWA Section 316(b) regulations direct the permitting authority to establish BTA entrainment requirements for each facility on a site-specific basis. For Monticello, MPCA will make that determination as one component of issuing a renewed NPDES permit. As part of its NPDES permit renewal application. Xcel Energy conducted an evaluation (Xcel 2023-TN9578: Attachment 8 and 9 of Enclosure 24)[7,8] of fine mesh screens that could be installed over the existing traveling screens to physically exclude a larger percentage of fish eggs, larvae, and juveniles from entrainment than the system's current configuration. Instead of becoming entrained, these organisms would instead be impinged on the fine mesh screens and would then be washed off the screens into the sluiceway and returned back to the Mississippi River. Xcel Energy estimated that fine mesh screens would reduce entrainment by 9.6 to 28.2 percent for 0.02 in. (0.5 mm) mesh screen, 9.6 to 26.5 percent for 0.04 in. (1 mm) mesh screen, and 6.5 to 9.1 percent for a 0.08 in. (2 mm) mesh screen. Xcel Energy estimated that this method would cost about $15 million to install approximately $440,000 per year to operate.

Xcel Energy also evaluated other potential options for reducing entrainment, but did not quantify the expected reductions (Xcel 2023-TN9578: Attachment 8 and 9 of Enclosure 24)[7,8]. These other options included MDCTs to convert Monticello to a closed-cycle recirculation system, using cylindrical screens attached to the front of water intake pipes, and using alternative cooling water sources (e.g., wastewater or groundwater).

Entrainment Conclusion

Entrainment studies indicate that larval cyprinids and catostomids are the most susceptible species to be entrained. Finfish monitoring trends, as described in Section 3.7.1.1, indicate no

[7] Enclosure 24 Attachment 8 Non-water Quality Environmental and Other Impacts Study for Monticello Nuclear Generating Plant.
[8] Enclosure 24 Attachment 9 Comprehensive Technical Feasibility and Cost Evaluation Study for the Monticello Nuclear Generating Plant pg. 654.

upward or downward trends in these taxa’s populations over several decades of monitoring. Further, the HZI covers a relatively small area of the Mississippi River that includes the intake canal, a segment of the main channel, and a relatively low portion of Mississippi River flows. Collectively, this information indicates that entrainment is unlikely to cause noticeable or detectable impacts on aquatic populations in the Mississippi River near Monticello. Shellfish were not specifically included in entrainment studies, so specific conclusions cannot be drawn regarding impacts on shellfish.

Because water withdrawals, and the associated risk of entrainment, would remain the same under the proposed action as under the current license, the NRC staff anticipates similar (i.e., nondetectable) effects during the proposed SLR period. Further, the MPCA will make an entrainment BTA determination as part of issuing a renewed NPDES permit (the current NPDES permit expires in 2028). If the MPCA imposes any additional requirements beyond those contained in the current permit, those requirements would likely further reduce the impacts of entrainment over the course of the proposed SLR term, in accordance with CWA Section 316(b) requirements. For instance, if MPCA requires Xcel Energy to institute fine mesh screens, such as those described under “Entrainment Reduction Methods,” the impacts of entrainment would be further reduced from current levels.

For the reasons described above, the NRC staff finds that the impacts of entrainment of aquatic organisms resulting from the proposed SLR of Monticello would be SMALL.

Impingement and Entrainment Conclusion

Based on the discussion summarized under “Impingement Conclusion” and “Entrainment Conclusion,” the NRC staff concludes that the impacts of impingement and entrainment on aquatic organisms resulting from the proposed Monticello SLR of term would be SMALL.

3.7.2.2 Entrainment of Phytoplankton and Zooplankton (All Plants)

This issue concerns entrainment of phytoplankton and zooplankton from cooling water withdrawal. Entrainment occurs when organisms pass through the cooling system’s screening device and travel through the entire system, including the pumps, condenser or heat exchanger tubes, and discharge pipes (79 FR 48300-TN4488). Organisms susceptible to entrainment are of smaller size, such as ichthyoplankton, zooplankton, and phytoplankton. During travel through the cooling system, entrained organisms experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals (Mayhew et al. 2000-TN8458). Because entrainable organisms generally consist of fragile life stages (e.g., eggs, which exhibit poor survival after interacting with a cooling water intake structure, and early larvae, which lack a skeletal structure and swimming ability), the EPA has concluded that, for purposes of assessing the impacts of a cooling water intake system on the aquatic environment, all entrained organisms are assumed to die (79 FR 48300-TN4488). The NRC staff assesses the site-specific impacts of entrainment of fish and shellfish during the Monticello SLR term in Section 3.7.2.1 of this EIS. This issue concerns entrainment of phytoplankton and zooplankton.

Most nuclear power plants were required to monitor the entrainment effects during the initial years of operation. The effects of entrainment on phytoplankton and zooplankton are of small significance if monitoring indicates no evidence that the nuclear power plant operation has reduced or otherwise affected populations of these organisms in the source waterbody. The 2013 LR GEIS (NRC 2013-TN2654) summarizes the results of entrainment monitoring at several nuclear power plants. The 1996 LR GEIS (NRC 1996-TN288) and 2013 LR GEIS concluded that this was a Category 1 issue and that nuclear power plants had not noticeably altered phytoplankton or zooplankton abundance near these and other plants. As a result, NRC staff concluded that the impacts of initial license renewal would be similar and SMALL. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for Monticello initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

Phytoplankton and zooplankton inhabiting the Mississippi River may be entrained when water is drawn from the Mississippi River into the intake structure under three operating modes: open-cycle, helper cycle, and partial recirculation modes (see Sections 2.1.3 and 3.7.2.1). In these operating modes, Monticello can withdraw up to 290,000 gpm of water from the Mississippi River under the Water Appropriations Permit (No. 66-1172; Xcel 2023-TN9084). As Monticello withdraws water from the Mississippi River, fish and other aquatic organisms that cannot swim fast enough to escape the flow of water may be swept into the intake. Monticello can also operate in a closed cycle mode, however, to date, it has not operated in this mode. If closed cycle mode were used in the future, entrainment would be expected to be minimal as Monticello would withdraw water from the Mississippi River through two makeup water pumps that withdraw less water than the other operating modes (14,000 gpm) to replace water lost due to evaporation, drift, and blowdown and entrainment.

Researchers conducted field studies in the 1960s and 1970s to characterize phytoplankton and zooplankton in the Mississippi River (NRC 2006-TN7315; Amish et al. 1978-TN9580). As discussed in Section 3.7.1.2, these studies found that phytoplankton is limited in the Mississippi River and can likely be attributed to a few backwater areas with standing water, and most of the phytoplankton caught during the studies was attributed to fragments of periphyton that broke off the bottom. Researchers have found that zooplankton populations to be limited in the main channel of the Mississippi River by Monticello due to the high gradients (NRC 2006-TN7315[6]; Amish et al. 1978-TN9580). Although Xcel Energy conducted entrainment studies at Monticello, these studies only considered ichthyoplankton and not phytoplankton or zooplankton. In the absence of specific studies, the NRC staff considers the HZI and results of finfish monitoring to reasonably characterize the effects of entrainment on phytoplankton and zooplankton in the Mississippi River.

Although phytoplankton and zooplankton are likely limited in the reach of the Mississippi River near Monticello, the HZI is an important factor for determining potential impacts. As described in Section 3.7.2.1, researchers determined that most of the main channel is not influenced by the withdrawal of water by Monticello (Xcel 2023-TN9578[6]: Attachment 6 of Enclosure 24). Therefore, most phytoplankton and zooplankton moving past the Monticello intake system are not at risk of entrainment due to the relatively small area influenced by the intake structure. The HZI would remain the same during the proposed SLR period.

Finfish monitoring can provide insight into the health phytoplankton and zooplankton communities inhabiting the reach of the Mississippi River near Monticello. As described in Section 3.7.1.2, Xcel Energy conducts annual electrofishing and seining surveys of the reach of the Mississippi River near Monticello to monitor the aquatic community. Survey results have not shown major decreases in fish abundance or diversity. Although these studies do not directly gather information on phytoplankton and zooplankton populations, it is reasonable to assume that entrainment is not affecting these communities to a degree that causes trophic cascade or monitoring would reveal downward trends or other shifts in the abundance and composition of finfish species that are primary consumers in the trophic structure.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on phytoplankton and zooplankton would be similar. For these reasons, the effects of entrainment of phytoplankton and zooplankton would be minor and would neither destabilize nor noticeably alter any important attribute of these populations during the SLR term. The NRC staff concludes that the impacts of entrainment of phytoplankton and zooplankton during the Monticello SLR term would be SMALL.

3.7.2.3 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

This section evaluates the thermal impacts of Monticello operations during the proposed SLR term on aquatic organisms. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff evaluated the thermal impacts from “heat shock.” The NRC staff determined the impacts of continued operation of Monticello would be SMALL during the initial license renewal term (i.e., 2010–2030). In 2013, the NRC issued Revision 1 of the LR GEIS (NRC 2013-TN2654) and renamed the issue of “heat shock” to “thermal impacts on aquatic organisms.” The renaming did not affect the scope of the issue for license renewal. This section of the EIS evaluates thermal impacts as they apply to continued operation of Monticello during the proposed subsequent license renewal term (i.e., 2030–2050).

The primary form of thermal impact of concern at Monticello is heat shock. Heat shock occurs when water temperature meets or exceeds the thermal tolerance of an aquatic species for some duration of the exposure (NRC 2013-TN2654). In most situations, fish can avoid areas that exceed their thermal tolerance limits, although some aquatic species or life stages lack such mobility. Heat shock is typically observable only for fish because fish tend to float when dead. In addition to heat shock, thermal plumes resulting from thermal effluent can create barriers to fish passage, which is of particular concern for migratory species. Thermal plumes can also reduce the available aquatic habitat or alter habitat characteristics in a manner that results in cascading effects on the local aquatic community.

<u>Monticello Effluent Discharge</u>

As described in Section 2.1.3, Monticello’s NPDES permit establishes thermal limits for heated effluent discharges into the Mississippi River (MPCA 2023-TN9690). Monticello discharges heated effluent approximately through two 108 in. (274 cm) pipes to a concrete discharge structure, which is located approximately 700 ft (213.4 m) downriver of the intake structure. The concrete discharge structure is equipped with two isolation and sluice gates. During open cycle, helper, and partial recirculation modes, the sluice gates are opened to allow the heated effluent to enter into the discharge canal and return to the Mississippi River. The discharge canal is approximately 1,000 ft (304.8 m) long. Heated effluent from the cooling towers is discharged to the south bank of the discharge canal. Water that collects in the discharge canal then flows downhill toward a discharge weir with a control gate. The discharge weir controls the amount of water that is released into the Mississippi River and acts as a blockade that prevents fish from the Mississippi River from entering the discharge canal. Water from the discharge canal pours over the crest of the discharge weir, flows down a concrete apron to prevent scouring, and then flows into the Mississippi River with a flow rate of up to 645 cfs (18.3 m/s).

Heated effluent entering the Mississippi River creates a distinct thermal plume (Xcel 2023-TN9578[9]: Attachment 4 of Enclosure 24; NRC 2006-TN7315; NMC 2006-TN9677; Xcel 2023-TN9084). The sections below summarize thermal plume studies.

Clean Water Act of 1972 Section 316(a) Requirements for Point Source Discharges

The CWA Section 316(a) addresses the adverse environmental impacts associated with thermal discharges into waters of the United States. This section of the CWA grants the EPA the authority to impose alternative, less-stringent, facility-specific effluent limits (called “variances”) on the thermal component of point source discharges. To be eligible, facilities must demonstrate, to the satisfaction of the NPDES permitting authority, that facility-specific effluent limitations will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water. CWA Section 316(a) variances are valid for the term of the NPDES permit (i.e., 5 years). Facilities must reapply for variances with each NPDES permit renewal application. The EPA issued regulations under CWA Section 316(a) at 40 CFR 125, Subpart H (TN254).

Analysis Approach

When available, the NRC staff relies on the expertise and authority of the NPDES permitting authority with respect to thermal impacts on aquatic organisms. Therefore, if the NPDES permitting authority has made a determination under CWA Section 316(a) that thermal effluent limits are sufficiently stringent to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water, and that facility has implemented any associated requirements; then, the NRC staff assumes that adverse impacts on the aquatic environment will be minimized. In such cases, the NRC staff concludes that thermal impacts on aquatic organisms would be SMALL for the proposed SLR term.

In cases in which the NPDES permitting authority has not granted a CWA Section 316(a) variance, the NRC staff analyzes the potential impacts of thermal discharges using a weight-of-evidence approach. In this approach, the staff considers multiple lines of evidence to assess the presence or absence of ecological impairment (i.e., noticeable or detectable impact) on the aquatic environment. For instance, as its lines of evidence, the staff might consider characteristics of the cooling water discharge system design, the results of thermal studies performed at the facility, and trends in fish and shellfish population abundance indices. The staff then considers these lines of evidence together to predict the level of impact (SMALL, MODERATE, or LARGE) that the aquatic environment is likely to experience over the course of the proposed SLR term.

Baseline Condition of the Resource

For the purposes of this analysis, the NRC staff assumes that the baseline condition of the resource is the Mississippi River aquatic community as it occurs today, which is described in Section 3.7.1 of this EIS. While species richness, evenness, and diversity within the community may change or shift between now and when the proposed SLR period would begin, the NRC staff finds the aquatic community as it occurs today to be a reasonable surrogate in the absence of fishery and species-specific projections.

CWA 316(a) Thermal Variance

The MPCA has regulated thermal discharge temperatures at Monticello through the NPDES permit since it began operating in 1975 (NMC 2006-TN9677; NRC 2006-TN7315; Xcel 2023-TN9084). These temperature limits are not explicitly called thermal variances in the NPDES permits. The MPCA and MDNR uses an adaptive permitting approach to ensure that aquatic resources are protected during Monticello operations (see Sections 2.1.3, 3.7.2.1, and the above summary in this section). The MPCA sets maximum thermal effluent temperatures in the NPDES permit, and the MDNR limits surface water appropriations from the Mississippi River in the Surface Water Appropriation Permit. The conditions for Monticello for both of these permits are designed to be protective of aquatic and terrestrial life in accordance with State and Federal regulations. The NPDES permit contains fishery monitoring requirements and biennial reporting to MPCA as well as requirements for discharge sampling and testing for water quality parameters. MPCA uses these water quality and fishery reports to assess the safety and population stability of native shellfish and fish populations, and could require Xcel Energy to conduct a Section 316(a) study if aquatic biota are impacted by surface water discharges (Xcel 2023-TN9084).

1971–1975 Thermal Plume Analyses

University of Minnesota researchers collected surface water temperature data between 1971 and 1973 and conducted an initial thermal plume analysis (Xcel 2023-TN9578: Attachment 4, Enclosure 24). NUS Corporation further evaluated the thermal impacts from the Monticello discharges in a Section 316(a) demonstration report from 1975. The NRC staff summarized the main findings of the Section 316(a) demonstration report in the 2006 Monticello LR SEIS (NRC 2006-TN7315). The summary of the 1975 analysis that was prepared by NRC staff included some findings similar to the earlier 1971–1973 study: (1) the main thermal plume was confined to the southern and western river bank; (2) the plume extended to less than half the width of the river during summer months (June through September); and (3) the temperature differentials of the plume outside of the exit of the discharge location were similar for the 1975 study (4.2°F [2.3°C]) and the 1971–1973 study (3°F [1.7°C]).

2009 Extended Power Uprate Evaluation

URS Corporation conducted a EPU Evaluation in 2009, and the modelers used the approach from the 1971–1973 isotherm analysis to analyze thermal impacts for the EPU (Xcel 2023-TN9084, Xcel 2023-TN9578: Attachment 4, Enclosure 24). The NRC approved a license amendment authorizing Xcel Energy to operate at a higher license power rate that became effective in 2013. The EPU increased the licensed power generation rate by 12.9 percent. The researchers determined that the EPU could increase water temperatures in the discharge canal by up to 4.5°F (2.5°C) during operations under the once-through cooling mode and by 2°F (1.1°C) during operations under the helper and partial recirculation modes. The researchers found that the size and shape of the thermal plume would remain similar to the 1971–1973 evaluation (Xcel 2023-TN9578[9]: Attachment 4, Enclosure 24).

URS Corporation also determined that the EPU could increase the temperatures of the thermal plume in the Mississippi River. The researchers conducted this EPU evaluation by comparing the predicted plume temperatures before the EPU and after the EPU during January (peak cold months) and August (peak warm months). For August, the researchers predicted that the EPU could increase plume temperatures by 2.8°F (1.5°C) near the exit of the discharge, by 2.2°F (1.2°C) at a location 500 ft (152 m) downriver of the discharge canal, and by 1.1°F (0.6°C) at the furthest location that they analyzed 17,540 ft (5,346 m) downriver. For January, the authors predicted the EPU could increase plume temperatures by 3.3°F (1.8°C) near the exit of the

[9] Xcel Energy 2023. Enclosure 24 Attachment 4 Thermal Effluent Discharge Analysis for Monticello Nuclear Generating Plant. Enclosure 24 in Xcel 2023-TN9578, page 345.

discharge canal, by 2.6°F (1.4°C) at a location 500 ft (152 m) downriver of the discharge canal, and by 1.3°F (0.7°C) at a location 17,540 ft (5,346 m) downriver of the discharge canal.

Thermal Impacts Conclusion

The thermal plume studies demonstrate that the temperature differentials of the plume begin to rapidly decrease downriver of the discharge canal, the plume does not cross the entire river, and the plume is localized along the western bank downriver of Monticello. Mobile organisms such as fish can therefore swim around the plume and the impacts to immobile organisms would be limited the small area of peak temperature differentials by the exit of the discharge canal. The electrofishing and seining surveys also demonstrate there have not been major decreases in fish abundance or diversity for areas upriver and downriver of Monticello.

In addition, because MPCA has granted Xcel Energy multiple, sequential NPDES permits with temperature limits that are designed to be protective of aquatic life under CWA Section 316(a) and Minnesota Administrative Rules, the NRC staff finds that the adverse impacts on the aquatic environment associated with thermal effluents are minimized. Because characteristics of the thermal effluent would remain the same under the proposed action, the NRC staff anticipates similar effects during the proposed SLR period. Further, MPCA will continue to review the CWA Section 316(a) variance with each successive NPDES permit renewal and may require additional mitigation or monitoring in a future renewed NPDES permit if it deems such actions to be appropriate to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in the Mississippi River. The NRC staff assumes that any additional requirements that MPCA imposes would further reduce the impacts of the Monticello thermal effluent over the course of the proposed SLR term. For these reasons, the NRC staff finds that thermal impacts during the proposed SLR period would neither destabilize nor noticeably alter any important attribute of the aquatic environment and would, therefore, result in SMALL impacts on aquatic organisms.

3.7.2.4 Infrequently Reported Thermal Impacts (All Plants)

This issue concerns the infrequently reported effects of thermal effluents. These effects include cold shock, thermal migration barriers, accelerated maturation of freshwater aquatic insects, and proliferated growth of aquatic nuisance species.

Cold shock occurs when an organism has been acclimated to a specific water temperature or range of temperatures and is subsequently exposed to a rapid decrease in temperature. This can result in a cascade of physiological and behavioral responses and, in some cases, death (Donaldson et al. 2008-TN7515). Rapid temperature decreases may occur from either natural sources (e.g., thermocline temperature variation and storm events) or anthropogenic sources (e.g., thermal effluent discharges). The magnitude, duration, and frequency of the temperature change, as well as the initial acclimation temperatures of individuals, can influence the extent of the consequences of cold shock on fish and other aquatic organisms (Donaldson et al. 2008-TN7515). At nuclear power plants, cold shock could occur during refueling outages, reductions in power generation level, or other situations that would quickly reduce the amount of cooling capacity required at the nuclear power plant. Cold shock is most likely to be observable in the winter. The 1996 LR GEIS reports that cold shock events have only rarely occurred at nuclear power plants. Fish mortalities usually involved only a few fish and did not result in population-level effects. Gradual depowering or shutdown of nuclear power plant operations, especially in winter months, can mitigate the effects of cold shock.

Thermal effluents have the potential to create migration barriers if the thermal plume covers an extensive cross-sectional area of a river and temperatures within the plume exceed a species' physiological tolerance limit. This impact has been examined at several nuclear power plants, but it has not been determined to result in observable effects (NRC 1996-TN288, NRC 2013-TN2654).

The 1996 LR GEIS (NRC 1996-TN288) and 2013 LR GEIS (NRC 1996-TN288) also considered that the heated effluents of nuclear power plants could accelerate the maturation of aquatic insects in freshwater systems and cause premature emergence. The maturation and emergence of aquatic insects are often closely associated with water temperature regimes. If insects develop or emerge early in the season, they may be unable to feed or reproduce or they may die because the local climate is not warm enough to support them.

The 1996 LR GEIS and 2013 LR GEIS also considered that heated effluents could proliferate the growth of aquatic nuisance organisms. Aquatic nuisance species are organisms that disrupt the ecological stability of infested inland (e.g., rivers and lakes), estuarine, or marine waters (EPA 2022-TN7519). The LR GEISs discuss the zebra mussel (*Dreissena polymorpha*) and Asiatic clam (*Corbicula fluminea*), two bivalves that are of particular concern in many freshwater systems because they can cause significant biofouling of industrial intake pipes at power and water facilities. These species are also of ecological concern because they outcompete and lead to the decline of native freshwater mussels. Nuclear power plants that withdraw water from water bodies in which these species are known to occur often periodically chlorinate intake pipes or have other procedures in place to mitigate the spread of these bivalves. There is no evidence, however, that thermal effluent leads to these species' proliferation.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that these infrequently reported thermal impacts were a Category 1 issue and would be SMALL during the initial license renewal term. The 1996 LR GEIS evaluated these concerns as five issues; the 2013 LR GEIS consolidated them into one issue. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning these issues, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL impact for Monticello initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

<u>Cold Shock</u>

Xcel Energy has reported two fish kill incidents due to cold shock in the past 5 years, both of which were attributed to routine maintenance shutdowns, which reduced heat load in the Mississippi River (Table 3-17; Xcel 2023-TN9578[10]: Enclosure 26). Xcel Energy estimated the total fish mortality to be 1,577 fish in 2022 and 230 fish in 2023 (Table 3-17; Xcel 2023-TN9578[10]: Enclosure 26). Most fish were smallmouth bass (48.6 percent combined across the two events), channel catfish (22.9 percent), and shorthead redhorse (14.3 percent). Data on length and age composition of the affected fish are not available.

[10] Xcel Energy 2023. Enclosure 26, RAI AQ-1 Thermal Impacts on Aquatic Organisms. Xcel 2023-TN9578 p. 1000.

Table 3-17 Summary of Cold Shock Fish Kill Events at Monticello, 2022 and 2023

Species	No. of Fish (January 2022)	No. of Fish (March 2023)	Total No. of Fish	Percent of Total Fish
smallmouth bass	825	54	879	48.6
channel catfish	384	29	413	22.9
shorthead redhorse	161	97	258	14.3
silver redhorse	96	19	115	6.4
northern hogsucker	34	1	35	1.9
white sucker	35	0	35	1.9
common carp	14	15	29	1.6
bluegill	7	10	17	0.9
rock bass	10	4	14	0.8
northern pike	3	1	4	0.2
walleye	4	0	4	0.2
black crappie	2	0	2	0.1
black bullhead	2	0	2	0.1
Total	**1,577**	**230**	**1,807**	**100**

Source = Xcel 2023-TN9578[10]: Enclosure 26.

Xcel Energy has observed cold shock-related fish kills since Monticello began operating (NMC 2006-TN9677). Between 1975 and 1979, Xcel Energy reported that eight winter shutdown events caused the death of about 1,200 total fish (or an average of 150 fish per event). In response to these events, Xcel Energy constructed a barrier weir at the mouth of the discharge canal in 1980 to prevent fish from entering the warmest areas of the discharge canal, which Xcel Energy expected would reduce the potential for cold shock events. From 1980 to 2004, Xcel Energy observed eight cold shock-related fish kills resulting in a total mortality of 969 fish (or an average of 121 total fish per event), which indicates that the barrier weir has likely reduced the frequency of such events. However, the magnitude and periodicity of the cold shock events in 2022 (1,577 total fish) and 2023 (230 total fish) are high compared to historical events that occurred both before and after barrier weir construction. The NRC staff also does not have information on the period from 2004 through 2021. Therefore, the NRC staff is uncertain whether the 2022 and 2023 cold shock events were anomalies and whether any other factors, such as extreme weather or climate change factors, contributed to these events.

As discussed in Section 3.7.2.1, Xcel Energy's annual electrofishing and seining surveys indicate that the local fish populations are healthy and diverse, and sampling indicates no major upward or downward trends in juvenile or adult fish populations. For this reason, the NRC staff concludes that fish mortality in connection with occasional cold shock events is not affecting fish populations to an extent that changes in these populations are detectable.

Thermal Migration Barriers

With respect to thermal migration barriers, Section 3.7.2.3 observes that the thermal plume does not span the entire river. Therefore, fish and other aquatic organisms can avoid areas of heated water when migrating upriver and downriver. For this reason, the thermal plume is not expected to create a barrier to migration.

Accelerated Maturation of Freshwater Aquatic insect and Proliferated Growth of Aquatic Nuisance Species

Accelerated maturation of freshwater aquatic insects and proliferated growth of aquatic nuisance species have not been documented to occur due to Monticello operations. The one exception is that heated effluent released by Monticello has allowed a localized population of invasive Asian clams to survive the cold Minnesota winters (see Section 3.7.1.3). The Asian clam population has not proliferated to levels requiring Xcel Energy to implement control measures. This population by Monticello is not expected to survive or spread outside the region of warmer water directly in the vicinity of Monticello's thermal effluent because colder winter water temperatures upstream or downstream of Monticello would kill them. Shipworms are not of concern because Monticello does not discharge to coastal waters.

Conclusion

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. The NRC staff concludes that fish mortality in connection with occasional cold shock events would likely continue during the SLR period but that these events would not affect fish populations to an extent that would be detectable at the population level. No other thermal impacts discussed in this section have been found to be an issue at Monticello and, therefore, the NRC staff does not expect that these issues would be of concern during the SLR period. For these reasons, infrequently reported thermal impacts would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that infrequently reported thermal impacts on aquatic resources during the Monticello SLR term would be SMALL.

3.7.2.5 Effects of Cooling Water Discharge on Dissolved Oxygen, Gas Supersaturation, and Eutrophication

This issue concerns the effects of thermal effluents on dissolved oxygen, gas supersaturation, and eutrophication. Because nuclear power plant effluents are heated, discharged water can change certain biological conditions in the receiving waterbody in a manner that affects the characteristics of that habitat and the potential suitability of that habitat for local fish, shellfish, and other aquatic organisms.

Aerobic organisms, such as fish, require oxygen, and the concentration of dissolved oxygen in a waterbody is one of the most important ecological water quality parameters. Dissolved oxygen also influences several inorganic chemical reactions. In general, dissolved oxygen concentrations of less than 3 parts per million (ppm) in warmwater habitats, or less than 5 ppm in coldwater habitats, can adversely affect fish (Morrow and Fischenich 2000-TN7351). Oxygen dissolves into water via diffusion, aeration, and as a product of photosynthesis. The amount of oxygen water can absorb depends on temperature; the amount of oxygen that can dissolve in a volume of water (i.e., the saturation point) is inversely proportional to the temperature of the water. Thus, when other chemical and physical conditions are equal, the warmer the water is, and the less dissolved oxygen it can hold. Increased water temperatures also affect the amount of oxygen that aquatic organisms need by increasing metabolic rates and chemical reaction rates. The rate of many chemical reactions in water approximately doubles for every 18°F (10°C) increase in temperature.

The thermal effluent discharges of nuclear power plants have the potential to stress aquatic organisms by simultaneously increasing these organisms' need for oxygen and decreasing oxygen availability. Aquatic organisms are more likely to experience adverse effects from thermal effluents in ecosystems where dissolved oxygen levels are already approaching suboptimal levels from other factors in the environment. This is most likely to occur in ecosystems where increased levels of detritus and nutrients (e.g., eutrophication), low flow, and high ambient temperatures already exist. These conditions can occur from drought conditions or in hot weather, especially in lakes, reservoirs, or other dammed freshwater.

Although the thermal effluents of nuclear power plants may contribute to reduced dissolved oxygen in the immediate vicinity of the discharge point, as the effluent disperses, diffusion and aeration from turbulent movement introduces additional oxygen into the water. As the water cools, the saturation point increases, and the water can absorb additional oxygen as it is released by aquatic plants and algae through photosynthesis, which is a continuously ongoing process during daylight hours. Therefore, lower dissolved oxygen is generally only a concern within the thermal mixing zone, which is typically a small area of the receiving waterbody. Many States address thermal mixing zones in State water quality criteria to ensure that mixing zones provide a continuous zone of passage for aquatic organisms. Additionally, the EPA, or authorized States and Tribes often impose conditions specifically addressing dissolved oxygen through NPDES permits to ensure that receiving water bodies maintain adequate levels of oxygen to support aquatic life. These conditions are established pursuant to CWA Section 316(a), which requires that regulated facilities operate under effluent limitations that ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving waterbody.

Rapid heating of cooling water can also affect the solubility and saturation point of other dissolved gases, including nitrogen. As water passes through the condenser cooling system, it can become supersaturated with gases. Once the supersaturated water is discharged in the receiving waterbody, dissolved gas levels equilibrate as the effluent cools and mixes with ambient water. This process is of concern if aquatic organisms remain in the supersaturated effluent for a long enough period to become equilibrated to the increased pressure associated with the effluent. If these organisms then move into water of lower pressure too quickly when, for example, swimming out of the thermal effluent or diving to depths, the dissolved gases within the affected tissues may come out of solution and form embolisms (bubbles). The resulting condition is known as gas bubble disease. In fish, it is most noticeable in the eyes and fins. Affected tissues can swell or hemorrhage and result in behavioral abnormalities, increased susceptibility to predation or death. Mortality in fish generally occurs at gas supersaturation levels above 110 or 115 percent (EPA 1986-TN7726). Aquatic insects and crustaceans appear to be more tolerant of supersaturated water (Nebeker et al. 1981-TN7725).

The ability to detect and avoid supersaturated waters varies among species. A fish can avoid supersaturated waters by either not entering the affected area or by diving to avoid the onset of supersaturated conditions near the surface. Some species, however, may not avoid supersaturated waters until symptoms of gas bubble disease occur; at that point, some fish may already be lethally exposed. Other species may be attracted to supersaturated waters because it is often warmer (Gray et al. 1983-TN7727).

An early concern about nuclear power plant discharges was that thermal effluents would cause or speed eutrophication by stimulating biological productivity in receiving water bodies (NRC 1996-TN288). Eutrophication is the gradual increase in the concentration of phosphorus, nitrogen, and other nutrients in a slow-flowing or stagnant aquatic ecosystem, such as a lake.

These nutrients enter the ecosystem primarily through runoff from agricultural land and impervious surfaces. The increase in nutrient content allows alga to proliferate on the water's surface, which reduces light penetration and oxygen absorption necessary for underwater life. The 1996 LR GEIS reports that several nuclear power plants conducted long-term monitoring to investigate this potential effect. No evidence of eutrophication was detected.

The 1996 LR GEIS (NRC 1996-TN288) and 2013 LR GEIS (NRC 2013-TN2654) report cases of fish mortality from gas bubble disease at hydroelectric dams and coal-fired power plants. Typically, gas bubble disease is of concern at facilities where the configuration of the discharge allows organisms to reside in the supersaturated effluent for extended periods of time (e.g., discharge canals that fish can freely enter). However, fish mortality from gas bubble disease has been observed in only one instance in the mid-1970s at a nuclear power plant that is no longer operating.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication were a Category 1 issue and would be SMALL during the initial license renewal term. The 1996 LR GEIS evaluated these concerns as three issues, while the 2013 LR GEIS consolidated them into one issue. In the 2006 Monticello LR SEIS, the NRC staff found no new and significant information concerning these issues, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for Monticello initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

With respect to dissolved oxygen, Monticello's NPDES permit requires that Xcel Energy monitor dissolved oxygen levels. The NRC staff reviewed Xcel Energy's biennial monitoring reports from 1995–2021. These reports indicate that there have not been any significant changes to the water quality in cooling water discharges during this period. If the MDNR were to determine that dissolved oxygen levels in Monticello's thermal discharge were of concern, it could impose limits in a future renewed NPDES permit in accordance with CWA Section 316(a) requirements to ensure that a balanced, indigenous population of fish and shellfish is maintained in the reach of the river near Monticello. Additionally, as discussed in Section 3.7.2.1, Xcel Energy's annual electrofishing and seining surveys indicate that the local fish populations are healthy and diverse, and sampling indicates no major upward or downward trends in juvenile or adult fish populations. For this reason, the NRC staff concludes that Monticello operations are not affecting dissolved oxygen in the Mississippi River to an extent that is causing measurable changes in local fish populations. Because SLR would continue current operating conditions and because the site's NPDES permit would continue to require Xcel Energy to monitor dissolved oxygen, reduced dissolved oxygen resulting from Monticello's thermal effluent is not expected to be of concern during the SLR period.

With respect to gas supersaturation, Xcel Energy has not reported any instances of gas-supersaturation-related fish kills at Monticello or any other information indicating that fish may have experienced symptoms of gas bubble disease (Xcel 2023-TN9084). As described above, gas supersaturation has only been reported at one nuclear power plant that is no longer in service.

With respect to eutrophication, this is not a concern at Monticello since it lies along a free-flowing section of the Mississippi River with swift currents and rapids. As discussed previously in this section, eutrophication occurs in slow-flowing or stagnant ecosystems, such as lakes and reservoirs.

In conclusion, the effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication during Monticello operations are minor. The SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on aquatic resources would be similar. For these reasons, these effects would be minor and would neither destabilize nor noticeably alter any important attribute of aquatic ecosystems during the SLR term. The NRC staff concludes that the impacts of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication during the Monticello SLR term would be SMALL.

3.7.2.6 Effects of Nonradiological Contaminants on Aquatic Organisms

This issue concerns the potential effects of nonradiological contaminants on aquatic organisms that could occur from nuclear power plant operations. This issue initially became a concern because some nuclear power plants used heavy metals in condenser tubing that could leach from the tubing and expose aquatic organisms to these contaminants. Because aquatic organisms can bioaccumulate heavy metals, even when exposed at low levels, this can be toxic to fish and other animals that consume contaminated organisms. Section 3.9.2 of the 2013 LR GEIS (NRC 2013-TN2654) describes instances in which copper contamination was an issue at operating nuclear power plants. Heavy metals have not been found to be of concern other than in these few instances. In all cases, the nuclear power plants eliminated leaching by replacing the affected piping, and these changes were implemented during the initial operating license terms. The NRC staff has not identified this issue to be of concern during any license renewal reviews to date.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the effects of nonradiological contaminants on aquatic organisms were a Category 1 issued and would be SMALL during the initial license renewal term. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), NRC staff did not identify any nonradiological contamination impacts beyond what was discussed in the 1996 LR GEIS (NRC 1996-TN288). Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

With respect to heavy metals, Monticello has stainless steel condenser tubes that do not leach metals to the cooling water discharge (Xcel 2023-TN9084).

With respect to nonradiological contaminants in effluent discharges, the MPCA regulates these discharges through Monticello’s NPDES permit (MPCA 2023-TN9401). For instance, the NPDES permit authorizes Xcel Energy to use chloride and bromine biocides to control biofouling in the cooling water system and specifies the conditions for doing so (e.g., dechlorination has to occur prior to discharging the treated water). During the proposed SLR term, the MPCA would continue to regulate nonradiological contaminants through the NPDES permit and could impose additional conditions and requirements if it identifies any concerns regarding Monticello’s effluent discharges in the future.

To prevent pollution from stormwater or chemicals spills from entering the Mississippi River, Xcel Energy maintains a SWPPP, a spill prevention, control, and countermeasure (SPCC) plan, a hazardous substance spill contingency plan, a chemical control program. In accordance with these plans, Xcel Energy reports spills to the MPCA (Xcel 2023-TN9084). The NRC staff reviewed records related to these plans as part of its environmental review. During the period of 2019 through 2022, Xcel Energy reported no chemical spills.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, the effects of nonradiological contaminants on aquatic organisms would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that the effects of nonradiological contaminants on aquatic organisms during the Monticello SLR term would be SMALL.

3.7.2.7 Exposure of Aquatic Organisms to Radionuclides

This issue concerns the potential impacts on aquatic organisms from exposure to radionuclides from routine radiological effluent releases. During normal operations, nuclear power plants can release gaseous emissions that deposit small amounts of radioactive particulates in the surrounding environment. Gaseous emissions typically include krypton, xenon, and argon (which may or may not be radioactive), tritium, isotopes of iodine, and cesium. Emissions may also include strontium, cobalt, and chromium. Radionuclides also may be released into water as liquid effluent. Aquatic plants can absorb radionuclides that enter shallow groundwater or surface waters through their roots. Aquatic animals can be exposed externally to ionizing radiation from radionuclides in water, sediment, and other biota and can be exposed internally through ingested food, water, and sediment and absorption through the integument and respiratory organs.

The 1996 LR GEIS (NRC 1996-TN288) did not address this issue. In 2007, the International Commission on Radiation Protection (ICRP) issued revised recommendations for a system of protection to control exposure from radiation sources (ICRP 2007-TN422). The recommendations included a section about the protection of the environment in which the ICRP found that a clearer framework for assessing nonhuman organisms was warranted. The ICRP indicated that it would develop a set of reference animals and plants as the basis for relating exposure to dose, and dose to radiation effects, for different types of organisms. This information would then provide a basis from which agencies and responsible organizations could make policy and management decisions. Subsequently, the ICRP developed and published a set of 12 reference animals and plants (ICRP 2008-TN7530, ICRP 2009-TN7531). They include a large and small terrestrial mammal, an aquatic bird, and a large and small terrestrial plant, among others. The ICRP also issues publications and information related to radiological effects and radiosensitivity in non-human biota (Adam-Guillermin et al. 2018-TN7972).

In 2009, following the NRC staff's review of the ICRP's 2007 recommendations, the Commission found that there is no evidence that NRC's current set of radiation protection controls is not protective of the environment (NRC 2009-TN6651). For this reason, the Commission determined that the NRC staff should not develop separate radiation protection regulations for plant and animal species (NRC 2009-TN6651). The Commission charged the NRC staff with continuing to monitoring international developments on this issue and to keep the Commission informed of any such developments. Nonetheless, the NRC addressed radiological exposure of nonhuman organisms in the 2013 LR GEIS (NRC 2013-TN2654) due to public concern about these impacts at some nuclear power plants.

In the 2013 LR GEIS, the NRC staff adopted DOE's standard on a graded approach for evaluating radiation doses to terrestrial and aquatic biota (DOE 2019-TN6817). The DOE standard provides methods, models and guidance that can be used to characterize radiation doses to terrestrial and aquatic biota exposed to radioactive material (DOE 2019-TN6817).

The following DOE guidance dose rates are the levels below which no adverse effects to resident populations are expected:

- riparian animal (0.1 radiation-absorbed dose per day [rad/d]; 0.001 gray per day [Gy/d])
- terrestrial animal (0.1 rad/d) (0.001 Gy/d)
- terrestrial plant (1 rad/d) (0.01 Gy/d)
- aquatic animal (1 rad/d) (0.01 Gy/d)

Previously, in 1992, the International Atomic Energy Agency (IAEA 1992-TN712) also concluded that chronic dose rates of 0.1 rad/d (0.001 Gy/d) or less do not appear to cause observable changes in terrestrial animal populations. The United Nations Scientific Committee on the Effects of Atomic Radiation concluded in 1996 and re-affirmed in 2008 that chronic dose rates of less than 0.1 mGy/hr (0.24 rad/d or 0.0024 Gy/d) to the most highly exposed individuals would be unlikely to have significant effects on most terrestrial communities (UNSCEAR 2010-TN7974).

In the 2013 LR GEIS, the NRC staff estimated the total radiological dose that the four non-human receptors listed above (i.e., riparian animal, terrestrial animal, terrestrial plant, and aquatic animal) would be expected to receive during normal nuclear power plant operations based on plant-specific radionuclide concentrations in water, sediment, and soils at 15 operating nuclear power plants using Argonne National Laboratory's RESRAD-BIOTA dose evaluation model. The NRC staff found that total calculated dose rates for aquatic animals at all 15 plants were all less than 0.2 rad/d (0.002 Gy/d), which is less than the guideline value of 1 rad/d (0.01 Gy/d). As a result, the NRC staff anticipated in the 2013 LR GEIS that normal operations of these facilities would not result in negative effects on terrestrial biota. The 2013 LR GEIS concluded that the impact of radionuclides on terrestrial biota from past operations would be SMALL for all nuclear plants and would not be expected to change appreciably during the initial license renewal period.

The NRC staff did not specifically evaluate the exposure of aquatic organisms to radionuclides during the initial license renewal period in the 2006 Monticello LR SEIS (NRC 2006-TN7315) as the issue was not addressed in the 1996 LR GEIS. However, as explained above, the 2013 LR GEIS later addressed this issue generically for initial license renewal of all nuclear power plants and concluded that impacts would be SMALL. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

The NRC requires nuclear power plants to maintain a REMP through its regulations at 10 CFR Part 50, Appendix I (TN249), 10 CFR Part 20 (TN283), and 10 CFR Part 72 (TN4884), and through plant-specific technical specifications (see Section 3.13 for more detail). These collectively require that licensees establish and implement a REMP to obtain data on measurable levels of radiation and radioactive material. The NRC provides guidance to licensees on acceptance methods for establishing and conducting REMPs in Regulatory Guide 4.1 (NRC 2009-TN3802).

Xcel Energy's REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity (links to REMP reports are provided below). Monitoring is conducted for the following: direct radiation, air, well water, river water, surface water, food products and vegetation (such as edible broad leaf vegetation), fish tissue, shoreline sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon. For aquatic testing, Xcel Energy obtains samples from fish tissue (smallmouth bass and shorthead redhorse), river water, and river sediments at locations below Monticello to evaluate potential radiological contamination and they also collect samples at upriver sites that serve as controls.

As part of its environmental review, the NRC staff reviewed the past 5 years of REMP reports from 2018–2022 that Xcel Energy calls their Annual Radiological Environmental Operating Reports (Xcel 2019-TN9621, Xcel 2020-TN9612, Xcel 2021-TN9613, Xcel 2022-TN9614, Xcel 2023-TN9615). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. During this period, all samples were below reportable limits for radionuclides in environmental samples. Although the fish tissue samples did detect potassium-40 (e.g., 3.43 ± 0.13 pCi/g wet weight for the four downstream samples in 2022), this is a common radioisotope that is naturally found in nature and is not attributed to Monticello operations. Furthermore, the data from the 2018–2022 REMP reports consistently shows that the readings of potassium-40 are at similar levels in fish tissue samples at the downriver and upriver sample sites.

NRC regulations require nuclear power plants to monitor radiation in the environment and to report the results of such monitoring to the NRC through a REMP. REMP monitoring demonstrates that levels of radiation are below regulatory limits. To date, Xcel Energy has not detected levels of radioactivity attributable to Monticello operations that would result in measurable radiological impacts on aquatic organisms.

<u>2022 Tritium Leak</u>

Section 3.5.2.3 describes the 2022 tritium release to groundwater that was due to a rupture of a CRD suction pipe. In summary, Xcel Energy notified the State of Minnesota and the NRC on November 23, 2022, that a tritium sample result for an onsite monitoring well was above the ODCM and NEI Groundwater Protection Initiative reporting levels. In January 2023, after identifying the leak, Xcel Energy implemented a recovery system for the contaminated groundwater (i.e., effluent was directed to holding tanks, waste process systems, and/or reused on site). In March 2023, Xcel Energy replaced the ruptured pipe. In May 2023, Xcel Energy identified a second tritium leak that it attributed to a spill from a groundwater holding tank that was being used for the remediation efforts. This spill was released back into the area where remediation pumping was occurring, and Xcel Energy identified no health or safety concerns.

Section 3.5.2.3 describes Xcel Energy’s remediation response for the tritium leak. In summary, Xcel Energy has already added new groundwater monitoring wells and built a holding pond to store the contaminated groundwater. Xcel Energy is also planning to build a sheet pile containment structure to reduce groundwater flows into the Mississippi River. Xcel Energy has also started to drill five gradient control wells that will help keep groundwater levels below the top of the sheet pile containment structure to further reduce spread into the Mississippi River.

Minor concentrations (>100 pCi/L) of tritium were measured in river samples in March and April 2023. Further sampling, up until August 2023, has not identified tritium above detection limits in the river. The NRC staff does not expect these low concentrations of tritium in the Mississippi River to negatively impact aquatic resources. If such a spill were to occur during the SLR term, the NRC staff expects that Xcel Energy would take appropriate action, as it has in this case, to mitigate and resolve the issue, in accordance with all relevant State and NRC requirements.

Conclusion

In summary, NRC regulations require nuclear power plants to monitor radiation in the environment and to report the results of such monitoring to the NRC through a REMP. REMP monitoring ensures that levels of radiation are below regulatory limits and that any changes in radionuclide concentrations are detected and addressed. To date, Xcel Energy has not detected levels of radioactivity attributable to Monticello operations that would result in measurable radiological impacts on aquatic organisms. SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. For these reasons, radiological impacts would be minor and would neither destabilize nor noticeably alter any important attribute of the aquatic environment during the SLR term. The NRC staff concludes that exposure of aquatic organisms to radionuclides during the Monticello SLR term would be SMALL.

3.7.2.8 Effects of Dredging on Aquatic Organisms

This issue concerns the effects of dredging at nuclear power plants on aquatic resources. Small-particle sediment, such as sand and silt, that enters water bodies through erosion can subsequently deposit and accumulate along shorelines and in shallow water areas. If sediment deposition affects cooling system function or reliability, a nuclear power plant may need to periodically dredge to improve intake flow and keep the area clear of sediment. Nuclear power plants where dredging may be necessary are typically located along fast-flowing waters with sandy or silty bottoms, such as large rivers or the ocean. In some instances, dredging may be performed to maintain barge slips for transport of materials and waste to and from the site. Dredging entails excavating a layer of sediment from the affected areas and transporting that sediment to onshore or offshore areas for disposal. The three main types of dredges are mechanical dredges, hydraulic dredges, and airlift dredges. The selection of dredge type generally is related to the sediment type, the size of the area to be dredged, and the aquatic resources present.

Dredging results in the direct removal of soft bottom substrates along with in faunal and epifaunal organisms of limited mobility inhabiting those substrates. Small organisms living within and on the affected sediments are likely to be killed in the process. Smaller benthic invertebrates, such as mollusks and crustaceans, may also be susceptible to entrainment into the dredge head. Larger benthic individuals or those that are farther from the dredge head could move away from the suction flow field to avoid being entrained. Thus, dredging can be expected to cause short-term reductions in the biomass of benthic organisms. Dredging also creates sediment plumes that increase water turbidity, which can adversely affect aquatic biota and create short-term decreases in habitat quality during and after dredging. Turbidity primarily affects liquid-breathing organisms, such as fish and shellfish, as well as aquatic plants, because turbid conditions typically decrease photosynthetic capabilities. Turbidity levels associated with the sediment plumes of cutterhead dredges typically range from 11.5 to 282.0 milligrams per liter (mg/L) with decreasing concentrations at greater distances from the dredge head (Nightingale and Simenstad 2001-TN7538). Studies of benthic community recovery following dredging indicate that species abundance and diversity can recover within several years of dredging (Michel et al. 2013-TN7838). Specifically, within temperate, shallow water regions containing a combination of sand, silt, or clay substrate, benthic communities can recover in 1 to 11 months, according to studies reviewed by Wilber et al. (2006-TN7563). Recovery of benthic communities following dredging also tends to be faster in areas exposed to periodic disturbances, such as tidally influenced habitats (Diaz 1994-TN7773).

Sediments may be contaminated with a variety of pollutants from agricultural runoff and stormwater runoff from impervious surfaces. These pollutants can also be introduced to waterways from point sources, such as combined sewer overflows, municipal and industrial discharges, and spills. Contaminants that have accumulated in buried layers of sediment are often less readily bioavailable or less chemically active (EPA 2004-TN7739). Depending on the concentrations of specific contaminants in accumulated sediments, dredging could increase the bioavailability of those contaminants if they are resuspended in the water column (Petersen et al. 1997-TN7740; Su et al. 2002-TN7742; EPA 2004-TN7739).

The 2013 LR GEIS (NRC 2013-TN2654) analyzed the effects of dredging on aquatic organisms and concluded that the effects of this issue would be SMALL during the initial license renewal term for all nuclear power plants. The 1996 LR GEIS did not address this issue and it was, therefore, not specifically analyzed in the 2006 Monticello LR SEIS (NRC 2006-TN7315). Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

Xcel Energy conducts periodic hydraulic and mechanical dredging to remove sediment from the traveling screen bays, service water bays, and intake bay (Xcel 2023-TN9084). Dredging typically removes up to 600 yd^3 (459 m^3) of sediment from the intake bay every 2 years and 350 yd^3 (459 m^3) of sediment from the joint bay for traveling screens and service water every 12 to 18 months. Xcel Energy dewaters and transports all dredged material inland to the Sherco Power Plant, which is located approximately 3.9 mi (6.3 km) northwest of Monticello. Xcel Energy uses the dredged material for fill purposes at this site. Xcel Energy routes water from the dewatering process to the cooling tower basin. This water eventually reenters the Mississippi River via the discharge canal. Xcel Energy anticipates that it will conduct periodic maintenance dredging during the SLR period at a similar rate as it does currently (Xcel 2023-TN9084). Most recently, Xcel Energy conducted dredging in 2022, which was authorized under a U.S. Army Corps of Engineers Nationwide permit under CWA Section 404 and an MDNR dredging permit (1967-0743) (Xcel 2023-TN9084). Additionally, the NPDES permit contains reporting requirements for contaminants in dredge sediments. Taken together, these permits ensure that Xcel Energy takes steps to minimize the impacts of dredging on the aquatic environment.

The proposed SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on would be similar. The NRC staff assumes that Xcel Energy would continue to implement site environmental procedures and would obtain any necessary permits for dredging activities. Implementation of such controls would further reduce or mitigate potential effects. For these reasons, the effects of dredging on aquatic resources would be minor and would neither destabilize nor noticeably alter any important attribute of aquatic resources during the SLR term. The NRC staff concludes that the impacts of dredging on aquatic resources during the Monticello SLR term would be SMALL.

3.7.2.9 Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

Water use conflicts occur when the amount of water needed to support aquatic resources is diminished as a result of demand for agricultural, municipal, or industrial use or decreased water availability due to droughts, or a combination of these factors.

In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff evaluated “water use conflicts (plants with cooling towers and cooling ponds using make-up water from a small river with low flow)” as a surface water quantity issue and included impacts on ecological resources, including aquatic communities. The NRC staff determined that impacts of water use conflicts would be SMALL during the initial license renewal term (i.e., 2010–2030). In 2013, the NRC issued Revision 1 of the LR GEIS (NRC 2013-TN2654) and separated out ecological impacts from surface water, expanded the issue to include cooling towers, and titled the issue “water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)”. This section of the EIS evaluates water use conflicts as they apply to continued operation of Monticello during the proposed subsequent license renewal term (i.e., 2030–2050).

Section 3.5.3.1 describes surface water use conflicts that also apply to aquatic resources. In summary, surface water appropriations are managed by the MDNR through the Surface Water Appropriation Permit, which is designed to be protective of aquatic and terrestrial life in accordance with Minnesota Clean Water Quality Standards. When river flows are above 860 cfs (24.4 m^3/s), a maximum of 645 cfs (18.2 m^3/s) may be appropriated for cooling purposes. When river flows are between 240 and 860 cfs (6.7 and 24.4 m^3/s), the maximum water appropriation is 75 percent, and cooling towers may be required to stay within surface water appropriations and NPDES temperature limits. To date, Xcel Energy has not needed to operate in closed cycle mode, and it has only been required to operate in partial recirculation mode on two occasions. Xcel Energy can also use the cooling towers as needed on a voluntary basis, and it has done this about 130 to 150 days per year on average.

The NRC staff also analyzed surface water conflicts in Section 3.5.3.1. The NRC staff did this by evaluating the percentage of Mississippi River flows that are permanently removed from the river due to Monticello operations (e.g., evaporative loss from cooling towers). The NRC staff estimated that less than 1 percent of the Mississippi River flows are permanently removed in an average year. The NRC staff also estimated that consumptive water use would represent approximately 8 percent of the 6-day river flow during periods of extreme low flows in the past 25 years of record (1998–2023). These extreme low flows were from a period of six consecutive days from August 15 to August 20, 2021. The average flow during these six days was 650 cfs (18.4 m^3/s) and this was the only time that flows had dropped below the 860 cfs (24.4 m^3/s) threshold from the Surface Water Appropriation Permit that triggers more restrictive water appropriations (i.e., appropriations shall not exceed 75 percent of flows).

In Section 3.5.3.1, the NRC staff concluded that surface water use conflicts would be SMALL due to the Surface Water Appropriation Permit, the permit conditions that can require use of cooling towers to stay within the water appropriations, and because Monticello operations only permanently remove a small portion of Mississippi River flows during an average year (less than 1 percent) and during extreme lows (approximately 8 percent). Thus, a high percentage (92 to 99 percent) of Mississippi River flows would remain in the river even during extreme low flows, which would preserve aquatic habitats and aquatic resources.

The proposed SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on this resource category would be similar. For the reasons explained in this section, water use conflicts with aquatic resources would either not occur from SLR or would be so minor that the effects on aquatic resources would be undetectable. The NRC staff concludes that water use conflicts with aquatic resources during the Monticello SLR term would be SMALL.

3.7.2.10 Effects on Aquatic Resources (Non-Cooling System Impacts)

This issue concerns the effects of nuclear power plant operations on aquatic resources during SLR that are unrelated to operation of the cooling system. Such activities include landscape and grounds maintenance, stormwater management, and ground-disturbing activities that could directly disturb aquatic habitat or cause runoff or sedimentation. These impacts are expected to be like past and ongoing impacts that aquatic resources are already experiencing at the nuclear power plant site.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the non-cooling system impacts on aquatic resources would be SMALL during the initial license renewal term. In the 1996 LR GEIS, the NRC evaluated the impacts of refurbishment on aquatic resources. In the 2013 LR GEIS, the NRC expanded this issue to include impacts of other site activities, unrelated to cooling system operation, that may affect aquatic resources. In the 2006 Monticello LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for Monticello initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

Within the Monticello site, the Mississippi River is the only aquatic feature. As explained in Section 3.6.4.2, environmental impacts from landscape maintenance, ground disturbing activities, and other operational activities would be minimized because Xcel Energy maintains a site excavation and trenching controls procedure for any ground disturbance greater than 6 in. (15 cm). As part of this procedure, if personnel identify the potential for impacts to ecological resources, Xcel Energy may be required to seek an environmental review by MPCA. However, Xcel Energy does not plan on any ground disturbing activities in natural areas during the proposed SLR term (Xcel 2023-TN9084).

With respect to stormwater management, stormwater runoff from impervious surfaces can change the frequency or duration of inundation and soil infiltration within wetlands and neighboring habitats. Effects of stormwater runoff may include erosion, altered hydrology, sedimentation, and other changes in plant community characteristics. Runoff may contain sediments, contaminants and oils from road or parking surfaces, or herbicides. At Monticello, stormwater from the plant yard is collected and discharged to the Mississippi River through NPDES-permitted outfalls SD006 and SD007 (Xcel 2023-TN9578).[11] Xcel Energy maintains a SWPPP, which identifies potential sources of contamination that could affect stormwater discharges and specifies BMPs that Xcel Energy uses to minimize the impacts of stormwater discharges (Xcel 2023-TN9084). Monticello also maintains a spill prevention control and countermeasure (SPCC) plan and hazardous substance spill contingency plan to further reduce pollutants in stormwater discharges. Collectively, these measures ensure that the effects to aquatic resources from pollutants carried by stormwater would be minimized during the SLR term.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR on aquatic resources would be similar. For these reasons, the non-cooling system impacts on aquatic resources would be minor and would neither destabilize nor noticeably alter any important

[11] Xcel Energy 2023. Enclosure 24 Attachment 13, Final NPDES/SDS Permit, Monticello Nuclear Generating Facility. Enclosure 24 in Xcel 2023-TN9578, page 901.

attribute of aquatic resources during the SLR term. The NRC staff concludes that the non-cooling system impacts on aquatic resources during the Monticello SLR term would be SMALL.

3.7.2.11 Impacts of Transmission Line Right-of-Way Management on Aquatic Resources

This issue concerns the effects of transmission line ROW management on aquatic plants and animals. Transmission line management can directly disturb aquatic habitats if ROWs traverse aquatic features and heavy machinery is used in these areas. Heavy equipment can also compact soils, which can affect soil quality and reduce infiltration to shallow groundwater, resulting in runoff and erosion in nearby aquatic habitats. Chemical herbicides applied in ROWs can be transported to nearby aquatic habitats through precipitation and runoff. For small streams, trees may grow sufficiently between cutting cycles to provide shading and support microhabitats. Tree removal to maintain appropriate transmission line clearance could alter the suitability of habitats for fish and other aquatic organisms and locally increase water temperatures.

The 2013 LR GEIS (NRC 2013-TN2654) concluded that the impacts of transmission line ROW management on aquatic resources would be SMALL during the initial license renewal term. The 1996 LR GEIS did not address this issue and it was, therefore, not specifically analyzed in the 2006 Monticello LR SEIS (NRC 2006-TN7315). Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844).

In-scope transmission lines are described in Section 2.1.6. These transmission lines mainly cross industrial areas and some small patches of terrestrial vegetation on the site, but do not cross any water bodies or aquatic features (Xcel 2023-TN9084). Therefore, maintenance of these lines has no discernable effect on aquatic resources.

The SLR would continue current operating conditions and environmental stressors rather than introduce entirely new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, the effects of transmission line ROW maintenance on aquatic resources would be minor and would neither destabilize nor noticeably alter any important attribute of plant or animal populations during the SLR term. The NRC staff concludes that the impacts of transmission line ROW maintenance on aquatic resources during the Monticello SLR term would be SMALL.

3.7.2.12 Losses from Predation, Parasitism, and Disease Among Organisms Exposed to Sublethal Stresses

This issue concerns the effects of nuclear power plant operation that can increase aquatic organisms’ susceptibility to predation, parasitism, and disease. Such sublethal effects can result from impingement, if an organism is subsequently returned to the source waterbody, as well as from exposure to thermal effluents. This issue does not apply to entrainment. Because entrainable organisms generally consist of fragile life stages, all entrained organisms are assumed to die (79 FR 48300-TN4488) and would, therefore, not survive entrainment to subsequently experience sublethal effects.

The 1996 LR GEIS (NRC 1996-TN288) and the 2013 LR GEIS (NRC 2013-TN2654) concluded that the losses from predation, parasitism, and disease among organisms exposed to sublethal stresses would be SMALL during the initial license renewal term. In the 2006 Monticello

LR SEIS (NRC 2006-TN7315), the NRC staff found no new and significant information concerning this issue, and the NRC staff adopted the 1996 LR GEIS's conclusion of SMALL for Monticello initial license renewal. Below, the NRC staff analyzes this issue site-specifically for the SLR term, in accordance with CLI-22-02 and CLI-22-03 (NRC 2022-TN8182, NRC 2022-TN9844.

Sublethal Effects of Impingement

The regulations in the EPA's 2014 CWA Section 316(b) establish BTA standards for impingement mortality. Impingement mortality considers the survival rate of impinged organisms, rather than simply the total number of organisms impinged. Survival studies typically consider latent mortality associated with stunning, disorientation, or injury. Such effects can result from the injury itself or from increased susceptibility to predation, parasitism, or disease that results from the sublethal effects of impingement. As explained in Section 3.7.2.1, the Monticello intake system includes a fish return system and Xcel Energy has no plans to alter the design or function of the cooling system under the proposed action. Latent mortality and other sublethal effects that impinged fish may experience have not specifically been studied.

Sublethal Effects of Thermal Effluents

Fish and shellfish that are exposed to the thermal effluent of a nuclear power plant may experience stunning, disorientation, or injury. These sublethal effects can subsequently affect an organism's susceptibility to predation, parasitism, or disease.

With respect to susceptibility to predation, laboratory studies of the secondary mortality of fish following exposure to heat or cold shock demonstrate increased susceptibility of these fish to predation; however, field evidence of such effects is often limited to anecdotal information, such as observations of increased feeding activity of seagulls and predatory fish near effluent outfalls (e.g., Cada et al. 1981-TN7733). For example, Barkley and Perrin (1971-TN7734) and Romberg et al. (1974-TN7891) reported increased concentrations of predators feeding on forage fish attracted to thermal plumes. However, these studies did not quantify whether the observed behaviors resulted in population-level effects on prey species.

With respect to susceptibility to parasitism and disease, Langford (1983-TN7676) found that the tendency of fish to congregate in heated effluent plumes, the increased physiological stress that higher water temperatures exert on fish, and the ability of some diseases and parasites to proliferate at higher temperatures include all the factors that could contribute to increased rates of disease or parasitism in exposed fish. Some studies have suggested that crowding of fish within the thermal plume, rather than the thermal plume itself, may lead to an increased risk of exposure to infectious diseases (Coutant 1987-TN7736).

The 1996 and 2013 LR GEISs reported that neither scientific literature reviews nor consultations with agencies or utilities yielded clear evidence of nuclear power plant operation causing sublethal effects that result in noticeable increases in the susceptibility of exposed organisms to predation, parasitism, or disease. Xcel Energy (Xcel 2023-TN9084) reports no evidence of such effects, and Xcel Energy's continued adherence to the thermal conditions in its NPDES permit described in Section 3.7.2.3 would ensure that such effects would be minimized.

SLR would continue current operating conditions and environmental stressors rather than introduce wholly new impacts. Therefore, the impacts of current operations and SLR would be similar. For these reasons, losses from predation, parasitism, and disease among organisms exposed to sublethal stresses would be minor and would neither destabilize nor noticeably alter any important attribute of aquatic populations during the SLR term. The NRC staff concludes that the impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the Monticello SLR term would be SMALL.

3.7.3 No-Action Alternative

If Monticello were to cease operating, impacts on the aquatic environment would decrease or stop following reactor shutdown. Some withdrawal of water from the Mississippi River would continue during the shutdown period to provide cooling to spent fuel in the spent fuel pool until that fuel could be transferred to dry storage. The amount of water withdrawn for these purposes would be a small fraction of water withdrawals during operations, would decrease over time, and would likely end within the first several years following shutdown. The reduced demand for cooling water would substantially decrease the effects of impingement, entrainment, and thermal effluent on aquatic organisms, and these effects would entirely cease following the transfer of spent fuel to dry storage. A fish kill from cold shock might happen when the plant stops producing power and heated effluent, but this would be a one-time event that would not negatively impact the sustainability of local fish populations (see Section 3.7.2.4). The NRC staff concludes that the impacts of the no-action alternative on aquatic resources would be SMALL.

3.7.4 Replacement Power Alternatives: Common Impacts

This section describes the common impacts for all three replacement power alternatives described in Sections 3.7.5 through 3.7.7. The renewables (i.e., wind and solar), and battery storage would be built partially on the Monticello site and partially offsite. The small modular nuclear reactors would be built in a different State because Minnesota law (Minnesota Statute 216B.243, Subdivision 3b-TN9184) prohibits the construction and operation of new nuclear power plants. The new natural gas plant would likely be built in a different State because Minnesota law (MN Stat. 216B-TN9184) requires that a utility generate, procure sufficient electricity generated from a carbon-free energy technology, or purchase renewable energy credits equivalent to at least 100 percent of the electric utility’s total retail sales to retail customers in Minnesota by 2040.

Construction impacts for many components of all three replacement power alternatives would be generally similar. Construction could result in aquatic habitat loss, alteration, or fragmentation, disturbance and displacement of aquatic organisms, mortality of aquatic organisms, and increase in human access. For instance, construction-related chemical spills, runoff, and soil erosion could degrade water quality in aquatic environments by introducing pollutants and increasing sedimentation and turbidity. Dredging and other in-water work could directly remove or alter the aquatic environment and disturb or kill aquatic organisms. Because construction effects would be short-term, associated habitat degradation would be relatively localized and temporary. Effects could be minimized by the use of existing infrastructure, such as the existing transmission lines, roads, parking areas, and certain existing buildings and structures on the site. Aquatic habitat alteration and loss could be minimized by siting components of the alternatives farther from waterbodies and away from drainages and other aquatic features.

Operational impacts for the alternative would be qualitatively similar but would vary in intensity, based on each alternative’s water use and consumption. Natural gas plants are thermoelectric, which means that they need water to produce and cool the steam that drives the turbines. Small modular reactors also require water to produce steam, but use MDCTs to dissipate waste heat.

The NRC staff assumes cooling tower impacts, if applicable, would be similar to those of the proposed action. As discussed in Sections 3.7.2.1 and 3.7.2.3 the staff determined that the operations of the cooling towers would result in SMALL impacts on the aquatic environment.

Water quality permits required through Federal and State regulations would control, reduce, or mitigate potential effects on the aquatic environment. Through such permits, the permitting agencies could include conditions requiring Xcel Energy to follow BMPs or to take certain mitigation measures if adverse impacts are anticipated. For instance, USACE oversees Section 404 permitting for dredge and fill activities, and State water quality agencies (e.g., MPCA) oversees NPDES permitting and general stormwater permitting. Xcel Energy would likely be required to obtain each of these permits to construct a new replacement power alternative at the Monticello site or offsite locations. Notably, the EPA final rule under Phase I of the CWA Section 316(b) regulations applies to new facilities and sets standards to limit intake capacity and velocity to minimize impacts on fish and other aquatic organisms in the source water (40 CFR 125.84-TN254). Any new replacement power alternative subject to this rule would be required to comply with the associated technology standards. Water use conflicts would be unlikely because the States also issue water rights permits (e.g., MDNR's Surface Water Appropriation Permit) to comply with State and Federal Clean Water Act standards (e.g., to be protective of the aquatic and terrestrial environment).

3.7.5 Natural Gas and Renewables Alternative

This alternative would involve the construction and installation of a new 750 MW natural gas-fired, two-unit combustion turbine power plant built either onsite or offsite within Xcel Energy's ROI, 750 MW wind turbines located offsite, and 200 MW of solar panels located both on and offsite (Xcel 2023-TN9084). Existing natural gas-fired power plants operated by Xcel Energy would provide additional power generation.

The impacts of construction of new wind, solar, and natural gas of this alternative are discussed in the section that describes common impacts on all alternatives (Section 3.7.4). These effects would be SMALL to MODERATE, depending on the site(s) selected, the aquatic habitats present, and the extent to which construction would degrade, modify, or permanently alter those habitats.

The operation of the solar photovoltaic component would have no discernable effects on the aquatic environment. The operation of the wind turbines could produce leaks of hydraulic fluid, antifreeze, and grease, but the impacts would be SMALL since these leaks occur in relatively small amounts and managed by State permitting authorities (e.g., spill response and prevention plans). Impacts of operating a new natural gas power plant would be SMALL because the water withdrawals and discharges would be regulated under the Clean Water Act and applicable State regulations to ensure that impacts to the aquatic environmental are minimal. Impacts of the small amount of additional power generation from existing natural gas plants would be SMALL since the water withdrawals and discharges would be managed by the MPCA and MDNR permits or other State agencies if outside of Minnesota.

The NRC staff concludes that the impacts on aquatic resources for the natural gas and renewables alternative would be SMALL to MODERATE during construction and SMALL during operation. Impacts from the alternative would be managed and regulated by Federal and State water quality permits.

3.7.6 Renewables and Storage Alternative

This alternative would involve the construction and installation of 950 MW of wind turbines located offsite, 700 MW of solar panels located both on and offsite of Monticello, and 300 MW of lithium battery storage at solar offsite locations. This alternative would be supplemented by purchased power as needed, along with occasional additional power generation from existing natural gas-fired power plants operated by Xcel Energy.

The impacts of construction of new wind, solar, and battery storage components of this alternative are discussed in the section that describes common impacts on all alternatives (see Section 3.7.4). These effects would be SMALL to MODERATE, depending on the site(s) selected, the aquatic habitats present, and the extent to which construction would degrade, modify, or permanently alter those habitats.

The operation of the solar photovoltaic component would have no discernable effects on the aquatic environment. The operation of the wind turbines could produce leaks of hydraulic fluid, antifreeze, and grease, but the impacts would be SMALL since these leaks occur in relatively small amounts and managed by State permitting authorities (e.g., spill response and prevention plans). Impacts of operating the battery storage systems would be SMALL because these systems are regulated under the Resources Conservation Recovery Act (RCRA) and are stored in liquid-tight containment systems. Impacts of the small amount of additional power generation from existing natural gas plants would be SMALL since the water withdrawals and discharges would be managed by the MPCA and MDNR permits to minimize impacts on the aquatic environment.

The NRC staff concludes that the impacts on aquatic resources for the renewables and storage alternative would be SMALL to MODERATE during construction and SMALL during operation. Impacts from the alternative would be managed and regulated by Federal and State water quality permits.

3.7.7 New Nuclear (Small Modular Reactor) Alternative

This alternative would involve the construction of a 12-unit SMR power plant generating approximately 880 MWe power outside of Minnesota. The SMR units would use a closed-cycle cooling system using MDCTs. This alternative would require an estimated 740 gal/MWh of water from natural surface water sources. Total annual water consumption would be approximately 5.7 billion gallons (see Section 2.3.2.3).

The types of impacts that the aquatic environment would experience from this alternative would likely be similar to those described in the previous section discussing impacts common to all replacement power alternatives. However, the SMR power plant would be built outside of Minnesota and the existing Monticello infrastructure could not be used. The NRC staff concludes that these effects would be SMALL to MODERATE, depending on the site(s) selected, the aquatic habitats present, and the extent to which construction would degrade, modify, or permanently alter those habitats. Required Federal and State water quality permits would likely include conditions requiring BMPs and mitigation strategies to minimize environmental effects, but there is uncertainty as to where the SMR power plant will be built.

With respect to operation, Federal and State water quality permits would control and mitigate many of the potential effects on the aquatic environment, including water withdrawals and discharges, such that the associated effects would be unlikely to noticeably alter or destabilize any important attribute of the aquatic environment. The NRC staff finds that the impacts of operation of a new nuclear (SMR) alternative would be SMALL.

The NRC staff concludes that the impacts on aquatic resources from construction and operation of a new nuclear (SMR) alternative would be SMALL to MODERATE.

3.8 Federally Protected Ecological Resources

The NRC must consider the effects of its actions on the ecological resources protected under several Federal statutes and must consult with the FWS or the National Oceanic and Atmospheric Administration prior to acting in cases where an agency action may affect those resources. These statutes include the following:

- ESA (16 U.S.C. § 1531 et seq.) (TN1010)
- MSA (16 U.S.C. § 1801 et seq.) (TN1061)
- National Marine Sanctuaries Act (NMSA) (16 U.S.C. § 1431 et seq.) (TN4482)

This section describes the species and habitats that are federally protected under these statutes and analyzes how the proposed LR and alternatives may affect these resources.

3.8.1 Endangered Species Act

Congress enacted the ESA in 1973 to protect and recover imperiled species and the ecosystems upon which they depend. The ESA provides a program for the conservation of endangered and threatened plants and animals (collectively, “listed species”) and the habitats in which they are found. The FWS and National Marine Fisheries Service (NMFS) are the lead Federal agencies for implementing the ESA, and these agencies determine the species that warrant listing. The following sections describe the Monticello action area and the species and habitats that may occur in the action area under each of the Services’ jurisdictions.

3.8.1.1 Endangered Species Act: Action Area

The implementing regulations for Section 7(a)(2) of the ESA define “action area” as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR Part 402-TN4312). The action area effectively bounds the analysis of federally listed species and critical habitats because only species and habitats that occur within the action area may be affected by the Federal action.

For the purposes of assessing the potential impacts of the proposed Monticello SLR, the NRC staff considers the action area to consist of the following:

Monticello Site: The terrestrial region of the action area consists of 2,051 ac (830 ha) within the Monticello site in Wright and Sherburne Counties, Minnesota (Xcel 2023-TN9084: Table 3.2-1). The site is situated on both sides of the Mississippi River, with most of the site on the south side of the Mississippi River in Wright County. It includes developed land supporting nuclear power plant operations (216 ac [87 ha]), deciduous forest (715 ac [289 ha]), evergreen forest (17 ac [7 ha]), mixed forest (3 ac [1 ha]), shrub/scrub (8 ac [3 ha]), woody wetlands (90 ac [36 ha]), emergent herbaceous wetlands (46 ac [18 ha]), and cultivated lands (640 ac [259 ha]). Sections 3.2 and 3.6 of this EIS describe the developed and natural features of the site and the characteristic vegetation and habitats.

Mississippi River: The aquatic region of the action area encompasses the regions of the Mississippi River affected by cooling water withdrawals and discharges. This includes the hydraulic zone of influence (HZI), which is the portion of the source waterbody that is hydraulically affected by water withdrawal by the cooling water intake structure, and the area of the Mississippi River that experiences increased temperatures from the discharge of heated effluent. These regions are described in more detail in Section 3.7.1.1 of this EIS.

The NRC staff recognizes that, although the described action area is stationary, federally listed species can move in and out of the action area. For instance, a migratory bird could occur in the action area seasonally as it forages or breeds within the action area. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area but those species that may passively or actively move into the action area. The NRC staff then considers whether the life history and habitat requirements of each species make it likely to occur in the action area where it could be affected by the proposed SLR. The following sections first discuss the listed species and critical habitats under FWS jurisdiction, followed by those under NMFS jurisdiction.

3.8.1.2 Endangered Species Act: Federally Listed Species and Critical Habitats under U.S. Fish and Wildlife Service Jurisdiction

This section evaluates seven species that may be present in the action area. The NRC staff determined these species to be relevant to this review based on an analysis of the Monticello action area, available scientific literature and studies, the results of past ESA Section 7 consultations in connection with the Monticello site, and an official species list generated by the FWS's Information for Planning and Conservation (IPaC; FWS 2023-TN9083). No designated or proposed critical habitat occurs in the action area. Table 3-18 lists each of these species and its Federal status.

Table 3-18 Federally Listed Species under U.S. Fish and Wildlife Jurisdiction Evaluated for Monticello Nuclear Generating Plant Subsequent License Renewal

Common Name	Species	Federal Status[(a)]
northern long-eared bat	*Myotis septentrionalis*	FE
tricolored bat	*Perimyotis subflavus*	FPE
whooping crane	*Grus americana*	FE (NEP)
monarch butterfly	*Danaus plexippus*	FC
Higgins' eye pearlymussel	*Lampsilis higginsii*	FE
gray wolf	*Canis lupus*	FT
rusty patched bumble bee	*Bombus affinis*	FE

(a) Indicates protection status under the Endangered Species Act. FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; NEP = in the vicinity of the action area, this species is part of a nonessential experimental population.

During the NRC staff's environmental review for the initial Monticello LR (NRC 2006-TN7315: Section 4.6), the staff evaluated the effects of Monticello operations on three federally listed species: the Higgins' eye pearlymussel (*Lampsilis higginsii*), the gray wolf (*Canis lupus*), and the bald eagle. In 2005, the NRC (2005-TN9649) prepared a biological assessment for these species and submitted it to the FWS for concurrence. In its assessment, the staff concluded that Monticello operations during the initial LR period would have no effect on the Higgins' eye pearlymussel or gray wolf. During the initial LR review, the NRC submitted a biological assessment to the FWS to document its "no effect" findings (NRC 2005-TN9649: Appendix E).

The staff based its finding for the Higgins' eye pearlymussel on the facts that (1) the nearest known location of the species is too far downstream of Monticello to be affected by its operations; (2) Monticello thermal discharges are monitored and regulated by the MPCA through the NPDES program to be protective of aquatic biota, which includes fish species that can serve as hosts for mussel glochidia; and (3) no operational changes were planned for the initial LR term. The NRC staff based its finding for the gray wolf on the facts that (1) the species does not occur on the Monticello site or associated transmission lines, (2) no direct land-disturbing activities would occur as part of the initial LR, and (3) plant operations and vegetation maintenance practices on site and within transmission corridors would not be detrimental to the species. The NRC concluded that initial LR was not likely to adversely affect the bald eagle based on the facts that (1) Xcel Energy would follow the MDNR Management Guidelines for Bald Eagle Breeding Areas; (2) the potential for disturbance during nesting/breeding, either from the Monticello site activities or from ROW maintenance, was highly unlikely; and (3) the potential for bald eagle electrocutions and collisions is also highly unlikely. The FWS concurred with the NRC's "not likely to adversely affect" finding for the bald eagle in 2006 (DOI 2006-TN9678). While the bald eagle continues to occur in the area, the FWS has delisted this species from Federal protection under the ESA. The bald eagle remains federally protected under the Bald and Golden Eagle Protection Act, which is discussed in Section 3.6.3.3 of this EIS.

In the SLR ER, Xcel Energy evaluated whether rusty patched bumble bee (*Bombus affinis*), which is federally listed as endangered, could occur within the vicinity of the Monticello site (Xcel 2023-TN9084: Section 3.7.8.1.3). According to the FWS model habitat (ESRI 2023-TN9651), the Monticello site and surrounding area are unlikely to support the rusty patched bumble bee. Moreover, the rusty patched bumble bee is not identified as occurring in the action area on the FWS's IPaC official species list (FWS 2023-TN9083)." Therefore, the NRC staff does not consider this species in this EIS.

Based on the NRC staff's analysis of the federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction the NRC staff finds that the northern long-eared bat (*Myotis septentrionalis*), tricolored bat (*Perimyotis subflavus*), whooping crane (*Grus americana*), and monarch butterfly (*Danaus plexippus*) warrant further consideration to determine if they may occur in the action area. These species are discussed in detail below.

<u>Northern Long-Eared Bat</u>

The FWS listed the northern long-eared bat as threatened throughout its range in 2015 (80 FR 17974-TN4216). In 2016, FWS determined that designating critical habitat for the species was not prudent because such a designation would increase threats to the species resulting from vandalism and disturbances and could potentially increase the spread of white-nose syndrome (81 FR 24707-TN8388). In 2022, the FWS reclassified this species as endangered with an effective date of January 30, 2023 (87 FR 73488-TN8545). Information in this section is organized according to the description of the species in the FWS *Federal Register* notice associated with the final rule to list the species (80 FR 17974-TN4216) and draws from this source unless otherwise indicated.

Although there have been few genetic studies on the northern long-eared bat, FWS describes it as a monotypic species (i.e., having no subspecies). This species has been recognized by different common names including Keen's bat, northern Myotis, and the northern bat. The northern long-eared bat is a medium-sized bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. Adults weigh 5–8 g (0.2–0.3 oz), and females tend to be slightly larger than males. Individuals are medium to dark brown on the back, dark brown on the ears and wing membranes, and tawny to pale brown on the ventral side. Within its range, the northern long-eared bat can be confused with the little brown bat or the western long-eared myotis (*M. evotis*).

The northern long-eared bat is found across much of the eastern and north-central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. Its range includes 37 U.S. states.

Northern long-eared bats predominantly overwinter in hibernacula of various sizes that include underground caves and abandoned mines. Preferred hibernacula have relatively constant, cool temperatures with very high humidity and no air currents. Individuals most often roost in small crevices or cracks in cave or mine walls or ceilings but are also infrequently observed hanging in the open. Less commonly, northern long-eared bats overwinter in abandoned railroad tunnels, storm sewers, aqueducts, attics, and other noncave or nonmine hibernacula with temperature, humidity, and air flow conditions resembling suitable caves and mines.

In summer, northern long-eared bats typically roost individually or in colonies underneath bark or in cavities or crevices of both live trees and snags. Males and nonreproductive females may also roost in cooler locations including caves and mines. Individuals have also been observed roosting in colonies in barns and other buildings, on utility poles, and in other human-made structures. The species has been documented to roost in many species of trees, including black oak (*Quercus velutina*), northern red oak (*Q. rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*A. saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*). Foster and Kurta (1999-TN8499) found that, rather than being dependent on particular tree species, northern long-eared bats are likely to use a variety of trees as long as they form suitable cavities or retain bark. Owen et al. (TN8500) found that tree-roosting maternal colonies chose roosting sites in larger trees that were taller than the surrounding stand and in areas with abundant snags. Carter and Feldhamer (TN8501) indicate that resource availability drives roost tree selection more than the actual tree species. However, several studies have shown that the species more often roosts in shade-tolerant deciduous trees than in conifers. Additionally, the FWS concludes in its final listing that the tendency for northern long-eared bats to use healthy live trees for roosting is low.

Northern long-eared bats actively form colonies in the summer, but such colonies are often in flux because members will frequently depart to be solitary or to form smaller groups and later return to the main unit. This behavior is described as “fission–fusion,” and it also results in individuals often switching tree roosts (typically every 2–3 days). Roost trees are often near each other within the species’ summer range, with various studies documenting distances between roost trees ranging from 20 ft (6.1 m) to 2.4 mi (3.9 km).

Spring staging is the period between winter hibernation and spring migration to summer habitat when bats begin to gradually emerge from hibernation. Individuals will exit the hibernacula to feed but reenter the same or alternative hibernacula to resume periods of physical inactivity. The spring staging period is believed to be short for the northern long-eared bat and may last from mid-March through early May, with variations in timing and duration based on latitude and weather.

Fall swarming is the period between the summer and winter seasons and includes behaviors such as copulation, introduction of juveniles to hibernacula, and stopovers at sites between summer and winter regions. Both males and females are present together at swarming sites, and other bat species are often present as well. For northern long-eared bats, the swarming period may occur between July and early October, depending on the latitude within the species' range. Northern long-eared bats may use caves and mines during swarming. Little is known about roost tree selection during this period, but some studies suggest that a wider variation in tree selection may occur during swarming than during the summer.

Northern long-eared bats roost in cavities, crevices, and hollows or under the bark of live and dead trees and snags greater than 3 in. (8 cm) in diameter at breast height. Isolated trees may be considered suitable habitats when they exhibit these characteristics and are less than 1,000 ft (300 m) from the next nearest suitable roost tree within a wooded area. Northern long-eared bats appear to choose roost trees based on structural suitability rather than exhibiting a preference for specific species of trees.

Northern long-eared bats hibernate during winter months. Individuals arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from hibernacula in March or April. The species has shown a high degree of repeated hibernaculum use, although individuals may not return to the same hibernacula in successive seasons. Northern long-eared bats often inhabit hibernacula in small numbers with other bat species including little brown bats, big brown bats (*Eptesicus fuscus*), eastern small-footed bats (*Myotis leibii*), tricolored bats (*Perimyotis subflavus*), and Indiana bats (*M. sodalis*). Northern long-eared bats have been observed moving among hibernacula during the winter hibernation period, but individuals do not feed during this time. The function of this behavior is not well understood.

Northern long-eared bats migrate relatively short distances (between 56 and 89 km [35 and 55 mi]) from summer roosts and winter hibernacula. The spring migration period typically occurs from mid-March to mid-May, and fall migration typically occurs between mid-August and mid-October.

Northern long-eared bats mate from late July in northern regions to early October in southern regions. Hibernating females store sperm until spring, and ovulation takes place when females emerge from hibernacula. Gestation is estimated to be 60 days, after which time females give birth to a single pup in late May or early June. Females raise their young in maternity colonies, which generally consist of 30–60 individuals (females and young). Roost tree selection changes depending on the reproductive stage, with lactating females roosting higher in tall trees with less canopy cover. Young are capable of flight as early as 3 weeks following birth. Maximum lifespan for northern long-eared bats is estimated to be up to 18.5 years, and the highest rate of mortality occurs during the juvenile stage.

Northern long-eared bats are nocturnal foragers that use hawking and gleaning in conjunction with passive acoustic cues to collect prey. The species' diet includes moths, flies, leafhoppers, caddisflies, beetles, and arachnids. Individuals forage 1–3 m (3–10 ft) above the ground between the understory and canopy of forested hillsides and ridges, with peak foraging activity occurring within 5 hours after sunset.

Northern long-eared bats exhibit site fidelity to their summer home range, during which time individuals roost and forage in forests. Studies indicate a variety of home range sizes—from as little as 8.6 ha (21.3 ac) to as large as 172 ha (425 ac). Some studies indicate differences in ranges between sexes, while others find no significant differences.

Factors Affecting the Species

FWS identifies white-nose syndrome, a disease caused by the fungus *Pseudogymnoascus destructans*, to be the predominant threat to the northern long-eared bat's continued existence. Other factors include human disturbances of hibernacula and loss of summer habitat due to forest conversion and forest management.

Occurrence within the Action Area

FWS (FWS 2023-TN9083) identified the northern long-eared bat as potentially occurring in the action area in the IPaC report for the proposed action. Within Minnesota, the species is found throughout the State in the summer months. Xcel Energy reports no known occurrences of northern long-eared bats on the Monticello site. However, Xcel Energy has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat.

Based on the above information, the NRC staff conservatively assumes that the deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.1.1 of this EIS.

<u>Tricolored Bat</u>

The FWS issued a proposed rule to list the tricolored bat as endangered in 2022 (87 FR 56381-TN8546-TN8546). The FWS proposed no critical habitat with the rule because it found that such a designation could increase the degree of threat to the species. The information in this section is drawn from the FWS's species status assessment (FWS 2021-TN8589) unless otherwise cited.

The tricolored bat is a small insectivorous bat that can be distinguished by its unique tricolored fur, which often appears yellowish to orange. The species occurs across 39 states in the eastern and central United States and in portions of southern Canada, Mexico, and Central America. During the winter, tricolored bats often inhabit caves and abandoned mines. In the southern United States, where caves are sparse, tricolored bats also roost in road culverts where they exhibit shorter hibernation bouts and may leave hibernacula to forage during warm nights. Tricolored bats hibernate singly, but sometimes in pairs or in small clusters of both sexes away from other bats. Between mid-August and mid-October, males and females converge at cave and mine entrances to swarm and mate, and females typically give birth to two young between May and July.

Tricolored bats disperse from winter hibernacula to a summer roosting habitat in the spring. Tracking studies have recorded migration paths that span from 27 mi (44 km) to 151 mi (243 km). During the spring, summer, and fall, tricolored bats occupy forested habitats. Individuals roost among leaves of live or recently dead deciduous hardwood trees, but individuals may also roost in pines (*Pinus* spp.), eastern red cedar (*Juniperus virginiana*), Spanish moss (*Tillandsia usneoides*), *Usnea trichodea* lichen, and occasionally human structures. Tricolored bats are opportunistic feeders and consume small insects including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera).

Factors Affecting the Species

Tricolored bats face extinction primarily due to the range-wide impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats. The FWS estimates that white-nose syndrome has caused population declines of 90 percent or more in affected tricolored bat colonies across most of the species' range.

Occurrence within the Action Area

The FWS (FWS 2023-TN9083) identified the tricolored bat as potentially occurring in the action area in the IPaC report for the proposed action. Within Minnesota, the species is found throughout the State in the summer months. Xcel Energy reports no occurrences of tricolored bats on the Monticello site. However, Xcel Energy has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitats.

Based on the above information, the NRC staff conservatively assumes that the deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.1.1 of this EIS.

<u>Whooping Crane</u>

FWS listed the whooping crane as endangered wherever found in 1967 on the original endangered species list under the Endangered Species Preservation Act of 1966 prior to the ESA's promulgation (32 FR 4001-TN2750). The FWS lists the population of whooping crane whose range overlaps with the Monticello site as an experimental, nonessential population not necessary for the continued species existence (66 FR 33903-TN9652). Experimental populations are treated as threatened under the ESA, regardless of the species' designation elsewhere; however, for purposes of ESA consultation, the FWS considers experimental populations as proposed for listing such that the bar for consultation is higher than that for listed species (FWS 2018-TN9653). Information in this section is drawn from the FWS's species profile (FWS 2023-TN8854) unless otherwise cited.

The whooping crane is North America's tallest bird. It is a large snowy white wading bird with black markings on the face. Whooping cranes currently exist in the wild at three locations and in captivity at 12 sites. There is only one self-sustaining wild population, the Aransas–Wood Buffalo National Park population, which nests in Wood Buffalo National Park and adjacent areas in Canada and winters in the coastal marshes of Aransas County, Texas. Migrations occur from March through April in the spring and from October through November in the fall (FWS 2018-TN5743). Migrants travel during the day along narrow corridors in small groups under limited cloud cover, tail winds, and otherwise favorable conditions. At night, whooping cranes roost in palustrine and riverine wetlands. The species typically selects stopover sites with wide, open views that are isolated from human disturbance (NGPC 2023-TN8876). In a 2009–2015 study of nocturnal roost and diurnal sites used by migrating whooping cranes, Pearse et al. (TN8855) determined that cranes selected roosts in emergent wetlands (50 percent), lacustrine wetlands (25 percent), riverbanks (20 percent), and dryland sites (5 percent). Migrants selected day-use sites in drylands (54 percent), wetlands (45 percent), and riverbanks (1 percent). Whooping cranes tend to stop wherever they happen to be later in the day when conditions are no longer suitable for migration such that stopover use patterns are often very unpredictable (FWS 2009-TN8856). Thus, whooping cranes could use a particular wetland pond regularly, rarely, or even just once over the course of several years of migrations.

Factors Affecting the Species

Direct mortality from hunting and wetland habitat destruction during agricultural development are two primary drivers of whooping crane population declines. Historically, more than 10,000 whooping cranes once populated North America. All whooping cranes alive today have come from the all-time low of 15 whooping cranes that were wintering at Aransas National Wildlife Refuge in Austwell, Texas in 1941 (FWS 2023-TN8857).

Occurrence within the Action Area

The FWS identified the whooping crane as potentially occurring in the action area in the IPaC report (FWS 2023-TN9083) for the proposed action. Xcel Energy reports no known occurrences of whooping cranes on the Monticello site (Xcel 2023-TN9578: Enclosure 28). However, Xcel Energy has conducted no ecological surveys to specifically assess the species' presence or the suitability of an onsite habitat.

Because occurrences of whooping cranes are known within 15 mi (24 km) of the site (CLO 2023-TN9654) and because the site contains multiple wetland types and riverbanks, the site may provide a suitable roosting habitat and stopover habitat. The NRC staff conservatively assumes that whooping cranes may occur on site. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.1.2 of this DEIS.

<u>Monarch Butterfly</u>

The monarch butterfly is a candidate for Federal listing. In 2020, the FWS issued a 12-month finding announcing its intent to prepare a proposed rule to list the monarch butterfly as threatened (85 FR 81813-TN8590). In 2022, the FWS identified the monarch butterfly listing action as a priority because the magnitude of threats is moderate to low; however, these threats are imminent for the eastern and western North American populations. Although the ESA does not require consultation for candidates, the NRC staff considers this species here at the recommendation of the FWS (FWS 2023-TN9083) in its IPaC report for the proposed project. The information in this section is drawn from the FWS's candidate review unless otherwise cited (87 FR 26152-TN8591).

The monarch is a large butterfly with bright orange wings and black veining and borders. During the breeding season, females lay eggs on milkweed (primarily *Asclepias* spp.). Developing larvae feed on milkweed, which allows them to sequester toxic chemicals as a defense against predators, before pupating into a chrysalis to transform into the adult butterfly form. Monarchs produce multiple generations each breeding season, and most adult butterflies live 2–5 weeks. Overwintering adults, however, enter reproductive diapause and live 6–9 months.

Monarch butterflies occur in 90 countries, islands, or island groups. Monarch butterflies have become naturalized at most of these locations outside North America since 1840. The populations outside eastern and western North America (including southern Florida) do not exhibit long-distance migratory behavior. In many regions, monarchs breed year-round. In temperate climates such as eastern and western North America, monarchs migrate long distances and live for an extended period. In both eastern and western North America, monarchs begin migrating in the fall to their respective overwintering sites in the forests of California and Mexico. These overwintering sites provide protection from the elements and moderate temperatures as well as nectar and clean water sources located nearby. Migration distances can be greater than 1,900 mi (3,000 km) and span a 2-month period. In early spring

(February–March), surviving monarchs break diapause and mate at overwintering sites before dispersing. The same individuals that undertook the initial southward migration begin flying back through the breeding grounds, and their offspring restart the cycle of generational migration.

Factors Affecting the Species

The primary threats to the monarch's biological status include loss and degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, forest and tree senescence, and incompatible management of overwintering sites in California, urban development, drought, exposure to insecticides, and effects of climate change.

Occurrence within the Action Area

Monarchs are associated with prairie, meadow, and grassland habitats. Within Minnesota, 15 native species of milkweed provide a habitat for the development of monarch eggs and larvae (iNaturalist 2023-TN9655). Along publicly accessible roads directly adjacent to the site, three milkweed species are known to occur (iNaturalist 2023-TN9655): poke milkweed (*Asclepias exaltata*), common milkweed (*A. syriaca*), and swamp milkweed (*A. incarnata)*.

Xcel Energy reports no known occurrences of monarch butterfly on the Monticello site (Xcel 2023-TN9084: Section 3.7.8.1.2). However, Xcel Energy has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat. Given the proximity of known milkweed occurrences adjacent to the site, the NRC staff conservatively assumes that milkweeds could occur on site and that the site may provide a larval habitat. If milkweeds are not present, monarchs could occur in the action area during spring and fall migration when individuals are moving between areas of more suitable habitat. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.1.3 of this EIS.

<u>Summary of Potential Species Occurrences in the Action Area</u>

Table 3-19 summarizes the likelihood of each species discussed in this section to occur in the action area. Based on the NRC staff's analysis, four species have the potential to occur within the action area. No proposed or designated critical habitat occurs within the action area.

3.8.1.3 Endangered Species Act: Federally Listed Species and Critical Habitats Under NMFS Jurisdiction

No federally listed species or designated critical habitats under NMFS jurisdiction occur in the action area. Therefore, this EIS does not discuss any such species or habitats.

3.8.2 Magnuson–Stevens Act: Essential Fish Habitat

Congress enacted the MSA in 1976 to foster the long-term biological and economic sustainability of the Nation's marine fisheries (TN7841). The MSA directs the Fishery Management Councils, in conjunction with NMFS, to designate areas of essential fish habitat (EFH) and to manage marine resources within those areas. EFH is the coastal and marine waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity (50 CFR Part 600-TN1342). For each federally managed species, the Fishery Management Councils and NMFS designate and describe EFH by life stage (i.e., egg, larva, juvenile, and adult).

Table 3-19 Summary of the Potential for Federally Listed Species under the Jurisdiction of the U.S. Fish and Wildlife Service to Occur within the Action Area

Common Name	Type and Likelihood of Occurrence in the Action Area
northern long-eared bat	Seasonal presence in spring, summer, and fall possible in very low numbers in action area forests of sufficient size to support foraging, mating, and sheltering.
tricolored bat	Presence possible in spring, summer, and fall in the deciduous forest habitat within the action area.
whooping crane	Occasional occurrence in very low numbers for foraging and sheltering.
monarch butterfly	Larval habitat may be present if milkweeds are present. Otherwise, occasional transitory presence when moving between areas of more suitable habitat.
Higgins’ eye pearlymussel	Not present.
gray wolf	Not present.
rusty patch bumble bee	Not present.

No coastal or marine waters occur near Monticello. Therefore, this EIS does not discuss EFH.

3.8.3 National Marine Sanctuaries Act: Sanctuary Resources

Congress enacted the NMSA in 1972 to protect areas of the marine environment that have special national significance. The NMSA authorizes the Secretary of Commerce to establish the National Marine Sanctuary System and designate sanctuaries within that system, which includes 15 sanctuaries and 2 marine national monuments, encompassing more than 600,000 mi^2 of marine and Great Lakes waters from Washington State to the Florida Keys and from Lake Huron to American Samoa. Within these areas, sanctuary resources include any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary.

No coastal or marine waters or Great Lakes occur near Monticello. Therefore, this EIS does not discuss national marine sanctuaries or their resources.

3.8.4 Proposed Action

The following sections address the site-specific environmental impacts of the proposed Monticello SLR on the environmental issues identified in Table 3-1 that relate to federally protected ecological resources.

3.8.4.1 Endangered Species Act: Federally Listed Species and Critical Habitats under U.S. Fish and Wildlife Service Jurisdiction

In Section 3.8.1.2, the NRC staff determined that two federally listed species, the northern long-eared bat and whooping crane, may occur in the action area. Additionally, the tricolored bat, which the FWS has proposed for Federal listing as endangered, and the monarch butterfly, which is a candidate for Federal listing, may occur in the action area. Section 3.8.1 includes the relevant information about the habitat requirements, life history, and regional occurrence of these species. In the sections below, the NRC staff analyzes the potential impacts of the proposed Monticello SLR on these four species. Table 3-20 summarizes the NRC staff's ESA effect determinations that resulted from the staff's analysis.

Table 3-20 Effect Determinations for Federally Listed Species under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]
northern long-eared bat	FE	Yes	NLAA
tricolored bat	FPE	Yes	NLAA
whooping crane	FE (NEP)	Yes	NLAA
monarch butterfly	FC	Yes	NLAA
Higgins' eye pearlymussel	FE	No	NE
gray wolf	FT	No	NE
rusty patched bumble bee	FE	No	NE

FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; NE = no effect; NEP = in the vicinity of the action area, this species is part of a nonessential experimental population; NLAA = may affect but is not likely to adversely affect.

(a) Indicates protection status under the Endangered Species Act.

(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the FWS and NMFS Endangered Species Consultation Handbook (FWS and NMFS 1998-TN1031).

In Section 3.8.1.2, the NRC staff describes several additional federally listed species. The staff explains that these species do not occur in the action area; therefore, the staff does not address these species any further because SLR would have no effect on them. Table 3-20 identifies these species and the NRC's staff's "no effect" findings.

3.8.4.1.1 Northern Long-eared Bat and Tricolored Bat

In Section 3.8.1 of this EIS, the NRC staff concludes that northern long-eared bat and tricolored bat may occur in the action area's forests in spring, summer, and fall. If present, these bats would occur rarely and in low numbers.

The potential stressors that northern long-eared and tricolored bats could experience from the operation of a nuclear power plant (generically) are as follows:

- mortality or injury from collisions with nuclear power plant structures and vehicles
- habitat loss, degradation, disturbance, or fragmentation; and associated effects
- behavioral changes resulting from refurbishment or other site activities

This section addresses each of these stressors below.

Mortality or Injury from Collisions with Nuclear Power Plant Structures and Vehicles

Several studies have documented bat mortality or injury resulting from collisions with human-made structures. Saunders (1930-TN8504) reported that five bats of three species—eastern red bat, hoary bat (*L. cinereus*), and silver-haired bat—were killed when they collided with a lighthouse in Ontario, Canada. In Kansas, Van Gelder (1956-TN8505) documented five eastern red bats that collided with a television tower. In Florida, Crawford and Baker (1981-TN8506) collected 54 bats of seven species that collided with a television tower over a 25 year period, Zinn and Baker (1979-TN8507) reported 12 dead hoary bats at another television tower over an 18-year period, and Taylor and Anderson (1973-TN8508) reported 1 dead yellow bat (*Lasiurus intermedius*) at a third Florida television tower. Bat collisions with communications towers have been reported in North Dakota, Tennessee, and Saskatchewan, Canada; with convention center windows in Chicago, IL; and with power lines, barbed wire fences, and vehicles in numerous locations (Johnson and Strickland 2003-TN8509).

More recently, bat collisions with wind turbines have been of concern in North America. Bat fatalities have been documented at most wind facilities throughout the United States and Canada (USGS 2016-TN8510). For instance, during a 1996–1999 study at the Buffalo Ridge wind power development project in Minnesota, Johnson et al. (TN8511) reported 183 bat fatalities, most of which were hoary bats and eastern red bats. The USGS Fort Collins Science Center estimates that tens to hundreds of thousands of bats die at wind turbines in North America each year (USGS 2016-TN8510).

Bat collisions with human-made structures at nuclear power plants are not well documented but are likely rare based on available information. In an assessment of the potential effects of the operation of the Davis-Besse Nuclear Power Station in Ohio, the NRC staff (NRC 2014-TN7385) noted that four dead bats were collected at the nuclear power plant during bird mortality studies conducted from 1972 through 1979. Two red bats (*Lasiurus borealis*) were collected at the cooling tower, and one big brown bat and one tricolored bat were collected near other nuclear power plant structures. The NRC staff (NRC 2014-TN7385) found that future collisions of bats would be extremely unlikely and, therefore, discountable, given the small number of bats collected during the study and the marginal suitable habitat that the nuclear power plant site provides. The FWS (FWS 2014-TN7605) concurred with this determination. In a 2015 assessment associated with Indian Point Nuclear Generating Units 2 and 3 in New York, the NRC staff (NRC 2015-TN7382) determined that bat collisions were less likely to occur at Indian Point than at Davis-Besse because Indian Point does not have cooling towers or similarly large obstructions. The tallest structures on the Indian Point site are 134 ft (40.8 m)-tall turbine buildings and 250 ft (76.2 m)-tall reactor containment structures. The NRC staff (NRC 2015-TN7382) concluded that the likelihood of bats colliding with these and other nuclear power plant structures on the Indian Point site during the LR period was extremely unlikely to occur and, therefore, discountable. FWS concurred with this determination (FWS 2015-TN7612). In 2018, the NRC staff (NRC 2018-TN7381) determined that the likelihood of bats colliding with site buildings or structures on the Seabrook Station, Unit 1, site in New Hampshire would be extremely unlikely. The tallest structures on that site are the 199 ft (61 m)-tall containment structure and the 103 ft (31 m)-tall turbine and heater bay building. The FWS (FWS 2018-TN7610) concurred with the NRC staff's determination. Since that time, the FWS has concurred with similar findings for initial and subsequent license renewals at multiple other nuclear power plant sites, including Surry Power Station, Units 1 and 2, in Surry, VA (FWS 2019-TN7609); Peach Bottom Atomic Power Station, Units 2 and 3, in Delta, PA (FWS 2019-TN9742); Point Beach Nuclear Plant, Units 1 and 2, in Two Rivers, WI (FWS 2021-TN9740); North Anna Power Station, Units 1 and 2, in Louisa, VA (FWS 2023-TN9093); and Perry Nuclear Power Plant, Unit 1, in Perry, OH (FWS 2023-TN9741), among others.

The tallest structures on the Monticello site are the off-gas stack and the primary MET, both of which are 328 ft (100 m) above ground level (Xcel 2023-TN9084: ER Sections 2.2.4 and 3.2.3). The turbine buildings and transmission lines are also prominent features on the site. To date, Xcel Energy has reported no incidents of injury or mortality of any species of bat on the Monticello site associated with site buildings or structures. Accordingly, the NRC staff finds the likelihood of future northern long-eared bat collisions with site buildings or structures to be extremely unlikely and, therefore, discountable.

Vehicle collision risk for bats varies depending on factors including time of year, location of roads and travel pathways in relation to roosting and foraging areas, the characteristics of individuals' flight, traffic volume, and whether young bats are dispersing. Although collision has been documented for several species of bats, the Indiana Bat Draft Recovery Plan (FWS 2007-TN934) indicates that bat species do not seem to be particularly susceptible to vehicle collisions. However, the FWS also finds it difficult to determine whether roads pose a greater risk for bats colliding with vehicles or a greater likelihood of decreasing risk of collision by deterring bat activity (FWS 2016-TN7400). In most cases, the FWS expects that roads of increasing size decrease the likelihood of bats crossing the roads and, therefore, reduce collision risk (FWS 2016-TN7400).

During the proposed Monticello SLR term, vehicular traffic from truck deliveries, site maintenance activities, and personnel commuting to and from the site would continue throughout the LR period as they have during the current licensing period. Vehicle use would occur primarily in areas that bats would be less likely to frequent, such as along established county and State roads or within industrial-use areas of the Monticello site. Additionally, most vehicle activity would occur during daylight hours when bats are less active. To date, Xcel Energy has reported no incidents of injury or mortality of any species of bat on the Monticello site associated with vehicle collisions. Accordingly, the NRC staff finds the likelihood of future northern long-eared or tricolored bat collisions with vehicles to be extremely unlikely and, therefore, is not considered further.

Habitat Loss, Degradation, Disturbance, or Fragmentation, and Associated Effects

As previously discussed in this EIS, the Monticello action area includes a forested habitat that protected bats may rarely to occasionally inhabit in spring, summer, and fall. In its final rule listing the northern long-eared bat (80 FR 17974-TN4216), the FWS stated that forest conversion and forest modification from management are two of the most common causes of habitat loss, degradation, disturbance, or fragmentation affecting the species. Forest conversion is the loss of forest to another land-use type, such as cropland, residential, or industrial. This can lead to loss of a suitable habitat, fragmentation of remaining habitat patches, and elimination of travel corridors (80 FR 17974-TN4216). Forest management practices maintain forest habitat at the landscape level, but they involve practices that can have direct and indirect effects on bats. Impacts from forest management are typically temporary in nature and can include positive, neutral, and negative impacts.

The proposed action would not involve forest conversion or management and would generally not disturb the existing forested habitat on the site. Xcel Energy states that it would continue to perform vegetation maintenance on the site over the course of the proposed SLR term. Most maintenance would be of grassy, mowed areas between buildings and along walkways within the industrial portion of the site or on adjacent hillsides. Xcel Energy would continue to maintain onsite transmission line ROWs in accordance with North American Electric Reliability Corporation standards. Less-developed areas and forested areas would be largely unaffected. Xcel Energy does not intend to expand the existing facilities or otherwise perform construction or maintenance activities within these areas (Xcel 2023-TN9084: ER Sections 2.3 and 3.7.2.6). Site personnel may occasionally remove select trees around the margins of existing forested areas if those trees are deemed hazardous to buildings, infrastructure, or other site facilities or to existing overhead clearances. Negative impacts on bats could result if such trees are potential roost trees. Bats could also be directly injured during tree clearing. However, tree removal would be infrequent, and Xcel Energy personnel would follow company guidance to minimize potential impacts on bats.

The NRC staff finds that infrequent to rare hazardous tree removal in forested areas during the proposed SLR term would not measurably affect any potential bat habitat in the action area. Direct injury or mortality to bats during tree removal is also unlikely because Xcel Energy company guidance would ensure that personnel take the appropriate measures to avoid this potential impact. For instance, Xcel Energy could avoid this impact by removing hazardous trees in the winter when bats are unlikely to be present on the site. Additionally, the continued preservation of the existing forested areas on the site during the Monticello SLR term would result in positive impacts on tricolored or long-eared bats if they are present within or near the action area.

Behavioral Changes Resulting from Refurbishment or Other Site Activities

Construction or refurbishment and other site activities, including site maintenance and infrastructure repairs, could prompt behavioral changes in bats. Noise, vibration, and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities (FWS 2016-TN7400). At low noise levels or farther distances, bats initially may be startled but would likely habituate to the low background noise levels. At closer range and louder noise levels, particularly if accompanied by physical vibrations from heavy machinery, many bats would likely be startled to the point of fleeing from their daytime roosts. Fleeing individuals could experience increased susceptibility to predation and would expend increased levels of energy, which could result in decreased reproductive fitness (FWS 2016-TN7400, Table 4-1). Increased noise may also affect foraging success. Schaub et al. (2008) found that the foraging success of the greater mouse-eared bat (*Myotis myotis*) diminished in areas with noise mimicking the traffic sounds that would be experienced within 15 m (49 ft) of a highway.

Within the Monticello action area, noise, vibration, and other human disturbances could dissuade bats from using the action area’s forested habitat during migration, which could also reduce the fitness of migrating bats. However, bats that use the action area have likely become habituated to such disturbances because Monticello has been consistently operating for several decades. According to the FWS, bats that are repeatedly exposed to predictable, loud noises may habituate to such stimuli over time (FWS 2010-TN8537). For instance, Indiana bats have been documented as roosting within approximately 1,000 ft (300 m) of a busy State route adjacent to Fort Drum Military Installation and immediately adjacent to housing areas and construction activities on the installation (U.S. Army 2014-TN8512). Northern long-eared and tricolored bats would likely respond similarly.

Continued operation of Monticello during the SLR term would not include major construction or refurbishment and would involve no other maintenance or infrastructure repair activities besides routine activities already performed on the site. Levels and intensity of noise, lighting, and human activity associated with continued day-to-day activities and site maintenance during the SLR term would be similar to ongoing conditions since Monticello began operating, and such activity would only occur on the developed, industrial-use portions of the site. While these disturbances could cause behavioral changes in migrating or summer roosting bats, such as the expenditure of additional energy to find alternative suitable roosts, the NRC staff assumes that northern long-eared bats, if present in the action area, have already acclimated to regular site disturbances. Thus, continued disturbances during the SLR term would not cause behavioral changes in bats to a degree that would be able to be meaningfully measured, detected, or evaluated or that would reach the scale where a take might occur.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the northern long-eared and tricolored bats that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- Bat collisions with nuclear power plant structures in the United States are rare, and none have been reported at Monticello. Vehicle collisions attributable to the proposed action are also unlikely, and none have been reported at Monticello.
- The proposed action would not involve any construction, land clearing, or other ground-disturbing activities.
- Continued preservation of the existing forested areas on the site would result in positive impacts on bats.
- Bats, if present in the action area, have likely already acclimated to the noise, vibration, and general human disturbances associated with site maintenance, infrastructure repairs, and other site activities. During the SLR term, such disturbances and activities would continue at current rates and would be limited to the industrial-use portions of the site.

Conclusion for the Northern Long-eared Bat

All potential effects on the northern long-eared bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the northern long-eared bat.

In a letter dated June 27, 2023 (FWS 2023-TN9082), the FWS concurred with this determination based on a standing analysis completed by the Service in its development of the IPaC Northern Long-eared Bat Rangewide Determination Key. The FWS's June 27, 2023, letter documents that the NRC staff has fulfilled its ESA Section 7(a)(2) obligations with respect to the proposed Monticello SLR. The NRC staff notes that ESA regulations at 50 CFR 402.16 prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this EIS, the NRC staff has identified no information that would warrant reinitiation of consultation (50 CFR 402.16-TN4312).

Conclusion for the Tricolored Bat

All potential effects on the tricolored bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the tricolored bat.

In a letter dated June 27, 2023 (FWS 2023-TN9081), the FWS concurred with this determination. The FWS's June 27, 2023, letter documents that the NRC staff has fulfilled its ESA Section 7(a)(2) obligations with respect to this species. The NRC staff notes that ESA regulations at 50 CFR 402.16 prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this EIS, the NRC staff has identified no information that would warrant reinitiation of consultation (50 CFR 402.16-TN4312).

3.8.4.1.2 Whooping Crane

In Section 3.8.1.2 of this EIS, the NRC staff concludes that whooping cranes may occur in the action area when moving between areas of more suitable habitat. If present, whooping cranes would occur occasionally and for short periods of time. Xcel Energy reports neither mortalities (Xcel 2023-TN9578: Enclosure 31) nor any occurrences (Xcel 2023-TN9578: Enclosure 28) of whooping cranes on site.

The primary human drivers affecting the whooping crane habitat include activities that cause a loss of wetlands or the degradation of wetland and riverine habitats (FWS 2023-TN8854). Xcel Energy proposes no construction or ground disturbance during the SLR term that would impact wetland or riparian habitats. All plant operations would continue to occur within already developed land on the Monticello site. Xcel Energy would continue to comply with its NPDES permit, and no activities during the SLR term would alter the river flow in a manner that could result in the degradation of the riverine habitat for whooping cranes.

During the proposed Monticello SLR term, vehicular traffic from truck deliveries, site maintenance activities, and personnel commuting to and from the site would continue throughout the SLR period as they have during the current licensing period. Vehicle use would occur primarily in areas that whooping cranes would be less likely to frequent, such as along established county and State roads or within industrial-use areas of the Monticello site. Accordingly, the NRC staff finds the likelihood of future whooping crane collisions with vehicles to be extremely unlikely and, therefore, is not considered further.

The risk of collisions with tall structures and in-scope transmission lines poses a threat to whooping cranes and other birds. As described in Section 3.6.4, Xcel Energy maintains an Avian Protection Plan to avoid and minimize bird mortality and injury incidents. Over the course of 2014–2023, Xcel Energy reported 10 bird deaths (Xcel 2023-TN9578: Enclosure 31). Nine of these were of unknown causes, and one was a collision with a building. One of these bird deaths with unknown cause was a great blue heron (*Ardea herodias*), a large wading bird. Given that only one large wading bird has died on the Monticello site over a 10-year period and that whooping cranes are unlikely to pass through the site, the NRC staff finds the collision risk to be low. Accordingly, the NRC staff finds the likelihood of future whooping crane collisions with buildings, infrastructure, or in-scope transmission lines to be extremely unlikely and, therefore, is not considered further.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on whooping cranes that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- The proposed action would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential wetland habitat for whooping cranes.
- Continued preservation of the existing natural areas on the site would result in positive impacts on whooping cranes.
- Collisions with tall structures or in-scope transmission lines are unlikely. Vehicle collisions attributable to the proposed action are also unlikely, and none have been reported at Monticello.

Conclusion for the Whooping Crane

All potential effects on the whooping crane resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* whooping cranes.

In a letter dated June 27, 2023 (FWS 2023-TN9081), the FWS stated that because the proposed action is not likely to result in jeopardy of the nonessential experimental population of whooping crane, the NRC's obligations under Section 7 for the whooping crane are complete. The FWS's June 27, 2023, letter documents that the NRC staff has fulfilled its ESA Section 7(a)(1) and 7(a)(4) obligations with respect to this species. The NRC staff notes that ESA regulations at 50 CFR 402.16 prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this EIS, the NRC staff has identified no information that would warrant re-initiation of consultation (50 CFR 402.16-TN4312).

3.8.4.1.3 Monarch Butterfly

In Section 3.8.1.2 of this EIS, the NRC staff concludes that monarch butterflies may occur in the action area during spring and fall migration when individuals are moving between areas of more suitable habitat. If present, monarchs would occur occasionally and for short periods of time.

The FWS (FWS 2020-TN8593) identifies the primary drivers affecting the health of the two North American migratory populations of monarch butterfly as (1) habitat loss and degradation, (2) insecticide exposure, and (3) climate change effects.

Monarch habitat loss and degradation has resulted from the conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, and drought (FWS 2020-TN8593). The proposed Monticello SLR would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential habitats for monarch butterflies. The continued preservation of existing natural areas on the site would result in positive impacts on monarch butterflies.

Most insecticides are nonspecific and broad-spectrum in nature. Furthermore, the larvae of many Lepidopterans are considered major pest species, and insecticides are specifically tested on this taxon to ensure that they will effectively kill individuals at the labeled application rates (FWS 2020-TN8593). Although insecticide use is most often associated with agricultural production, any habitat where monarchs are found may be subject to insecticide use. Studies looking specifically at the dose response of monarchs to neonicotinoids, organophosphates, and pyrethroids have demonstrated monarch toxicity (e.g., Krischik et al. 2015-TN8596; James 2019-TN8595; Krishnan et al. 2020-TN8597; Bagar et al. 2020-TN8594). Moreover, the magnitude of risk posed by insecticides may be underestimated, as research usually examines the effects of the active ingredient alone, while many of the formulated products contain more than one active insecticide.

During the proposed SLR period, Xcel Energy would continue applying herbicides as needed, according to labeled uses, but has no plans to apply herbicides in natural areas. Application would primarily be confined to industrial-use and other developed portions of the site, such as perimeters of parking lots, roads, and walkways. Continued herbicide application could directly affect monarchs in the action area by injuring or killing individuals exposed to these chemicals.

Certain herbicides such as glyphosate (e.g., Round Up) can kill milkweed, which can affect the ability of female monarchs to lay eggs. Although milkweed is not specifically known to occur on the Monticello site, it has the potential to occur on site in the grasslands and open areas, given its occurrence in the Monticello vicinity (Section 3.8.1). Monarchs are only likely to occur in the action area seasonally during spring and fall migration when individuals are moving between areas of more suitable habitat. Because of the low likelihood of monarchs to be exposed to hazardous levels of chemicals, this potential impact is insignificant because it is unlikely to reach the scale where a take might occur.

Because the current and projected monarch population numbers are low, both the eastern and western populations are more vulnerable to catastrophic events, such as extreme storms at the overwintering habitat, and other climate change related phenomena. The FWS (FWS 2020-TN8593) anticipates that the eastern population will gain habitat in the northcentral region of North America as the species expands northward in response to increasing ambient temperatures. The degree and rate at which this expansion occurs will depend on the simultaneous northward expansion of milkweed. In the southern region of the continent, the population will either experience no gain or some loss of habitat.

Impacts on climate change during normal operations at nuclear power plants can result from the release of GHGs from stationary combustion sources, refrigeration systems, electrical transmission and distribution systems, and mobile sources. However, such emissions are typically very minor because nuclear power plants do not normally combust fossil fuels to generate electricity. During the proposed SLR term, the contribution of Monticello operations to climate-change-related effects on monarch butterflies would be too small to be meaningfully measured, detected, or evaluated.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on monarch butterflies that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- The proposed action would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential habitat for monarchs.
- Continued preservation of the existing natural areas on the site would result in positive impacts on monarchs.
- Herbicides would only be applied according to labeled uses in developed and manicured areas of the site. Herbicides would not be applied in natural areas. Monarchs would only have the potential to occur in the action area seasonally and infrequently, making the likelihood of herbicide exposure low. This represents an insignificant effect because it is unlikely to reach the scale where a take might occur.
- The contribution of Monticello operations to climate-change-related effects on monarchs would be too small to be meaningfully measured, detected, or evaluated.

Conclusion for the Monarch Butterfly

All potential effects on the monarch butterfly resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the monarch butterfly. Because the monarch is a candidate for Federal listing, the ESA does not require the NRC to consult with or receive concurrence from the FWS regarding this species.

3.8.4.2 Endangered Species Act: Federally Listed Species and Critical Habitats under NMFS Jurisdiction

No federally listed species or critical habitats under NMFS jurisdiction occur within the action area (see Section 3.8.2). Therefore, the NRC staff concludes that the proposed action would have no effect on federally listed species or habitats under this agency's jurisdiction.

3.8.4.3 Endangered Species Act: Cumulative Effects

The ESA regulations at 50 CFR 402.12(f)(4) direct Federal agencies to consider cumulative effects as part of the proposed action effects analysis (TN4312). Under the ESA, cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 TN4312). Cumulative effects under the ESA do not include past actions or other Federal actions requiring separate ESA Section 7 consultation, which differs from the definition of "cumulative impacts" under the NEPA.

When formulating biological opinions under formal ESA Section 7 consultation, the FWS and NMFS (FWS and NMFS 1998-TN1031) consider cumulative effects when determining the likelihood of jeopardy or adverse modification. Therefore, cumulative effects need only be considered under the ESA if listed species will be adversely affected by the proposed action and formal Section 7 consultation is necessary (FWS 2017-TN5753). Because the NRC staff concluded earlier in this section that the proposed SLR is not likely to adversely affect any federally listed species and would not destroy or adversely modify designated critical habitats, the NRC staff did not separately consider cumulative effects for the listed species and designated critical habitats. Further, the NRC staff did not identify any actions within the action area that meet the definition of cumulative effects under the ESA.

3.8.4.4 Magnuson–Stevens Act: Essential Fish Habitat

No EFH occurs within the affected area (Section 3.8.2). Therefore, the NRC staff concludes that the proposed action would have no effect on EFH.

3.8.4.5 National Marine Sanctuaries Act: Sanctuary Resources

No national marine sanctuaries occur within the affected area (see Section 3.8.3). Therefore, the NRC staff concludes that the proposed action would have no effect on sanctuary resources.

3.8.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and Monticello would shut down on or before the expiration of the current renewed facility operating licenses. Upon shutdown, the nuclear power plant would require substantially less cooling water and would produce little to no discernable thermal effluent. Thus, the potential for impacts on all aquatic species related to cooling system operation would be significantly reduced. The ESA action area under the no-action alternative would most likely be the same or similar to the area described in Section 3.8.1.1. Northern long-eared bats, tricolored bats, whooping cranes, and monarch butterflies may occur within the action area (Section 3.8.1). The NRC would consult with the FWS, as appropriate, to address potential effects to these species resulting from the shutdown and decommissioning of the plant. No EFH or national marine sanctuaries occur in the region (Sections 3.8.2 and 3.8.3). Thus, shutdown would not result in impacts on EFH or sanctuary resources. Actual impacts would depend on the specific shutdown activities and whether any listed species or critical habitats are present when the no-action alternative is implemented.

3.8.6 Replacement Power Alternatives: Common Impacts

This section describes the common impacts for all three replacement power alternatives described in Sections 3.8.7 through 3.8.9. The natural gas, renewables (i.e., wind and solar), and battery storage would be built partially onsite and offsite of the Monticello location. The small modular nuclear reactors would have to be built in a different State because Minnesota law (216B.243 Minnesota Statues -TN9184) prohibits the construction and operation of new nuclear power plants in Minnesota.

The ESA action area for any of the replacement alternatives would depend on various factors including site selection, current land uses, planned construction activities, temporary and permanent structure locations and parameters, and the timeline of the alternative. The ESA action area would occur within Xcel Energy's ROI, which includes Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin.

The listed species, critical habitats, EFH, and national marine sanctuaries potentially affected by a replacement power alternative would depend on the boundaries of that alternative's effects and the species and habitats federally protected at the time that the alternative is implemented. For instance, if Monticello continues to operate until the end of the current license terms and a replacement power alternative is implemented at that time, the FWS and NMFS may have listed new species, delisted currently listed species whose populations have recovered, or revised EFH designations. These listing and designation activities would change the potential for the various alternatives to impact federally protected ecological resources. Additionally, requirements for consultation under ESA, MSA, and NMSA would depend on whether Federal permits or authorizations are required to implement each alternative.

Sections 3.6 and 3.7 describe the types of impacts that terrestrial and aquatic resources would experience under each alternative. Impacts on federally protected ecological resources would likely be similar in type. However, the magnitude and significance of such impacts could be greater for federally protected ecological resources because such species and habitats are rare and more sensitive to environmental stressors.

3.8.7 Natural Gas and Renewables Alternative

Xcel Energy's ROI includes Minnesota and seven other states: Colorado, Michigan, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin. This analysis assumes that the natural gas-fired power plant would be constructed either onsite or offsite in one of the states within Xcel Energy's ROI. Solar panels could be installed on the Monticello site, offsite within Minnesota, or elsewhere within the ROI. Wind turbines would be installed offsite within Minnesota or elsewhere within the ROI.

The NRC does not license natural gas or renewable energy facilities; therefore, the NRC would not be responsible for ESA, MSA, or NMSA consultations for this alternative. The Federal and private responsibilities for addressing impacts on federally protected ecological resources under this alternative would be like those described in Section 3.8.5 of this EIS. Ultimately, the magnitude and significance of adverse impacts on federally protected ecological resources resulting from this alternative would depend on the site location and layout, plant design, plant operations, and the protected species and habitats present in the area when the alternative is implemented.

3.8.8 Renewables and Storage Alternative

Xcel Energy estimates that solar panels would be installed at as many as three different project sites within the Xcel Energy ROI. Wind turbines would be installed offsite within Minnesota or the ROI. Types of impacts to terrestrial species from the solar and wind energy facilities would be similar to those described for the solar and wind portions of the previous alternative (Section 3.6.7) as would permitting requirements from regulatory agencies. A small amount of additional land would be needed to support the battery storage system at each solar project site.

The NRC does not license renewable energy facilities; therefore, the NRC would not be responsible for ESA, MSA, or NMSA consultations for this alternative. The Federal and private responsibilities for addressing the impacts on federally protected ecological resources under this alternative would be like those described in Section 3.8.5 of this EIS. Ultimately, the magnitude and significance of adverse impacts on federally protected ecological resources resulting from this alternative would depend on the site location and layout, plant design, plant operations, and the protected species and habitats present in the area when the alternative is implemented.

3.8.9 New Nuclear (Small Modular Reactor) Alternative

Because Minnesota prohibits the construction and operation of new nuclear power plants within the State, the NRC staff assumes that the replacement plant would be constructed in one of the other seven states within Xcel Energy’s service area (i.e., Colorado, Michigan, New Mexico, North Dakota, South Dakota, Texas, or Wisconsin).

The impacts of the new nuclear alternative are largely addressed in the impacts common to all replacement power alternatives described in the previous section. Because the NRC would remain the licensing agency under this alternative, the ESA and MSA would require the NRC to consult with the FWS and NMFS, as applicable, before issuing a license for the construction and operation of the new facility. During these consultations, the agencies would determine whether the new reactors would affect any federally listed species, adversely modify or destroy designated critical habitat, or result in adverse effects on EFH. If the new facility requires a CWA Section 404 permit, USACE may be a cooperating agency for required consultations, or USACE may be required to consult separately. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, nuclear power plant design, nuclear power plant operations, and the special status species and habitats present in the area when the alternative is implemented.

3.9 <u>Historic and Cultural Resources</u>

This section describes the cultural background and the historic and cultural resources at Monticello and its surrounding area. Historic and cultural resources describes material culture left behind from past human activity. Cultural resources include sites, objects, landscapes, structures, or other natural features of significance to groups of people who have traditional association with it.

In this section of the EIS, a description of historic and cultural resources is followed by the NRC staff's analysis of the potential impact on historic and cultural resources from the proposed action (subsequent license renewal). This review also addresses the requirements of the NHPA (TN4157) Section 106 process, specifically addressed in 36 CFR 800.3 through 800.5, to determine if there is a potential for project-related activities to cause direct or indirect effects to historic properties, and if so, to address those potential impacts. Section 106 of the NHPA requires Federal agencies to consider the effects of their undertakings on historic properties included on, or eligible for inclusion on, the National Register of Historic Places (NRHP [36 CFR Part 800-TN513]). The NRHP is the Nation's official list recognizing buildings, structures, objects, sites, and districts of national, State, or local historical significance which merit preservation. The criteria for eligibility are listed in 36 CFR 60.4 (TN1682), Criteria for Evaluation.

The proposed undertaking is subsequent renewal of the current renewed operating license, which would extend the current operating term another 20 years. The Area of Potential Effect (APE) consists of the 2,000 ac (809 ha) Monticello site located within the site boundary, where activities associated with the operation of the facility could potentially compromise the integrity of historic properties.

3.9.1 Cultural Background

Archaeological records document physical human occupation in Minnesota extending back about 12,000 years. The Minnesota Office of the State Archaeologist (MnDA Undated-TN9657) has general summaries of each time period. A synopsis is presented below.

3.9.1.1 Paleoindian Period (prior to 7000 BC)

Minnesota was glaciated until about 18,000 years ago, when warming temperatures and receding glaciers began to uncover the southern half of the State during the end of the Pleistocene epoch. Minnesota's archaeological record documents sites as early as around 12,000 years ago, or approximately 10,000 BC (MnDA Undated-TN9657).

Date ranges for the Paleoindian period that are generally accepted by archaeologists fall between 11,500 before present (BP) to around 7,000 BP (9,550 to 5,050 BC). This period is characterized by small groups of highly nomadic hunter-gatherers who followed big game such as mammoths, mastodons, and bison across the landscape.

Stone tool technologies of this era are mostly associated with the Clovis and Folsom (10,800 BC–9500 BC) cultures. Both cultures are known for their fluted points – large well-made spear points characterized by a groove notched out in the middle to bottom half of the point, allowing it to be attached to handles. Minnesota has documented numerous Clovis, or an eastern variety of the fluted points, and Folsom points, in the State's archaeological record (MnDA Undated-TN96577). A recent archaeological review identified at least two Folsom points and one Plainview point recovered from Wright County, Minnesota, and one Folsom point from Sherburne County, Minnesota, within the vicinity of the Monticello Nuclear Plant (Buhta et al. 2011-TN9656).

3.9.1.2 Archaic Period (7000 BC to 500 BC)

The Archaic period is the longest cultural period in Minnesota (MnDA Undated-TN9657). During the Archaic period, Indigenous peoples became more sedentary, relying more on horticulture and agriculture with a reduction in big game hunting for subsistence. Stone tool technologies changed from larger spear points to smaller points that fit on atlatl darts. Copper tools associated with the Old Copper Culture began to appear in tool assemblages (MnDA Undated-TN9657). This era is divided into four subperiods based on the type of environmental adaption that occurred: Prairie Archaic (west), Lake Forest Archaic (central and north central), Shield Archaic (northeast), and Riverine Archaic (southeast) (MnDA Undated-TN9657).

Prairie Archaic

The Prairie Archaic consisted of an adaptation to a grassland environment principally focused on bison hunting for subsistence. The Itasca Bison site (located in Clearwater County), first excavated in 1937, and again in the mid-1960s, is characteristic of this time period. The remains of 16 now-extinct individual bison were recovered as well as side-notched dart points. Radiocarbon dating confirm a site use between 7600 and 6000 BC (MnDA Undated-TN9657).

Lake Forest Archaic

The Lake Forest Archaic in the central and north central portion of the State was characterized by its wetter climate. Lakes increased in depth (by more than 30 ft [more than 9 m]) and woodlands increased as well during this era. This period is the least understood archaeologically as there are few sites excavated dating to the Lake Forest Archaic period. Like the Prairie Archaic, there was a reliance on bison. However, regional variety allowed for broader subsistence gathering (MnDA Undated-TN9657).

The Petaga Point site at the Mille Lacs Kathio State Park is a Lake Forest Archaic period site. The site was first excavated in the 1920s and 1930s. Cultural material uncovered extensive Old Copper components. Additional excavations completed in the 1960s by the University of Minnesota also identified stone spear points, stone tools, and copper tools dating to over 3,000 years ago (Cummings Undated-TN9659).

Shield Archaic

The Shield Archaic in northeastern Minnesota is named after the geological region it exists in- the Canadian Shield (MnDA Undated-TN9657). The archaeological record for the Shield Archaic is heavily based on sites from Canada. The absence of sites in Minnesota may be attributed to the acidic soils of the coniferous forests and thus poor survival of bone (MnDA Undated-TN9657). In Canada, sites dating to this time period are traditionally found at the narrows of lakes and rivers where caribou may have crossed (MnDA Undated-TN9657).

The Fowl Lake site just south of the Canadian border is an example of a Shield Archaic site. However, most of the existing artifact assemblage consists of surface collections collected by non-archaeological professionals (MnDA Undated-TN9657).

Riverine Archaic

The Riverine Archaic occurred along the Mississippi River and in deep-cut river valleys in southeastern Minnesota. The river valley produced a variety of aquatic resources such as waterfowl, fish, mussels, and tubers. Additionally, elk, deer, and bison were found in the uplands. This area also provided fertile lands for growing squash and other crops (MnDA Undated-TN9657).

The King Coulee site in Washaba County offers the most complete Late Archaic (1500–500 BC) record. Excavations in the late 1980s showed deposits almost 6.5 ft (2 m) below the surface. Artifacts such as stemmed projectile points, mussel shells, nuts, and squash seeds were identified. Radiocarbon dates obtained directly from the squash, yielded dates of occupation around 2,500 years ago, making it one of the earliest dates for cultigens in Minnesota's archaeological record (MnDA Undated-TN9657).

3.9.1.3 Woodland Period (500 BC to 1650 AD)

The Woodland Period represents more intensive plant cultivation (varieties of corn and wild rice), the introduction of the bow and arrow, and the construction of burial mounds (MnDA Undated-TN9657). Burial mounds have been recorded throughout the State except in the northeast. The highest concentration of mounds is in the Red Wing area, the Lake Minnetonka area, and near the Mille Lacs Lake (MnDA Undated-TN9657). Religion and technological advances such as pottery also emerged during this time.

Individual Woodland complexes within the State are defined by the local ceramic types found in those areas. The Laurel, Brainerd, and Blackduck complexes are in the north, while the Malmo, St. Croix, Onamia, and Kathio complexes are found in the central region (MnDA Undated-TN9657). The Lake Benton and Fox Lake complexes are noted in southwest Minnesota. Effigy Mound, La Moille, Howard Lake, and Sorg have been identified in southeast Minnesota.

3.9.1.4 Contact Period/Mille Lacs Band of Ojibwe History (1600s AD to present)

In the mid-17th century, European explorers and fur traders began arriving in the region. The area was mostly occupied by the Dakota. The French initially claimed the land, ceded it to Spain in 1762, then regained it in 1800 only to sell it to the United States in 1803 as part of the Louisiana Purchase. During this time, the Ojibwe began moving westward into the area, in some cases conflicting with the Dakota. In 1849, Minnesota was established as a territory. Treaties with the Tribes were signed around 1850. In 1858, Minnesota became a State (NRC 2006-TN7315). The Mille Lacs Band of Ojibwe considers the area where the Monticello plant is located as part of their usual and accustomed places, where they exercise the protection of natural and cultural resources (Mille Lacs Band of Ojibwe 2023-TN9666).

The Mille Lacs Band of Ojibwe refer to themselves as *Anishinaabe*, the first and original people (Godfrey 1993-TN9660). Approximately 500 years ago, the Ojibwe migrated west from the Atlantic coast, eventually settling around the Mille Lacs Lake, in what is now the east central part of Minnesota (Mille Lacs Band of Ojibwe Undated-TN9661). European fur traders and missionaries began contact with Indigenous groups, including the Mille Lacs Band of Ojibwe, around the mid-1600s (MnDA Undated-TN9657).

In 1837, the Ojibwe and Dakota ceded millions of acres to the United States under the Treaty of 1837, relinquishing lands in what is present-day Minnesota and Wisconsin. The treaty guaranteed the rights to hunt, fish, and gather on the ceded lands (Minnesota Indian Affairs Council Undated-TN9662). Following the Treaty of 1837, the Treaty of 1855 reserved 61,000 ac (24685 ha) to establish the Mille Lacs Band of Ojibwe Reservation (Mille Lacs Band of Ojibwe Undated-TN9661).

Over the decades, European settlers continued to occupy reservation lands. In 1879, the U.S. government opened the reservation lands for timber companies and others to purchase (Mille Lacs Band of Ojibwe Undated-TN9663), violating the Mille Lacs Band of Ojibwe rights under the treaty. By the late 1800s, the Band was left nearly landless, and members were removed from their homelands (Mille Lacs Band of Ojibwe Undated-TN9661). The passing of the Nelson Act in 1889 allowed Ojibwe populations to acquire land allotments on their own reservations but also allowed the government to sell the non-allotted “surplus” lands to the public. In 1999, the U.S. Supreme Court upheld the rights of the Mille Lacs Band of Ojibwe under the Treaty of 1855, affirming that the treaty had not ceded rights to land that the Ojibwe had retained in 1837 (Minnesota Indian Affairs Council Undated-TN9664; USDOJ 2023-TN9665) and that the U.S. government had violated the treaty.

The following is a brief history from the 1600s to late 1800s as viewed by the Mille Lacs Band of Ojibwe (Mille Lacs Band of Ojibwe 2023-TN9666):

> To start, along with our Ojibwe migration into this region in the mid-1600s came the French fur traders who took advantage of our trade and commerce networks. Our migration brought on resource competition with the Dakota peoples in the area, resulting in frequent disputes, often hyper-inflated by the Euro-American communities as “wars.” One such disputed area was the land between the current Cities of Monticello–Big Lake to Otsego–Elk River, bounded by the *Misi-ziibi* (Great River, i.e., Mississippi River) on the south and the *Gaabiitootigweyaa-ziibi* (That Which the Stream Parallels [the Mississippi] River, i.e.Elk River) on the north. In our Ojibwe language we call this area as our *Miigaadiwining* (At the “Battling”) due to the disputes that occurred in 1772 and 1773, and various historical documents in English call this region “Battle Point.”
>
> As a result, Artz et al. (1976-TN9667) recorded 334 burial mounds in 26 groups in Sherburne County, and 383 burial mounds in 57 groups in Wright County. Additionally, Battle Rapids which is located downstream of the Minnesota Highway 25 (MN-25) bridge in the City of Monticello is called in Ojibwe *Miigaadiwini-zaasijiwan* (Battling Rapids), with City of Monticello’s Battle Rapids Park along its shores. Otter Creek, located between the Monticello Plant and City of Monticello’s downtown, in Ojibwe goes by two names: as *Nigigo-ziibiwishenh* (Otter Brook), but also as *Miigaadiwin-ziibiwishenh* (“Battling” Brook).
>
> Next, approximately 6-miles upstream from there, located in the Mississippi River within the Monticello Plant’s site boundaries is our *Basa’igaan* (Place of Hewing), to which Cedar Island known in Ojibwe as *Basa’igaani-minis* (Hewing Island) and *Basa'igaani-zaasijiwan* (Hewing Rapids) are located due to the rich red cedar (Juniperus virginiana) forest that once stood along the banks of the Mississippi River, to which red cedar wood were hewn for our dugout canoes. This red cedar forest extended to Cedar Lake located 5-miles south of the Monticello Plant, which in Ojibwe is called *Meskwaawaako-minisiwang zaaga’igan* (Red Cedar Islanding Lake). Farther upstream along the *Misi-ziibi* from the Monticello Plant site are *Zhooniyaa-ziibiwishenh* (Silver Brook) known in English as Silver Creek and *Gaa-biskaabiitigweyaag-ziibiwishenh* (Brook of the Oxbowing Place), recorded by Joseph Nicollet as “Bend Creek” but is known today in English as Fish Creek.
>
> With the signing of the 1825 Treaty of Prairie du Chien (7 Stat. 272), the territorial dispute between the Ojibwe and the Dakota were settled, and the area where the Monticello Plant site sits became undisputed Dakota territory. But due to this history, we do consider the area as our historical landscapes and cultural

properties and claim the area as part of our Usual and Accustomed Places for the protection of our cultural resources, with the Dakota nations taking the lead.

When the 1837 Ojibwe ceded territory (Royce Area 242) and the 1837 Dakota ceded territory (Royce Area 243) became part of the United States, Tribal nations reserved certain usufructuary privileges which the Treaties protect. With this dynamic change, the whole area north of the Mississippi River was opened up to Euro-American settlement. Later, the United States entered into Treaty negotiations with various Dakota nations for the area south of the Mississippi River; the 1851 Treaties of Traverse des Sioux (10 Stat. 949) and of Mendota (10 Stat. 954) ceded territory (Royce Area 289) officially became part of the United States, further opening up the area for Euro-American settlement.

Settlement patterns by the Euro-Americans in the area created series of Red River Ox-cart Trails, appearing along both banks of the Mississippi River as east river road (known formally as the Red River Road) which was eventually improved and replaced by US Highway 10 (US-10), and as west river road which was improved with the section near the Monticello Plant becoming Broadway St and County Road 75 (CR-75), and replaced by Interstate Highway 94 (I-94). These river roads are depicted in the General Land Office surveys of Township 33 North Range 28 West of the 4th Parallel Meridian in Royce Area 243 in 1851, and of Township 122 North Range 25 West of the 5th Parallel Meridian in Royce Area 289 in 1857. Understanding the importance of roads and riverways for the economy, our ancestors ensured the United States would build roads to serve our reservation. Under Articles III and VIII of the 1855 Treaty of Washington (11 Stat. 1165), roads were authorized to be built from our Mille Lacs Reservation to what today is the City of Anoka to ensure our access to the Red River Road and to the Mississippi River. In addition to roads, the US Army had conducted surveys of the upper Mississippi River in 1873 and conducted further assessments in 1874 to determine the feasibility of navigation.

3.9.2 Historic and Cultural Resources at Monticello

Historic and cultural resources within the Monticello site can include prehistoric and historic era archaeological sites, historic districts, and buildings, as well as any site, structure, or object that may be considered eligible for listing on the NRHP. Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture. “Historic property” is the legal term for a historic or cultural resource that is included on, or eligible for inclusion on, the NRHP. To gain a better understanding of the archaeological resources within the region, a 1 mi (1.6 km) buffer was incorporated in the literature search to learn what previously recorded sites and surveys exist within the APE and beyond. This information helps cultural resources professionals understand what resources may potentially be in the field.

Previously Recorded Historic and Archaeological Resources

There are no previously recorded sites within the project site. Three previously recorded archaeological sites, all consisting of lithic scatters, are within 1 mi (1.6 km) of the APE. The closest site is approximately 0.75 mi (1.2 km) (MnDA Undated-TN9688). Fifteen historic resources are also within 1 mi (1.6 km) of the APE. This includes four historic roads, four historic houses, four historic farmsteads, two historic railroads, and one historic bridge (MnSHIP Undated-TN9687).

Previous surveys

Cultural resource surveys were not conducted within the Monticello site before its construction in 1967. In 2022, Xcel Energy commissioned SEARCH, Inc. to conduct an architectural history survey to evaluate Monticello's eligibility for listing. SEARCH performed an intensive architectural survey of Monticello in September 2022, surveying 80 ac (32.4 ha) of the built environment (Xcel 2023-TN9578). In total, 27 individual resources were inventoried. Additionally, Monticello was evaluated collectively as a potential historic district. On February 27, 2023, the Minnesota State Historic Preservation Office (MNSHPO) concurred with the recommendation in the architectural survey report that none of the inventoried resources met the criteria for listing in the NRHP (Theriot et al. 2023-TN9689; MnDA SHPO 2023-TN9668).

In 2023, Xcel Energy contracted Westwood Professional Services, Inc. (Westwood) to conduct a Phase IA cultural resources literature search. In support of the literature search, a field visit was conducted in late October 2023 to assess the nature of the ground cover, identify areas of archaeological interest, and determine the level of effort that might be required to conduct a formal and comprehensive archaeological survey of the property at a later date.

Westwood summarized previous disturbances throughout the APE and identified areas that may have a higher potential of encountering intact archaeological deposits. Approximately 12 percent of the APE has been previously disturbed and 88 percent is potentially undisturbed. Of the disturbed areas, approximately 19 percent is deeply disturbed (greater than 10 ft [3.0 m]) and approximately 81 percent is surface level disturbance (disturbance is limited to the upper 10 ft [3.0 m] of ground surface) or unknown depths of disturbance (Xcel 2024-TN9859). In the field visit, Westwood confirmed that no additional buildings 45 years or older were within the APE. However, as part of the literature search, Westwood reviewed historical maps and aerial photography and noted more than 20 nonextant building sites. Westwood concurred with the recommendations previously described in SEARCH's architectural survey report (Theriot et al. 2023-TN9689).

Westwood identified areas within the APE that had a lower possibility of encountering intact archaeological deposits versus areas with a higher potential. As such, Westwood recommends Xcel Energy conduct a formal Phase I survey in high archaeological potential areas prior to any ground disturbance. For areas that have the lower potential for intact archaeological deposits, Westwood recommends that a qualified archaeological professional review proposed construction within these areas to determine the appropriate next steps, which could include monitoring or a survey. For areas of deep disturbance, Westwood recommends no additional cultural resources survey due to the documented significant ground disturbance that most likely eliminated the potential for intact cultural resource deposits.

Through consultation (see Section 3.9.4.1 below), the Mille Lacs Band of Ojibwe identified red cedar (*Juniperus virginiana*) and wild rice (*Zizania* spp.) as part of their cultural resources and requested that a vegetation survey occur within the APE to confirm the presence or absence of the natural resources within the property. Westwood biologists conducted a tree survey between October and December 2023 to inventory red cedar within the 2,000 ac (809 ha) APE. Based on their December 2023 summary report (Xcel 2024-TN9859), Westwood confirmed about 12,000 red cedar trees within the APE. Because the peak growth period for wild rice is between July and early October, Westwood was not able to complete a survey for wild rice during their field visit. Westwood plans to complete the survey in early summer 2024 (Xcel 2024-TN9859).

3.9.3 Procedures

Xcel Energy has three procedures in place to identify, protect, and minimize the potential impact to cultural resources at Monticello (Xcel 2023-TN9084). The procedures currently define what actions are taken in the event of unanticipated discoveries. Xcel Energy is in process of updating these procedures to incorporate the results and recommendations provided in Westwood's literature review and consultation with the Mille Lacs Band of Ojibwe to ensure the continued protection of archaeological, cultural, and historic resources. Procedures will be updated to stipulate:

(1) No further cultural resources work where deep-level disturbances have been documented.

(2) For projects that would take place in areas that have a lower potential for intact archaeological deposits, Xcel Energy will review projects with a Secretary of Interior qualified archaeologist to determine the appropriate next steps based on that assessment (i.e., archaeological monitoring, survey).

(3) For projects where ground disturbance would occur in higher potential areas, a Phase 1 cultural resources survey should be done prior to any development.

(4) For projects where ground disturbance would occur outside the Monticello facility complex and that are under the control of NSPM, the Mille Lacs Band of Ojibwe will be notified and invited to monitor ground disturbing activities. Exceptions to having a Tribal monitor would apply to situations such as emergencies or other extenuating circumstances that would require time-sensitive excavations.

Because the Monticello facility has been evaluated and determined to be not eligible for the NRHP, no further cultural resources considerations is recommended.

3.9.4 Proposed Action

The NHPA of 1966, as amended (54 U.S.C. 300101 et seq. TN4157), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a subsequent renewed operating license to a nuclear power plant is a Federal undertaking that could potentially affect historic properties. Historic properties are defined as resources included on, or eligible for inclusion on, the NRHP. The criteria for eligibility are listed in "Parks, Forests, and Public Property" of the 36 CFR Part 60 (TN1682) Section 60.4 "Criteria for Evaluation," and include (a) association with significant events in history, (b) association with the lives of persons significant in the past, (c) embodiment of distinctive characteristics of a type, period, or method of construction, or (d) sites or places that have yielded, or may be likely to yield, information important in prehistory or history.

In accordance with NHPA provisions, the NRC is required to make a reasonable effort to identify historic properties included on, or eligible for inclusion on, the NRHP in the APE. The APE for a subsequent license renewal action includes the power plant site, the transmission lines up to the first substation, and immediate environs that may be affected by the subsequent license renewal decision and land-disturbing activities associated with continued reactor operations during the subsequent license renewal term. In addition, the NRC is required to notify the State Historic Preservation Officer (SHPO) if historic properties would not be affected by subsequent license renewal or if no historic properties are present. In Minnesota, the Minnesota State

Historic Preservation Office administers the State's historic preservation program. The NRC also notifies all consulting parties, including American Indian Tribes, and makes this finding public (through the NEPA process) before issuing subsequent renewed operating licenses. Similarly, if historic properties are present and could be affected by the undertaking, the NRC is required to assess and resolve any adverse effects in consultation with the SHPO and any American Indian Tribe that attaches religious and cultural significance to identified historic properties.

The proposed undertaking is the subsequent renewal of the current renewed operating license, which would extend the current operating term another 20 years. The APE consists of the 2,000 ac (809 ha) Monticello site where activities associated with the operation of the facility could potentially compromise the integrity of historic properties.

3.9.4.1 Consultation

In accordance with 36 CFR 800.8, "Coordination with the National Environmental Policy Act," on March 13, 2023, the NRC staff initiated written consultations with the Advisory Council on Historic Preservation (ACHP) and the Minnesota State Historic Preservation Office (TN513). Also, on March 13, 2023, the NRC staff-initiated consultation with 30 federally recognized Tribes. In these letters, the NRC staff provided information about the proposed action, defined the APE, and indicated that the NHPA review would be integrated with the NEPA process, in accordance with 36 CFR 800.8(c) (TN513). The NRC staff invited participation in the identification of, and possible decisions concerning, historic properties and invited participation in the scoping process. Appendix C includes copies of consultation documents.

On July 3, 2023, the Minnesota SHPO stated in its correspondence to the NRC that based on their understanding of the scope of the proposed Federal undertaking, their office "generally agree[s] that relicensing of Monticello facility does not require an archaeological survey due to the extensive existing disturbance created when the facility was constructed in the late 1960s to 1971 and also that no new construction will occur as part of the relicensing" (MnDA SHPO 2023-TN9668). However, the Minnesota SHPO requested documentation "that describes and/or shows the horizontal and vertical extent of these disturbed areas within the site boundary and a clearer understanding that the relicensing would not result in any future ground-disturbance beyond what has already been documented as thoroughly disturbed" and a map indicating areas within the site boundary where Xcel Energy is committed to performing an archaeological survey due to the lack of previous ground disturbance (MnDA SHPO 2023-TN9668). On August 3, 2023, NRC staff met with representatives from the Minnesota SHPO (NRC 2023-TN9773). During this meeting, NRC staff (1) discussed the APE of the undertaking; (2) provided a general discussion related to routine operation and maintenance activities; and (3) requested clarification regarding the documentation requested in the July 3, 2023 letter. By letter dated August 21, 2023, to the NRC, the Minnesota SHPO stated that "based on the clarification regarding the agency's definition of the APE for this type of undertaking and the potential activities that may occur within the APE, we recommend that a Phase I archaeological survey be completed by a qualified archaeologist." However, the Minnesota SHPO stated that if the project area can be documented as previously surveyed or disturbed, as they indicated in their July 3, 2023 letter, they will reconsider the need for a survey (MnDA SHPO 2023-TN9669).

On April 12, 2023, in correspondence to the NRC, the Mille Lacs Band of Ojibwe provided their concerns related to the undertaking and requested continued discussions through government-to-government consultation (Mille Lacs Band of Ojibwe 2023-TN9666). On July 25, August 10, 2023, and January 11, 2024(NRC 2023-TN9671, NRC 2023-TN9670, NRC 2024-TN9772), the

NRC staff conducted teleconferences with representatives from the Mille Lacs Band to continue dialogue and consultation. During the July 25, 2023, teleconference, the Mille Lacs Band expressed concern that Monticello has not been subject to a cultural resources survey. During the August 10, 2023, teleconference, the Mille Lacs Band requested that an inventory of culturally important plant species be conducted to determine/identify if red cedar (*Juniperus virginiana*) and wild rice (*Zizania* spp.) are present on the Monticello site. Additionally, the Mille Lacs Band requested to participate in surveys conducted on the Monticello site. As discussed in Section 3.9.2 above, Xcel Energy contracted Westwood Professional Services, Inc. (Westwood) to conduct a Phase IA cultural resources literature search and a survey of culturally important plant species within the Monticello site. In support of the literature search, a field visit was conducted in late October 2023 and a representative of the Mille Lacs Band's Tribal Historic Preservation Office was in attendance. On December 6, 2023, a representative of the Mille Lacs Band's Tribal Historic Preservation Office was also in attendance when the culturally important plant species survey was conducted (Xcel 2024-TN9859). Because the peak growth period for wild rice is between July and early October, Westwood was not able to complete a survey for wild rice during their field visit. Westwood plans to complete the survey in early summer of 2024. Xcel Energy will invite the Mille Lacs Band to participate in the wild rice survey (Xcel 2024-TN9859). During the January 11, 2024, the NRC discussed comments from the Mille Lacs Band regarding the Monticello site cultural resource literature search and red cedar survey commissioned by Xcel Energy. During the January 11, 2024 teleconference, the Mille Lacs Band requested that should ground disturbance occur outside the Monticello facility complex, a Tribal monitor should be present (NRC 2024-TN9772). As discussed in Section 3.9.3 above, Xcel Energy is updating its site procedures to incorporate a direction to notify and invite the Mille Lacs Band to monitor ground disturbing activities should ground disturbance occur in areas outside the Monticello facility complex and that are under the control of NSPM (Xcel 2024-TN9859).

3.9.4.2 Findings

Section 3.9.2 discusses historic and cultural resources on the Monticello property. Xcel Energy did not identify refurbishment activities or new construction necessary for the continued operation of Monticello during the SLR period (Xcel 2023-TN9084). Xcel Energy does not plan to alter operations, expand existing facilities, physical changes, or disturb additional land to support SLR. Plant operations and maintenance activities necessary to support subsequent license renewal would be limited to previously disturbed areas and is expected to be similar to current operations (Xcel 2023-TN9084, Xcel 2023-TN9578).

Section 2.1 of this EIS describes the types of activities carried out during nuclear power plant operations; these include reactor operation, waste management, cooling water intake and discharge, nuclear fuel receipt and storage, spent fuel security, office and clerical work, maintenance, and refueling outages. Section 2.1.7 describes that maintenance activities conducted at Monticello include inspection, testing, and surveillance to maintain the current licensing basis of the facility. These activities include in-service inspections of safety-related structures, systems, and components; quality assurance and fire protection programs, and radioactive and nonradioactive water chemistry monitoring. If operations and maintenance activities (such as inspection or maintenance of subsurface features like pipelines and conduits) require ground disturbance during the SLR period, Xcel Energy anticipates that they would occur on previously disturbed ground (Xcel 2023-TN9084, Xcel 2023-TN9578).

For the purposes of the NRC's NHPA review, the NRC staff has determined that the undertaking will result in No Adverse Effect, as defined in 36 CFR 800.5(b). In the event that ground disturbance is necessary for future development, Xcel Energy will have procedures in place to reduce impacts to any cultural resources encountered. Archaeologists would be consulted prior to development to determine the potential for encountering intact cultural deposits and/or a Phase 1 archaeological survey would be conducted. Archaeological monitoring would also occur during project activities to minimize impacts to cultural resources.

Based on (1) Xcel Energy's statement that it does not plan to alter operations, expand existing facilities, or disturb additional land during the subsequent license renewal period, (2) input from consulting parties, and (3) Xcel Energy's updates to procedures to identify, protect, and minimize the potential impact to cultural resources at Monticello, the NRC staff concludes that SLR for Monticello would not adversely affect historic properties or historic and cultural resources.

3.9.5 Alternatives

3.9.5.1 No-Action Alternative

Under the no-action alternative, land-disturbance activities or dismantlement are not anticipated, as these would be conducted during decommissioning. Therefore, facility shutdown and adoption of the no action alternative would have no immediate effect on historic properties or historic and cultural resources.

Known historic properties and cultural resources at Monticello would be unaffected if the NRC does not renew the operating license and Xcel Energy terminates reactor operations. Under 10 CFR 50.82, "Termination of License," power reactor licensees are required to submit a post-shutdown decommissioning activities report to the NRC, which would describe the plant's planned decommissioning activities. (TN249). Until the post-shutdown decommissioning activities report is submitted, the NRC staff cannot determine whether historic properties would be affected outside the existing industrial site boundary by decommissioning activities, after the nuclear power plant ceases operations.

3.9.5.2 Replacement Power Alternatives: Common Impacts

The potential for impacts to historic and cultural resources from construction and operation of a replacement power alternative would vary greatly depending on the location of the site. If construction and operation of replacement power alternatives require a Federal undertaking (e.g., license, permit), in accordance with Section 106 of the NHPA, a reasonable effort to identify historic properties within the APE and consideration of the effects of their undertakings on historic properties would be required. Historic and cultural resources identified would need to be recorded and evaluated for eligibility for listing on the NRHP. If historic properties are present and could be affected by the undertaking, adverse effects would be assessed, determined, and mitigated with the State Historic Preservation Officer and any American Indian Tribe that attaches religious and cultural significance to identified historic properties through the Section 106 consultation process.

Construction

Impacts to historic and cultural resources from the construction of replacement power alternatives are primarily related to ground disturbance (e.g., land clearing, excavations). The potential impact on historic and cultural resources during the construction of replacement power-generating facilities would vary depending on the degree disturbance. Areas subject to ground disturbance would need to be surveyed to identify and record historic and cultural material. In accordance with 36 CFR Part 800 (TN513), any historic and cultural resources found during these surveys would need to be evaluated for eligibility for listing in the NRHP if construction of the replacement alternative requires a Federal undertaking. Areas of greatest cultural sensitivity should be avoided while maximizing the use of previously disturbed areas. Viewshed impacts to historic and cultural resources present can occur from the introduction of structures and new transmission lines that are out of character with the current setting.

Operations

The potential for impacts on historic and cultural resources from the operation of replacement power alternatives would be related to ground disturbing activities at the site or modifications to the facility. Areas subject to ground disturbance would need to be surveyed to identify and record historic and cultural material. Avoidance of historic and cultural resources should be possible and effectively managed. Modifications to structures would have the potential for viewshed impacts to historic and cultural resources.

3.9.5.3 Natural Gas and Renewables Alternative

Impacts on historic and cultural resources from the construction and operation of a natural gas and renewable alternative would include those discussed above as impacts common to all replacement alternatives (see Section 3.9.5.2). The potential for impacts during construction on historic and cultural resources of this alternative would vary greatly, depending on the location of the proposed sites. The construction of a natural gas, two-unit combustion turbine power plant and wind turbines could be at an existing power plant or a greenfield site. The potential for impacts on historic and cultural resources would result from land disturbances. Impacts would depend on the resource richness of the sites, the gas pipeline corridor, and transmission corridors. Using previously disturbed sites (such as at an existing power plant site) and co-locating any new transmission lines with existing rights-of-way could minimize impacts to historic and cultural resources. Aesthetic changes from new structures and new transmission lines could have a noticeable effect on the viewshed of historic and cultural resources present. If an existing power plant site is selected, the NRC does not anticipate viewshed impacts to historic or cultural resources from the introduction of structures as they would be compatible with the power plant setting. However, if a greenfield site is selected, viewshed impacts to historic or cultural resources could occur from the introduction of new structures that are not compatible with the setting.

Solar panels could be installed at as many as three locations, both on the Monticello site and offsite in Minnesota or elsewhere in Xcel Energy’s service area. Installation of solar panels would require 1,500 ac (586 ha) and an additional 1,450 ac (586 ha) for a new transmission corridor. Wind turbines could be installed offsite within Minnesota or elsewhere in Xcel Energy’s service area. Utility-scale wind farms would require relatively large areas. Approximately 66,000 ac (2,709 ha) would be disturbed during installation of the wind turbines and would require an additional 2,700 ac (1,093 ha) for a new transmission corridor. The potential for impacts on historic and cultural resources from the solar and wind components would result from land disturbances and aesthetic changes that could have a noticeable effect on the viewshed of nearby historic properties. Using previously disturbed sites (such as the Monticello site) and co-locating any new transmission lines with existing rights-of-way could minimize impacts to historic and cultural resources.

The potential for impacts on historic and cultural resources from purchased power or existing natural gas power plants would depend on the need for plant modifications. For instance, if purchased power would require plant modifications at existing facilities or construction of transmission lines requiring land disturbance, there is a potential for impacts on historic and cultural resources. However, if there are no changes to the facilities or no need for additional transmission lines, impacts on historic and cultural resources would not be anticipated.

Routine facility operations would not result in impacts to historic and cultural resources. Any maintenance activities that require ground disturbing activities have the potential to impact historic and cultural resources. Ground disturbing maintenance activities in previously disturbed areas within the sites would minimize impacts to historic and cultural resources.

Overall, the potential for impacts on historic and cultural resources from construction and operation of a natural gas and renewables alternative would vary greatly depending on site locations and resources present.

3.9.5.4 Renewables and Storage Alternative

Impacts on historic and cultural resources from the construction and operation of a renewables and storage alternative would include those discussed above as impacts common to all replacement alternatives (see Section 3.9.5.2). The potential for impacts during construction on historic and cultural resources from the wind and solar portion of this alternative would vary greatly, depending on the location of the proposed sites. Wind turbines could be installed offsite within Minnesota or elsewhere in Xcel Energy’s service area. Utility-scale wind farms would require relatively large areas. Approximately 84,000 ac (3,400 ha) would be disturbed during installation of the wind turbines and would require an additional 2,700 ac (1,093 ha) for a new transmission corridor. Solar panels could be installed at as many as three sites, both on the Monticello site and offsite in Minnesota or Xcel Energy’s service area. Installation of solar panels would require 5,300 ac (2,144 ha) and additional 4,500 ac (1,821 ha) for a new transmission corridor. Construction of wind turbines (their support infrastructure) and solar panels, and to a lesser extent, battery storage, could impact historic and cultural resources because of earth moving activities (e.g., grading and digging) and aesthetic changes that could have a noticeable effect on the viewshed of resources nearby. Using previously disturbed sites and co-locating any new transmission lines with existing rights-of-way could minimize impacts to historic and cultural resources.

The potential for impacts on historic and cultural resources from purchased power or existing natural gas power plant would depend on the need for plant modifications. For instance, if purchased power would require plant modifications at existing facilities or construction of transmission lines requiring land disturbance, there is a potential for impacts on historic and cultural resources. However, if there are no changes to the facilities or no need for additional transmission lines, impacts on historic and cultural resources would not be anticipated.

Routine facility operations of the renewable and storage alternative would not result in impacts to historic and cultural resources. Any maintenance activities that require ground-disturbing activities has the potential to impact historic and cultural resources. Ground disturbing maintenance activities in previously disturbed areas within the sites would minimize impacts to historic and cultural resources.

Overall, the potential for impacts on historic and cultural resources from construction and operation of a renewable and storage alternative would vary greatly depending on site locations and resources present.

3.9.5.5 New Nuclear (Small Modular Reactor) Alternative

Impacts on historic and cultural resources from the construction and operation of a new nuclear alternative (12 unit small modular reactor power plant) would include those discussed above as impacts common to all replacement alternatives (see Section 3.9.5.2). The construction of new nuclear alternative would require 130 ac (52 ha) and would be located at a greenfield site or existing power plant site outside of Minnesota, but within Xcel Energy’s service area. An additional 450 ac (182 ha) would be needed for the new transmission corridor. The potential for impacts on historic and cultural resources would result from land disturbances. Impacts would depend on the resource richness of the site and transmission corridor. Using previously disturbed sites (such as at an existing power plant site) and co-locating any new transmission lines with existing rights-of-way could minimize impacts to historic and cultural resources. Aesthetic changes from the 76 ft (23 m) tall containment structure, steam plume from cooling towers, and new transmission lines could have a noticeable effect on the viewshed of historic and cultural resources present. If an existing power plant site is selected, the NRC staff does not anticipate viewshed impacts to historic or cultural resources from the introduction of structures as they would be compatible with the power plant setting. However, if a greenfield site is selected, viewshed impacts to historic or cultural resources could occur from the introduction of new structures.

Routine normal plant operations would not result in impacts to historic and cultural resources. Any maintenance activities that require ground disturbing activities has the potential to impact historic and cultural resources. Ground disturbing maintenance activities in previously disturbed areas within the site would minimize impacts to historic and cultural resources. Modifications or additions to the existing facility would have the potential to cause viewshed impacts to historic and cultural resources.

Overall, the potential for impacts on historic and cultural resources from construction and operation of a new nuclear alternative would vary greatly depending on the location of the site.

3.10 Socioeconomics

This section describes current socioeconomic factors that have the potential to be affected by changes in power plant operations at Monticello. Monticello and the communities that support it can be described as a dynamic socioeconomic system. The communities supply the people, goods, and services required to operate the nuclear power plant. Nuclear power plant operations, in turn, supply wages and benefits for people and dollar expenditures for goods and services. The measure of a community’s ability to support Monticello continued reactor operations depends on its ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Nuclear Power Plant Employment

The socioeconomic ROI is defined by the areas where Monticello workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions of the region. Xcel Energy employs a permanent and supplementary full-time workforce of 663 workers (Xcel 2023-TN9084). Sixty-six percent of Monticello permanent workers reside in Sherburne and Wright Counties, Minnesota (Xcel 2023-TN9084). The remaining workers are spread among other counties in Minnesota and other States (Xcel 2023-TN9084) (Table 3-21). Because most Monticello workers are based in Sherburne and Wright Counties, the greatest socioeconomics effects are likely to be experienced there. The focus of the impact analysis, therefore, is on the socioeconomic impacts of continued Monticello operation in Sherburne and Wright counties.

Table 3-21 Residence of Xcel Energy Permanent Employees

State or County	Number of Employees	Percentage of Total
Sherburne	146	39
Wright	102	27
Hennepin	42	11
Stearns	37	10
Other Minnesota counties	44	12
Other States	3	1
Total	374	100

Refueling outages occur on a 2 year staggered cycle during April and May. Refueling outages last 25–33 days and additional 650 workers are onsite during a typical outage (Xcel 2023-TN9084).

3.10.2 Regional Economic Characteristics

Goods and services are needed to operate the Monticello site. Although procured from a wider region, some portion of these goods and services are purchased directly from within the socioeconomic ROI. These transactions sustain existing jobs and maintain income levels in the local economy. This section presents information about employment and income in the Monticello socioeconomic ROI.

3.10.2.1 Regional Employment and Income

According to the U.S. Census Bureau's (USCB's) 2017–2021 American Community Survey 5-Year Estimates, educational services and the healthcare and social assistance industry represented the largest employment sector in the socioeconomic ROI, followed by manufacturing (USCB 2022-TN9556). The Sherburne and Wright County civilian labor force consisted of 130,919 individuals and the number of employed individuals was 127,600 (USCB 2022-TN9556). Estimated income information for the socioeconomic ROI is presented in Table 3-22.

Table 3-22 Estimated Income Information for the Monticello Socioeconomic Region of Influence (2017–2021, 5-Year Estimates)

Metric	Sherburne County	Wright County	Minnesota
Median household income (dollars)[(a)]	92,374	94,276	77,706
Per capita income (dollars)(a)	38,423	39,327	41,204
Families living below the poverty level (percent)	3	3.3	5.6
People living below the poverty level (percent)	5	4.9	12.6
Unemployment rate	2.7	2.4	4.0

(a) In 2019 inflation-adjusted U.S. dollars.
Source USCB 2022-TN9556

3.10.2.2 Unemployment

As shown in Table 3-22, people living in the two-county socioeconomic ROI had a median household income greater than the State average. Additionally, the percentage of individuals living below the poverty level in Sherburne and Wright counties was lower than the percentage of individuals living below the poverty level in the State of Minnesota.

According to the USCB 2017–2021 American Community Survey 5-Year Estimates, the unemployment rate in Sherburne County and Wright Counties were 2.7 and 2.4 percent, respectively. Comparatively, the unemployment rate in Minnesota during this same time period was 4 percent (USCB 2022-TN9556).

3.10.3 Demographic Characteristics

According to the 2020 Census, an estimated 258,805 people live within 20 mi (32 km) of Monticello, which equates to a population density of 206 persons per square mile (Xcel 2023-TN9084). This amount translates to a Category 4 population density using the LR GEIS (NRC 1996-TN288) measure of sparseness, which is defined as “greater than or equal to 120 persons per square mile within 20 mi (32 km).” An estimated 3,285,866 people live within a 50 mi (80 km) radius of the Monticello site, which equates to a population density of 418 persons per square mile (Xcel 2023-TN9084). This translates to a Category 4 proximity index. Therefore, Monticello is a combination of “sparseness” Category 4 and “proximity” Category 4 translating to a “high” population area based on the LR GEIS spareness and proximity matrix (NRC 1996-TN1162).

shows population projections and percent growth from 2000 to 2050 for Sherburne and Wright counties. During the last several decades, both counties have experienced increasing population. Based on population projections, the population in both counties is generally expected to continue to increase through 2050, but at a slower rate.

The 2020 Census demographic profile of the Monticello ROI population is presented in Table 3-24. According to the 2020 Census, minorities (race and ethnicity combined) composed 11.6 percent of the total population in the socioeconomic ROI. The largest minority population of any race in the socioeconomic ROI were two or more races (3.9 percent of total population; 33 percent of the total minority population) and Hispanic of any race (3.2 percent of the total population; 27 percent of the total minority population) (USCB 2020-TN9673).

According to the USCB’s 2017–2021 5-year estimates, minority populations in the two-county socioeconomic ROI were relatively stable at 11.7 percent (see Table 3-25).

Table 3-23 Population and Percent Growth in Monticello Socioeconomic Region of Influence Counties

Metric	Year	Sherburne County Population	Sherburne County Percent Change	Wright County Population	Wright County Percent Change
Recorded	2000	64,417	-	89,986	-
Recorded	2010	88,499	3.23	124,700	3.32
Recorded	2020	97,183	0.94	141,337	1.26
Projected	2030	106,065	0.88	152,493	0.76
Projected	2040	113,712	0.70	164,652	0.77
Projected	2050	120,188	0.56	175,236	0.62

Sources: USCB 2000-TN9672 Xcel 2023-TN9084.

Table 3-24 Demographic Profile of the Population in the Monticello Two-County Region of Influence, 2020

Demographic	Sherburne County	Wright County	Region of Influence
Total population	**97,183**	**141,337**	**238,520**
Percent White race	87.2	89.2	88.4
Percent Black or African American race	3.8	1.8	2.6
Percent American Indian and Alaska Native race	0.4	0.2	0.3
Percent Asian race	1.3	1.3	1.3
Percent Native Hawaiian and Other Pacific Islander race	0.0	0.0	0.0
Percent some other race	0.3	0.4	0.3
Percent two or more races	4.1	3.7	3.9
Hispanic, Latino, or Spanish Ethnicity of Any Race (Total Population)	2,820	4,697	7,517
Percent Hispanic, Latino, or Spanish Ethnicity of Any Race of total population	2.9	3.3	3.2

Source: USCB 2020-TN9673.

Table 3-25 Demographic Profile of the Population in the Monticello Two-County Region of Influence, 2017–2021 (5-Year Estimates)

Demographic	Sherburne County	Wright County	Region of Influence
Total population	**96,295**	**139,890**	**236,185**
Percent White race	89.1	91.4	91.4
Percent Black or African American race	2.9	1.6	2.2
Percent American Indian and Alaska Native race	0.4	0.3	0.3
Percent Asian race	1.4	1.2	1.3
Percent Native Hawaiian and other Pacific Islander race	0.0	0.0	0.0
Percent some other race	1.7	1.2	1.4
Percent two or more races	3.6	3.2	3.4
Hispanic, Latino, or Spanish Ethnicity of Any Race (Total Population)	2,704	4,501	7,205
Percent Hispanic, Latino, or Spanish Ethnicity of Any Race of total population	2.8	3.2	3.1

Source: USCB 2020-TN9673.

3.10.3.1 Transient Population

Sherburne County and Wright County can experience seasonal transient population growth as a result of local tourism and recreational activities associated with multiple Federal, State, and local parks as well as camping areas in the counties. There are 53 public use lands within 6 mi (10 km) of Monticello. The closest public use lands include a portion of the Mississippi River State Wild and Scenic Recreational District, all of the Mississippi Island Sherburne State Aquatic Management Area, and the Mississippi Island Wright State Aquatic Management Area within the Monticello site boundary. A transient population creates a demand for temporary housing and services in the area.

Based on the Census Bureau's 2017–2021 American Community Survey 5-year estimates (USCB 2022-TN9556), 3,019 seasonal housing units are located in the two-county socioeconomic ROI.

3.10.3.2 Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting to census data collectors. If uncounted, these minority and low-income workers are underrepresented in the decennial Census population counts.

Since 2002, the Census of Agriculture has reported the numbers of farms hiring migrant workers defined as a farm worker whose employment required travel that prevented the worker from returning to his or her permanent place of residence the same day (USDA 2017-TN9674). The Census of Agriculture is conducted every 5 years and results in a comprehensive compilation of agricultural production data for every county in the nation.

Information about both migrant and temporary farm labor (i.e., working fewer than 150 days) can be found in the 2017 Census of Agriculture. Table 3-26 presents information about migrant and temporary farm labor in Sherburne and Wright Counties. According to the 2017 Census of Agriculture, 676 farm workers were hired to work for fewer than 150 days and were employed on 184 farms in the two-county socioeconomic ROI. Thirteen farms in Sherburne County and five farms in Wright County reported hiring migrant workers.

Table 3-26 Migrant Farm Workers and Temporary Farm Labor in Counties Located in the Socioeconomic Region of Influence (50 mi [80 km]) of Monticello

County[(a)]	Number of Farms with Hired Farm Labor[(b)]	Number of Farms Hiring Workers for Less Than 150 Days[(b)]	Number of Farm Workers Working for Less Than 150 Days[(b)]	Number of Farms Reporting Migrant Farm Labor[(b)]
Sherburne	101	58	260	13
Wright	278	126	416	5
Total	379	184	676	18

Source: Table 7. Hired farm Labor—Workers and Payroll: 2017 (USDA 2017-TN9674).

3.10.4 Housing and Community Services

3.10.4.1 Housing

Table 3-27 lists the total number of occupied and vacant housing units, vacancy rates, and median values in the two-county socioeconomic ROI. Based on the USCB's 2017–2021 American Community Survey 5-year estimates, there were 89,342 housing units in the ROI, of which 70,261 were occupied. The median values of owner-occupied housing units in the ROI is $265,000. The homeowner vacancy rate was approximately 0.4 percent in both counties (USCB 2022-TN9556).

Table 3-27 Housing in the Monticello Region of Influence (2017–2021, 5-Year Estimate)

Housing Data	Sherburne County	Wright County	Region of Influence
Total housing units	**35,491**	**53,851**	**89,342**
Occupied housing units	33,825	50,290	84,115
Total vacant housing units	1,666	3,561	5,227
Percent total vacant	5%	7%	6%
Owner occupied units	28,500	41,761	70,261
Median value (dollars)	264,500	265,500	265,103[a]
Owner vacancy rate (percent)	0.4	0.4	0.4[b]
Renter occupied units	5,325	8,529	13,854
Median rent (dollars/month)	1,055	1,072	1,065[c]
Rental vacancy rate (percent)	3.8	3	3.3[b]

(a) Weighted average by owner-occupied units in Sherburne County and Wright County.
(b) Weighted average by total housing units in Sherburne County and Wright County.
(c) Weighted average by occupied units paying rent in Sherburne County and Wright County.
Source: USCB 2022-TN9556.

3.10.4.2 Education

Sherburne County comprises of three public school districts, with a total of 19,792 students in 42 schools (NCES 2024-TN9724, NCES 2024-TN9725). These 42 public schools include 18 elementary schools, 9 middle schools, and 15 high schools. Wright County comprises 12 public school districts, with approximately 27,000 students in over 75 schools. (NCES 2024-TN9724, NCES 2024-TN9725).

3.10.4.3 Public Water Supply

Water service is supplied to residents of Sherburne County by eight public water systems and to Wright County by 19 public water systems (Xcel 2023-TN9084). The primary source of water for Sherburne and Wright County is groundwater. Both counties have sufficient capacity for water supply and are projected to continue to have sufficient capacity into the future.

3.10.5 Tax Revenues

Xcel Energy pays property taxes to the State of Minnesota and to four local tax jurisdictions including Wright County, the city of Monticello, the Monticello Public School District (PSD) #882-01, and the Economic Development Authority in support of Monticello Housing Redevelopment Authority initiative. Table 3-28 presents Monticello's annual property tax payments to each local tax jurisdiction as well as the annual revenue of each jurisdiction from 2017–2022. Monticello property taxes are a significant source of revenue for several jurisdictions and Xcel Energy is the largest taxpayer in the county (Xcel 2023-TN9084). Xcel Energy's tax payments have remained consistent the last 6 years. Xcel Energy also pays into the State general tax revenue fund, these payments were between $1.1 million and $1.3 million between 2017 and 2022 and represent less than 1 percent of the State's total tax revenue.

Xcel Energy also contributes $1.6 million annually in support of emergency planning and preparedness to the State of Minnesota Homeland Security and Emergency Management in 2022.

Table 3-28 Monticello Property Tax Payments by Local Tax Jurisdiction, 2017–2022

Jurisdiction	2017	2018	2019	2020	2021	2022
Wright County – Annual Revenue	119,225,722	138,724,187	151,084,235	187,838,242	171,533,344	171,866,785
Wright County – Monticello Nuclear Generating Plant (Monticello) Property Tax Paid	6,589,558	7,013,061	7,058,266	6,988,007	7,103,919	6,681,301
Wright County – % of Annual Revenue	6	5	5	4	4	4
City of Monticello – Annual Revenue	25,030,313	26,313,579	32,500,261	34,347,195	37,051,766	34,527,054
City of Monticello – Monticello Property Tax Paid	5,520,060	5,676,495	5,462,252	5,500,769	5,794,246	5,579,484
City of Monticello – % of Annual Revenue	22	22	17	16	16	16
Monticello PSD 882-01 – Annual Revenue	50,631,365	55,184,742	56,195,029	58,533,716	60,609,014	63,201,820
Monticello PSD 882-0 – Monticello Property Tax Paid	4,469,195	4,551,474	4,450,457	4,040,190	4,076,957	3,724,864
Monticello PSD 882-0t – % of Annual Revenue	9	8	8	7	7	6
Other EDA/MHRA – Annual Revenue	1,012,481	1,007,703	1,174,749	1,323,022	1,126,638	1,617,733
Other EDA/MHRA – Monticello Property Tax Paid	168,903	192,066	190,833	186,888	191,901	190,737
Other EDA/MHRA – % of Annual Revenue	17	19	16	14	17	12
Total – Annual Revenue	195,899,881	221,230,211	240,954,274	282,042,175	270,320,762	271,213,392
Total – Monticello Property Tax Paid	16,747,716	17,433,096	17,161,808	16,715,854	17,167,023	16,176,386
Total – % of Annual Revenue	9	8	7	6	6	6

EDA = Economic Development Authority; MHRA = Monticello Housing Redevelopment Authority; PSD = Public School District.
Source: Xcel 2023-TN9084, Xcel 2023-TN9578, Wright County 2023-TN9839, City of Monticello 2022-TN9838, MPSD 2023-TN9837.

3.10.6 Local Transportation

The transportation network surrounding the Monticello site comprises Interstate and State highways and local roads. Interstate 94 (I-94) is a major interstate highway southwest of Monticello that runs east–west through Minnesota. County Road 75 NE is a two-lane paved road that's runs parallel to I-94 and connects commuter traffic to plant entrance roads. As shown in Table 3-29, average annual daily traffic volumes for County Road 75 between 2000 and 2016 have remained consistent. Based on those volumes the level-of-service (LOS) rating for County Road 75 NE ranges between LOS "A" to LOS "C" (Xcel 2023-TN9084).

Within a 10 mi (16 km) radius of Monticello, there are four private airports/heliports and two public airports (Xcel 2023-TN9084). The Minneapolis-St Paul International Airport is 44 mi southeast of Monticello.

Table 3-29 Total Average Annual Daily Traffic Counts on County Road 75

Roadway and Location	Annual Average Daily Traffic Volume Estimates				
Year	2000	2004	2008	2012	2016
County Road 75 (NW of Monticello Nuclear Generating Plant [Monticello] plant entrance)	1,050	3,300	3,650	NA	1,600
County Road 75 (SE of Monticello plant entrance)	3,250	3,700	3,350	3,500	3,350

NA = not available; NW = northwest; SE = southeast.
Source: Xcel 2023-TN9084.

3.10.7 Proposed Action

The following sections address the site-specific environmental impacts of the Monticello SLR on environmental issues related to socioeconomics.

3.10.7.1 Employment and Income, Recreation and Tourism

Nuclear power plants generate employment and income in the local economy. Therefore, continued operations associated with SLR can impact employment, income, recreation, and tourism. Nuclear power plant operations provide employment and income and pays for goods and services from local communities. Wages, salaries, and expenditures generated by nuclear plant operation create demand for goods and services in the local economy, while wage and salary spending by workers creates additional demand for services and housing. Payments for these goods and services create additional employment and income opportunities in the community. Communities located near nuclear power plants may experience population increases due to the increased demand for goods and services from plant workers and visitors. Communities located near nuclear power plants may experience summer, weekend, and retirement population increases due to the recreational and tourism related activities that attract visitors. Xcel Energy indicated in its ER that it has no plans to increase or decrease its workforce, will not conduct refurbishment activities, and does not anticipate changes to Monticello during the SLR term (Xcel 2023-TN9084). Consequently, people living near Monticello would not experience any changes in employment, income, recreation, and tourism during the SLR term beyond what is currently being experienced. Employment, income, recreational, and tourism are not expected to change. Based on this information, the NRC staff concludes that employment, income, recreational, and tourism impacts during the Monticello SLR term would be SMALL.

3.10.7.2 Tax Revenues

Nuclear plants provide tax revenue to local jurisdictions in the form of property tax payments, payments in lieu of tax payments, or tax payments related to energy production. Changes in the workforce and property taxes, or property tax payments to local governments and public schools, can directly affect socioeconomic conditions in the counties and communities near the nuclear power plant. Since commencement of reactor operations, Monticello has become a well-established source of property and sales tax revenue in local communities. As shown in Table 3-8, Monticello contributes an appreciable percentage of the total tax revenue collected by Wright County and the City of Monticello, respectively, most recently totaling from 4% to 16%. Xcel Energy indicated in its ER that it has no plans to conduct refurbishment activities during the SLR term that would affect the value of Monticello (Xcel 2023-TN9084). Therefore, tax payments during the SLR term would be similar to those already being paid. Based on these considerations, the NRC staff concludes that tax revenue impacts during the SLR term would be SMALL.

3.10.7.3 Community Service and Education

Nuclear plant operations as a result of workforce changes can affect the availability and quality of community (i.e., public safety and public utilities) and educational services. An increase in operations workforce and related populations can increase the demand and cause disruption of community services and education. The impact on community and educational services will depend on the projected number of in-migrating workers and their families during the SLR term and the ability to respond to the level of demand for services. Tax payments from nuclear power plants can support a range of community services and have a beneficial impact on the quality and availability of these services to local residents. Xcel Energy indicated in its ER that it has no plans to increase or decrease its workforce and will not conduct refurbishment activities affecting the value of Monticello (Xcel 2023-TN9084) and property tax payments. Therefore, revenue from Monticello property tax payments used to support community services and education are not expected to change. Based on these considerations, the NRC staff concludes that impacts to community services and education during the SLR term would be SMALL.

3.10.7.4 Population and Housing

The availability of resources like housing are affected by changes in population. For example, plant-induced population growth could cause a greater need for permanent housing and lead to a regional housing shortage or increases in housing prices for the community. In its ER, Xcel Energy states that it does not plan to increase or decrease its regular workforce during the SLR term. Xcel Energy also states that it will continue to require approximately 650 additional temporary workers to support regular refueling outages on a two-year schedule. Because these refueling outages have long occurred on an expected schedule, there is sufficient short-term rental housing in the vicinity of the plant for refueling outage workers without affecting the availability of regular rental housing in the community. Xcel Energy also does not plan any refurbishment activities during the SLR term that might require supporting workers that require housing. Because the size of the Monticello workforce will remain the same during the SLR term, the staff concludes the impact of SLR on population and housing would be SMALL.

3.10.7.5 Transportation

This issue concerns how Monticello SLR could impact local transportation. Transportation impacts depend on many factors including the size of the workforce, the capacity of the local road networks, and the availability of alternate commuting routes to and from the plant. As stated in Xcel Energy's ER, Monticello currently employes 663 full and part time regular workers. The plant requires an additional 650 temporary workers for refueling outages which occur every two years. In its ER, Xcel Energy states that it has no plans to increase or decrease its workforce during the SLR term. Aside from routine plant operations, major construction and refurbishment projects can also cause transportation impacts by requiring temporary workers to support the projects. The ER states that Xcel Energy has no plans to conduct refurbishment activities during the SLR term. Since the size of the Monticello workforce will remain the same during the SLR term with no temporary or permanent increase in workforce above current operations, the NRC staff concludes that transportation impacts during the SLR term will be SMALL.

3.10.8 No-Action Alternative

3.10.8.1 Socioeconomics

Under the no-action alternative, the NRC would not renew the operating license, and Monticello would shut down on or before the expiration of the current facility operating license. This would have a noticeable impact on socioeconomic conditions in the counties and communities near Monticello. The loss of jobs, income, and tax revenue would have an immediate noticeable socioeconomic impact. As jobs are eliminated, some, but not all, of the more than 660 workers could leave. Income from the buying and selling of goods and services needed to maintain the nuclear power plant would also be reduced. In addition, loss of tax revenue could affect the availability of public services.

If workers and their families move away, increased vacancies and reduced demand for housing would likely cause property values to fall. The greatest socioeconomic impact would be experienced in the communities located nearest to Monticello in Sherburne and Wright counties. However, the loss of jobs, income, and tax revenue may not be as noticeable in large communities due to the time and steps required to prepare the nuclear power plant for decommissioning. Also, Monticello would continue to pay taxes, albeit in amounts based on the reduced value of its facility following shutdown, while decreased tax revenue from Monticello could possibly be obtained by taxing authorities by other means. Therefore, depending on the jurisdiction, socioeconomic impacts from not renewing the operating license and terminating reactor operations at Monticello could range from SMALL to LARGE, depending on the affected community.

3.10.8.2 Transportation

Traffic volume on roads near Monticello may be noticeably reduced after the termination of reactor operations. Any reduction in traffic volume would coincide with workforce reductions at Monticello. The number of truck deliveries and shipments would also be reduced until active decommissioning. Therefore, due to the time and steps required to prepare the nuclear power plant for decommissioning, traffic-related transportation impacts would be SMALL.

3.10.9 Replacement Power Alternatives: Common Impacts

Replacement power alternative facilities could be constructed in any State in the ROI for the Xcel Energy service area, with some exceptions. These States include Colorado, Michigan, New Mexico, North Dakota, South Dakota, Texas, Wisconsin, and Minnesota. Under Minnesota law, no new nuclear plants can be built in the State. Therefore, any new nuclear alternative would be built in one of the other States in the ROI. Workforce requirements for replacement power alternatives were evaluated to measure their possible effects on current socioeconomic and transportation conditions. Table 3-30 summarizes socioeconomic and transportation impacts of replacement power alternatives. The following sections provides a discussion of the common socioeconomic and transportation impacts during construction and operations of replacement power-generating facilities.

Table 3-30 Socioeconomic and Transportation Impacts of Replacement Power Alternatives

Alternative	Resource Requirements	Impacts	Discussion
New Nuclear (SMRs)	Construction: peak 1,200 workers for several months	MODERATE to LARGE	If all 12 SMRs are constructed/installed at the same time. Noticeable traffic impacts.
New Nuclear (SMRs)	Operations: 600 workers	SMALL	If all 12 SMRs are constructed/installed at the same time. Approximately same number of operations workers as Monticello.
Natural Gas and Renewables	Construction: peak 800 (NGCC), 140 (Solar), 450 (Wind) workers for several months	MODERATE	Workers would likely be scattered throughout the region and would not have a noticeable effect on local economy.
Natural Gas and Renewables	Operations: 150 workers (NGCC), 15 (Solar), 40 (Wind)	SMALL	If all four combined-cycle combustion turbines are constructed/installed at the same time. Some operations workers could transfer from Monticello.
Renewables and Storage Alternative	Construction: peak 700 (Solar & battery), and 580 (Wind) workers for several months	MODERATE	Workers would likely be scattered throughout the region and would not have a noticeable effect on local economy.
Renewables and Storage Alternative	Operations: 75 (Solar & battery), and 55 (Wind) workers	SMALL	Workers would likely be scattered throughout the region and would not have a noticeable effect on local economy.

NGCC = natural gas-fired combined-cycle; SMR = small modular reactors.
Source: BLM 2019-TN8386; DOE 2011-TN8387; NRC 2011-TN6437; Xcel 2023-TN9084; NRC 2019-TN6136; Tegen 2016-TN8826.

3.10.9.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes in the social and economic conditions of a region. For example, the creation of jobs and the purchase of goods and services during the construction and operation of a replacement power plant could affect regional employment, income, and tax revenue. For each alternative, two types of jobs would be created:

(1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts.

While the selection of a replacement power alternative could create opportunities for employment and income and generate tax revenue in the local economy, employment, income, and tax revenue could be greatly reduced or eliminated in communities located near Monticello. These impacts are described in the “No-Action Alternative” (Section 3.10.8).

3.10.9.1.1 Construction

The relative economic effect of an influx of workers on the local economy and tax base would vary and depend on the size of the workforce and construction phase. The greatest impact would occur in the communities where the majority of construction workers would reside and spend their incomes. As a result, some local communities could experience a short-term economic boom during construction from increased tax revenue, income generated by expenditures for goods and services, and increased demand for temporary (rental) housing. After construction, local communities would likely experience a return to preconstruction economic conditions.

3.10.9.1.2 Operation

Before the commencement of startup and operations, local communities could see an influx of operations workers and their families resulting in an increased demand for permanent housing and public services. These communities would also experience the economic benefits from increased income and tax revenue generated by the purchase of goods and services needed to operate a new replacement power plant. Consequently, power plant operations would have a greater potential for effecting permanent, long term socioeconomic impacts on the region.

3.10.9.1.3 Transportation

Transportation impacts are defined in terms of changes in LOS conditions on local roads. Additional vehicles during construction and operations could lead to traffic congestion and LOS impacts on local roadways and delays at intersections.

3.10.9.1.4 Construction

Transportation impacts would consist of commuting workers and truck deliveries of equipment and material to the construction site. Traffic volumes would increase substantially during shift changes. Trucks would deliver equipment and material to the construction site and remove waste material, thereby increasing the amount of traffic on local roads. The increase in traffic volumes could result in LOS impacts and delays at intersections during certain hours of the day. In some instances, construction material could also be delivered and removed by rail or barge.

3.10.9.1.5 Operation

Traffic volumes would be greatly reduced after construction because of the smaller size of the operations workforce. Transportation impacts would consist of commuting operations workers, truck deliveries, and removal of waste material.

3.11 Human Health

Monticello is both an industrial facility and a nuclear power plant. Similar to any industrial facility or nuclear power plant, the operation of Monticello during the SLR period will produce various human health risks for workers and members of the public. This section describes the human health risks resulting from the operation of Monticello, including from radiological exposure, chemical hazards, microbiological hazards, electromagnetic fields, and other hazards. The description of these risks is followed by the NRC staff's analysis of the potential impacts on human health from the proposed action (SLR) and alternatives to the proposed action.

3.11.1 Radiological Exposure and Risk

Operation of a nuclear power plant involves the use of nuclear fuel to generate electricity. Through the fission process, the nuclear reactor splits uranium atoms, resulting very generally in (1) the production of heat, which is then used to produce steam to drive the nuclear power plant's turbines and generate electricity; and (2) the creation of radioactive byproducts. As required by NRC regulations at 10 CFR 20.1101, "Radiation protection programs," (TN283) Xcel Energy designed a radiation protection program to protect on-site personnel (including employees and contractor employees), visitors, and off-site members of the public from radiation and radioactive material at Monticello. The Monticello radiation protection program is extensive and includes, but is not limited to, the following:

- Organization and Administration (e.g., a radiation protection manager who is responsible for the program and ensures trained and qualified workers for the program)
- Implementing Procedures
- An as low as reasonably achievable (ALARA) program to minimize radiation dose to workers and members of the public
- Dosimetry Program (i.e., measure radiation dose to nuclear power plant workers)
- Radiological Controls (e.g., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements)
- Radiation Area Entry and Exit Controls (e.g., locked or barricaded doors, interlocks, local and remote alarms, personnel contamination monitoring stations)
- Posting of Radiation Hazards (i.e., signs and notices alerting nuclear power plant personnel of potential hazards)
- Recordkeeping and Reporting (e.g., documentation of worker dose and radiation survey data)
- Radiation Safety Training (e.g., classroom training and use of mockups to simulate complex work assignments)
- Radioactive Effluent Monitoring Management (i.e., controlling and monitoring radioactive liquid and gaseous effluents released into the environment)
- Radioactive Environmental Monitoring (e.g., sampling and analysis of environmental media, such air, water, groundwater, milk, food products, and sediment to measure the levels of radiation emitted into the environment that may impact human health)
- Radiological Waste Management (i.e., controlling, monitoring, processing, and disposing of radioactive solid waste)

For radiation exposure to Monticello personnel, the NRC staff reviewed the data contained in NUREG-0713, Volume 42, *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities 2020: Fifty-Third Annual Report* (NRC 2022-TN8530). The Fifty-Third Annual Report was the most recent annual report available at the time of this environmental review. It summarizes the occupational exposure data in the NRC's Radiation Exposure Information and Reporting System database through 2020. Nuclear power plants are required by 10 CFR 20.2206, "Reports of individual monitoring," to report their occupational exposure data to the NRC annually (TN283).

NUREG-0713 contains a calculation of a 3-year average collective dose per reactor for workers at all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in the Reactor Oversight Process to evaluate the applicant's ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material during a 1-year time period. There are no NRC or EPA standards for collective dose. Based on the data for operating boiling water reactors like the unit at Monticello, the average annual collective dose per reactor year was 106-person roentgen equivalent man (rem) (NRC 2022-TN8530). In comparison, Monticello had a reported annual collective dose per reactor year of 60 person-rem.

Section 3.13.1, "Radioactive Waste," of this site-specific EIS discusses off-site dose to members of the public.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like Monticello manage minor chemical spills. Chemical and hazardous wastes can potentially affect workers, members of the public, and the environment.

At Monticello, chemical effects could result from discharge of waste, heavy metal leaching, the use and disposal of chemicals, and chemical spills. Workers may encounter chemicals when adjusting coolant systems, applying biocides, during maintenance activities on equipment containing hazardous chemicals, and when solvents are used for cleaning (Xcel 2023-TN9084).

Xcel Energy currently controls the use, storage, and discharge of chemicals, biocides, and sanitary wastes at Monticello in accordance with its chemical control procedures, waste management procedures, and Monticello site-specific chemical accident spill prevention provisions (Xcel 2023-TN9084). Xcel Energy monitors and controls discharges of chemicals, biocides, and sanitary wastes through Monticello's NPDES permit process, discussed in Section 3.5.1.3. These nuclear power plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize the impact on workers, members of the public, and the environment.

There were two inadvertent nonradioactive releases due to Monticello operations from 2016 through 2018. As discussed in ER Section 3.6.4.2.2, a Notice of Violation for carbon tetrachloride detection in Well 10 was issued by the Minnesota Department of Health in 2016. Monticello assessed water supply wells and determined a suitable alternative as discussed in the ER (Xcel 2023-TN9084). In 2020, Monticello was issued a "no further action" letter setting forth terms and conditions for Well 10. In addition, Well 10 was sealed at the end of 2020 and carbon tetrachloride is not currently being used or held in inventory at the plant. In July 2019, Monticello voluntarily reported a release of sodium hypochlorite through a floor drain. A release sampling report was completed and there was no additional follow up from the State of Minnesota regarding the release, which amounted to less than one-half gallon of water with less than 1 percent sodium hypochlorite as discussed in the ER Sections 3.6.4.2.2 and 9.5.3.7 (Xcel 2023-TN9084). At Monticello, no reportable spills occurred due to Monticello operations from October 1, 2018 through 2021. From the period of January 2022 until July 2023, Xcel Energy confirmed that no reportable inadvertent releases or spills of nonradioactive contaminants occurred (Xcel 2023-TN9578).

3.11.3 Microbiological Hazards

Microbiological hazards occur when workers or members of the public come into contact with disease-causing microorganisms, also known as etiological agents. Thermal effluents associated with nuclear power plants that discharge to a river, such as Monticello, have the potential to promote the growth of certain thermophilic microorganisms linked to adverse human health effects. Microorganisms of particular concern include several types of bacteria and the free-living amoeba *Naegleria fowleri* (*N. fowleri*). There are optimum growth temperatures for the microorganisms of concern as further discussed in the 2013 LR GEIS (NRC 2013-TN2654).

The public can be exposed to the thermophilic microorganisms during swimming, boating, or other recreational uses of freshwater. If these organisms are naturally occurring and a nuclear power plant's thermal effluent enhances their growth, the public could experience an elevated risk of infection when recreating in the affected waters. Public exposure to Legionella from nuclear power plant operation is generally not a concern because exposure risk is confined to cooling towers and related components and equipment, which are typically within the protected area of the site and, therefore, not accessible to the public.

Nuclear power plant workers can be exposed to Legionella when performing cooling system maintenance through inhalation of cooling tower vapors because these vapors are often within the optimum temperature range for Legionella growth. Nuclear power plant personnel at Monticello most likely to come in contact with aerosolized Legionella are workers who clean and maintain the condenser tubes. Nuclear power plant workers can also be exposed to *N. fowleri* during cooling water discharges. Monticello has an industrial safety program that includes procedures for entry to cooling water systems where Legionella is possible. Monticello also includes further training on Legionella exposure in the plant's annual training (Xcel 2023-TN9084).

As discussed in Section 2.2.3 of the Xcel Energy ER (Xcel 2023-TN9084), Monticello releases heated condenser cooling water to a discharge canal, which discharges to the Mississippi River. A plant computer chooses the optimal operating mode based on river flow, river temperature, and status of critical plant equipment to ensure cooling water discharges are within the limits of the NPDES permit. These modes include no cooling tower use in once-through circulation of river water and cooling tower use for closed cycle, helper mode, and partial recirculation mode. To ensure that the NPDES permit limits for discharge into the Mississippi River are maintained, Monticello replaced its two cooling towers with slightly greater cooling capacity in May of 2021 and May of 2022.

3.11.4 Electromagnetic Fields

EMFs are generated by any electrical equipment. All nuclear power plants have electrical equipment and power transmission systems associated with them. Power transmission systems consist of switching stations (or substations) located on the nuclear power plant site and the transmission lines needed to connect the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is low compared with the frequencies of 55 to 890 MHz for television transmitters and 1,000 MHz and greater for microwaves.

The scope of the evaluation of transmission lines includes only those transmission lines that connect the plant to the switchyard where electricity is fed into the regional power distribution system (encompassing those lines that connect the plant to the first substation of the regional electric power grid) and power lines that feed the plant from the grid are considered within the regulatory scope of the license renewal environmental review. Transmission lines in scope are confined to the Monticello site, spanning the short distance between the generating units and the switchyards, as depicted in Figure 2.2-3 of Xcel Energy's environmental report (Xcel 2023-TN9084)

Electric fields are produced by voltage and their strength increases with increases in voltage. A magnetic field is produced from the flow of current through wires or electrical devices, and its strength increases as the current increases. Electric and magnetic fields, collectively referred to as EMFs, are produced by operating transmission lines.

Occupational workers or members of the public near transmission lines may be exposed to the EMFs produced by the transmission lines. The EMF strength varies in time as the current and voltage change, so that the frequency of the EMF is the same (e.g., 60 Hz for standard alternating current, or AC). Electrical fields can be shielded by objects such as trees, buildings, and vehicles. Magnetic fields, however, penetrate most materials, but their strength decreases with increasing distance from the source.

The EMFs resulting from 60 Hz power transmission lines fall under the category of non-ionizing radiation. The LR license renewal GEIS (NRC 2013-TN2654) summarizes NRC accepted studies on the health effects of electromagnetic fields. There are no U.S. Federal standards limiting residential or occupational exposure to EMFs from transmission power lines, but some states have set electric field and magnetic field standards for transmission lines (NIEHS 2002-TN6560). A voluntary occupational standard has been set for EMFs by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998-TN6591). The National Institute of Occupational Safety and Health does not consider EMFs to be a proven health hazard (NIOSH 1996-TN6766).

3.11.5 Other Hazards

This section addresses two additional human health hazards: (1) physical occupational hazards and (2) occupational electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation utility. Nuclear power plant workers may perform electrical work, electric powerline maintenance, repair work and maintenance activities, and may be exposed to potentially hazardous physical conditions. A physical hazard is an action, agent or condition that can cause harm upon contact. Physical actions could include slips, trips, and falls from height. Physical agents could include noise, vibration, and ionizing radiation. Physical conditions could include high heat, cold, pressure, confined space, or psychosocial issues, such as work-related stress.

The Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. Congress created OSHA by enacting the Occupational Safety and Health Act of 1970, as amended (29 U.S.C. 651 et seq.- Occupational Safety and Health Act of 1970-TN4453) to safeguard the health of workers. With respect to nuclear power plants, nuclear power plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC as set forth in a Memorandum of Understanding (NRC and OSHA 2013-TN8542) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries caused by accidents may still occur. Xcel Energy maintains a comprehensive industrial safety program for its workers in accordance with OSHA regulations (Xcel 2023-TN9084).

Based on its evaluation in the LR GEIS (NRC 2013-TN2654), the NRC has not found electric shock resulting from direct access to energized conductors or from induced charges in metallic structures to be a problem at most operating nuclear power plants. Generally, the NRC staff also does not expect electric shock from such sources to be a human health hazard during the SLR period. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this EIS. Transmission lines that are within the scope of the NRC’s SLR environmental review are limited to: (1) those transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional distribution system, and (2) those transmission lines that supply power to the nuclear power plant from the grid (NRC 2013-TN2654).

As discussed in Section 2.1.6.5, “Power Transmission Systems,” of this EIS, the only transmission lines that are in regulatory scope for Monticello SLR are on-site. These in-scope lines are in compliance with National Electrical Safety Code clearances (Xcel 2023-TN9084). Therefore, there is no potential shock hazard to off-site members of the public from these on-site transmission lines.

3.11.6 Proposed Action

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues related to human health.

3.11.6.1 Radiation Exposures to the Public

Nuclear power plants, under controlled conditions, release small amounts of radioactive materials to the environment during normal operation. NRC regulations in 10 CFR Part 20 (TN283) identify maximum allowable concentrations of radionuclides that can be released from a licensed nuclear power plant, such as Monticello, into the air and water at the boundary of unrestricted areas to control radiation exposures of the public and releases of radioactivity. These concentrations are derived based on an annual total effective dose equivalent (TEDE) of 0.1 rem to individual members of the public. In addition, pursuant to 10 CFR 50.36a, “Technical specifications on effluents from nuclear power reactors” (TN249), nuclear power plants have special license conditions called technical specifications for radioactive gaseous and liquid releases from the nuclear power plant that are required to minimize the radiological impacts associated with nuclear power plant operations to levels that are ALARA.

Radioactive waste management systems are incorporated into the design of each nuclear power plant. They are designed to remove most of the fission product radioactivity that leaks from the fuel, as well as most of the activation- and corrosion-product radioactivity produced by neutrons in the vicinity of the reactor core. The amounts of radioactivity released through vents and discharge points to areas outside the nuclear power plant boundary are recorded and published annually in the radioactive effluent release reports. These environmental monitoring programs are in place at all nuclear power plants. Because there is no reason to expect effluents to increase at Monticello during the SLR term, doses from continued operation are expected to be well within regulatory limits established in 10 CFR Part 20, (TN283), and 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations” (TN739). No mitigation measures beyond those already implemented under the current license would be warranted because current mitigation practices have kept public radiation doses well below regulatory standards and are expected to continue to do so.

The NRC staff reviewed Monticello’s effluent reports from years 2018 – 2022 (Xcel 2019-TN9599, Xcel 2020-TN9598, Xcel 2021-TN9597, Xcel 2022-TN9595, Xcel 2023-TN9596) and determined that the annual public dose recorded is a fraction of the regulatory limits and was in accordance with radiation protection standards identified in 10 CFR Part 50 (TN249; Appendix I), 10 CFR Part 20 (TN283), and 40 CFR Part 190 (TN739). This 5-year review period provided a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (e.g., increasing radioactivity levels) over the period of 2018 through 2022. As discussed in Section 3.5.2, elevated tritium was indicated during routine sampling in 2022 and determined to be coming from an area between the reactor and turbine buildings. The NRC was notified in November 2022 following an analysis of monitoring well data. The NRC staff began monitoring Monticello’s actions to determine the source of the leak, actions to stop the leak, and the remediation plans. The NRC staff determined the leak had no impacts on public health and safety and did not impact drinking water wells used by the community (Xcel 2023-TN9578, Xcel 2023-TN9609; NRC 2023-TN9601, NRC 2023-TN9616). The groundwater monitoring program at Monticello is robust, and any future leaks that might occur during the SLR period should be readily detected. All spills are well monitored, characterized, and actively remediated. Taken together, the data show that there were no significant radiological impacts on the environment from operations at Monticello.

Radiation doses to the public from continued operation are expected to continue at current levels and would remain below regulatory limits during the SLR term. The NRC staff identified no information at Monticello that would result in different impacts than those of current operations. The NRC staff concludes that the health impacts from public radiation exposure due to continued nuclear plant operations at Monticello during the SLR term would be SMALL based on public doses being maintained within regulatory limits.

3.11.6.2 Radiation Exposure to Plant Workers

Nuclear power plant workers conducting activities involving radioactively contaminated systems or working in radiation areas can be exposed to radiation. Individual occupational doses are measured by nuclear power plant licensees as required by the NRC radiation protection standard, at 10 CFR Part 20 (TN283). Most of the occupational radiation dose to nuclear power plant workers results from external radiation exposure rather than from internal exposure from inhaled or ingested radioactive materials. Workers also receive radiation exposure during the storage and handling of radioactive waste. Occupational doses from any refurbishment activities associated with SLR, and occupational doses from continued operations during the SLR term are expected to be similar to the doses during current operations. The occupational doses are estimated to be much less than the regulatory dose limits.

Under 10 CFR 20.2206, “Reports of individual monitoring” (TN283), the NRC requires nuclear plant licensees to submit an annual report of the results of individual monitoring carried out by the licensee for each individual for whom monitoring was required by 10 CFR 20.1502, “Conditions requiring individual monitoring of external and internal occupational dose,” during that year. The NRC staff has reviewed the Monticello occupational dose reports and summary reports through 2022 (NRC 2022-TN8530) and identified no information for Monticello that would result in different impacts than those of current operations. The NRC staff concludes that the health impacts from occupational radiation exposure due to continued nuclear plant operations at Monticello during the SLR term would be SMALL based on individual worker doses being maintained within 10 CFR Part 20 limits (TN283). No mitigation measures beyond those implemented during the current license term would be warranted, because the ALARA process continues to be effective in reducing radiation doses.

3.11.6.3 Human Health Impact from Chemicals

Impacts of chemical discharges on human health are considered to be SMALL if the discharges of chemicals to water bodies are within effluent limitations designed to protect water quality and if ongoing discharges have not resulted in adverse effects on aquatic biota. During the SLR term, human health impacts from chemical hazards are expected to be the same as those experienced during operations under the current license term.

Small quantities of biocides can be both readily dissipated and chemically altered in the waterbody receiving them, so significant cumulative impacts on water quality would not be expected. Major changes in the operation of the cooling system are not expected during the SLR term (Xcel 2023-TN9084), so no change in the effects of biocide discharges on the quality of the receiving water is anticipated.

The effects of minor chemical discharges and spills at nuclear power plants on water quality have been of SMALL significance and mitigated as needed. Significant cumulative impacts on water quality would not be expected because the small amounts of chemicals released by these minor discharges or spills are readily dissipated in Mississippi River, the receiving waterbody.

Heavy metals (e.g., copper, zinc, and chromium) may be leached as small-volume waste streams or corrosion products into the cooling water effluents. These metals are typically addressed in NPDES permits so that any potential discharges are monitored and controlled. Monticello utilizes stainless steel condenser tubes and would not contribute to leached heavy metals to the cooling water discharge. The impact of metals in cooling system effluent streams due to continued operations at Monticello are of SMALL significance (Xcel 2023-TN9084).

Overall, the NRC staff concludes that the human health impacts from chemicals due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL based on these procedures, plans and processes.

3.11.6.4 Microbiological Hazards to the Public (Plants with Cooling Ponds or Canals or Cooling Towers That Discharge to a River)

In the LR GEIS (NRC 2013-TN2654), the NRC staff determined that effects of thermophilic microorganisms on the public for nuclear power plants using cooling ponds, lakes, or canals or cooling towers that discharge to a river is a Category 2 issue that requires site-specific evaluation during each license renewal review.

The thermophilic microorganism N. *fowleri* can pose public health concerns in recreational use waters when these organisms are present in high enough concentrations to cause infection. During the review for the 2010 environmental impact assessment for the proposed power uprate at Monticello, the NRC staff considered the projected temperature increase and its potential to affect the thermal plume in the Mississippi River. The NRC staff determined that thermophilic organisms are not likely to occur as a result of discharges by Monticello into the river. The daily maximum temperature at the discharge canal would remain within the NPDES discharge limits and well below the optimal growth rate temperature for thermophilic organisms (75 FR 2565-TN9617). In addition, as discussed in Section 3.11.3, the replacement of the two cooling towers at Monticello ensures cooling capability remains below the NPDES permit limits. During the proposed SLR term, the public health risk from *N. fowleri* remains extremely low and the proposed action would not result in operational changes that would affect thermal effluent temperature or otherwise create favorable conditions. The NRC staff concludes that the impacts of thermophilic microorganisms on the public due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL because thermal effluent discharges from Monticello during the proposed SLR term would not contribute to the proliferation of microorganisms of concern in the Mississippi River.

3.11.6.5 Microbiological Hazards to Plant Workers

Impacts from microbiological hazards to nuclear power plant workers due to continued nuclear power plant operations at Monticello during the SLR term are considered SMALL. Nuclear power plant workers can be exposed to Legionella during maintenance activities associated with complex water systems housed within buildings or structures, such as cooling towers. No change in existing microbiological hazards is expected due to SLR as Xcel Energy is not proposing changes in the cooling water system or sanitary wastewater treatment and disposal. Xcel Energy implements a health and safety program to minimize the potential for nuclear power plant worker exposure (Xcel 2023-TN9084).

3.11.6.6 Chronic Effects of EMFs

The LR GEIS (10 CFR Part 51-TN250), Subpart A, Appendix B; NRC 2013-TN2654 does not designate the chronic effects of 60 Hz EMFs from powerlines as either a Category 1 or 2 issue. Until a scientific consensus is reached on the health implications of electromagnetic fields, the NRC will not include them as Category 1 or 2 issues.

Scientific consensus on the health implications of EMFs has not been established. The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the DOE. The NIEHS report (NIEHS 1999-TN78) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or noncancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement did not cause the NRC to change its position with respect to the chronic effects of EMFs. The NRC staff considers the chronic effects of EMFs to be UNCERTAIN.

3.11.6.7 Physical Occupational Hazards

As nuclear power plants have many of the typical occupational hazards found at other electric power generation utilities, the issue of occupational hazards can be evaluated by comparing the rate of fatal injuries and nonfatal occupational injuries and illnesses in the utility sector with the rate in all industries combined. Based on the 2021 Bureau of Labor Statistics for incidence rate of fatal and nonfatal occupational injuries, utility sector rates are lower than those of many other sectors (BLS 2021-TN7691). Occupational hazards can be minimized when workers adhere to safety standards and use appropriate personal protective equipment; however, fatalities and injuries caused by accidents may still occur.

Work at Monticello is performed under the statutory authority of OSHA and managed on-site by an industrial safety program. The NRC staff expects that workers will continue to adhere to safety standards and use protective equipment. The NRC staff expects that Xcel Energy will continue to employ an occupational safety program and, as a result, the staff concludes that physical occupational hazards due to continued nuclear power plant power operations at Monticello during the SLR term are minimized and would be of SMALL significance (Xcel 2023-TN9084).

3.11.6.8 Electric Shock Hazards

Based on the LR GEIS (NRC 2013-TN2654), the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been identified as a problem at most operating nuclear power plants and generally is not expected to be a problem during the license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of Monticello SLR review.

As discussed in Section 3.11.5, “Other Hazards,” there are no off-site transmission lines that are in regulatory scope for Monticello SLR. Therefore, there are no potential impacts on members of the public resulting from such transmission lines. There are two transmission corridors on-site containing 115kV and 345 kV overhead transmission lines with the potential for electric shock to workers through induced currents. To address this occupational hazard, Xcel Energy adheres to the National Electrical Safety Code for clearances and OSHA compliance requirements for shock hazard avoidance (Xcel 2023-TN9084). As discussed in Section 3.11.5, Monticello maintains an occupational safety program in accordance with OSHA regulations for its workers, which includes protection from acute electric shock. Therefore, the NRC staff concludes that the potential impacts from acute electric shock during the SLR term would be SMALL.

3.11.6.9 Postulated Accidents

The LR GEIS (NRC 2013-TN2654) evaluates the following two classes of postulated accidents as they relate to license renewal:

Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.

Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core.

As shown in Table 3-1 of this report, the LR GEIS (NRC 2013-TN2654) addresses design-basis accidents as a Category 1 issue and concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants.

For Severe Accidents, Table 3-1 refers to EIS Appendix F of this report. Based on information in the 2013 LR GEIS, the NRC determined in 10 CFR Part 51 (TN250), Subpart A, Appendix B that for all nuclear power plants, the probability-weighted consequences of severe accidents associated with license renewal is SMALL, with a caveat as follows:

> 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. (NRC 2013-TN2654)

The NRC Staff evaluates Postulated Accidents and SAMAs for Monticello during the SLR term in Appendix F of this report. The results are summarized below.

As part of its initial license renewal application submitted in 2006, Nuclear Management Company, a subsidiary of Xcel Energy, included a SAMA analysis for Monticello in its LR ER (NMC 2006). The NRC staff documented its review of the Monticello SAMA in the 2006 NUREG-1437 Supplement 26,"Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Monticello Nuclear Generating Plant Unit 1," (NRC 1999-TN8942). Since the NRC staff had previously considered SAMAs for Monticello, Xcel Energy is not required to perform another SAMA analysis for its SLR application (see 10 CFR 51.53(c)(3)(ii)(L) [10 CFR Part 51-TN250]). However, the NRC's regulations at 10 CFR Part 51 (TN250), which implement Section 102(2) of the NEPA, require that all applicants for license renewal submit an environmental report to the NRC and in that report identify 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)).

Accordingly, in its SLR application environmental report (Xcel 2023-TN9084), Xcel Energy evaluated areas of new and potentially significant information that could affect the environmental impact of postulated accidents during the SLR period. The NRC staff provides a discussion of new information pertaining to Postulated Accidents and SAMAs in Appendix F, "Environmental Impacts of Postulated Accidents," in this EIS.

Based on the NRC staff's review and evaluation of Xcel Energy's analysis of new and potentially significant information regarding SAMAs and the staff's independent analyses as documented in Appendix F, "Environmental Impacts of Postulated Accidents," to this EIS, the staff finds that there is no new and significant information for Monticello related to Postulated Accidents or SAMAs, that the impact of design-basis accidents for Monticello SLR is SMALL, and the probability-weighted consequences of severe accidents associated with Monticello SLR are SMALL.

3.11.7 No-Action Alternative

Under the no-action alternative, the NRC would not issue subsequent renewed licenses, and Monticello would shut down on or before the expiration of the current renewed licenses. Human health risks would be smaller following nuclear power plant shutdown. The reactor unit, which currently operates within regulatory limits, would emit less radioactive gaseous, liquid, and solid material to the environment. In addition, following shutdown, the variety of potential accidents at the nuclear power plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 3.11.6, “Proposed Action,” the NRC staff concluded that the impacts of continued nuclear power plant operation on human health would be SMALL, except for “Chronic effects of electromagnetic fields (EMFs),” for which the impacts are UNCERTAIN. In Section 3.11.6.9, “Postulated Accidents,” the NRC staff concluded that the impacts of accidents during operation are SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and types of accidents decrease following shutdown, the NRC staff concludes that the risk to human health following nuclear power plant shutdown would be SMALL.

3.11.8 Replacement Power Alternatives: Common Impacts

Impacts on human health from construction of a replacement power station would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules, the use of personal protective equipment, training, and placement of engineered barriers would limit those impacts on workers to acceptable levels.

The human health impacts from the operation of a power station include public risk from inhalation of gaseous emissions. Regulatory agencies, including EPA and State of Minnesota agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits to protect human health.

3.11.9 Natural Gas and Renewables Alternative

This alternative would involve the construction and installation of a new 750 MW natural gas-fired, two-unit combustion turbine power plant built either onsite or off-site, 750 MW wind turbines located off-site, and 200 MW of solar panels located both on and off-site of Monticello (Xcel 2023-TN9084). Additional power generation would be provided by existing natural gas-fired power plants operated by Xcel Energy. Impacts on human health from the Natural Gas and Renewables alternative would include those identified in Section 3.11.8, “Replacement Power Alternatives: Common Impacts.” Because the NRC staff expects that licensees would limit access to active construction areas to only authorized individuals, the impacts on human health from the construction of the facility would be SMALL.

The human health effects from the operation of the natural gas alternative would include those identified in Section 3.11.8 as common to the operation of all replacement power alternatives. Health risk may be attributable to nitrogen oxide emissions that contribute to ozone formation (NRC 2013-TN2654). Given the regulatory oversight exercised by the EPA and State agencies, the NRC staff concludes that the human health impacts from the natural gas alternative would be SMALL, except for “chronic effects of electromagnetic fields (EMFs),” for which the impacts are UNCERTAIN.

Off-site wind turbines include operational hazards such as working at heights, working near rotating mechanical or electrically energized equipment, and working in extreme weather at times. Adherence to safety standards and the use of appropriate protective equipment through implementation of an OSHA approved worker safety program would minimize occupational hazards. Potential impacts on workers include ice thrown from rotor blades and broken blades thrown as a result of mechanical failure. Adherence to proper worker safety procedures and limiting public access to wind turbine sites would minimize the impacts from ice throw and broken rotor blades. Potential impacts also include EMF exposure, aviation safety hazards, and exposure to noise and vibration from the rotating blades. Impacts from EMF exposure would be minimized by adherence to proper worker safety procedures and limiting access to any components that could create an EMF. Aviation safety hazards would be minimized by proper siting of the offshore wind turbine facilities and maintaining all proper safety warning devices, such as indicator lights, for pilot visibility. Offshore installation of wind facilities would preclude most potential human health effects from noise and vibration. Furthermore, the NRC staff has identified no epidemiologic studies on noise and vibration from wind turbines that would suggest any direct human health impact. Based on this information, the human health impacts from the operation of the wind component for the combination alternative would be SMALL.

Solar PV panels are encased in heavy duty glass or plastic. Therefore, there is little risk that the small amounts of hazardous semiconductor material that they contain would be released into the environment. In the event of a fire, hazardous PM could be released into the atmosphere. Given the short duration of fires and the high melting points of the materials found in the solar PV panels, the impacts from inhalation are minimal. Also, the risk of fire at ground-mounted solar installations is minimal because of precautions taken during site preparation, such as the removal of fuels and the lack of burnable materials contained in the solar PV panels. Another potential risk associated with PV systems and fire is the potential for shock or electrocution from contact with a high voltage conductor. Proper procedures and clear marking of system components should be used to provide emergency responders with appropriate warnings to diminish the risk of shock or electrocution (Good Company 2011-TN8599). Solar PV panels do not produce EMFs at levels considered harmful to human health, as established by the International Commission on Non-Ionizing Radiation Protection. These small EMFs diminish significantly with distance and are indistinguishable from normal background levels within several yards (Good Company 2011-TN8599) Based on this information, the human health impacts from the operation of the solar PV component for the combination alternative would be SMALL.

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the Natural Gas and Renewables alternative would be SMALL.

3.11.10 Renewables and Storage Alternative

This alternative would involve the construction and installation of 950 MW of wind turbines located off-site, 700 MW of solar panels located both on and off-site of Monticello, and 300 MW of lithium battery storage at solar off-site locations. This alternative would be supplemented by purchased power as needed, along with occasional and small additional power generation from existing natural gas-fired power plants operated by Xcel Energy.

As noted in the discussion of the Natural Gas and Renewables Alternative above, the impacts on human health from wind turbines and solar panels would remain SMALL for human health under this alternative discussion.

Lithium-Ion batteries are used for utility-scale storage and would fall under industrial safety plans, environmental protection rules, and OSHA regulations. Lithium-ion batteries have the potential to catch fire due to an effect called thermal runaway; although an uncommon occurrence, thermal runaway is one of the most recognized safety issues for lithium-ion batteries. The self-perpetuating process can end in battery destruction, release of toxic gases, and has a high risk of fire or explosion (Łukasz et al. 2023-TN9618). Although thermal runaway is a concern, industrial safety practices would limit the impacts on human health and therefore overall impacts would be SMALL for the battery storage part of this alternative.

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the Renewables and Storage alternative would be SMALL.

3.11.11 New Nuclear (Small Modular Reactor) Alternative

The construction impacts of the new nuclear alternative would include those identified in Section 3.11.8, "Replacement Power Alternatives Common Impacts" above. Under Minnesota law, new nuclear plants would be sited outside the State. Construction impacts may differ depending on the site chosen but are expected to be relatively similar. Because the NRC staff expects that the licensee would limit access to active construction areas to only authorized individuals, the impacts on human health from the construction of two new nuclear units would be SMALL.

The human health effects from the operation of the new nuclear alternative would be similar to those of operating the existing Monticello. SMR designs would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as the plants considered in the NRC staff's evaluation in the LR GEIS (NRC 2013-TN2654). As such, their impacts would be similar to those at Monticello. Under Minnesota law, new nuclear plants would be sited outside the State. Human health impacts may differ depending on the site chosen but are expected to be relatively similar to the impacts at Monticello. As presented in Section 3.11.6, "Proposed Action," impacts on human health from the operation of Monticello would be SMALL, except for "chronic effects of electromagnetic fields (EMFs)," for which the impacts are UNCERTAIN. Therefore, the NRC staff concludes that the impacts on human health from the operation of the new nuclear alternative would be SMALL.

3.12 Environmental Justice

Under EO 12898, "Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629-TN1450), Federal agencies are responsible for identifying and addressing, as appropriate, disproportionate and adverse human health and environmental impacts on minority and low-income populations. Independent agencies, such as the NRC, are not bound by the terms of the order but are "requested to comply with the provisions of [the] order" (EO 12898, Section 6-604). In 2004, the Commission issued the agency's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040-TN1009), which states:

> The Commission is committed to the general goals set forth in EO 12898, and strives to meet those goals as part of its NEPA review process.

The CEQ provides the following information in Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ 1997-TN452):

Disproportionately High and Adverse Human Health Effects: Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997-TN452).

Disproportionately High and Adverse Environmental Effects: A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian Tribes are considered (CEQ 1997-TN452).

This environmental justice analysis assesses the potential for disproportionate and adverse human health or environmental effects on minority and low-income populations that could result from the continued operation of Monticello Nuclear Generating Plant associated with the proposed action (license renewal) and alternatives to the proposed action. In assessing the impacts, the following definitions of minority individuals, minority populations, and low-income population were used (CEQ 1997-TN452):

Minority Individuals: Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races, meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, White and Asian.

Minority Populations: Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income Population: Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau’s Current Population Reports, Series P60, on Income and Poverty.

In determining the location of minority and/or low-income populations, the NRC staff uses a 50 mi (80 km) radius from the facility as the geographic area to perform a comparative analysis. The 50 mi (80 km) radius is consistent with the impact analysis conducted for human health impacts. The NRC compares the percentage of minority and/or low-income populations in the 50 mi (80 km) geographic area to the percentage of minority and/or low-income populations in each census block group to determine which block groups exceed the regional percentage (or 50 percent, whichever is lower), thereby identifying the location of these populations (NRC 2020-TN6399).

<u>Minority Population</u>

According to the USCB’s 2020 Census data, there are a total of 2,673 block groups within a 50 mi (80 km) radius of the Monticello site and 29 percent of the population residing within a 50 mi (80 km) radius of Monticello identified themselves as minority individuals. The largest minority populations were Black or African American (10 percent) and Asian (7 percent) (USCB 2020-TN9675).

According to the CEQ definition, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. Because the population within the 50 mi (80 km) radius does not exceed 50 percent minority, the meaningfully greater threshold was used to identify minority populations. Therefore, for the purposes of analysis, census block groups within the 50 mi (80 km) radius of Monticello were identified as minority population block groups if the percentage of the minority population in the block group exceeded 29 percent. Based on this, there are 1,019 minority population blocks groups within a 50 mi (80 km) radius of Monticello.

As shown in Figure 3-17, high population minority block groups (race and ethnicity) are predominantly clustered southeast, north, and northwest of the Monticello site. Monticello is not located in a minority population block group.

As presented in Section Figure 3-17 of this EIS, in 2020, the minority population in the two-county ROI was 11.6 percent (Table 3-24). Furthermore, as shown in Table 3-25, based on the 2017–2021 estimates, minority populations in the two-county ROI are estimated to have remained relatively stable at 11.7 percent.

<u>Low-Income Population</u>

The U.S. Census Bureau’s 2017–2021 American Community Survey data identifies 9 percent of individuals residing within a 50 mi (80 km) radius of the Monticello site as living below the Federal poverty threshold (USCB 2021-TN9676). The 2020 Federal poverty threshold was $26,200 for a family of four (USCB 2021-TN8833).

shows the location of predominantly low-income population block groups within the 50 mi (80 km) radius of Monticello. In accordance with NRC guidance (NRC 2020-TN6399), census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within the block groups exceeded 9 percent (the percent of the individuals living below the Federal poverty threshold within the 50 mi (80 km) radius of the Monticello site). Based on this, there are 844 low-income population blocks groups within a 50 mi (80 km) radius of the Monticello site.

As shown in , low-income population block groups are distributed throughout the 50 mi (80 km) radius of the Monticello site. Monticello is located adjacent to low-income population block groups to the south and west.

As discussed in Sections 3.10, 3.10.2, 3.10.2.1 of this EIS, according to the USCB’s 2017–2021 American Community Survey 5-Year Estimates (USCB 2021-TN8818), people living in the two-county ROI had a median household income of $93,501 which is more than the State average of $77,706. Additionally, the percentage of individuals living below the poverty level in Sherburne and Wright Counties was lower than the percentage of individuals living below the poverty level in the State of Minnesota.

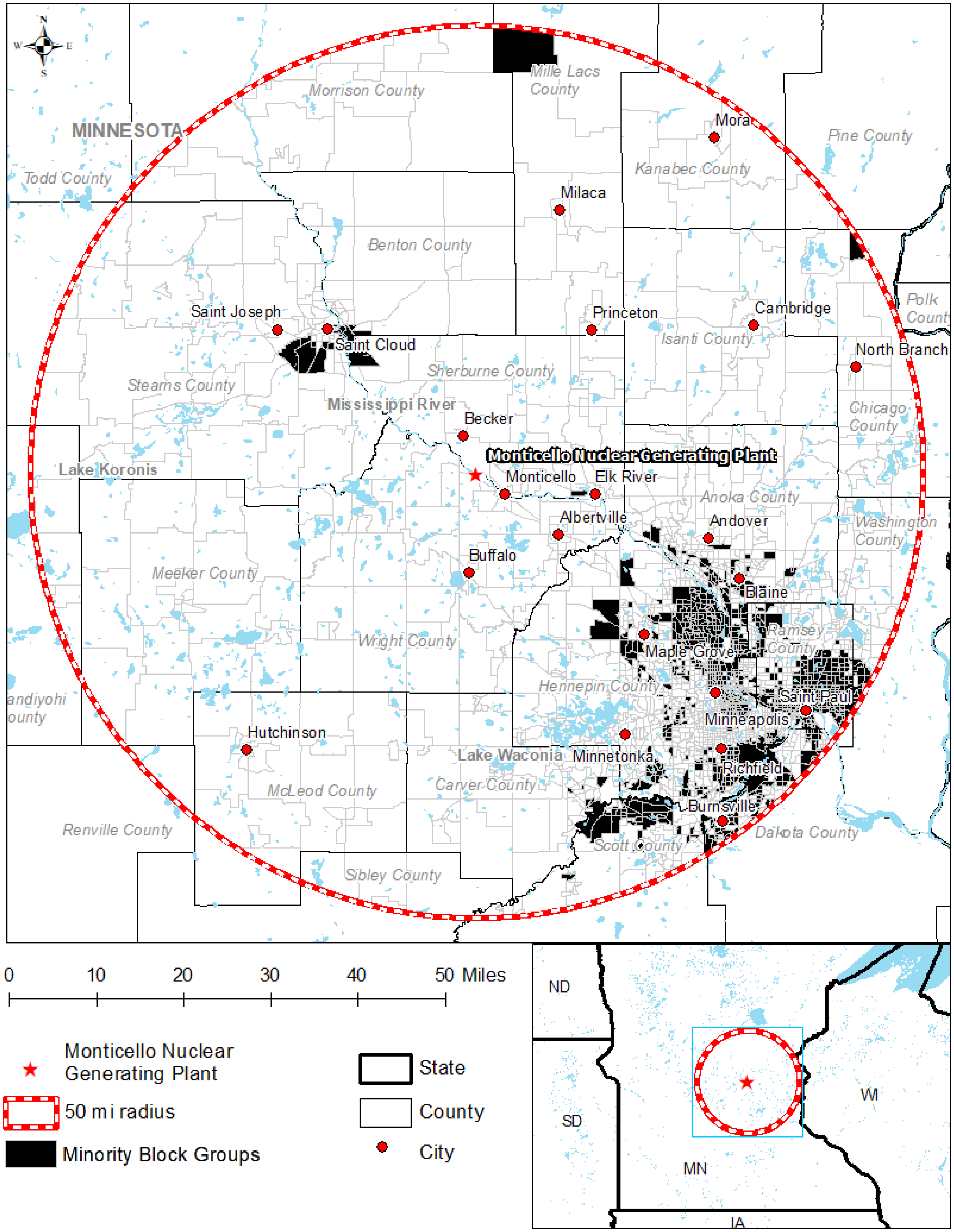


Figure 3-17 Minority Block Groups Within a 50 mi (80 km) Radius of Monticello.
Source: Modified from USCB 2020-TN9675.

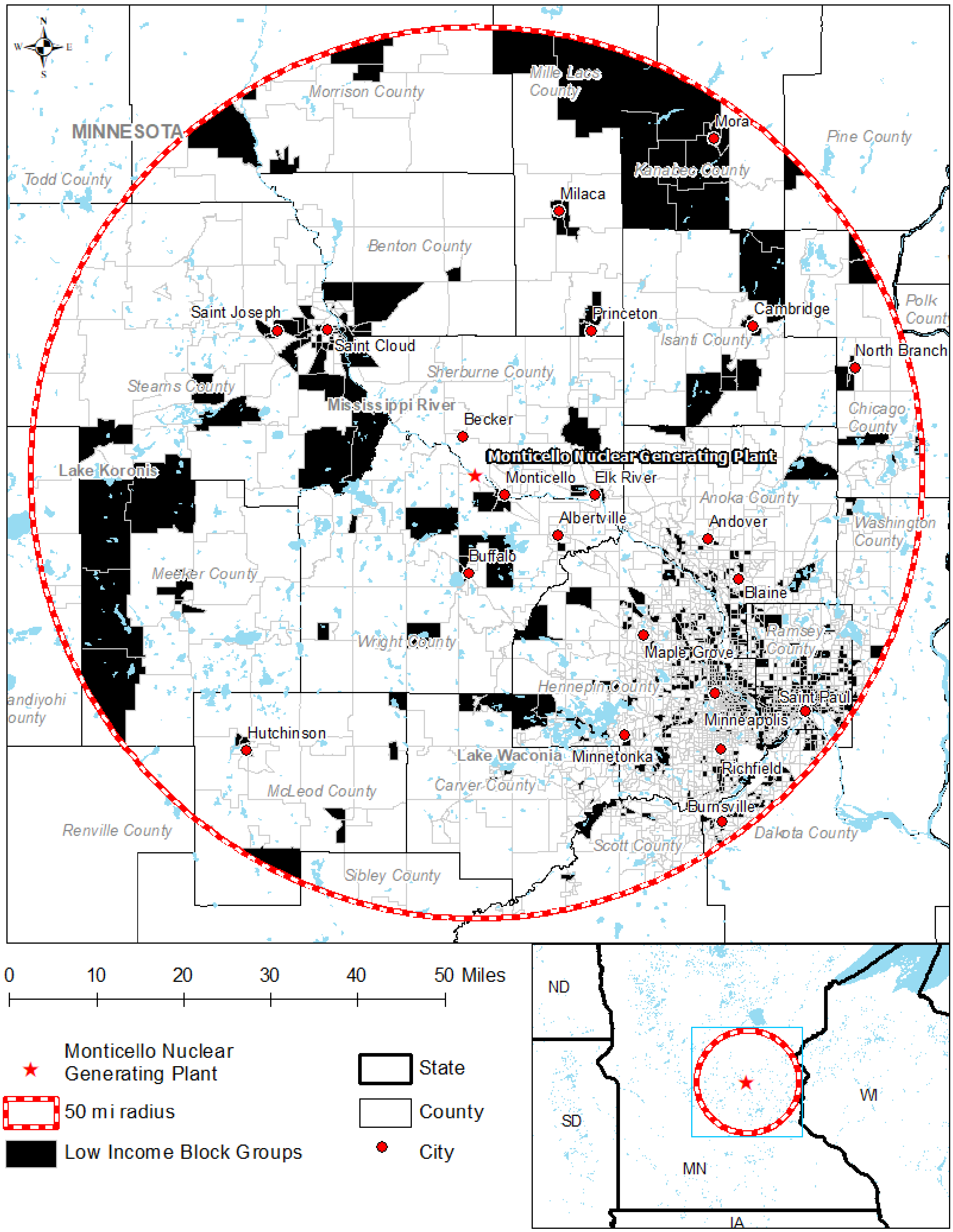


Figure 3-18 Low-Income Block Groups Within a 50 mi (80 km) Radius of Monticello. Source: Modified from UCSB (Modified from USCB 2021-TN9676).

3.12.1 Proposed Action

The NRC staff addresses environmental justice matters for license renewal by: (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the SLR term, (2) determining whether there would be any potential human health or environmental effects to these populations and special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determining whether any of the effects may be disproportionate and adverse.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionate environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Table 3-17 and Table 3-18 show the location of predominantly minority and low-income population block groups residing within a 50 mi (80 km) radius of Monticello. This area of impact is consistent with the 50 mi (80 km) impact analysis for public and occupational health and safety. This chapter of the EIS presents the assessment of environmental and human health impacts for each resource area. The analyses of impacts for all environmental resource areas indicated that the impact from SLR would be SMALL.

Potential impacts on minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the SLR term are expected to continue at current levels, and they would remain within regulatory limits. Section 3.11.6.9 discusses the environmental impacts from postulated accidents that might occur during the SLR term, which include both design-basis and severe accidents. As discussed there and in Appendix F to this EIS, the NRC staff concludes that the potential impacts of design-basis accidents, and the probability-weighted consequences of severe accidents, are SMALL (see Section 3.11.6.9).

Therefore, based on the information and the analysis of human health and environmental impacts, minority and low-income populations would not likely experience any disproportionate and adverse human health and environmental effects from the continued operation of Monticello during the SLR term.

Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice concerns associated with SLR, the NRC staff also assessed the potential radiological risk to special population groups (such as migrant workers or Native Americans) from exposure to radioactive material received through their unique consumption practices and interactions with the environment, including the subsistence consumption of fish and wildlife; native vegetation; contact with surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the plant during routine operation. The special pathway receptors analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area, such as migrant workers or Native Americans. The results of this analysis are presented here.

Section 4–4 of EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (1994) (59 FR 7629-TN1450), directs Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this EIS, the NRC staff considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts on American Indian, Hispanics, migrant workers, and other traditional lifestyle special pathway receptors.

As discussed in Section 3.6 and Section 3.9 of this EIS, the Mille Lacs Band of Ojibwe identified wild rice (*Zizania* spp.), which is a traditional food source of the Ojibwe, as a cultural resource that may occur on the Monticello site. Called *manoomin* in the Ojibwe language, wild rice is a naturally occurring aquatic grass that grows in shallow water, such as in the bottom of shallow lakebeds (MnDNR 2008-TN9711). It is a traditional subsistence staple food for Native American Tribes who lived in areas of Minnesota, Wisconsin, and Canada. Wild rice is also a food source for birds such as waterfowl that are traditional game animals for subsistence hunters. Radiological contamination could enter the human food chain through subsistence consumption of contaminated wild rice or through hunting and consumption of waterfowl that consume contaminated wild rice. Xcel Energy plans to conduct a survey to determine whether wild rice is present onsite in summer 2024 (Xcel 2024-TN9859). The NRC staff will include the results of the wild rice survey, if available, in the final EIS.

Subsistence harvest fishing can also be a source of radiological exposure for special population groups. The Upper Mississippi River Basin is home to 10 native American Tribes. Of these 10 Tribes, 5 do not have subsistence treaty fishing rights and have largely abandoned subsistence fishing. The Prairie Island Indian Community and the Shakopee Mdewakanton Sioux Community reservations can access fishing waters including the Mississippi River. However, because their land is located close to the Minneapolis–St. Paul metropolitan area and the Tribes participate in the local economy, subsistence fishing is less important (USACE 2012-TN9848). Upper Mississippi River Basin Tribes that continue to exercise subsistence treaty rights include the Mille Lac Band of Ojibwe, St. Croix Chippewa Indians of Wisconsin, Lac Courte Oreilles Band of Ojibwe, and the Lac du Flambeau Band of Lake Superior Chippewa Indians (USACE 2012-TN9848).

The assessment of special pathways considered the levels of radiological and nonradiological contaminants in fish, sediments, water, milk, and food products on or near Monticello. Radionuclides released to the atmosphere may deposit on soil and vegetation and may therefore eventually be incorporated into the human food chain. To assess the impact of reactor operations on humans from the ingestion pathway, Xcel Energy collects and analyzes samples of direct radiation, air, drinking water, river water, groundwater, vegetation, milk, fish, and shoreline sediment as part of its ongoing comprehensive REMP.

To assess the impact of nuclear power plant operations, samples are collected annually from the environment and analyzed for radioactivity. A plant effect would be indicated if the radioactive material detected in a sample was higher than background levels. Two types of samples are collected. The first type, a control sample, is collected from areas beyond the influence of the nuclear power plant or any other nuclear facility. These control samples are used as reference data to determine normal background levels of radiation in the environment.

The second type of samples, indicator samples, are collected near the nuclear power plant from areas where any radioactivity contribution from the nuclear power plant will be at its highest concentration. These indicator samples are then compared to the control samples, to evaluate the contribution of nuclear power plant operations to radiation or radioactivity levels in the environment. An effect would be indicated if the radioactivity levels detected in an indicator sample were larger or higher than the control sample or background levels.

Xcel Energy collected samples from the environment in the vicinity of Monticello (Xcel 2023-TN9084, Section 3.12 of this EIS). The pathways include direct radiation, air, drinking water, river water, groundwater, vegetation, milk, fish, and shoreline sediment. A five-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that could release radioactive effluents into the environment. The data show that there were no significant radiological impacts on the environment from operations at Monticello.

Based on radiological environmental monitoring data, special pathway receptor populations in the region would not likely experience disproportionate and adverse human health impacts because of subsistence consumption. In addition, the continued operation of Monticello would not have disproportionate and adverse human health and environmental effects on these populations.

3.12.2 No-Action Alternative

Under the no-action alternative, the NRC would not renew the operating licenses, and Monticello would shut down on or before the expiration of the current facility operating license. Impacts on minority and low-income populations would depend on the number of jobs and the amount of tax revenues lost in communities located near the nuclear power plant after reactor operations cease. Not renewing the operating licenses and terminating reactor operations could have a noticeable impact on socioeconomic conditions in the communities near Monticello. The loss of jobs and income could have an immediate socioeconomic impact. Some, but not all, of the 663 workers could leave the area. In addition, the nuclear power plant would generate less tax revenue, which could reduce the availability of public services. This reduction could disproportionately affect minority and low-income populations that may have become dependent on these services.

3.12.3 Replacement Power Alternatives: Typical Impacts

The following discussions identify typical impacts that often stem from the construction and operation of replacement power facilities that could disproportionately affect minority and low-income populations. Based on the information available at this time, and the lack of information on the replacement power facility design and siting, the NRC staff cannot determine if any of the replacement power alternatives would result in disproportionate and adverse human health and environmental effects on minority and low-income populations. This determination would depend on the site location, facility design, operational characteristics of the new facility, unique consumption practices and interactions with the environment of nearby populations, and the location of predominantly minority and low-income populations. Construction and operation impacts are not anticipated to be substantially different between the replacement power alternatives, so the NRC staff's analyses of these alternatives are combined.

Construction

Potential impacts on minority and low-income populations from the construction of a replacement power facility would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). The extent of the effects experienced by these populations would depend on the location of the power plant and transportation routes. 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 truck and commuter vehicle traffic during construction, especially during shift changes. However, these effects would be temporary, limited to certain hours of the day, and would not likely be high and adverse. Increased demand for rental housing during construction could disproportionately affect low-income populations reliant on low-cost housing.

Operation

Potential impacts on minority and low-income populations from the operation of a replacement power plant would mostly consist of environmental, health, and socioeconomic effects (e.g., employment and emissions). Minority and low-income populations living near the site may be subject to visual and noise impacts from the operation of replacement power generating facilities and transmission lines. Low-income populations that rely on subsistence consumption of fish and wildlife could be disproportionately affected. Emissions during power plant operations could also disproportionately affect nearby minority and low-income populations, depending on the type of replacement power. However, permitted air emissions are expected to remain within regulatory standards during operations. Socioeconomic impacts would likewise depend upon the location of the facility and its contribution to the local economy and tax base.

3.13 Waste Management

Like any operating nuclear power plant, Monticello will produce both radioactive and nonradioactive waste during the SLR period. This section describes waste management and pollution prevention at Monticello. The description of these waste management activities is followed by the NRC staff's analysis of the potential impacts of waste management activities from the proposed action (SLR) and alternatives to the proposed action.

3.13.1 Radioactive Waste

The NRC licenses nuclear power plants with the expectation that they will release a limited amount of radioactive material to both the air and water during normal operations. However, NRC regulations require that gaseous and liquid radioactive releases from nuclear power plants meet radiation dose-based limits specified in 10 CFR Part 20 (TN283), "Standards for Protection Against Radiation," and the ALARA criteria in 10 CFR Part 50 (TN249), Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." In other words, the NRC places regulatory limits on the radiation dose that members of the public can receive from radioactive effluents of a nuclear power plant. For this reason, all nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

Monticello uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of nuclear power plant operations.

Radioactive materials in liquid, gaseous, and solid effluents are reduced before being released into the environment so that the resultant dose to members of the public from these effluents is well within the NRC and EPA dose standards. Radionuclides that can be efficiently removed from the liquid and gaseous effluents before release are converted to a solid waste form for disposal in a licensed disposal facility.

Xcel Energy maintains a REMP to assess the radiological impact, if any, to the public and the environment from radioactive effluents released during operations at Monticello (Xcel 2023-TN9084).

Xcel Energy has an Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters for calculating offsite doses resulting from liquid and gaseous radioactive effluents. These methods ensure that radioactive material discharges from Monticello meet NRC and EPA regulatory dose standards. The ODCM also contains the requirements for the REMP (Xcel 2022-TN9595: Offsite Dose Calculation Manual [ODCM] 07.01 Monticello Nuclear Generating Plant Revision 26 Enclosure 2).

3.13.1.1 Radioactive Liquid Waste Management

Xcel Energy uses waste management systems to collect, analyze, and process radioactive liquids produced at Monticello. The Monticello liquid waste disposal system meets the design objectives of 10 CFR Part 50 (TN249), Appendix I, and controls the processing, disposal, and release of radioactive liquid wastes.

Liquid waste is processed through the radwaste system and is either returned to the condensate system for plant re-use or solidified and shipped to an offsite disposal location. Also, although liquid releases to the Mississippi River in accordance with the ODCM limit are allowed by the technical specifications of the plant license, Monticello has not had any planned radioactive releases to the Mississippi River since 1972. As discussed in Section 2.2.6.1 of the Xcel Energy ER (Xcel 2023-TN9084), Monticello does not perform planned radioactive liquid waste discharges. Unplanned abnormal releases containing radioactive material have occurred in certain years, but they are monitored, reported, and fall within Federal release limits and guidelines (NRC 2006-TN7315).

Xcel Energy's use of these radiological waste systems and the procedural requirements in the ODCM provides assurance that the dose from radiological liquid effluents at Monticello complies with NRC and EPA regulatory dose standards. Xcel Energy calculates dose estimates for members of the public using radiological liquid effluent release data.

Xcel Energy's annual radioactive effluent release reports contain a detailed presentation of liquid effluents released from Monticello and the resultant calculated doses (Xcel 2023-TN9596). These reports are publicly available on the NRC's website (https://www.nrc.gov/). The NRC staff reviewed five years of radioactive effluent release data from 2018 through 2022 (Xcel 2019-TN9599, Xcel 2020-TN9598, Xcel 2021-TN9597, Xcel 2022-TN9595, Xcel 2023-TN9596). A five-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance, which can affect the generation of radioactive effluents into the environment. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels or increasing radioactivity levels).

A review of five years of Radioactive Effluent Release Reports (Xcel 2019-TN9599, Xcel 2020-TN9598, Xcel 2021-TN9597, Xcel 2022-TN9595, Xcel 2023-TN9596) confirmed that no liquid effluents were released during normal operations; however, an abnormal discharge as well as instances of abnormal releases have occurred during this five-year period. This EIS uses the terms “abnormal discharge” and “abnormal release” as they are defined in Regulatory Guide 1.21, Revision 3 (NRC 2021-TN7227). An “abnormal release” is an unplanned or uncontrolled release of licensed radioactive material into the onsite environs while an “abnormal discharge” is an unplanned or uncontrolled discharge of licensed radioactive material to the unrestricted area. The following abnormal discharges or releases occurred in the period from 2018–2023:

- An abnormal discharge of approximately 480 gallons of liquid radioactive material occurred in 2021 due to contamination of the clean Turbine Building Normal Waste Sump during a refueling outage which resulted in a small release of tritium. The total dose was estimated to be 4.69×10^{-8} mrem (4.69×10^{-10} mSv) (Xcel 2022-TN9595).
- On November 22, 2022, Monticello measured elevated tritium levels in a groundwater monitoring well between the turbine building and reactor building. The licensee reported an onsite monitoring well that indicated tritium activity above the ODCM and Nuclear Energy Institute Groundwater Protection Initiative reporting levels (Xcel 2022-TN9595): Offsite Dose Calculation Manual [ODCM] 07.01 Monticello Nuclear Generating Plant Revision 26 Enclosure 2; NRC 2022-TN9600). Since November 2022, the licensee identified the location of the underground leak, repaired the leak, and implemented a recovery system to remove contaminated groundwater from the beneath the plant. NRC inspectors observed and evaluated the licensee’s initial response to identify and quantify the source of the tritium leak. Results of the inspection were documented in the Monticello Nuclear Generating Plant - Integrated Inspection Report 05000263/2023001 (NRC 2023-TN9601). Additional details and evaluation of the tritium leak are described in Section 3.5.2 of this EIS. No statistically significant concentrations of tritium were identified in sentinel wells in 2022; therefore, Monticello did not report a tritium discharge to the unrestricted area (Xcel 2023-TN9596).
- A second tritium abnormal release was reported on March 23, 2023. As discussed during the audit conducted in July 2023, this release was related to an increase in the flow through the Control Rod Drive supply piping that was leaking, and it was found that the temporary catchment basin used to collect the water was not large enough to handle the additional volume. The pipe was replaced on March 25, 2023 (Xcel 2023-TN9609).
- In May 2023, a holding tank containing tritium contaminated water spilled. Event Notification 56535 estimated that between 300–600 gallons overflowed off a holding tank (NRC 2023-TN9610). The licensee estimated the tritium activity concentration in the tank was 1.94×10^5 pCi/l of tritium based on a sample from pumping well 12a (Xcel 2023-TN9609). As observed during the audit, the site was using temporary above ground tanks to store the recovered tritiated water, which required a major facilities above ground storage tank permit. The site later transferred the tritiated water to the remediation pond that was being constructed at the time of the audit. As noted in the MPCA December 14, 2023, news release, “The MPCA issued the appropriate permit in May 2023, requiring the use of temporary tanks to end by Nov. 1 [2023]. The company has since transferred the tritiated water to a more permanent in-ground lined pond and has emptied and dismantled the temporary tanks.” (MPCA 2023-TN9694)

As part of ongoing reactor oversight activities, inspectors reviewed the licensee’s implementation of its corrective action program related to the onsite monitoring well that indicated tritium activity above the ODCM and Nuclear Energy Institute Groundwater Protection

Initiative reporting levels. As noted in the Inspection Report 05000263/2023002 dated August 7, 2023 (NRC 2023-TN9611), "The inspectors concluded the licensee developed a holistic plan with significant input from contracted vendor with expertise in groundwater management and cleanup. The inspectors noted a high level of support (time and resources) from all levels of the organization to recover and store the contaminated groundwater onsite and prevent any uncontrolled release from the site." For a detailed discussion, refer to Section 3.5.2 of this EIS.

The NRC staff's review of Xcel Energy's radioactive liquid effluent control program shows that the applicant maintained radiation doses to members of the public within NRC and EPA radiation protection standards, as stated in Appendix I to 10 CFR Part 50 (TN249), 10 CFR Part 20 (TN283), and 40 CFR Part 190 (TN739), "Environmental Radiation Protection Standards for Nuclear Power Operations." The NRC staff observed no adverse trends in the dose levels.

3.13.1.2 Radioactive Gaseous Waste Management

Radioactive gaseous wastes develop from gases in liquid contained in tanks and piping at Monticello. The gaseous wastes are monitored and released at an acceptable rate designated by the ODCM. The ODCM determines the effluent release rate to ensure that releases are within predetermined limits, which ascertains compliance with dose limitations of licensee commitments (Xcel 2022-TN9595: Offsite Dose Calculation Manual [ODCM] 07.01 Monticello Nuclear Generating Plant Revision 26 Enclosure 2). The gaseous radwaste systems provide gas holdup for decay, and the site releases the gases under controlled conditions.

Xcel Energy calculates dose estimates for members of the public based on radioactive gaseous effluent release data and atmospheric transport models. Xcel Energy's annual radioactive effluent release reports present in detail the radiological gaseous effluents released from Monticello and the resultant calculated doses. As described above in Section 3.13.1.1, the NRC staff reviewed five years of radioactive effluent release data from the 2018 through 2022 reports (Xcel Energy Effluent Report Xcel 2019-TN9599, Xcel 2020-TN9598, Xcel 2021-TN9597, Xcel 2022-TN9595, Xcel 2023-TN9596). The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels) over the period.

As a representative year, the following summarizes the calculated doses from radioactive gaseous effluents released from Monticello during 2022 (Xcel 2023-TN9596):

- The air dose due to noble gases with resulting gamma radiation in gaseous effluents was 3.84×10^{-3} millirad (mrad) (3.84×10^{-5} milligray), which is well below the 10 mrad/yr (0.1 milligray/yr) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The air dose from beta radiation in gaseous effluents was 2.24×10^{-3} mrad (2.24×10^{-5} milligray), which is well below the 20 mrad/yr (0.2 milligray/yr) dose criterion in Appendix I to 10 CFR Part 50 (TN249).
- The critical organ dose to an offsite member of the public from radiation in gaseous effluents as a result of radioisotopes of iodine, particulates, tritium gases and carbon-14 was 4.77×10^{-2} mrem (4.77×10^{-4} mSv), which is below the 15 mrem/yr (0.15 mSv/yr) dose criterion in Appendix I to 10 CFR Part 50 (TN249).

As discussed during the audit, Monticello has constructed a groundwater remediation storage pond (also referred to as a holding pond or retention pond) to store the tritiated groundwater that is being collected in response to the tritium leak. The water will either be reused in plant systems or be evaporated from the pond. If pond evaporation is implemented, it will be the third gaseous point for tritium at the plant. As discussed during the audit (Xcel 2023-TN9578):

1. tritium releases to the air from the current storage tanks associated with groundwater remediation are being controlled with the use of covers
2. a cover is planned to be placed on the groundwater remediation pond once it is filled
3. if evaporation from the groundwater remediation pond is implemented, the necessary updates to the Technical Specifications and ODCM will be made to appropriately measure the effluent pathway

The NRC staff's review of the Monticello radioactive gaseous effluent control program showed radiation doses to members of the public that were well below NRC and EPA radiation protection standards contained in Appendix I to 10 CFR Part 50 (TN249), 10 CFR Part 20 (TN283), and 40 CFR Part 190 (TN739). The NRC staff observed no adverse trends in the dose levels over the five years reviewed.

During the SLR term, Xcel Energy will continue to perform routine nuclear power plant refueling and maintenance activities. Based on Xcel Energy's past performance in operating a radioactive waste system at Monticello that maintains ALARA doses from radioactive gaseous effluents, the NRC staff expects that Monticello will maintain similar performance during the SLR term.

3.13.1.3 Radioactive Solid Waste Management

Monticello's solid waste disposal system provides for packaging and/or solidification of radioactive waste that will subsequently be shipped offsite to an approved burial facility. These activities reduce the amount of waste shipped for offsite disposal. Solid radioactive wastes are logged, processed, packaged, and stored for subsequent shipment and offsite burial. Solid radioactive wastes and potentially radioactive wastes include reactor components, equipment and tools removed from service, chemical laboratory samples, spent resins, used filter cartridges, and radioactively contaminated hardware, as well as compacted wastes such as contaminated protective clothing, paper, rags, and other trash generated from nuclear power plant design modifications and operations, and routine maintenance activities. In addition, nonfuel solid wastes result from treating and separating radionuclides from gases and liquids, and from removing containment material from various reactor areas.

3.13.1.4 Radioactive Waste Storage

At Monticello, low-level radioactive waste (LLRW) is stored temporarily onsite at a low-level waste storage facility before being shipped offsite for processing or disposal at licensed LLRW treatment and disposal facilities. In 2020, Monticello shipped LLRW to the Energy Solutions facility in Clive, Utah; the Erwin Resin Solutions facility in Erwin, Tennessee; and the UniTech Services facility in Oakridge, Tennessee. 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 a low percentage of the LLRW generated. Radioactive waste that is greater than Class C waste is the responsibility of the Federal government. Low-level mixed waste is managed through Xcel Energy's chemistry procedure. Xcel Energy uses a contractor to characterize, label, and manifest the waste, and transport it to a facility that can encapsulate, treat, or otherwise prepare the waste for disposal. As indicated in Xcel Energy's ER and discussed with NRC staff during the virtual audit, Monticello has sufficient existing capability to store all generated LLRW onsite.

No additional construction of onsite storage facilities is necessary for LLRW storage during the subsequent period of extended operation (Xcel 2023-TN9084; Xcel 2023-TN9578).

Monticello stores spent fuel in a spent fuel pool and in an onsite ISFSI. The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers. Spent fuel is stored in the ISFSI under the general license. Section 4.11.2.2 of the Xcel Energy ER states that there are 30 dry containers currently on the ISFSI pad. In order to store all the fuel that the site will have by 2030, Monticello would need 40 total dry containers, so an additional 10 containers would be needed by 2030 (Xcel 2023-TN9084). As discussed during the audit, the existing ISFSI security perimeter can accommodate another 36 dry containers potentially, but on a second support pad (to be built) without having to change the security perimeter (Xcel 2023-TN9578).

The ISFSI facility requires a State of Minnesota Certificate of Need. The placement of the 30 canisters was allowed by a Certificate of Need issued in 2006 that expires in 2030. The ER states that Xcel Energy applied for an additional Certificate of Need to allow Xcel Energy to place ~14 more canisters from 2030–2040 on a new storage pad within the security perimeter footprint. Following the audit, the Minnesota Public Utilities Commission approved the request to place ~14 additional canisters. Beyond 2040, Xcel Energy would need to seek additional Certificates of Need to place additional canisters on the second storage pad. As discussed during the audit, the licensee confirmed that the estimated timeframe for construction of the second pad in the Monticello ISFSI would be approximately 2026–2027 to support a 2028 dry storage loading campaign for the up to 15 additional canisters. The licensee also confirmed that the expanded ISFSI capacity along with the spent fuel pool is anticipated to be capable of storing all the spent nuclear fuel generated during the SLR term (Xcel 2023-TN9578). If the ISFSI pad needs to be expanded further, previously disturbed land near the ISFSI is likely to be sufficient for the expansion with no significant environmental impact.

The NRC staff notes that the impacts of onsite storage of spent nuclear fuel during the period of extended operation have been determined to be SMALL, as stated in 10 CFR Part 51-TN250, Appendix B, Table B-1; see also NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (NRC 2014-TN4117).

3.13.1.5 Radiological Environmental Monitoring Program

Xcel Energy maintains a REMP to assess the radiological impact, if any, to the public and the environment from Monticello operations. The REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity. Monitoring is conducted for the following: direct radiation, air, precipitation, well water, river water, surface water, milk, food products and vegetation (such as edible broad leaf vegetation), fish, silt, and shoreline sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). As part of the REMP program, Xcel Energy conducts analyses of selected wells for the presence of gamma emitters, tritium in groundwater on a quarterly basis (Xcel 2023-TN9084).

The NRC staff reviewed five years of annual radiological environmental monitoring data from 2018 through 2022 (Xcel 2019-TN9621, Xcel 2020-TN9612, Xcel 2021-TN9613, Xcel 2022-TN9614, Xcel 2023-TN9615). A five-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (i.e., increasing radioactivity levels) over the period of 2018 through 2022.

In addition to the REMP, Xcel Energy established an onsite groundwater protection initiative program in 2008 in accordance with Nuclear Energy Institute (NEI) 0707, “Industry Groundwater Protection Initiative” (NEI 2007-TN1913). This program monitors the onsite nuclear power plant environment to detect leaks from nuclear power plant systems and pipes containing radioactive liquid. Section 3.5.2.3, “Groundwater Quality,” of this site-specific EIS contains information on Monticello’s groundwater protection initiative program. As of the date of ER publication, Monticello was monitoring 19 wells and one stormwater drain location for potential radioactive releases to groundwater, environmental conditions, and groundwater elevation in accordance with Monticello procedures.

In response to the tritium leak in 2022, and as discussed in Section 3.5.2.3 of this site-specific EIS, the groundwater monitoring program was expanded and Xcel Energy increased groundwater sampling and the number of wells. Section 3.5.2.3 of this site-specific EIS also contains a more complete description of the groundwater protection program and a historical description of tritium and other radionuclide monitoring in groundwater at the site. As documented in the Monticello Nuclear Generating Plant - Integrated Inspection Report 05000263/2023001 dated August 7, 2023 (NRC 2023-TN9601), NRC inspectors determined that “the criteria, methodology, and requirements for reporting leaks and spills that contain licensed radioactive materials were consistent with the industry initiative and were performed in accordance with NRC requirements.”

Based on its review of the REMP and inadvertent release data, the NRC staff finds no apparent increasing trend in concentration or pattern indicating persistently high tritium or other radionuclide concentration that might indicate an ongoing inadvertent release from Monticello. The groundwater monitoring program data at Monticello show that Xcel Energy monitors, characterizes, and actively remediates spills, and that there were no significant radiological impacts to the offsite environment from operations at Monticello.

3.13.2 Nonradioactive Waste

Monticello generates nonradioactive waste as a result of nuclear power plant maintenance, cleaning, and operational processes. Monticello manages nonradioactive wastes in accordance with applicable Federal and State regulations, as implemented through its corporate procedures. Monticello generates and manages hazardous wastes, nonhazardous wastes, and universal wastes. Xcel Energy maintains a list of waste vendors that it has approved for use across the entire company to remove and dispose of the nonradioactive wastes offsite (Xcel 2023-TN9084).

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101 5084 TN6607) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94 580 TN1281).

The RCRA governs the disposal of solid waste. The MPCA is authorized by the EPA to implement the RCRA and regulate solid and hazardous waste in Minnesota (Xcel 2023-TN9084). Monticello has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. Monticello maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

The Monticello SWPPP identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The SWPPP also describes BMPs for reducing pollutants in stormwater discharges and assuring compliance with the site's NPDES permit (Xcel 2023-TN9084).

Monticello also has an environmental management system (Xcel 2023-TN9084). Procedures are in place to monitor areas within the site that have the potential to discharge oil into or on navigable waters, in accordance with the regulations in 40 CFR Part 112, "Oil Pollution Prevention" (TN1041). The Pollution Incident/Hazardous Substance Spill Procedure identifies and describes the procedures, materials, equipment, and facilities that Xcel Energy uses to minimize the frequency and severity of oil spills at Monticello.

Monticello is subject to the EPA reporting requirements in 40 CFR Part 110, "Discharge of Oil," under CWA Section 311(b)(4) (TN8485). Under these regulations, Monticello must report to the U.S. Coast Guard (USCG) National Response Center any discharges of oil if the quantity may be harmful to the public health or welfare or to the environment. Based on the NRC staff's review of Section 9.5.3.6 of the Xcel Energy ER (Xcel 2023-TN9084) and a review of records from 2016–2021, there have been no releases at Monticello that have triggered this notification requirement (Xcel 2023-TN9084).

Monticello is also subject to the reporting provisions of the (Minnesota Statutes Section 115.061(b) -TN9622) for reporting the release of a regulated substance from an underground storage tank (UST) containing a petroleum product or hazardous substance. Based on the NRC staff's review of Section 9.5.13.6 of the Xcel Energy ER (Xcel 2023-TN9084) and a review of records from 2018–2022, no reportable spills under the reporting provisions of the (Minnesota Statutes Section 115.061(b) -TN9622) occurred to date. In addition, the applicant confirmed that there have been no reportable spills that would trigger this notification requirement since the ER was written (Xcel 2023-TN9084).

3.13.3 Proposed Action

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 of this site-specific EIS that relate to waste management.

3.13.3.1 Low-Level Waste Storage and Disposal

At Monticello, low-level radioactive waste is stored temporarily onsite before being shipped offsite for treatment or disposal facilities (Xcel 2023-TN9084). Annual quantities of low-level radioactive waste generated at Monticello vary from year to year depending on the number of maintenance activities undertaken. Due to the comprehensive regulatory controls in place for the management of radioactive waste, Xcel Energy's compliance with these regulations, and Xcel Energy's use of licensed treatment and disposal facilities, the impacts of radioactive waste are expected to be SMALL during the SLR term. Also, there are no other operating nuclear power plants, fuel-cycle facilities, or radiological waste treatment and disposal facilities with a 50 mi (80 km) radius of Monticello. Therefore, the NRC staff concludes that the environmental impacts from low-level waste storage and disposal due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL.

3.13.3.2 Onsite Storage of Spent Nuclear Fuel

As discussed in Section 2.1.6.2 of this EIS, Monticello's spent fuel is stored in a spent fuel pool and in an onsite ISFSI. The Monticello ISFSI is licensed under the general license provided to nuclear power plant licensees under 10 CFR 72.210, "General license issued," (TN4884). The NRC's regulation and its oversight of onsite spent fuel storage ensure that the increased volume in onsite storage from operation during the SLR term can be safely accommodated with little environmental effect. The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers.

This issue was also considered for the NRC staff's environmental review of Monticello's initial license renewal, and no new and significant information was found at that time (NRC 2006-TN7315). The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at Monticello. Therefore, the NRC staff concludes that the environmental impacts from onsite storage of spent nuclear fuel due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL.

3.13.3.3 Offsite Radiological Impacts of Spent Nuclear Fuel and High-Level Waste Disposal

As related to the issue of offsite radiological impacts of spent nuclear fuel and high-level waste disposal, a history of the NRC's Waste Confidence activities is provided in NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (NRC 2014-TN4117), Section 1.1, History of Waste Confidence. The management and ultimate disposition of spent nuclear fuel is limited to the findings codified in the September 19, 2014, Continued Storage of Spent Nuclear Fuel, Final Rule (79 FR 56238-TN4104) and associated NUREG-2157 (NRC 2014-TN4117). The ultimate disposal of spent nuclear fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this site-specific review. Per 10 CFR Part 51 (TN250) Subpart A, the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the conclusion, for any nuclear power plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the offsite radiological impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants pursuant to 10 CFR 51.23 (TN250) and does not warrant a site-specific analysis for continued nuclear power plant operations at Monticello during the SLR term.

3.13.3.4 Mixed-Waste Storage and Disposal

Mixed waste, regulated under RCRA (TN1281) and the AEA of 1954, as amended (42 U.S.C. § 2011 et seq.-TN663), is waste that is both radioactive and hazardous. Mixed waste is subject to dual regulation: by the EPA or an authorized State for its hazardous component and by the NRC or an Agreement State for its radioactive component. Similar to hazardous waste, mixed waste is generally accumulated onsite in designated areas as authorized under RCRA then shipped offsite for treatment as appropriate and for disposal. Occupational exposures and any releases from onsite treatment of these and any other types of wastes are considered when evaluating compliance with the applicable Federal standards and regulations: for example, 10 CFR Part 20 (TN283), 40 CFR Part 190 (TN739), and 10 CFR Part 50, Appendix I (TN249). Due to the comprehensive regulatory controls in place for the management of mixed waste, Xcel Energy's compliance with these regulations, and Xcel Energy's use of licensed treatment and disposal facilities, the impacts of mixed waste are expected to be SMALL during the SLR term. The NRC staff identified no information or situations that would result in different impacts for this issue during the SLR term at Monticello. Therefore, the NRC staff concludes that, the radiological and nonradiological environmental impacts from the mixed waste storage and disposal due to continued nuclear plant operations at Monticello during the SLR term would be SMALL.

3.13.3.5 Nonradioactive Waste Storage and Disposal

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals. Monticello has a nonradioactive waste management system to handle its nonradioactive hazardous and nonhazardous wastes. The waste is managed in accordance with Xcel Energy's procedures. Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101-508; TN6607) and RCRA (Public Law 94-580; TN1281).

In addition, as discussed in Section 3.13.2 of this EIS, Monticello has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. Monticello will continue to store and dispose of nonradioactive hazardous and nonhazardous waste in accordance with EPA, State, and local regulations in permitted disposal facilities. With respect to unplanned, nonradiological releases, as described in Section 3.6.4.2.2 of the ER (Xcel 2023-TN9084), Xcel Energy reported two inadvertent nonradioactive releases between 2016–2022. The NRC staff incorporates the information in Section 3.6.4.2.2, "History of Nonradioactive Releases," of the ER (Xcel 2023-TN9084) herein by reference. No other accidental spills or releases of nonradioactive substances, including petroleum products, occurred at Monticello over the past 5 years, or were any associated notices of violation issued to Xcel Energy for such releases (Xcel 2023-TN9084; Xcel 2023-TN9578). The NRC staff's review of available information and regulatory databases found no documented instances of accidental spills of chemical or petroleum products to groundwater due to Monticello operations that resulted in a regulatory action over the last 5 years.

Due to the comprehensive regulatory controls in place for the management of nonradioactive waste and Xcel Energy's compliance with these regulations, the impacts of nonradioactive waste are expected to be SMALL during the SLR term. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at Monticello. Therefore, the NRC staff concludes that the environmental impacts from nonradioactive waste storage and disposal due to continued nuclear plant operations at Monticello during the SLR term would be SMALL.

3.13.4 No-Action Alternative

Under the no-action alternative, Monticello would cease operation at the end of the term of the current renewed facility operating license or sooner and enter decommissioning. After entering decommissioning, the nuclear power plant would generate less spent nuclear fuel, emit less gaseous and liquid radioactive effluents into the environment, and generate less low-level radioactive and nonradioactive wastes. In addition, following shutdown, the variety of potential accidents at the nuclear power plant (radiological and industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. Therefore, as radioactive emissions to the environment decrease, and the likelihood and variety of accidents decrease following shutdown and decommissioning, the NRC staff concludes that impacts resulting from waste management from implementation of the no-action alternative would be SMALL.

3.13.5 Replacement Power Alternatives: Common Impacts

Impacts from waste management common to all analyzed replacement power alternatives would be from construction-related nonradiological debris generated during construction activities. This waste would be recycled or disposed of in approved landfills.

3.13.6 Natural Gas and Renewables Alternative

Impacts from the waste generated during the construction of the natural gas combined-cycle and renewable energy alternative would include those identified in Section 3.13.5 of this site-specific EIS as common to all replacement power alternatives.

Waste generation from operation of the natural gas technology would be minimal. The only significant waste generated at a natural gas combined-cycle power plant would be spent selective catalytic reduction catalyst (plants use selective catalytic reduction catalyst to control nitrogen oxide emissions). This spent catalyst is considered hazardous and would be disposed of at a facility that handles hazardous materials. Other than the spent selective catalytic reduction catalyst, waste generation at an operating natural gas fired plant would be limited largely to typical operations and maintenance of nonhazardous waste. Based on this information, the NRC staff concludes that the waste impacts for the natural gas combined-cycle alternative would be SMALL.

The construction of the solar PV facilities would create sanitary and industrial waste. This waste could be recycled or shipped to an offsite waste disposal facility. All the waste would be handled in accordance with appropriate MPCA regulations. Impacts on waste management resulting from the construction and operation of the solar PV facilities of the combination alternative would be minimal. In summary, the NRC staff concludes that the waste management impacts resulting from the construction and operation of the PV facilities would be SMALL.

Construction of onshore wind turbine facilities would create sanitary, construction, and industrial waste. This waste would be recycled, disposed of onsite, or shipped to an offsite waste disposal facility. The operation of each wind installation is expected to generate minimal waste from daily operations. The nonhazardous and hazardous waste would be managed in compliance with State regulations and disposed of in permitted facilities. Therefore, the NRC staff concludes that the waste management impacts of the renewable energy alternatives would be SMALL.

Based on the above, the NRC staff concludes that the waste impacts for the natural gas and renewables alternative would be SMALL.

3.13.7 Renewables and Storage Alternative

Impacts from the waste generated during the construction of the renewable energy and storage alternative would include those identified in Section 3.13.5 of this site-specific EIS as common to all replacement power alternatives. Impacts from the waste generated during the construction of the renewable energy systems (solar PV and wind turbines) and would include those identified in Section 3.13.6 of this site-specific EIS. The battery storage system at each solar installation would have to be replaced after several years of operation; however, much of the components are recyclable, minimizing the waste generation. Based on the above, the NRC staff concludes that the waste impacts for the renewables and storage alternative would be SMALL.

3.13.8 New Nuclear (Small Modular Reactor) Alternative

Impacts from the waste generated during the construction of the new nuclear alternative would include those identified in Section 3.13.5 above, as common to all replacement power alternatives. During normal nuclear power plant operations, routine nuclear power plant maintenance and cleaning activities would generate radioactive low-level waste, spent nuclear fuel, high-level waste, and nonradioactive waste. Sections 3.13.1 and 3.13.2 of this site-specific EIS discuss radioactive and nonradioactive waste management at Monticello. Advanced light-water reactors would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as those nuclear power plants considered in the NRC staff's evaluation in the LR GEIS (NRC 2013-TN2654). As such, all wastes generated would be similar to those generated at Monticello. According to the LR GEIS, the NRC does not expect the generation and management of solid radioactive and nonradioactive waste during the SLR term to result in significant environmental impacts. Based on this information, the NRC staff concludes that the impacts on waste from the operation of the new nuclear alternative would be SMALL.

3.14 Impacts Common to All Alternatives

This section describes the impacts that the NRC staff considers common to all alternatives discussed in this EIS, including the proposed action and replacement power alternatives. In addition, the following sections discuss the termination of operations, the decommissioning of a power plant and potential replacement power facilities, and GHG emissions.

3.14.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of both the proposed action and all replacement power alternatives that are analyzed in detail in this EIS.

3.14.1.1 Uranium Fuel Cycle

The following sections address the site-specific environmental impacts of Monticello SLR on the environmental issues identified in Table 3-1 that relate to the uranium fuel cycle.

Offsite Radiological Impacts - Individual Impacts from Other Than the Disposal of Spent Fuel and High-Level Waste

The primary indicators of offsite radiological impacts on individuals who live near uranium fuel cycle facilities are the concentrations of radionuclides in the effluents from the fuel cycle facilities and the radiological doses received by a maximally exposed individual on the site boundary or at some location away from the site boundary. The basis for establishing the significance of individual effects is the comparison of the releases in the effluents and the maximally exposed individual doses with the permissible levels in applicable regulations. The analyses performed by the NRC in the preparation of Table S-3 in 10 CFR 51.51 (TN250) indicate that if the facilities operate under a valid license issued by either the NRC or an Agreement State, the individual effects will meet the applicable regulations. Based on these considerations, the NRC has concluded that the impacts on individuals from radioactive gaseous and liquid releases during the SLR term would remain at or below the NRC's regulatory limits. Efforts needed to keep releases and doses ALARA will continue to apply to fuel-cycle-related activities. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at Monticello. Therefore, the NRC staff concludes that the offsite radiological impacts of the uranium fuel cycle (individual effects from sources other than the disposal of spent fuel and high-level waste) due to continued nuclear plant operations at Monticello during the SLR term would be SMALL.

Offsite Radiological Impacts - Collective Impacts from Other Than the Disposal of Spent Fuel and High-Level Waste

The focus of this issue is the collective radiological doses to and health impacts on the public resulting from uranium fuel cycle facilities over the SLR term. The radiological doses received by the public are calculated based on the releases from the uranium fuel cycle facilities to the environment, as provided in Table S-3 (TN250). These estimates were provided in the 1996 LR GEIS for the gaseous and liquid releases listed in Table S-3 as well as for radon-222 and technetium-99 releases, which are not listed in Table S-3. The population dose commitments were normalized for each year of operation of the model nuclear power plant (per reference reactor year).

Based on the analyses provided in the 2013 LR GEIS (NRC 2013-TN2654), the estimated involuntary 100-year dose commitment to the U.S. population resulting from the radioactive gaseous releases from uranium fuel cycle facilities (excluding the nuclear power plants and releases of radon-222 and technetium-99) was estimated to be 400 person-rem (4 person-Sv) per reference reactor year. Similarly, the environmental dose commitment to the U.S. population from the liquid releases was estimated to be 200 person-rem (2 person-Sv) per reference reactor year. As a result, the total estimated involuntary 100-year dose commitment to the U.S. population from radioactive gaseous and liquid releases listed in Table S-3 was given as 600 person-rem (6 person-Sv) per reference reactor year (see Section 6.2.2 of the 1996 LR GEIS; NRC 1996-TN288).

The doses received by most members of the public would be so small that they would be indistinguishable from the variations in natural background radiation. There are no regulatory limits applicable to collective doses to the public from fuel cycle facilities. All regulatory limits are based on individual doses. All fuel cycle facilities are designed and operated to meet the applicable regulatory limits.

Based on its consideration of the available information, the Commission concluded that these impacts are acceptable in that they would not be sufficiently large to require the NEPA conclusion, for any nuclear power plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, the Commission has not assigned a single level of significance for the collective effects of the fuel cycle. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term. Therefore, the NRC staff concludes that the offsite radiological impacts of the uranium fuel cycle (collective impacts from sources other than the disposal of spent nuclear fuel and high-level waste) due to continued nuclear power plant operations at Monticello during the SLR term would not be sufficiently large to require the NEPA conclusion that the option of Monticello SLR should be eliminated.

Nonradiological Impacts of the Uranium Fuel Cycle

The nonradiological impacts associated with the uranium fuel cycle as they relate to LR are provided in Table S-3 (TN250). The significance of the environmental impacts associated with land use, water use, fossil fuel use, and chemical effluents was evaluated in the LR GEIS (NRC 2013-TN2654) based on several relative comparisons. The land requirements were compared to those for a coal-fired power plant that could be built to replace the nuclear capacity if the operating license is not renewed. The water requirements for the uranium fuel cycle were compared to the annual requirements for a nuclear power plant. The amount of fossil fuels (coal and natural gas) consumed to produce electrical energy and process heat during the various phases of the uranium fuel cycle was compared to the amount of fossil fuel that would have been used if the electrical output from the nuclear power plant was supplied by a coal-fired plant. Similarly, the gaseous effluents SO_2, nitric oxide (NO), hydrocarbons, carbon monoxide (CO), and other PM released because of the coal-fired electrical energy used in the uranium fuel cycle were compared with the equivalent quantities of the same effluents that would be released from a 45 MWe coal-fired plant. It was noted that the impacts associated with the uses of all resources would be SMALL. Any impacts associated with nonradiological liquid releases from the fuel cycle facilities would also be SMALL. The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at Monticello. Therefore, the NRC staff concludes that the aggregate nonradiological impacts of the uranium fuel cycle due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL.

Transportation

The environmental impacts associated with the transportation of fuel and waste to and from one model nuclear power plant as they relate to LR are addressed in Table S-4 (10 CFR Part 51-TN250). Table S-4 forms the basis for analysis of the environmental impacts of the transportation of fuel and waste when evaluating applications for nuclear power plant LR. The applicability of Table S-4 to LR applications was extensively evaluated in the 1996 LR GEIS (NRC 1996-TN288) and its Addendum 1 (NRC 1999-TN289). The environmental impacts from the transportation of fuel and waste attributable to LR were found to be SMALL when they are within the parameters identified in 10 CFR 51.52 (TN250). The NRC staff identified no information or situations that would result in different impacts for this issue for the SLR term at Monticello and determined that Monticello is within the parameters identified in 10 CFR 51.52 (TN250). Therefore, the NRC staff concludes that the transportation impacts of the uranium fuel cycle due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL.

3.14.1.2 Replacement Nuclear Power Plant Fuel Cycles

New Nuclear Energy Alternatives

The uranium fuel cycle impacts for a nuclear power plant result from the initial extraction of fuel, the transport of fuel to the facility, and the management and ultimate disposal of spent fuel. The environmental impacts of the uranium fuel cycle are referenced in Section 3.14.1.1 of this EIS.

Fossil Fuel Energy Alternatives

The fuel cycle impacts for a fossil-fuel-fired power plant result from the initial extraction of fuel, the cleaning and processing of fuel, the transport of fuel to the facility, and the management and ultimate disposal of any solid wastes from fuel combustion. These impacts are discussed in more detail in Section 4.12.1.2 of the 2013 LR GEIS (NRC 2013-TN2654) and can generally include the following:

- significant changes to land use and visual resources
- impacts on air quality, including the release of criteria pollutants, fugitive dust, volatile organic compounds, and methane into the atmosphere

- noise impacts
- geology and soil impacts caused by land disturbances and mining
- water resource impacts, including the degradation of surface water and groundwater quality
- ecological impacts, including the loss of habitat and wildlife disturbances
- impacts on historic and cultural resources within the mine or pipeline footprint
- socioeconomic impacts from employment of both the mining workforce and service and support industries
- environmental justice impacts
- health impacts on workers from exposure to airborne dust and methane gases
- generation of industrial wastes

Renewable Energy Alternatives

For renewable energy technologies that rely on the extraction of a fuel source (e.g., biomass), such alternatives may have fuel cycle impacts with some similarities to those associated with the uranium fuel cycle. Renewable energy technologies such as wind, solar, geothermal, and wave and ocean energy do not have a fuel cycle comparable to the uranium fuel cycle. This is because the natural resource exists (i.e., they are not consumed or irreversibly committed) regardless of any effort to use them for electricity production. The fuel cycle impacts for these renewable energy technologies cannot be determined.

3.14.2 Terminating Nuclear Power Plant Operations and Decommissioning

This section addresses the environmental impacts of Monticello SLR associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating nuclear power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations. For the proposed action at Monticello, SLR could delay this eventuality for an additional 20 years beyond the current license period, to end in 2050.

3.14.2.1 Existing Nuclear Power Plant

The decommissioning process begins when a licensee informs the NRC that it has permanently ceased reactor operations, defueled, and intends to decommission the nuclear plant. The licensee may also notify the NRC of the permanent cessation of reactor operations prior to the end of the license term. Consequently, most nuclear plant activities and systems dedicated to reactor operations would cease after reactor shutdown. The environmental impacts of decommissioning a nuclear power plant are evaluated NUREG-0586, “Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors” (NRC 2002-TN665). Additionally, Section 4.12.2.1 of the 2013 LR GEIS (NRC 2013-TN2654) summarizes the incremental environmental impacts associated with nuclear power plant decommissioning activities. As noted in Table 3-1, there is one Category 1 issue, “Termination of Nuclear Power Plant Operations and Decommissioning,” applicable to Monticello decommissioning following the SLR term. The LR GEIS did not identify any site-specific (Category 2) decommissioning issues.

Termination of Nuclear Power Plant Operations and Decommissioning

The NRC staff determined that SLR would have a negligible effect on the impacts of terminating operations and decommissioning on all resources. The NRC staff identified no information or situations that would result in different environmental impacts for this issue for the SLR term at Monticello. Therefore, the NRC staff concludes that the incremental environmental impacts of the termination of plant operations and decommissioning due to continued nuclear power plant operations at Monticello during the SLR term would be SMALL.

3.14.2.2 Replacement Power Plants

New Nuclear and Fossil Fuel Alternatives

The environmental impacts from the termination of power plant operations and the decommissioning of a power generating facility are dependent on the facility's decommissioning plan. Decommissioning plans generally outline the actions needed to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed. General elements and requirements for a thermoelectric power plant decommissioning plan can include the removal of structures below grade, the removal of all accumulated waste materials, the removal of intake and discharge structures, and the cleanup and remediation of incidental spills and leaks at the facility.

The environmental consequences of decommissioning can generally include the following:

- short-term impacts on air quality and noise from the deconstruction of facility structures
- short-term impacts on land use and visual resources
- long-term reestablishment of vegetation and wildlife communities
- socioeconomic impacts caused by decommissioning the workforce and the long-term loss of jobs
- elimination of health and safety impacts on operating personnel and the general public

These impacts are representative of those associated with decommissioning any thermoelectric power generating facility.

Activities that are unique to the termination of operations and the decommissioning of a nuclear power generating facility include the safe removal of the facility from service, the reduction of residual radioactivity to a level that permits the release of the property under restricted conditions or unrestricted use, and the termination of the license.

Renewable Energy Alternatives

The termination of power plant operation and decommissioning for renewable energy facilities would generally be similar to the activities and impacts discussed above for the new nuclear and fossil fuel alternatives. Decommissioning would involve the removal of facility components and any operational wastes and residues, if present, to restore sites to a condition equivalent in character and value to the site on which the facility was first constructed. In other circumstances, supporting infrastructure (e.g., buried utilities and pipelines) could be abandoned in place (NRC 2013-TN2654). The range of possible decommissioning considerations and impacts, depending on the renewable energy alternative considered, is discussed in Section 4.12.2.2 of the LR GEIS (see subsection, "Renewable Alternatives") (NRC 2013-

TN2654). The staff incorporates the information in NUREG-1437, Revision 1, Section 4.12.2.2 (NRC 2013-TN2654: 4 227, 4 228), herein by reference.

3.14.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss GHG emissions and climate change impacts. Section 3.14.3.1 of this EIS evaluates the GHG emissions associated with the operation of Monticello and replacement power alternatives. Section 3.14.3.2 discusses the observed changes in climate and potential future climate change during the SLR term, based on climate model simulations under future global GHG emissions scenarios, and the impacts from climate change on environmental resources where there are incremental impacts of the proposed action (subsequent license renewal).

3.14.3.1 Greenhouse Gas Emissions from the Proposed Action and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed GHGs. These GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor (H_2O), and fluorinated gases such as hydrofluorocarbons (HCFs), perfluorocarbons, and sulfur hexafluoride. The Earth's climate responds to changes in the concentrations of GHGs in the atmosphere because these gases affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing concentrations of GHGs in the atmosphere generally increase the Earth's surface temperature. The atmospheric concentrations of CO_2, CH_4, and N_2O have significantly increased since 1850. For instance, since 1850, CO_2 concentrations have increased by almost 50 percent (USGCRP 2023-TN9762). In 2019, global net GHG emissions were estimated to be 59 ± 6.6 gigatons of CO_2 equivalent (CO_2eq), with the largest share in gross GHG emissions being CO_2 from fossil fuel combustion and industrial processes (IPCC 2023-TN8557). The year 2022 set a record high concentration for global average atmospheric CO_2 concentration at 417.06 parts per million (NOAA 2023-TN9680). The annual rate of increase in atmospheric CO_2 over the last 60 years is 100 times faster than previous natural increases (NOAA 2023-TN9680).

Long-lived GHGs—CO_2, CH_4, N_2O, and fluorinated gases—are well mixed throughout the Earth's atmosphere, and their impact on climate is long-lasting and cumulative in nature as a result of their long atmospheric lifetimes (EPA 2016-TN7561, USGCRP 2023-TN9762). Therefore, the extent and nature of climate change are not specific to where GHGs are emitted. Carbon dioxide is of primary concern for global climate change because it is the primary gas emitted as a result of human activities. Climate change is the decades or longer changes in climate measurements (e.g., temperature and precipitation) that have been observed on global, national, and regional levels (IPCC 2007-TN7421; EPA 2016-TN7561; USGCRP 2014-TN3472) Climate change research indicates that the cause of the Earth's warming over the last 50 to 100 years is due to the buildup of GHGs in the atmosphere resulting from human activities (IPCC 2013-TN7434, IPCC 2021-TN7435, IPCC 2023-TN8557; USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847). Climate change can vary regionally, spatially, and seasonally depending on local, regional, and global factors. Just as regional climate differs throughout the world, the impacts of climate change can vary among locations.

The sixth assessment synthesis report from the Intergovernmental Panel on Climate Change (IPCC) states that "[i]t is unequivocal that human influence has warmed the atmosphere, ocean, and land" (IPCC 2023-TN8557). The Fifth National Climate Assessment states that "[i]t is unequivocal that human activities have increased atmospheric levels of carbon dioxide and other GHGs. It is also unequivocal that global average temperature has risen in response"

(USGCRP 2023-TN9762). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496-TN245).

3.14.3.1.1 Proposed Action

The operation of Monticello results in direct and indirect GHG emissions. Xcel Energy has calculated direct (diesel generators, pumps, boiler) and indirect (worker vehicles) GHG emissions, which are provided in Table 3-31. Xcel Energy does not maintain an inventory of GHG emissions resulting from visitors and delivery vehicles (Xcel 2023-TN9084). Fluorinated gas emissions from refrigerant sources and from electrical transmission and distribution systems can result from leakage, servicing, repair, or disposal of sources. In addition to being GHGs, chlorofluorocarbons and hydrochlorofluorocarbons are ozone-depleting substances that are regulated by the Clean Air Act under Title VI, "Stratospheric Ozone Protection." Chlorofluorocarbons and hydrochlorofluorocarbons are present at Monticello. Xcel Energy maintains a program to manage stationary refrigeration appliances at Monticello to recycle, recapture, and reduce emissions of ozone-depleting substances. Additionally, Monticello uses sulfur hexafluoride in a small number of high voltage breakers, but Monticello's air permit does not require sulfur hexafluoride emissions to be tracked. Therefore, Table 3-31 does not account for any potential emissions from stationary sources such as the refrigeration or high voltage breakers at Monticello.

Table 3-31 Annual Greenhouse Gas Emissions from Operation at Monticello Nuclear Generating Plant, Unit 1

Year	Combustion Sources[(a)]	Workforce Commuting[(b)]	Total[(c)]
2017	3,000	3,250	6,250
2018	3.070	3,250	6,320
2019	2,200	3,250	5,450
2020	2,790	3,250	6,040
2021	2,390	3,250	5,630

(a) Combustion sources include those listed in Table 3-4 (e.g., diesel generators, pumps, boiler).
(b) Emissions based on a workforce of 663 and the assumption of a 3.3 percent carpool rate was assumed.
(c) Greenhouse gas (GHG) emissions are reported in metric tons and converted to short tons. All reported values are rounded. To convert to metric tons per year, multiply by 0.90718. Carbon dioxide equivalent (CO_2eq) is a metric used to compare the emissions of GHGs based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_2eq is obtained by multiplying the amount of the GHG by the associated GWP.
Source: Xcel 2023-TN9084.

3.14.3.1.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue a subsequent renewed license, and Monticello would permanently shut down on or before the expiration of the current renewed license. At some point, all nuclear plants will terminate operations and undergo decommissioning. The decommissioning GEIS (NUREG-0586) (NRC 2002-TN7254) considers the environmental impacts of decommissioning. Therefore, the scope of impacts considered under the no-action alternative includes the immediate impacts resulting from activities at Monticello that would occur between plant shutdown and the beginning of decommissioning (i.e., activities and actions necessary to cease the operation of Monticello). Facility operations would terminate at or before the expiration of the current renewed license. When the facility stops operating, there would be a reduction in the GHG emissions from activities related to plant operation, such as the use of generators and employee vehicles. The NRC staff anticipates that the GHG emissions for the no-action alternative would be less than those presented in , which shows the estimated direct GHG emissions from the operation of Monticello and the associated mobile emissions.

3.14.3.1.3 Natural Gas and Renewables Alternative

The natural gas and renewables alternative would consist of a natural-gas-fired, two-unit combustion turbine power plant, wind turbines, solar panels, purchased power, and existing natural-gas-fired power plants. The emissions associated with the operation of renewable energy sources (wind and solar) would be negligible because no direct fossil fuels are burned to generate electricity. Purchased power and existing natural-gas-fired power plants would supplement renewable energy sources and new natural-gas-fired power plants on an as-needed basis to meet energy demand. Associated GHG emissions would primarily be from the new 750 MW natural-gas-fired, two-unit combustion turbine power plant and existing natural-gas-fired combustion turbines that would be operated as a peaking plant to provide energy during occasional extended periods of low renewable output (Xcel 2023-TN9084). The projected generation for the existing combustion turbines would average 368,000 MWh annually (Xcel 2023-TN9084). The NRC staff estimates that direct emissions from the operation of the new 750 MW natural-gas-fired, two-unit combustion turbine power plant (generating up to 6.570 million MWh) and the existing natural-gas-fired combustion turbine peaking plant (for a combined total of 6.938 million MWh) would emit 4.2 million tons (3.8 million MT) of CO_2eq.

3.14.3.1.4 Renewables and Storage Alternative

This alternative would consist of wind turbines, solar panels with battery storage, purchased power, and to a limited extent, existing natural-gas-fired power plants. Purchased power and existing natural-gas-fired power plants would supplement renewable energy sources. The emissions associated with the operation of renewable energy sources (wind and solar) would be negligible because no direct fossil fuels are burned to generate electricity. For this alternative, Xcel Energy projected an annual peak of 204,000 MWh from natural-gas-fired generation. Purchased power would supplement renewable generation on an as-needed basis (Xcel 2023-TN9084). Therefore, for this alternative, GHG emissions would primarily be from the operation of existing natural-gas-fired plants. The NRC staff estimates that the direct emissions from an annual peak of 204,000 MWh from natural-gas-fired generation would be 123,010 tons (111,570 MT) of CO_2eq.

3.14.3.1.5 New Nuclear Alternative

Sources of GHG emissions of the new nuclear alternative would include diesel generators, boilers, and pumps, similar to existing sources at Monticello. In NUREG-2226, the NRC estimated the total carbon footprint as a result of operating two or more small modular reactors with a maximum total electrical output of 800 MWe (NRC 2019-TN6136). In Section 5.7.1.2 of NUREG-2226 (page 5-45), the NRC estimated that the carbon footprint for operations for 40 years is 199,500 tons of CO_2eq (181,000 MT) or 4,990 tons of CO_2eq annually (4,525 MT). Therefore, the NRC staff estimates that operating a 12-unit small modular reactor plant generating 880 MWe would emit up to 5,490 tons (4,980 MT) of CO_2eq annually.

3.14.3.1.6 Comparison of Greenhouse Gas Emissions

Table 3-32 presents the direct GHG emissions from facility operations under the proposed action of SLR and alternatives to the proposed action. The GHG emissions from the Natural Gas and Renewables Alternative and the Renewables and Storage Alternative are significantly greater than those from the continued operation of Monticello. If Monticello's generating capacity were to be replaced by the Natural Gas and Renewables Alternative or the Renewables and Storage Alternative, there would be an increase in GHG emissions. Therefore, the NRC staff concludes that the continued operation of Monticello (proposed action) results in the avoidance of GHG emissions as compared to the Natural Gas and Renewables Alternative or the Renewables and Storage Alternative. However, the proposed action, the no-action alternative, and the new nuclear alternative would have similar and comparable GHG emissions.

Table 3-32 Direct Greenhouse Gas Emissions from Facility Operations under the Proposed Action and Alternatives

Technology/Alternative	Carbon Dioxide Equivalent (CO_2eq) TPY[(a)]
Proposed Action[(b)]	3,070
No-Action[(c)]	<3,070
Natural Gas and Renewables Alternative[(d)]	4.2 million
Renewables and Storage Alternative[(e)]	123,010
New Nuclear Alternative	5,490

TPY = ton(s) per year.
(a) Carbon dioxide equivalent (CO_2eq) is a metric used to compare the emissions of greenhouse gases (GHGs) based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_2eq is obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of methane is 21; therefore, 1 ton of methane emission is equivalent to 21 tons of carbon dioxide emissions.
(b) GHG emissions include direct emissions from onsite combustion sources.
(c) Emissions resulting from activities at Monticello that would occur between plant shutdown and the beginning of decommissioning and assumed not to be greater than the GHG emissions from operation at Monticello.
(d) Emissions primarily from the operation of a natural-gas-fired, two-unit combustion turbine power plant and existing natural-gas-fired power plants.
(e) Emissions primarily from the operation of existing natural-gas-fired power plants.

3.14.3.2 Observed Trends in Climate Change Indicators

The global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2,000 years (IPCC 2023-TN8557). On a global level, from 1901 to 2016, the average temperature has increased by 1.8°F (1.0°C) (USGCRP 2018-TN5847). Since 1901, precipitation has increased at an average rate of 0.04 in. (0.1 cm) per decade on a global level (EPA 2021-TN7420). The United States Global Change Research Program (USGCRP) reports that from 1901 to 2016, average surface temperatures have increased by 1.8°F (1.0°C) across the contiguous United States (USGCRP 2018-TN5847). Since 1901, average annual precipitation has increased by 4 percent across the United States (USGCRP 2018-TN5847). The USGCRP reports that, since 1970, the contiguous United States is warming faster than the global average. Since 1970, the global temperature has increased by 1.7°F (0.9°C), while the average surface temperature in the contiguous United States has increased by 2.5°F (1.4°C) (USGCRP 2023-TN9762). The observed climate change indicators across the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of the sea level and increased tidal flooding in coastal areas, an increased occurrence of heat waves, and a decrease in the occurrence of cold waves.

Climate change and its impacts can vary regionally, spatially, and seasonally depending on local, regional, and global factors. Observed climate changes and impacts have not been uniform across the United States. Annual average temperature data for the Midwest for 2002–2021 (relative to 1901–1960) exhibit an increase of more than 2.0°F (1.1°C), and winter is warming nearly twice as fast as summer (USGCRP 2023-TN9762, Figure 2.4). The number of hot days (days at or above 95°F [at or above 35°C]) has decreased by 5.6 days, while the number of cold days (days at or below 32°F) has decreased by 4.9 days in the Midwest from 2002–2021 relative to 1901–1960 (USGCRP 2023-TN9762).

Average annual precipitation from 2002–2021 for the Midwest was 5–15 percent higher relative to the 1901–1960 average (USGCRP 2023-TN9762, Figure 2.4). The Midwest has experienced a 45 percent increase in the number of extreme precipitation days (defined as the top 1 percent of heaviest precipitation events) from 1958–2021 (USGCRP 2023-TN9762, Figure 2.8).

The NRC staff used the MDNR’s Minnesota Climate Trends tool to analyze temperature and precipitation trends for 1895–2022 in Minnesota’s Mississippi River St. Cloud watershed area, which encompasses Monticello. A trend analysis shows that the ambient average temperature has increased at a rate of 0.26°F (0.14°C) per decade, and average precipitation increased at a rate of 0.44 in (1.1 cm) per decade (MnDNR 2023-TN9681).

3.14.3.3 Climate Change Projections

Future global GHG emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate model simulations often use GHG emission scenarios to represent possible future social, economic, technological, and demographic development that, in turn, drive future emissions. Climate models indicate that over the next decade, warming is very similar across all emission scenarios (USGCRP 2023-TN9762). However, by mid-century (2040–2070), the differences between the projected temperatures under higher and lower emission scenarios become observable. The impacts of climate change increase with warming, and warming is certain to continue if emissions of CO_2 do not reach net zero (USGCRP 2023-TN9762).

The IPCC has generated various representative concentration pathway (RCP) scenarios commonly used by climate modeling groups to project future climate conditions (IPCC 2000-TN7652, IPCC 2013-TN7434, USGCRP 2017-TN5848, USGCRP 2018-TN5847). In the IPCC Fifth Assessment Report, four RCPs were developed and are based on the predicted changes in radiative forcing (a measure of the influence that a factor such as GHG emissions has in changing the global balance of incoming and outgoing energy) in the year 2100, relative to preindustrial conditions. The four RCP scenarios are numbered in accordance with the change in radiative forcing measured in watts per square meter (i.e., +2.6 [very low], +4.5 [lower], +6.0 [mid-high], and +8.5 [higher]) (USGCRP 2018-TN5847). For example, RCP 2.6 is representative of a mitigation scenario aimed at limiting the increase in the global mean temperature to 3.6°F (2°C) (IPCC 2014-TN7651). RCP 8.5 reflects a continued increase in global emissions resulting in increased warming by 2100. In the IPCC Working Group contribution to the Sixth Assessment Report, five shared socioeconomic pathways (SSPs) were used along with the associated modeling results as the basis for their climate change assessments (IPCC 2021-TN7435). These five socioeconomic pathway scenarios (SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5) cover a range of GHG pathways and climate change mitigation.

The Fourth National Climate Assessment uses RCPs when presenting projected climate change (USGCRP 2017-TN5848). The Fifth National Climate Assessment uses SSPs, RCPs, and global warming levels when presenting projected climate change (USGCRP 2023- TN9679).The Minnesota Climate Mapping and Analysis Tool (CliMAT) provides highly localized climate projections for Minnesota based on SSPs (Liess et al. 2023-TN9684). The NRC summarizes the regional projections for the Midwest, presented below from the Fourth and Fifth National Climate Assessment reports and CliMAT.

Projections based on the intermediate (RCP 4.5) and very high (RCP 8.5) scenarios for mid-century (2036–2065) indicate annual average temperature increases across the Midwest ranging from 4.21 to 5.29°F (2.3 to 2.9°C) relative to that for 1976–2005 (USGCRP 2017-TN5848: Table 6.4). The coldest and warmest daily temperatures of the year are expected to increase by 9.44°F (5.2°C) and 6.71°F (3.7°C), respectively, under a very high emission scenario (RCP 8.5) by mid-century (2036–2065) relative to those for 1975–2005 (USGCRP 2017-TN5848: Table 6.5). Specific to Wright and Sherburne Counties, the projections for the mid-century (2040–2059, relative to 1995–2014) indicate an increase of 3.1 to 4.4°F (1.72 to 2.4°C) in the average annual daily temperature for both the moderate (SSP2-45) and high (SSP5-85) emission scenarios (Liess et al. 2023-TN9684).

Precipitation projections based on the intermediate (RCP 4.5) and very high (RCP 8.5) emission scenarios for the mid-century (2036–2065) indicate precipitation increases across the Midwest ranging from 8 to 20 percent relative to that for the previous five decades (1991–2020) (USGCRP 2023-TN9762, Figure 4.3). Winter and spring precipitation is projected to increase, but summer and autumn precipitation is projected to be more variable. Specific to Wright and Sherburne Counties, projections based on the moderate scenario (SSP2-4.5) for the mid-century (2040–2059, relative to 1995–2014) indicate an increase of 2.1 to 6.2 percent in average annual precipitation (Liess et al. 2023-TN9684). Under the high emission scenario (SSP5-8.5), CliMAT projects that average annual precipitation for mid-century for Wright and Sherburne Counties can increase (up to 1.6 percent) or decrease (up to 1.6 percent).

The effects of climate change on Monticello structures, systems and components are outside the scope of the NRC staff's SLR environmental review. The environmental review describes the potential effects of continued nuclear power plant operation on the environment. Site-specific environmental conditions are considered when siting nuclear power plants. This includes the consideration of meteorological and hydrologic siting criteria as set forth in 10 CFR Part 100 (TN282), "Reactor Site Criteria." NRC regulations require that plant structures, systems and components important to safety be designed to withstand the effects of natural phenomena such as flooding, without loss of capability to perform safety functions. Further, nuclear power plants are required to operate within technical safety specifications in accordance with the NRC operating license, including coping with natural phenomenon hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes because of changing environmental conditions. Additionally, the NRC evaluates the operating conditions and physical infrastructure of nuclear power plants to assure ongoing safe operations under the plant's initial and renewed operating licenses through the NRC's Reactor Oversight Program. If new information about changing environmental conditions (such as rising sea levels or potential flooding that threaten safe operating conditions or challenge compliance with the plant's technical specifications) becomes available, the NRC will evaluate the new information to determine whether any safety-related changes are needed at licensed nuclear power plants.

This is a separate and distinct process from the NRC staff's SLR environmental review conducted in accordance with NEPA. Nonetheless, changes in climate could have broad implications for certain resource areas. As discussed below, the NRC staff considers the impacts of climate change on environmental resources that are incrementally affected by the proposed action.

Air Quality: Climate change can impact air quality as a result of changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007-TN7421). Ozone and $PM_{2.5}$ are particularly sensitive to climate change (IPCC 2007-TN7421; EPA 2009-TN9068; USGCRP 2023-TN9762). Ozone is formed by the chemical reaction of nitrogen oxides and volatile organic compounds in the presence of heat and sunlight. The emission of ozone precursors also depends on the temperature, wind, and solar radiation (IPCC 2007-TN7421). Warmer temperatures, air stagnation, droughts, and wildfires are favorable conditions for higher levels of ozone and $PM_{2.5}$ (USGCRP 2023-TN9762). USGCRP reports that there is medium confidence that climate change is projected to worsen air quality in many U.S. regions (USGCRP 2023-TN9762). Across the Midwest, year-round ozone is projected to increase by 2035 under a very high emissions scenario (RCP 8.5) (USGCRP 2023-TN9762).Surface Water Resources: Climate change can impact surface water resources because of changes in the temperature, precipitation, and other parameters. Increases in annual precipitation and heavy precipitation events, as is projected for Minnesota, can result in greater runoff from the land while increasing the potential for riverine flooding. In turn, these changes can result in the transport of a higher sediment load and other contaminants to surface waters with potential degradation of the ambient water quality. The projected changes in the cumulative annual runoff for mid-century (2036–2065, relative to 1991–2020) for the Midwest under an intermediate scenario (RCP 4.5) and very high scenario (RCP 8.5) indicate increases ranging from 5 to 20 percent (USGCRP 2023-TN9762: Figure 24.11). Cumulative runoff increases are projected throughout the Midwest region in winter. However, in the autumn and spring, cumulative runoff decreases are projected in southern areas of the Midwest and the northern Great Lakes areas, respectively. Cumulative runoff in the summer is projected to vary throughout the Midwest. Increases in the cumulative annual runoff may lead to increases in riverine flooding. Regulatory agencies would need to account for changes in water availability in their water resource allocation and environmental permitting programs. Regardless of water use permitting constraints, nuclear power plant operators would have to account for any changes in the water temperature in operational practices and procedures.

3.15 Cumulative Effects

Actions considered in the cumulative effects (impacts) analysis include the proposed SLR action when added to the environmental effects from past, present, and reasonably foreseeable future actions. The analysis considers all actions including minor ones, because the effects of individually minor actions may be significant when considered collectively over a period of time. The goal of the cumulative effects analysis is to identify potentially significant impacts. The environmental effects of the proposed SLR action when combined with the effects of other actions could result in a cumulative impact.

The cumulative effects or impacts analysis only considers resources and environmental conditions that could be affected by the proposed license renewal action, including the effects of continued reactor operations during the SLR term and any refurbishment activities at a nuclear power plant. For there to be a cumulative effect, the proposed action (i.e., SLR) must have an incremental new, additive, or increased physical effect or impact on the resource or environmental condition beyond what is already occurring.

For the purposes of analysis, past and present actions include all actions that have occurred since the commencement of reactor operations up to submittal of the SLR request. Older actions are accounted for in baseline assessments presented in the affected environment discussions in Sections 3.2 through 3.13. The time frame for the consideration of reasonably foreseeable future actions is the 20-year SLR term. Reasonably foreseeable future actions include current and ongoing planned activities through the end of the period of extended operation.

The incremental effects of the proposed action (SLR) when added to the effects from past, present, and reasonably foreseeable future actions and other actions result in the overall cumulative effect. A qualitative cumulative effects analysis is conducted in instances where the incremental effects of the proposed action (SLR) and past, present, and reasonably foreseeable future actions are uncertain or not well known.

Information from Xcel Energy's ER; responses to requests for additional information; information from other Federal, State, and local agencies; scoping comments; and information gathered during the environmental site audit at Monticello were used to identify past, present, and reasonably foreseeable future actions in the cumulative effects analysis.

Since the initial Monticello license renewal was completed, Xcel Energy completed replacement of both cooling towers. This project was conducted in two phases using the same footprint as the previously existing cooling towers; replacement of the second cooling tower was completed in May 2022. Multiple groundwater monitoring and pumping wells and tanks associated with groundwater tritium remediation have been installed at the Monticello site, along with a large storage pond and a sheet pile wall near the Mississippi River (Xcel 2023-TN9578). Other activities include minor and ongoing construction and maintenance activities on the Monticello site.

Proposed future projects at Monticello include a proposal to construct a second concrete storage pad within the existing Monticello ISFSI fenced area to increase spent fuel storage capacity. The existing ISFSI is approximately 3.5 ac (1.4 ha) in size; the proposed expansion project would require less than 1 ac (0.4 ha). Similarly, the expanded ISFSI capacity along with the spent fuel pool is anticipated to be capable of storing all the spent nuclear fuel generated during the SLR term. If the ISFSI storage needs to be expanded, previously disturbed land near the ISFSI is likely to be sufficient for the expansion with no significant environmental impact.

Construction at the ISFSI is dependent on the State of Minnesota issuing a Certificate of Need. The Minnesota Public Utilities Commission issued an order on October 17, 2023, granting a Certificate of Need for additional dry cask storage to support 2030–2040 operations. As stated in the order, "Xcel Energy's petition anticipated only needing around 14 canisters through 2040, but proposed building space for approximately 36 canister vaults." Xcel Energy anticipates the placement of up to 15 canisters during its 2028 dry storage loading campaign. (Xcel 2023-TN9578).

Potential projects near Monticello include:

- Sherco Solar Project – A 460 MW solar energy facility proposed by Xcel Energy. The project covers approximately 3,480 ac (1,408 ha) of land outside the city of Becker in Sherburne County. The proposed project would include the installation of two new 345 kV transmission lines totaling approximately 5 mi (1.6 km). The project would generate 900 temporary construction jobs and 24 long-term jobs for operations and maintenance. The project is expected to be completed in 2024 (Xcel 2023-TN9578).

- Four natural gas facilities – Proposed by Xcel Energy as a replacement for the Sherco coal-fired plant.

The following sections discuss the cumulative effects on the environment near Monticello—when the incremental environmental effects of the proposed license renewal action are compounded by the effects from past, present, and reasonably foreseeable future actions. For the most part, environmental conditions near Monticello are not expected to change appreciably during the SLR term beyond what is already being experienced. Consequently, no cumulative impacts analysis was performed for the following resource areas: land use, noise, geology and soils, terrestrial resources, aquatic resources, and historic and cultural resources.

3.15.1 Air Quality

The region of influence for the cumulative air quality analysis consists of Sherburne and Wright Counties, where the Monticello site is located. Xcel Energy has not proposed any refurbishment related activities during the SLR term. As a result, air emissions from the nuclear power plant during the SLR term would be similar to those presented in Section 3.3 of this EIS. Consequently, cumulative changes to air quality in Sherburne and Wright counties would be the result of future projects and action that change present-day emissions within the counties, unrelated to the proposed action (i.e., SLR). Therefore, based on this information the proposed action would have no cumulative effect on air quality beyond what is already being experienced.

Construction activities (e.g., Sherco Solar Project, transmission installation) identified in Section 3.15 of this EIS could increase air emissions during their respective construction periods, but those air emissions would be temporary and localized. The four proposed natural gas facilities could be significant long-term sources of air emissions. Vehicular traffic associated with operation of the Sherco Solar Project and natural gas facilities also will contribute to long-term air emissions.

3.15.2 Water Resources

3.15.2.1 Surface Water Resources

The description of the affected environment in Section 3.5.1, “Surface Water Resources,” of this EIS serves as the baseline for the cumulative impacts assessment for surface water resources. Monticello withdraws cooling water from the Mississippi River and discharges return flows and comingled effluents back to the river within the Mississippi River–St. Cloud watershed. As discussed in Section 3.5.1, none of the surface water quality of use issues would have a greater than SMALL impact on surface water quality or use. Additionally, Xcel Energy has not identified any refurbishment activities or major changes to Monticello operations for the SLR term (Xcel 2023-TN9084).

3.15.2.1.1 Water Use Considerations

State-wide, the combined water use (surface water and groundwater) in Minnesota has declined approximately 28 percent from 2010 to 2019 while over that same timeframe the population has increased by approximately 7 percent (MnDNR 2020-TN9685). Much of the decrease in the state's water use can be attributed to a decrease in water needed for power plant cooling, even as the overall demand for electricity remains constant.

The State of Minnesota requires an appropriation permit for anyone who uses more than 10,000 gallons of water per day (37,854 Liters per day) or 1 million gallons of water per year (3,785,411 Liters per day) (MnDNR 2020-TN9685). These water users must submit annual reports to the Minnesota Department of Natural Resources detailing their monthly water usage, which helps the department manage water resources, especially during times of drought (MnDNR 2020-TN9685).

The U.S. Geological Survey publishes State water-use data by type, category use (e.g., public supply, power generation, industrial) and county every 5 years since 1985. As shown in Figure 3.1-3 of Xcel Energy's ER (Xcel 2023-TN9084), the Monticello site boundary encompasses portions of both Sherburne and Wright counties. Data from the U.S. Geological Survey distinguishes between water type (groundwater, surface water, saline, or freshwater), but does not identify the water source (e.g., river, stream, reservoir) or basin. Table 3-33 presents surface water withdrawals from Wright and Sherburne counties for 2015. As shown in the table, the vast majority of surface water usage is for thermoelectric power generation, with relatively minor amounts for irrigation and mining.

As assessed in Section 3.5.1 "Surface Water Resources," of this EIS, Monticello consumes only a small amount of the water available in the Mississippi River, and changes in Monticello's surface water withdrawal rates over the SLR term are not anticipated (Xcel 2023-TN9084). The nearest permitted intake downstream that has been actively appropriating water over the last 10 years is located approximately 20 mi (32 km) downstream of Monticello and supports agricultural use (MnDNR 2023-TN9863). Therefore, continued operation of Monticello under the proposed action should not have any significant impact on the amount of water available to users downstream from Monticello, with minimal contributions to cumulative impacts on surface water availability.

No new or proposed projects, with the potential to substantially impact surface water withdrawals or consumptive water use within the reach of the Mississippi River where Monticello is located, were identified during the NRC staff's review. Therefore, based on the available information, the proposed action would have no cumulative effect on surface water use beyond what is already being experienced.

Table 3-33 Surface Water Withdrawals from Wright and Sherburne Counties, 2015

Category	Wright County (MGD)	Sherburne County (MGD)
Public Supply	0.00	0.00
Domestic, Self-Supplied	0.00	0.00
Industrial, Self-Supplied	0.00	0.00
Irrigation	0.13	0.08
Livestock	0.00	0.00
Aquaculture	0.00	0.00
Mining	0.12	0.15
Power Generation (Thermoelectric)	315.06	53.30
Total	**315.31**	**53.53**

MGD = million gallon(s) per day.
Source: Dieter et al. 2018-TN9686.

3.15.2.1.2 Water Quality Considerations

The water quality of the upper Mississippi River varies from near-pristine north of St Cloud to no longer meeting river life and recreation standards by the time it reaches the Twin Cities. The primary pollutants affecting water quality in this region include phosphorus, bacteria, nitrate, and sediment. The streams and rivers that feed into the Mississippi are the source of most of these nonpoint source pollutants, as south of St. Cloud, the land use changes from forests and wetlands to crops and cities.

As discussed in Section 3.5.1.3, the MDNR classifies the portion of the Mississippi River adjacent to the plant as suitable for aquatic recreation, including fishing and swimming, as well as for protection as a drinking water source (NMC 2005-TN9345). While this reach is also listed by MPCA as impaired for fish consumption due to PCB and mercury in fish tissue, and impaired for aquatic recreation due to fecal coliform (MPCA 2022-TN9539), Monticello does not contribute to these impairments.

Monticello periodically conducts mechanical or hydraulic maintenance dredging in the area in front of the plant's concrete intake apron and the Mississippi River. The material removed consists primarily of silt, sand, and rocks. Monticello holds both a USACE regional general permit (RGP- 003-MN) and a MDNR State dredge permit (1967-0743). Dredging may result in a localized impact on water quality by temporarily increasing the turbidity of the water column.

As stated in Section 3.5.1.3, Monticello's CWA Section 401 Water Quality Certification remains valid (see Attachment E in Xcel 2023-TN9084). To operate, Monticello is required to comply with its surface water withdrawal limits, NPDES permit, stormwater permits and other regulations. Continued operation of Monticello would require renewed permits from the MPCA, which would address changing requirements such that cumulative water quality objectives would be served. Moreover, offsite projects would similarly have to comply with MPCA regulations.

In summary, a substantial regulatory framework exists to address current and potential future sources of water quality degradation within the watershed of the Monticello site with respect to potential cumulative impacts on surface water quality. Therefore, based on this information, the proposed action would have no cumulative effect on surface water quality beyond what is already being experienced.

3.15.2.2 Groundwater Resources

The description of the affected environment in Section 3.5, "Groundwater Resources," of this EIS serves as the baseline for the cumulative impacts assessment for groundwater resources. The normal flow of groundwater at Monticello is toward the Mississippi River with some local reversal of flow when river levels are high. Monticello's location near the river and the distance to other groundwater users helps to limit the potential for any noticeable cumulative groundwater use impacts. In addition, Monticello's groundwater withdrawals for potable use and other plant purposes is small enough that the NRC staff expects off-site groundwater levels would not be affected. Monticello has received a permit for more significant groundwater withdrawals to address remediation of a tritium release. As described in Section 3.5 of this EIS, the staff determined that these withdrawals would result in a small, temporary reduction of groundwater levels at the site boundary. Therefore, these withdrawals would not contribute significantly to potential offsite cumulative groundwater use impacts.

As described in Section 3.5.2 of this EIS, a November 2022 release of tritium has affected groundwater quality at the plant site. Monticello monitors the groundwater quality regularly and has taken a number of actions to remediate the onsite groundwater contamination and prevent the movement of affected groundwater offsite. As noted above, groundwater at the site discharges to the Mississippi River; tritium levels in the river are regularly monitored and were below detection limits as of August 2023. As described in Section 3.5.3.2 of this EIS, the NRC staff concluded that groundwater quality impacts due to the release of radionuclides would be SMALL to MODERATE during the SLR term because of uncertainty in the duration of groundwater remediation. However, the NRC staff expects that the effects of the tritium release will be limited to the immediate vicinity of the plant and would not contribute significantly to potential offsite cumulative groundwater quality impacts.

3.15.3 Socioeconomics

As discussed in Section 3.9, continued operation of Monticello during the SLR term would have no impact on socioeconomic conditions in the region beyond what is already being experienced. Xcel Energy has no planned activities at Monticello beyond impacts already being experienced. The only activities Xcel Energy plans at Monticello are the proposed expansion of the existing ISFSI (which would be of limited duration and impact), and continued reactor operations and maintenance.

Because Xcel Energy has no plans to hire additional workers during the SLR term, overall expenditures and employment levels at Monticello would remain unchanged with no new or increased demand for housing and public services. Therefore, the only contributory effects would come from reasonably foreseeable future planned operational activities at Monticello and other planned offsite activities, unrelated to the proposed action (SLR). When combined with past, present, and reasonably foreseeable future activities, the proposed action would have no new or increased cumulative effect beyond what is already being experienced.

3.15.4 Human Health

The NRC and EPA have established radiological dose limits to protect the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are specified in 10 CFR Part 20 (TN283) and 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations” (TN739). As discussed in Section 3.11, “Human Health,” of this EIS, the impacts on human health from continued nuclear power plant operations during the SLR term would be SMALL.

For the purposes of this cumulative impact analysis, the geographical area considered is the area within a 50 mi (80 km) radius of Monticello. There are no other operational nuclear power plants within this 50 mi (80 km) radius. As discussed in Section 3.13.1, “Radioactive Waste,” of this EIS, Xcel Energy stores spent nuclear fuel from Monticello in a storage pool and in an onsite ISFSI. Per the Monticello ER, the ISFSI will exhaust its current state-approved spent nuclear fuel dry storage capacity in 2030 and will need to be expanded prior to the SLR period of extended operation. The needed dry storage capacity would involve construction of a second pad within the ISFSI fenced area. This expansion is within the boundary of the existing ISFSI footprint The State of Minnesota approved the request for a Certificate of Need to place up to 15 additional canisters on a second pad. Beyond 2040, Xcel Energy would need to seek additional Certificates of Need to place additional canisters on the second storage pad. (Xcel 2023-TN9084).

The EPA regulations at 40 CFR Part 190 (TN739) limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.13 in this EIS, Xcel Energy has a radiological environmental monitoring program that measures radiation and radioactive materials in the environment from Monticello, its ISFSI, and all other sources. The NRC staff reviewed the radiological effluent and environmental monitoring reports for the five-year period from 2018 through 2022 as part of this cumulative impacts assessment (Xcel 2023-TN9596, Xcel 2022-TN9595, Xcel 2021-TN9597, Xcel 2020-TN9598, Xcel 2019-TN9599, Xcel 2023-TN9615, Xcel 2022-TN9614, Xcel 2021-TN9613, Xcel 2020-TN9612, Xcel 2019-TN9621). The NRC staff's review of Xcel Energy's data showed no indication of an adverse trend in radioactivity levels in the environment from either Monticello or the ISFSI. The data showed that there was no measurable impact on the environment from operations at Monticello.

Based on this information, there would be no significant cumulative radiological effect on human health resulting from the proposed action (SLR), in combination with the cumulative effects from other sources. This conclusion is based on the NRC staff's review of radiological environmental monitoring program data, radioactive effluent release data, and worker dose data; the expectation that Monticello would continue to comply with Federal radiation protection standards during the period of extended operation; continued NRC oversight of plant emissions and activities, and the continued regulation of any future development or actions in the vicinity of Monticello by the State of Minnesota.

3.15.5 Environmental Justice

This cumulative impact analysis evaluates the potential for disproportionate and adverse human health and environmental effects on minority and low-income populations that could result from past, present, and reasonably foreseeable future actions, including the continued operational effects of Monticello during the SLR term. Everyone living near Monticello, including minority and low-income populations, currently experience its operational effects. The NRC addresses environmental justice by identifying the location of minority and low-income populations and determining whether there would be any potential human health or environmental effects and whether any of the effects may be disproportionate and adverse to these populations.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionate environmental effects refer to impacts or risks of impacts in the natural or physical environment in a minority or low-income community that appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas presented in preceding sections of this chapter. As previously discussed in this chapter, the SLR impacts for all resource areas (e.g., land, air, water, and human health) would be SMALL.

As discussed in Section 3.11 of this EIS, there would be no disproportionate and adverse human health and environmental effects on minority and low-income populations from the continued operation of Monticello during the SLR term. Because Xcel Energy has no plans to hire additional workers during the SLR term, employment levels at Monticello would remain unchanged, and there would be no additional demand for housing or increase in traffic. Based on this information and the analysis of human health and environmental effects, it is not likely that there would be any disproportionate and adverse contributory effects on minority and low-income populations from the continued operation of Monticello during the SLR term beyond what is already being experienced. Therefore, the only contributory effects would come from reasonably foreseeable future planned activities at Monticello, and other reasonably foreseeable future offsite activities that are not related to the proposed action (SLR).

When combined with past, present, and reasonably foreseeable future activities, the proposed action (SLR) would not likely cause disproportionate and adverse human health and environmental effects on minority and low-income populations near Monticello.

3.15.6 Waste Management and Pollution Prevention

This section considers the incremental waste management impacts of the SLR term when added to the contributory effects of other past, present, and reasonably foreseeable future actions. In Section 3.13.3, “Proposed Action,” the potential waste management impacts from continued operations at Monticello during the SLR term would be SMALL.

As discussed in Sections 3.13.1 and 3.13.2, Xcel Energy maintains waste management programs for radioactive and nonradioactive waste generated at Monticello and is required to comply with Federal and State permits and other regulatory waste management requirements. All industrial facilities, including nuclear power plants and other facilities within a 50 mi (80 km) radius of Monticello, are also required to comply with appropriate NRC, EPA, and State requirements for the management of radioactive and nonradioactive waste. Current waste management activities at Monticello would likely remain unchanged during the SLR term, except for the possibility of including tritium gaseous releases from the remediation pond as an additional effluent point, see Section 3.13.1.2. Furthermore, the NRC staff expects that Monticello will continue to comply with Federal and State requirements for radioactive and nonradioactive waste.

Therefore, the proposed action, including continued radioactive and nonradioactive waste generation during the SLR term, would have no cumulative effect beyond what is already being experienced. This is based on Monticello’s expected continued compliance with Federal and State of Minnesota requirements for radioactive and nonradioactive waste management and the expected regulatory compliance of other waste producers in the area.

3.16 Resource Commitments Associated with the Proposed Action

This section describes the NRC’s consideration of potentially unavoidable adverse environmental impacts that could result from implementation of the proposed action and alternatives, the relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity, and the irreversible and irretrievable commitments of resources.

3.16.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out any of the replacement energy alternatives considered in this EIS, including the proposed action, would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur because of the emission and release of various chemical and radiological constituents from nuclear power plant operations. Nonradiological emissions resulting from nuclear power plant operations are expected to comply with Federal EPA and State emissions standards. Chemical and radiological emissions would not exceed the national emission standards for hazardous air pollutants.

Continued nuclear power plant operation would result in industrial wastewater discharges to the Mississippi River containing small amounts of water treatment chemical additives and other pollutants. Discharges are expected to comply with limits set in the NPDES permit.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to low levels of radiation as well as hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine nuclear power plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and would not exceed regulatory standards or administrative control limits. In comparison, alternatives involving construction and operation of a nonnuclear power generating facility also would result in unavoidable exposure to hazardous and toxic chemicals for workers and the public.

Generation of spent nuclear fuel and waste material, including low-level radioactive waste, hazardous waste, and nonhazardous waste, would be unavoidable. Hazardous and nonhazardous wastes would be generated at some nonnuclear power generating facilities. Wastes generated during nuclear power plant operations would be collected, stored, and shipped for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Because of the costs of handling these materials, the NRC staff expects that nuclear power plant operators would optimize all waste management activities and operations in a way that generates the smallest possible amount of waste.

3.16.2 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment, as described in sections titled, “Proposed Action,” “No-Action,” and “Replacement Power Alternatives: Common Impacts”). “Short term” is defined as the time period over which continued power generating activities occurs.

Nuclear power plant operations require short-term use of the environment and commitment of resources (e.g., land and energy), indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including SLR, than under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives require similar relationships to be sustained between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from nuclear power plant operations introduce small amounts of radiological and nonradiological materials to the region around the nuclear power plant site. Over time, these emissions would result in increased concentrations and exposures, but the NRC staff does not expect that these emissions would affect air quality or radiation exposure to the extent that public health and long-term productivity of the environment would be impaired.

Continued employment, expenditures, and tax revenues generated during nuclear power plant operations directly benefit local, regional, and State economies over the short term. Local governments that invest project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste require an increase in energy and consume space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Nuclear power plant facilities are committed to electricity production over the short term. After these facilities are decommissioned and the area restored, the land could be available for other future productive uses.

3.16.3 Irreversible and Irretrievable Commitment of Resources

Resource commitments are irreversible when primary or secondary impacts limit the future options for a resource. For example, consumption or loss of nonrenewable resources is irreversible. An irretrievable commitment refers to the use or consumption of resources for a period (e.g., for the duration of the action under consideration) that is neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and human-made resources required for power plant operations. In general, commitments of capital, energy, labor, and material resources are also irreversible.

Implementation of any of the replacement energy alternatives considered in this site-specific EIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, minerals, and—in some cases—fossil fuels. These resources would be committed during the SLR term and during the entire life cycle of the nuclear power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and nuclear power plant operations and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems or withdrawn from surface water or groundwater. Continued nuclear power plant operation would result in continued consumptive water use of Mississippi River water by the plant’s cooling system. These resources are readily available, and the NRC staff does not expect that the amounts required would deplete available supplies or exceed available system capacities.

4 CONCLUSION

This site-specific EIS contains the NRC staff's environmental review of Xcel Energy's request to renew the Monticello operating license for an additional 20 years, as required by 10 CFR Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The regulations in 10 CFR Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.-TN661). This chapter presents the NRC staff's conclusions regarding the environmental impacts of Monticello SLR, lists and compares the environmental impacts of alternatives to SLR, and presents the NRC staff's preliminary conclusions and recommendation.

4.1 Environmental Impacts of License Renewal

After reviewing the site-specific environmental impacts for all issues in this EIS, the NRC staff has concluded that subsequent license renewal of the Monticello facility operating license would have SMALL environmental impacts for all issues other than groundwater resources, which would have SMALL to MODERATE environmental impacts. The NRC staff considered mitigation measures for each environmental issue, as applicable, and concluded that no additional mitigation measure is warranted.

4.2 Comparison of Alternatives

In Section 3 of this EIS, the NRC considered the following alternatives to renewing the Monticello facility operating license:

- no-action
- natural gas and renewables
- renewables and storage
- new nuclear (SMR)

Based on the review presented in this draft EIS, the NRC staff concludes that the environmentally preferred alternative is the proposed SLR action. The NRC staff recommends approving the subsequent license renewal of the Monticello facility operating license. As shown Table 2-1, all other replacement power-generation alternatives have environmental impacts that are greater than SLR, in addition to the environmental impacts inherent to new construction. To make up for the lost power generation in case the NRC does not renew the Monticello facility operating license (i.e., the no-action alternative), energy decisionmakers may implement one of the replacement energy-generating alternatives discussed in Section 2, or a comparable combination alternative capable of replacing the power generated by Monticello.

4.3 Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of SLR are not so great that preserving the option of continued reactor operations for energy-planning decisionmakers would be unreasonable. This preliminary recommendation is based on the following:

- Xcel Energy's environmental report
- consultation with Federal, State, Tribal, and local governmental agencies
- the NRC staff's independent environmental review
- the consideration of public comments received during the scoping process

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6 LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Material Safety and Safeguards prepared this draft site-specific environmental impact statement with assistance from other NRC organizations and Pacific Northwest National Laboratory (PNNL). Table 6-1 identifies each contributor's name, education, affiliation, and function or expertise.

Table 6-1 List of Preparers

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Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
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Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
	experience in groundwater resource assessment and environmental impact evaluation	
Ann Miracle, PNNL	PhD Molecular Immunology MS Molecular Genetics BA Biology Over 15 years of experience in ecological impact analysis, Endangered Species Act Section 7 consultations, and EFH consultations	Terrestrial Resources
Patrick Mirick, PNNL	MS Fisheries; BA Biology and Economics; 15 years of experience in environmental assessments, policy and technical analysis for fisheries, and public outreach and engagement	Aquatic Resources
Jaime Moore, PNNL	MPM Master of Project Management BS Business Administration 23 years of Project Management experience	Project Management
Jon Napier, PNNL	PhD Radiation Health Physics MS Health Physics BS Environmental Science Certified Health Physicist with 7 years of experience in health physics, nuclear materials inspections and licensing, and radiation safety	Radiological Human Health, Radiological Waste, Spent Nuclear Fuel
Michelle Niemeyer, PNNL	MS Agricultural Economics BS Agricultural Economics	Environmental Justice, Socioeconomics
Mike Parker, PNNL	BA English Literature 25 years of experience copyediting, document design, and formatting and 20 years of experience in technical editing	Document Production
Rajiv Prasad, PNNL	PhD Civil and Environmental Engineering MTech Civil Engineering BE Civil Engineering 25 years of experience in applying hydrologic principles to water resources engineering, hydrologic design, flooding assessments, environmental engineering, and impacts assessment including 15 years of experience in NEPA environmental assessments of surface water resources	Surface Water Resources
Adrienne Rackley, PNNL	MS Economics BA Business Administration AA General Studies	Environmental Justice, Socioeconomics
Lindsey Renaud, PNNL	MA Anthropology BA Anthropology 10 years in cultural resource management, NEPA environmental impact assessments and Section 106 and 110 compliance. Secretary of the Interior-qualified registered professional archaeologist. Experience in Tribal engagement and Native American Graves Protection and Repatriation Act (NAGPRA) compliance	Historical and Cultural Resources

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Kacoli Sen, PNNL	PhD Cancer Biology MS Zoology (specialization Ecology) BS Zoology Diploma in Environmental Law Over 6 years of technical and scientific editing and production experience	Production Editor
Isaiah Steinke, PNNL	PhD Electrical Engineering MS Data Analytics BS Materials Science and Engineering 10+ years of technical and scientific editing	Production Editor
Kazi Tamaddun, PNNL	PhD Civil and Environmental Engineering MS Civil Engineering 8 years of experience in hydrologic, hydraulic, ecosystem, and water systems modeling; hydro-climatology; climate change modeling and analysis	Surface Water Resources
Anita Waller, PNNL	BA English MA American Studies 20 years of experience in reference management, developmental and copyediting, and document production	Production Editor

AA = associate degree; AM = Master of Arts; BA = Bachelor of Arts; BE = Bachelor of Engineering; BS = Bachelor of Science; DoD = U.S. Department of Defense; DOE = Department of Energy; DOI = U.S. Department of Interior; EFH = essential fish habitat; MBA Master of Business Administration; MHP = Master of Public Health; MPM = Master of Project Management; MRP = Master of Regional Planning; MS = Master of Science; MTech = Masters of Technology; NEPA = National Environmental Policy Act of 1969; NNSA = National Nuclear Security Administration; NRC = U.S. Nuclear Regulatory Commission; PhD = Doctor of Philosophy; PMP = Project Management Professional; PNNL = Pacific Northwest National Laboratory.

7 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM THE NRC SENDS COPIES OF THIS EIS

Name and Title	Affiliation and Address
Shawn Hafen	Xcel Energy
David Ogulei, Kathleen Kowal	U.S. Environmental Protection Agency, Region 5
U.S. Fish and Wildlife Service	Minnesota-Wisconsin Ecological Services Field Office
Reid Nelson	Office of Federal Agency Programs Advisory Council on Historic Preservation
Sarah J. Beimers	Minnesota State Historic Preservation Office
Kelly Applegate	Mille Lacs Band of Ojibwe
Charlie Lippert	Mille Lacs Band of Ojibwe

APPENDIX A

COMMENTS RECEIVED ON THE MONTICELLO POWER STATION, UNITS 1 AND 2 ENVIRONMENTAL REVIEW

The U.S. Nuclear Regulatory Commission (NRC) staff began the scoping process for the Environmental Review of Monticello subsequent license renewalSLR application January 31, 2023, in accordance with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. § 4321, et seq-TN8608). On March 10th, 2023 the NRC issued a notice of intent to conduct an environmental scoping process for Monticello that was published in the Federal Register on March 10, 2023 *Federal Register* (88 FR 15103-TN9715). *Federal Register* notices are searchable using the notice number (e.g., 88 FR 15103) at Regulations.gov. In its notice, the NRC requested that members of the public and stakeholders submit comments on the North Anna subsequent license renewal environmental review to the Federal Rulemaking Website at Regulations.gov.

As part of the environment impact statement scoping process, the NRC staff held a in person public meeting on March 22, 2023, followed by a virtual public scoping meeting on March 29, 2023.

The in-person and the virtual public scoping meetings consisted of prepared statements by the NRC staff and a public comment session. Attendees provided oral statements that were recorded and transcribed by a certified court reporter. Written statements submitted at the public meeting are captured in the NRC's Agencywide Documents Access and Management System.

The transcript of the in-person meeting is an attachment of the scoping meeting summary dated May 1, 2023 (NRC 2023-TN9818), and the transcript of the virtual public scoping meeting is an attachment of the scoping meeting summary, dated May 1, 2023 (NRC 2024-TN9817). In addition to the comments received during the virtual and in-person public meeting, were also received electronically, via Regulations.gov and email.

At the conclusion of the scoping process, the staff issued the Monticello Nuclear Power Plant Scoping Summary Report ML24059A342 (NRC 2024-TN9817). The report contains comments received during the public meetings and electronically during the scoping period as well as the NRC staff's initial consideration of those comments.

A.1 References

88 FR 15103. March 10, 2023. "Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement; Northern States Power Company—Minnesota; Monticello Nuclear Generating Plant, Unit 1." *Federal Register*, Nuclear Regulatory Commission. TN9715.

42 U.S.C. § 4321 et seq. U.S. Code Title 41, The Public Health and Welfare, Section 4321 "Congressional Declaration of Purpose." TN8608.

NRC (U.S. Nuclear Regulatory Commission). 2023. Memorandum from J. Umana, Project Manager Environmental Review License Renewal Branch, to T. Smith, Chief Environmental Review License Renewal Branch, dated May 1, 2023, regarding "Meeting Summary: Public Scoping Meeting for the Environmental Review of the Subsequent License Renewal Application for Monticello Nuclear Generating Plant, Unit 1 (EPID No.: L-2023-SLE-0000).” Washington, D.C. ADAMS Accession No. ML23110A013. TN9818.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from S. Koenick, Chief Environmental Project Management Branch 1, to S. Hafen, Site Vice President Northern States Power Company, dated March 18, 2024, regarding “Issuance of Environmental Scoping Summary Report Associated with the U.S. Nuclear Regulatory Commission Staff’s Review of the Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application (Epid Number: L-2023-Sle-0000) (Docket Number: 50-263).” Washington, D.C. ADAMS Accession No. ML24059A288. TN9817.

APPENDIX B

APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

There are several Federal laws and regulations that affect environmental protection, health, safety, compliance, and consultation at U.S. Nuclear Regulatory Commission (NRC)-licensed nuclear power plant sites. Some of these laws and regulations require permits by or consultations with other Federal agencies or State, Tribal, or local governments. Certain Federal environmental requirements have been delegated to State authorities for enforcement and implementation. Furthermore, States also have enacted laws to protect public health and safety and the environment. It is NRC policy that nuclear power plants are operated in a manner that provides adequate protection of public health and safety and protection of the environment through compliance with applicable Federal and State laws, regulations, and other requirements, as appropriate.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.-TN663), authorizes the NRC to enter into an agreement with any State to allow the State to assume regulatory authority for certain activities (see 42 U.S.C. 2021-TN6606). A State that enters into such an agreement with the NRC is called an Agreement State. Minnesota is one such NRC Agreement State, as outlined in the Agreement between the NRC and State of Minnesota for Discontinuance of Certain Commission Regulatory Authority and Responsibility within the State pursuant to the Section 274 of the Atomic Energy Act of 1954, as amended https://www.nrc.gov/cdn/nmss/pdf/mnagreement.pdf (NRC and MN 2006-TN9819).

The NRC discontinued the regulatory authority of the Commission, and the State of Minnesota assumed regulatory authority for the licensing, rulemaking, inspection, and enforcement activities involving: (1) radioactive materials produced as a result of processes related to the production or utilization of special nuclear material; (2) uranium and thorium source materials; and (3) special nuclear material in quantities not sufficient to form a critical mass. (NRC and MN 2006-TN9819).Integrated Materials Performance Evaluation Program review for the State of Minnesota, the Minnesota Department of Health regulated 148 specific licenses authorizing possession and use of radioactive materials. (IMPEP 2022, NRC 2022-TN9834). The NRC retains regulatory authority over all other activities not specifically discontinued, including the regulation of commercial nuclear power plants. (NRC and MN 2006-TN9819).

The Homeland Security and Emergency Management Preparedness program helps to ensure the health and safety of the public in the event of a radiological incident at the Monticello Nuclear Plant.

In addition to carrying out some Federal programs, State legislatures develop their own laws. State statutes can supplement, as well as implement, Federal laws for protection of air, surface water, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The U.S. Environmental Protection Agency (EPA) has the primary responsibility to administer the Clean Water Act (33 U.S.C. 1251 et seq.-TN662). The National Pollutant Discharge Elimination System program addresses water pollution by regulating the discharge of potential pollutants to waters of the United States. The Clean Water Act, as administered by the EPA, allows for primary enforcement and administration through State agencies, as long as the State program is at least as stringent as the Federal program.

The EPA has delegated the authority to issue National Pollutant Discharge Elimination System permits to the State of Minnesota. The Minnesota Pollution Control Agency provides oversight for public water supplies, provides permits to regulate the discharge of industrial and municipal wastewaters—including discharges to groundwater—and monitors State water resources for water quality.

B.1 Federal and State Requirements

Monticello Nuclear Generating Plant, Unit 1 (Monticello) is subject to various Federal and State requirements. Table B-1 lists the principal Federal and State regulations and laws that are considered or mentioned in this environmental impact statement for Monticello subsequent license renewal.

Table B-1 Federal and State Requirements

Law or Regulation	Requirements
Current Operating License and License Renewal	
Atomic Energy Act (AEA) (42 U.S.C. 2011 et seq.TN663)	The AEA of 1954, as amended, and the Energy Reorganization Act (ERA) of 1974 (42 U.S.C. 5801 et seq.-TN4466) give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, “Energy,” of the *Code of Federal Regulations* (CFR).
Archeological and Historic Preservation Act of 1974, as amended (54 U.S.C. § 312501 et seq.-TN4844)	The Archeological and Historic Preservation Act establishes procedures for preserving historical and archeological resources. Analysis of environmental compliance includes assessing energy alternatives for possible impacts on prehistoric, historic, and traditional cultural resources.
Antiquities Act of 1906, as amended (54 U.S.C. §§ 320301–320303 and 18 U.S.C. § 1866(b)-TN6602)	The Antiquities Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands from appropriation, excavation, injury, and destruction without permission.
American Indian Religious Freedom Act of 1978 (42 U.S.C. § 1996-TN5281)	The American Indian Religious Freedom Act protects Native Americans’ rights of freedom to believe, express, and exercise traditional religions.
Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668–668d-TN1447)	The Bald and Golden Eagle Protection Act makes it unlawful to take, pursue, molest, or disturb bald and golden eagles, their nests, or their eggs anywhere in the United States. The U.S. Fish and Wildlife Service (FWS) may issue take permits to individuals, government agencies, or other organizations to authorize limited, non-purposeful disturbance of eagles, in the course of conducting lawful activities such as operating utilities or conducting scientific research.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001-TN1686)	The Native American Graves Protection and Repatriation Act establishes provisions for the treatment of inadvertent discoveries of Indian remains and cultural objects. When discoveries are made during ground-disturbing activities, the activity in the area must immediately stop, and reasonable protective efforts, proper notifications, and appropriate disposition of the discovered items must be pursued.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. § 9601 et seq.-TN6592)	CERCLA includes an emergency response program to respond to a release of a hazardous substance to the environment. Releases of source, byproduct, or special nuclear material from a nuclear incident are excluded from CERCLA requirements if the releases are subject to the financial protection requirements of the AEA. CERCLA is intended to provide a response to, and cleanup of, environmental problems that are not covered adequately by the permit programs of the many other environmental laws, including the Clean Air Act (CAA); CWA; Safe Drinking Water Act; Marine Protection, Research, and Sanctuaries Act (33 U.S.C. § 1401 et seq.-TN4479); Resource Conservation and Recovery Act (RCRA); and AEA. Under Section 120 of CERCLA, each department, agency, and instrumentality (e.g., a municipality) of the United States is subject to, and must comply with, CERCLA in the same manner as any nongovernmental entity (except for requirements for bonding, insurance, financial responsibility, or applicable time period). Under CERCLA, the EPA would have the authority to regulate hazardous substances at a facility in the event of a release or a “substantial threat of a release” of those materials. Releases greater than reportable quantities would be reported to the National Response Center. Assessment of alternatives for environmental compliance includes consideration of whether hazardous substances, in reportable quantity amounts, could be present at nuclear power plants during the license renewal term.
Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 (42 U.S.C. § 11001 et seq.-TN6603) (also known as “SARA Title III”)	The EPCRA, which is the major amendment to CERCLA (42 U.S.C. § 9601 et seq.-TN6592*)*, establishes the requirements for Federal, State, and local governments; Tribes; and industry regarding emergency planning and “Community Right-to-Know” reporting on hazardous and toxic chemicals. The “Community Right-to-Know” provisions increase the public’s knowledge of and access to information about chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment. The EPCRA requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. The EPA implements the EPCRA under regulations found in 40 CFR Part 355 (TN5493), Part 370 (TN6612), and Part 372 (TN6613).
Pollution Prevention Act of 1990 (42 U.S.C. § 13101 et seq.-TN6607)	The Pollution Prevention Act establishes a national policy for waste management and pollution control that focuses first on source reduction, then on environmental issues, safe recycling, treatment, and disposal.
National Environmental Policy Act of 1969 (NEPA), (42 U.S.C. 4321 et seq.-TN661)	NEPA requires Federal agencies to integrate environmental values into their decision-making process by considering the environmental impacts of proposed Federal actions and reasonable alternatives to those actions. NEPA establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. Section 102(2) contains provisions that force actions to make sure Federal agencies follow the letter and spirit of the Act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(c) of the NEPA requires Federal

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information. This environmental impact statement (EIS) has been prepared in accordance with NEPA requirements and NRC regulations (10 CFR Part 51-TN250) for implementing NEPA to assure compliance with Section 102(2).
10 CFR Part 20 (TN283)	Regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the AEA of 1954, as amended, and the ERA of 1974, as amended. The purpose of these regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part.
10 CFR Part 50 (TN249)	Regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," are NRC regulations issued under the AEA, as amended, and Title II of the ERA of 1974, to provide for the licensing of production and utilization facilities, including power reactors.
10 CFR Part 51 (TN250)	Regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," contain the NRC's regulations that implement NEPA.
10 CFR Part 54 (TN4878)	NRC regulations in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," govern the issuance of renewed operating licenses and renewed combined licenses for nuclear power plants licensed under Sections 103 or 104b of the AEA, as amended, and Title II of the ERA of 1974. The regulations focus on managing adverse effects of aging. The rule is intended to ensure that important systems, structures, and components will continue to perform their intended functions during the period of extended operation.
Air Quality Protection	
Clean Air Act, (42 U.S.C. 7401 et seq.-TN1141)	The CAA is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." The CAA establishes regulations to ensure maintenance of air quality standards and authorizes individual States to manage permits. Section 118 of the CAA requires each Federal agency, with jurisdiction over properties or facilities engaged in any activity that might result in the discharge of air pollutants, to comply with all Federal, State, inter-State, and local requirements regarding the control and abatement of air pollution. Section 109 of the CAA directs the EPA to set National Ambient Air Quality Standards (NAAQS) for criteria pollutants. The EPA has identified and set NAAQS for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the CAA requires the establishment of national performance standards for new or

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	modified stationary sources of atmospheric pollutants. Section 160 of the CAA requires that specific emission increases must be evaluated before permit approval to prevent significant deterioration of air quality. Section 112 requires specific standards for release of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. Nuclear power plants may be required to comply with the CAA Title V, Sections 501–507, for sources subject to new source performance standards or sources subject to National Emission Standards for Hazardous Air Pollutants. EPA regulates the emissions of air pollutants using 40 CFR Parts 50 to 99 (TN5264).
Occupational Safety and Health Act (OSHA) of 1970 (29 U.S.C. § 651 et seq.-TN4453)	The OSHA establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration, a U.S. Department of Labor agency. Employers who fail to comply with OSHA standards can be penalized by the Federal Government. The act allows States to develop and enforce OSHA standards if such programs have been approved by the U.S. Secretary of Labor.
Noise Control Act of 1972 (42 U.S.C. § 4901 et seq.-TN4294)	The Noise Control Act delegates the responsibility of noise control to State and local governments. Commercial facilities are required to comply with Federal, State, inter-State, and local requirements regarding noise control. Section 4 of the Noise Control Act directs Federal agencies to carry out programs in their jurisdictions "to the fullest extent within their authority" and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.
Water Resources Protection	
Clean Water Act (33 U.S.C. § 1251 et seq.-TN1067)	The CWA (formerly the Federal Water Pollution Control Act) was enacted to restore and maintain the chemical, physical, and biological integrity of the Nation's water. The Act requires all branches of the Federal Government, with jurisdiction over properties or facilities engaged in any activity that might result in a discharge or runoff of pollutants to surface waters, to comply with Federal, State, inter-State, and local requirements. As authorized by the CWA, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program requires all facilities that discharge pollutants from any point source into waters of the United States to obtain an NPDES permit. An NPDES permit is developed with two levels of controls: (1) technology-based limits and (2) water quality-based limits. NPDES permit terms may not exceed 5 years, and the applicant must reapply at least 180 days prior to the permit expiration date. A nuclear power plant may also participate in the NPDES General Permit for Industrial Stormwater due to stormwater runoff from industrial or commercial facilities to waters of the United States. The EPA is authorized under the CWA to directly implement

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	the NPDES program, but the EPA has authorized many States to implement all or parts of the national program. Section 316(a) of the CWA addresses thermal effects and requires that facilities operate under effluents limitations that assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving body of water. Section 316(b) of the CWA requires that cooling-water intake structures of regulated facilities must reflect the best technology available for minimizing impingement mortality and entrainment of aquatic organisms. These sections of the CWA are implemented and enforced through the NPDES program. Section 401 of the CWA requires States to certify that the permitted discharge would comply with all limitations necessary to meet established State water quality standards, treatment standards, or schedule of compliance. Under this section, the EPA or a delegated State agency has the authority to review and approve, condition, or deny all permits or licenses that might result in a discharge to waters of the State, including wetlands. CWA Section 401 [33 U.S.C. 1341(a)(1)] states: "No license or permit shall be granted until the certification required by this section has been obtained or has been waived as provided in the preceding sentence. No license or permit shall be granted if certification has been denied by the State, interstate agency, or the Administrator, as the case may be." Therefore, the NRC cannot issue its license without a Section 401 Certification or an NRC determination that a waiver has occurred, in accordance with 40 CFR 121.9(c) (TN6718). In accordance with 10 CFR 50.54(aa) (TN249), conditions in the Section 401 Certification become a condition of the NRC license. The U.S. Army Corps of Engineers (USACE) is the lead agency for enforcement of CWA wetland requirements (33 CFR Part 320-TN424). A Section 404 permit would need to be obtained from the USACE before implementing any action, such as earthmoving activities and certain erosion controls, which could disturb wetlands. Federal and State permits/certifications are obtained using the same form and permit applications for activities affecting waterways and wetlands and are reviewed by the USACE in consultation with the FWS, the Soil Conservation Service, the EPA, and the delegated State agency.
Coastal Zone Management Act of 1972 (CZMA), as amended (16 U.S.C. 1451 et seq.-TN1243)	Congress enacted the CZMA in 1972 to address the increasing pressures of over-development upon the Nation's coastal resources. The National Oceanic and Atmospheric Administration administers the act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary. To encourage States to participate, the CZMA makes Federal financial assistance available to any coastal State or territory, including those on the Great Lakes that are willing to develop and implement a comprehensive coastal management program.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	Section 307(c)(3)(A) of the CZMA requires that applicants for Federal licenses who conduct activities in a coastal zone provide certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. The NRC cannot issue its license without CZMA compliance by the applicant.
Safe Drinking Water Act of 1974 (SDWA) (42 U.S.C. § 300(f) et seq.-TN1337)	The SDWA was enacted to protect the quality of public water supplies and sources of drinking water and establishes minimum national standards for public water supply systems in the form of maximum contaminant levels for pollutants, including radionuclides. Other programs established by the SDWA include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program. In addition, the act provides underground sources of drinking water with protection from contaminated releases and spills. If a nuclear power plant is located within an area designated as a sole source aquifer pursuant to Section 1424(e) of the SDWA, the supplemental environmental impact statement would be subject to EPA review. If the EPA review raises concerns that nuclear power plant operations are not protective of groundwater quality, specific mitigation recommendations or additional pollution prevention requirements may be required.
Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. § 401 et seq.-TN660)	The Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.) requires USACE authorization in order to protect navigable waters in the development of harbors and other construction and excavation. Section 10 of the act prohibits the unauthorized obstruction or alteration of any navigable water of the United States. That section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been authorized by the Secretary of the Army through the USACE. Activities requiring Section 10 permits include structures (e.g., piers, wharves, breakwaters, bulkheads, jetties, weirs, transmission lines) and work such as dredging or disposal of dredged material, or excavation, filling, or other modifications to the navigable waters of the United States.
Wild and Scenic Rivers Act, (16 U.S.C. 1271 et seq.-TN1811)	The Wild and Scenic Rivers Act created the National Wild and Scenic Rivers System that was established to protect the environmental values of free-flowing streams from degradation by impacting activities, including water resources projects.
Minnesota Pollution Control Agency (MPCA) National Pollution Discharge Program (NPDES) Minnesota Statutes Chapters 115 (TN9622) and 116 (TN9820) Permit MN0000868	The MPCA Implements the NPDES under the Clean Water Act (CWA).

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Minnesota Department of Natural Resources (MDNR), Minnesota Statutes Chapter 103 G. 255 – 315 Appropriation and Use of Waters (TN9648)	The MDNR Implements the Minnesota Statutes in Chapter 103 G 255 – 315 Water Diversion and Appropriation, "The Minnesota Surface Water Withdrawal, Permitting, Use, and Reporting Act," and "establishes a system and rules for permitting and registering the withdrawal and use of surface water from within the State of Minnesota and those surface water shared with adjacent states."
Waste Management and Pollution Prevention	
Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.-TN1281)	The RCRA requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 (42 U.S.C. 6926) allows States to establish and administer these permit programs with EPA approval. The EPA regulations implementing the RCRA are found in 40 CFR Parts 260 through 283 (TN6617). Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also affects the extent and complexity of the requirements.
Nuclear Waste Policy Act of 1982 (42 U.S.C. § 10101 et seq.-TN740)	The Nuclear Waste Policy Act provides for the research and development of repositories for the disposal of high-level radioactive waste, spent nuclear fuel, and low-level radioactive waste. Title I includes the provisions for the disposal and storage of high-level radioactive waste and spent nuclear fuel. Subtitle A of Title I delineates the requirements for site characterization and construction of the repository and the participation of States and other local governments in the selection process. Subtitles B, C, and D of Title I deal with the specific issues for interim storage, monitored retrievable storage, and low-level radioactive waste.
Low-Level Radioactive Waste Policy Act of 1980, as amended (42 U.S.C. § 2021b et seq.-TN6606)	The Low-Level Radioactive Waste Policy Act amended the AEA to improve the procedures for implementation of compacts that provide for the establishment and operation of regional low-level radioactive waste disposal facilities. It also allows Congress to grant consent for certain inter-State compacts. The amended act sets forth the responsibilities for disposal of low-level waste by States or inter-State compacts. The act states the amount of waste that certain low-level waste recipients can receive over a set time period. The amount of low-level radioactive waste generated by both pressurized and boiling water reactor types is allocated over a transition period until a local waste facility becomes operational.
Hazardous Materials Transportation Act, as amended (49 U.S.C. § 5101 et seq.-TN6605)	The Hazardous Materials Transportation Act regulates the transportation of hazardous material (including radioactive material) in and between states. According to the act, States may regulate the transport of hazardous material as long as their regulation is consistent with provisions of the act or U.S. Department of Transportation regulations provided in 49 CFR Parts 171 through 177 (TN5466). Other regulations regarding packaging for transportation of radionuclides are contained in 49 CFR Part 173, Subpart I.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Protected Species	
Endangered Species Act (ESA) 16 U.S.C. 1531 et seq.-TN1010	The ESA was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7, "Interagency Cooperation," of the Act requires Federal agencies to consult with the FWS or the National Marine Fisheries Service (NMFS) on Federal actions that may affect listed species or designated critical habitats.
Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§ 661–666e-TN4467)	The Fish and Wildlife Coordination Act requires Federal agencies that construct, license, or permit water resource development projects to consult with the FWS (or NMFS, when applicable) and State wildlife resource agencies for any project that involves an impoundment of more than 10 ac (4 ha), diversion, channel deepening, or other waterbody modification regarding the impacts of that action on fish and wildlife and any mitigative measures to reduce adverse impacts.
Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 U.S.C. § 136 et seq.-TN4535)	The Federal Insecticide, Fungicide, and Rodenticide Act, as amended, by the Federal Environmental Pesticide Control Act and subsequent amendments, requires the registration of all new pesticides with the EPA before they are used in the United States. Manufacturers are required to develop toxicity data for their pesticide products. Toxicity data may be used to determine permissible discharge concentrations for an NPDES permit.
Fish and Wildlife Conservation Act of 1980 (16 U.S.C. § 2901 et seq.-TN6604)	The Fish and Wildlife Conservation Act provides Federal technical and financial assistance to States for the development of conservation plans and programs for nongame fish and wildlife. The Fish and Wildlife Conservation Act conservation plans identify significant problems that may adversely affect nongame fish and wildlife species and their habitats and appropriate conservation actions to protect the identified species. The Act also encourages Federal agencies to conserve and promote the conservation of nongame fish and wildlife and their habitats.
Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.-TN7841)	The Magnuson–Stevens Fishery Conservation and Management Act, as amended, governs marine fisheries management in U.S. Federal waters. The Act created eight regional fishery management councils and includes measures to rebuild overfished fisheries, protect essential fish habitat, and reduce bycatch. Under Section 305 of the act, Federal agencies are required to consult with the NMFS for any Federal actions that may adversely affect essential fish habitat.
National Marine Sanctuaries Act of 1966 (NMSA), as amended (16 U.S.C. § 1431 et seq.-TN7197)	The NMSA establishes provisions for the designation and protection of marine areas that have special national significance. The NMSA authorizes the. Secretary of Commerce to designate national marine sanctuaries and establish the National Marine Sanctuary System. Pursuant to Section 304(d) of the NMSA, Federal agencies must consult with the National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries when their proposed actions are likely to destroy, cause the loss of, or injure a sanctuary resource.

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
Toxic Substances Control Act (TSCA) (15 U.S.C. § 2601 et seq.-TN4454)	The TSCA regulates the manufacture, processing, distribution, and use of certain chemicals not regulated by RCRA or other statutes, including asbestos-containing material and polychlorinated biphenyls. Any TSCA-regulated waste removed from structures (e.g., polychlorinated biphenyls-contaminated capacitors or asbestos) or discovered during the implementation phase (e.g., contaminated media) would be managed in compliance with TSCA requirements in 40 CFR Part 761 (TN6610).
Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. § 703 et seq.-TN3331)	The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. The Act stipulates that, except as permitted by regulations, it is unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, or kill any migratory bird.
Marine Mammal Protection Act of 1972 (MMPA) (16 U.S.C. § 1361 et seq.-TN4478)	The MMPA was enacted to protect and manage marine mammals and their products (e.g., the use of hides and meat). The primary authority for implementing the Act belongs to the FWS and NMFS. The FWS manages walruses, polar bears, sea otters, dugongs, marine otters, and the West Indian, Amazonian, and West African manatees. The NMFS manages whales, porpoises, seals, and sea lions. The two agencies may issue permits under Section 104 (16 U.S.C. 1374) to persons, including Federal agencies, that authorize the taking or importing of specific species of marine mammals. After the Secretary of the Interior or the Secretary of Commerce approves a State's program, the State can take over responsibility for managing one or more marine mammals. The Act also established a Marine Mammal Commission whose duties include reviewing laws and international conventions related to marine mammals, studying the condition of these mammals, and recommending steps to Federal officials (e.g., listing a species as endangered) that should be taken to protect marine mammals. Federal agencies are directed by MMPA Section 205 (16 U.S.C. 1405) to cooperate with the commission by permitting it to use their facilities or services.
Environmental Standards for Uranium Fuel Cycle (40 CFR Part 190, Subpart B-TN739)	These regulations establish maximum doses to the body or organs of members of the public as a result of normal operational releases from uranium fuel cycle activities, including uranium enrichment. These regulations were promulgated by the EPA under the authority of the AEA, as amended, and have been incorporated by reference in the NRC regulations in 10 CFR 20.1301(e) (TN283).
Historic Preservation and Cultural Resources	
National Historic Preservation Act, (54 U.S.C. 300101 et seq.-TN4157) (formerly 16 U.S.C. 470 et seq.)	The National Historic Preservation Act was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation. Section 106 of the Act requires Federal agencies to take into account the effects of their undertakings on historic properties. The Advisory Council on Historic Preservation regulations implementing Section 106 of the Act are found in 36 CFR Part 800, "Protection of Historic Properties" (TN513). The regulations call for

Table B-1 Federal and State Requirements (Continued)

Law or Regulation	Requirements
	public involvement in the Section 106 consultation process, including involvement from Indian Tribes and other interested members of the public, as applicable.

ac =acre(s); AEA = Atomic Energy Act; CAA = Clean Air Act; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CFR = *Code of Federal Regulations*; CWA = Clean Water Act; EIS = environmental impact statement; CZMA = Coastal Zone Management Act; EPA = U.S. Environmental Protection Agency; EPCRA = Emergency Planning and Community Right-to-Know Act; FWS = U.S. Fish and Wildlife Service; ha = hectare(s); NAAQS = National Ambient Air Quality Standards; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; NMSA = National Marine Sanctuaries Act; NPDES = National Pollutant Discharge Elimination System; OSHA = Occupational Safety and Health Act; RCRA = Resource Conservation and Recovery Act; SDWA = Safe Drinking Water Act of 1974; TSCA = Toxic Substances Control Act; USACE = United States Army Corp of Engineers.

B.2 Operating Permits and Other Requirements

Table B-2 lists the permits and licenses issued by Federal, State, and local authorities for operational activities at Monticello as identified in Chapter 9 of Xcel Energy's environmental report.

Table B-2 Operating Permits and Other Requirements

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
Monticello Nuclear Generating Plant (Monticello) license to operate Unit 1	Nuclear Regulatory Commission (NRC)	DPR-22	Renewed: 11/08/2006 Expires: 09/08/2030	Operation of Monticello
Certification of water quality standards	Minnesota Pollution Control Agency (MPCA)	N/A	N/A	Section 401 Water Quality Certification issued by the State for operation of Monticello.
Regional general permit (Section 404)	US Army Corp of Engineers USACE	RGP-003-MN	03/01/2026	Maintenance dredging in front of the intake apron on the Mississippi River.
Uniform Program Credentials (Hazmat permit and registration)	Alliance for Uniform Hazmat Transportation Procedures	UPM211635NV	03/31/2024	Hazardous material shipment.
License to ship radioactive material	Tennessee Department of Environment and Conservation (TDEC)	T-MN002-L21	12/31/2022	Shipment of radioactive material to a licensed disposal/processing facility in Tennessee.

Table B-2 Operating Permits and Other Requirements (Continued)

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
General site access permit for radioactive waste disposal	Utah Department of Environmental Quality (UDEQ)	0209001562	10/18/2023	Delivery of radioactive waste to a land disposal facility located in Utah.
Hazardous waste generator license	Minnesota Pollution Control Agency (MPCA)	MND000681639	06/30/2024	Authorizes facility to operate as a hazardous waste generator.
NPDES permit	Minnesota Pollution Control Agency (MPCA)	MN0000868	04/30/2028	Discharges of wastewater to waters of the state.
Air emission permit	Minnesota Pollution Control Agency (MPCA)	17100019-04	11/15/2018[a]	Operate air emission facility (four diesel generators, diesel fire pump, three flexible pumps, and heating boiler).
Tank registration	Minnesota Pollution Control Agency (MPCA)	TS0051508	N/A	Underground storage tank registration.
Tank registration	Minnesota Pollution Control Agency (MPCA)	TS0051508	5/19/2033	Aboveground storage tank registration.
State dredging permit	Minnesota Department of Health (MNDR)	1967-0743	5/14/2023	Maintenance dredging of sand and silt from discharge canal and intake skimmer area.
Water appropriations permit	Minnesota Department of Health (MNDR)	67-0083	N/A	Groundwater withdrawals from Well #1 and Well #2.
Water appropriations permit	Minnesota Department of Health (MNDR)	66-1172	N/A	Surface water withdrawals from the Mississippi River.
Division of Fish and Wildlife special permit	Minnesota Department of Health (MNDR)	32875	12/31/2022 Renewal requested.	Collection of fish for scientific purposes.
Division of Ecological and Water Resources permit	Minnesota Department of Health (MNDR)	511	12/31/2023	Transport of zebra mussels and other prohibited invasive species to Xcel Energy facilities or to a repair site for purposes of control,

Table B-2 Operating Permits and Other Requirements (Continued)

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
				disposal, and maintenance of equipment.
Sanitary Sewer Wastewater Discharge Agreement	City of Monticello	N/A	N/A	Agreement to discharge domestic sanitary waste to the City of Monticello sanitary sewer collection system.
ISFSI Certificate of Need	State of Minnesota	DOCKET NO. E-002/CN-21-668	1/1/2040	Certificate of Need for Additional Dry Cask Storage at the Monticello Nuclear Generating Plant Independent Spent Fuel Storage Installation in Wright County
License to ship radioactive material	Tennessee Department of Environment and Conservation (TDEC); TDEC Rule 0400-20-10-.32	T-MN002-L21	12/31/2023	Shipment of radioactive material to a licensed disposal/processing facility in Tennessee.
General Site Access Permit for Radioactive Waste Disposal	Utah Department of Environmental Quality (UDEQ); Utah Administrative Code R313-26	209001562	10/18/2023	Delivery of radioactive waste to a land disposal facility located in Utah.

FERC = Federal Energy Regulatory Commission; ISFSI = independent spent fuel storage installation; MB = migratory birds; N/A = not applicable; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; SQG = Small Quantity Generators; USACE = U.S. Army Corps of Engineers; USDOT = U.S. Department of Transportation; USFWS = U.S. Fish and Wildlife Service.
Sources: Xcel 2023-TN9084.

B.3 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." TN283.

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." TN249.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." TN250.

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.” TN4878.

33 CFR Part 320. *Code of Federal Regulations*, Title 33, *Navigation and Navigable Waters*, Part 320, “General Regulatory Policies.” TN424.

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, “Protection of Historic Properties.” TN513.

40 CFR Part 121. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 121, “State Certification of Activities Requiring a Federal License or Permit.” TN6718.

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.” TN739.

40 CFR Part 355. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 302, “Emergency Planning and Notification.” TN5493.

40 CFR Part 370. *Code of Federal Regulations*, Title 40, *Protection of Environmen*t, Part 370, “Hazardous Chemical Reporting: Community Right-To-Know.” TN6612.

40 CFR Part 372. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 372, “Toxic Chemical Release Reporting: Community Right-To-Know.” TN6613.

40 CFR Part 761. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 761, “Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions.” TN6610.

40 CFR Parts 260–283. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Parts 260–283, EPA Regulations Implementing RCRA. TN6617.

40 CFR Parts 50-99. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Subchapter C, Parts 50-99, “Air Programs.” TN5264.

49 CFR Parts 171-177. *Code of Federal Regulations*, Title 49, *Transportation*, Subchapter C, “Hazardous Materials Regulations (49 CFR Parts 171-177).” TN5466.

American Indian Religious Freedom Act, as amended. 42 U.S.C. § 1996 *et seq*. TN5281.

Antiquities Act of 1906, as amended. 54 U.S.C. § 320301–320303 and 18 U.S.C. § 1866(b). TN6602.

Archeological and Historic Preservation Act of 1974, as amended. 54 U.S.C. § 312501 *et seq*. TN4844.

Atomic Energy Act of 1954. 42 U.S.C. § 2011 et seq. Public Law 112-239, as amended. TN663.

Bald and Golden Eagle Protection Act. 16 U.S.C. § 668-668d *et seq.* TN1447.

Clean Air Act. 42 U.S.C. § 7401 *et seq*. TN1141.

Coastal Zone Management Act of 1972. 16 U.S.C. § 1451 *et seq*. TN1243.

Comprehensive Environmental Response, Compensation, and Liability Act, as amended. 42 U.S.C. § 9601 *et seq*. TN6592.

Emergency Planning and Community Right-to-Know Act of 1986. 42 U.S.C. § 11001 *et seq*. TN6603.

Endangered Species Act of 1973. 16 U.S.C. § 1531 *et seq.* TN1010.

Energy Reorganization Act of 1974, as amended. 42 U.S.C. § 5801 *et seq*. TN4466.

EPA/USACE (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers). 2011. *Draft Guidance on Identifying Waters Protected by the Clean Water Act.* EPA/USACE, Washington, D.C. ADAMS Accession No. ML12178A570. TN1067.

Federal Insecticide, Fungicide, and Rodenticide Act, as amended. 7 U.S.C. § 136 *et seq*. TN4535.

Federal Water Pollution Control Act of 1972 (commonly referred to as the Clean Water Act). 33 U.S.C. § 1251 *et seq.* TN662.

Fish and Wildlife Conservation Act of 1980. 16 U.S.C. § 2901 *et seq.* TN6604.

Fish and Wildlife Coordination Act, as amended. 16 U.S.C. § 661 *et seq*. TN4467.

Hazardous Materials Transportation Act. 49 U.S.C. § 5101 *et seq*. TN6605.

Low-Level Radioactive Waste Policy Act of 1980. 42 U.S.C. § 2021b *et seq*. Public Law 96-573. TN6606.

Magnuson Stevens Fishery Conservation and Management Reauthorization Act of 2006. 16 U.S.C. 1801 Note. Public Law 109-479, January 12, 2007, 120 Stat. 3575. TN7841.

Marine Mammal Protection Act of 1972, as amended. 16 U.S.C. § 1361 *et seq*. TN4478.

Marine Protection, Research, and Sanctuaries Act of 1972, as amended. 33 U.S.C. § 1401 et seq. TN4479.

Migratory Bird Treaty Act of 1918. 16 U.S.C. § 703 *et seq.* TN3331.

MN Stat. 103G. 2023. Chapter 103G, “Waters of the State.” *Minnesota Statues*, St. Paul, Minnesota. TN9648.

MN Stat. 115. 2023. Chapter 115, “Water Pollution Control; Sanitary Districts.” *Minnesota Statues*, St. Paul, Minnesota. TN9622.

MN Stat. 116. 2023. Chapter 116, “Pollution Control Agency.” *Minnesota Statues,* St. Paul, Minnesota. TN9820.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 U.S.C. § 4321 *et seq.* TN661.

National Historic Preservation Act. 54 U.S.C. § 300101 *et seq*. TN4157.

Native American Graves Protection and Repatriation Act. 25 U.S.C. § 3001 *et seq*. TN1686.

NMSA (National Marine Sanctuaries Act). 2000. “National Marine Sanctuaries Act, Title 16, Chapter 32 § 1431 et seq. United States Code as amended by Public Law 106-513.” Silver Spring, M.D. Available at https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/library/national/nmsa.pdf. TN7197.

Noise Control Act of 1972. 42 U.S.C. § 4901 *et seq*. TN4294.

NRC (U.S. Nuclear Regulatory Commission). 2022. Letter from C. Haney, Deputy Executive Director for Materials, Waste, Research, State, Tribal, Compliance, Administration, and Human Capital Programs, to D. Huff, Assistant Commissioner Minnesota Department of Health, dated April 12, 2022, regarding “Final Minnesota Agreement State Program Integrated Materials Performance Evaluation Program (IMPEP) Report.” Washington, D.C. ADAMS Accession No. ML22083A236. TN9834.

NRC and MN (U.S. Nuclear Regulatory Commission and State of Minnesota). 2006. “Agreement between the United States Nuclear Regulatory Commission and the State of Minnesota for Discontinuance of Certain Commission Regulatory Authority and Responsibility within the State Pursuant to Section 274 of the Atomic Energy Act Of 1954, as Amended.” Washington, D.C., St. Paul, Minnesota. TN9819.

Nuclear Waste Policy Act of 1982. 42 U.S.C. § 10101 et seq. TN740.

Occupational Safety and Health Act of 1970, as amended. 29 U.S.C. § 651 et seq. TN4453.

Pollution Prevention Act of 1990. 42 U.S.C. § 13101 et seq. TN6607.

Resource Conservation and Recovery Act of 1976. 42 U.S.C 6901 Note. Public Law 94-580, 90 Stat. 2795. TN1281.

Rivers and Harbors Appropriation Act of 1899. 33 U.S.C. § 401 et seq. TN660.

Safe Drinking Water Act of 1974, as amended. 42 U.S.C. § 300f et seq. TN1337.

Toxic Substances Control Act, as amended. 15 U.S.C. § 2601 et seq. TN4454.

Wild and Scenic Rivers Act. 16 U.S.C. § 1271 et seq. TN1811.

Xcel (Xcel Energy). 2023. Letter from C.P. Domingos, Site Vice President, Monticello and Prairie Island Nuclear Generating Plant Northern States Power Company, to NRC Document Control Desk, dated January 9, 2023, regarding “Monticello Nuclear Generating Plant Docket No. 50-263, Renewal License Numbers DPR-22 Application for Subsequent Renewal Operating License.” Monticello, Minnesota. ADAMS Accession No. ML23009A352. TN9084.

APPENDIX C

CONSULTATION CORRESPONDENCE

C.1 Endangered Species Act Section 7 Consultation

As a Federal agency, the U.S. Nuclear Regulatory Commission (NRC) must comply with the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.; TN1010), as part of any action authorized, funded, or carried out by the agency. In this case, the proposed agency action is whether to issue a subsequent renewed facility operating license for the continued operation of Monticello Nuclear Generating Plant, Unit 1 (Monticello). The proposed action would authorize Xcel Energy to operate Monticello for an additional 20 years beyond the current renewed operating license term. Under Section 7 of the ESA, the NRC must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) ("the Services" [collectively] or "Service" [individually]), as appropriate, to ensure that the proposed action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

C.2 Federal Agency Obligations under Section 7 of the Endangered Species Act

The ESA and the regulations that implement ESA Section 7 at Title 50 of the *Code of Federal Regulations* (50 CFR Part 402-TN4312) describe the consultation process that Federal agencies must follow in support of agency actions. As part of this process, the Federal agency shall either (1) request that the Services provide a list of any listed or proposed species or designated or proposed critical habitats that may be present in the action area or (2) request that the Services concur with a list of species and critical habitats that the Federal agency has created (50 CFR 402.12(c)). If any such species or critical habitats may be present, the Federal agency prepares a biological assessment to evaluate the potential effects of the action and determine whether the species or critical habitats are likely to be adversely affected by the action (50 CFR 402.12(a); 16 U.S.C. 1536(c)-TN4459).

Biological assessments are required for any agency action that is a "major construction activity" (50 CFR 402.12(b)) (TN4312). A major construction activity is a construction project or other undertaking having construction-type impacts that is a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.) (NEPA) (51 FR 19926-TN7600). Federal agencies may fulfill their obligations to consult with the Services under ESA Section 7 and to prepare a biological assessment, if required, in conjunction with the interagency cooperation procedures required by other statutes, including NEPA (50 CFR 402.06(a)). In such cases, the Federal agency should include the results of ESA Section 7 consultation(s) in the NEPA document (50 CFR 402.06(b)).

C.2.1 Biological Evaluation

Subsequent license renewal (SLR) does not require the preparation of a biological assessment because it is not a major construction activity. Nonetheless, the NRC staff must consider the impacts of its actions on federally listed species and designated critical habitats. In cases where the staff finds that license renewal "may affect" ESA-protected species or habitats, ESA Section 7 requires the NRC to consult with the relevant Service(s).

To support such consultations, the NRC staff has incorporated its analysis of the potential impacts of the proposed license renewal into Section 3.7 of this environmental impact statement (EIS). The NRC staff refers to its ESA analysis as a "biological evaluation."

The NRC staff structured its evaluation in accordance with the Services' suggested biological assessment contents described at 50 CFR 402.12(f) (TN4312). Section 3.8.4.1 of this report describes the action area as well as the ESA-protected species and habitats potentially present in the action area. Section 3.8.4.2 assesses the potential effects of the proposed Monticello SLR on the ESA-protected species and habitats present in the action area and contains the NRC staff's effect determinations for each of those species and habitat. Section 3.8.4.3 addresses cumulative effects. Finally, Sections 3.8.5 through 3.8.9 address the potential effects of the no-action alternative and power replacement alternatives. The results of the NRC staff's analysis are summarized below in Table C-1.

Table C-1 Effect Determinations for Federally Listed Species under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]	FWS Concurrence Date[(c)]
northern long-eared bat	FE	Yes	NLAA	06/27/23
tricolored bat	FPE	Yes	NLAA	06/27/23
whooping crane	NEP	Yes	NLAA	06/27/23
monarch butterfly	FC	Yes	NLAA	06/27/23
Higgins' eye pearlymussel	FE	No	NE	n/a
gray wolf	FT	No	NE	n/a
rusty patched bumble bee	FE	No	NE	n/a

(a) Indicates protection status under the Endangered Species Act (ESA). FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; FT = federally threatened.
(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) Endangered Species Consultation Handbook (FWS and NMFS 1998-TN1031). NLAA = may affect but is not likely to adversely affect; NE = no effect.
(c) The ESA does not require Federal agencies to seek FWS concurrence for "no effect" determinations or for conclusions regarding effects on candidate species. n/a = not applicable.

C.2.2 Chronology of Endangered Species Act Section 7 Consultation

Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service

On June 27, 2023, the FWS concurred with the NRC's determination that the proposed Monticello SLR may affect but is not likely to adversely affect the northern long-eared bat and tricolored bat (FWS 2023-TN9082, FWS 2023-TN9081). Also on June 27, 2023, the FWS determined that because the proposed action is not likely to result in jeopardy of the nonessential experimental population of whooping crane, the NRC's obligations under Section 7 for whooping crane are complete (FWS 2023-TN9081). Because the monarch butterfly is a candidate for Federal listing, the ESA does not require the NRC to consult with or receive concurrence from the FWS regarding this species. The FWS's June 27, 2023, letters document that the NRC staff has fulfilled its ESA Section 7(a)(2) obligations with respect to the proposed Monticello SLR. The ESA regulations at 50 CFR 402.16 prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this draft site-specific environmental impact statement, the NRC staff has identified no information that would warrant re-initiation of consultation.

Table C-2 lists the correspondence between the NRC and the FWS pursuant to ESA Section 7 that has transpired to date.

Table C-2 Endangered Species Act Section 7 Consultation Correspondence with the U.S. Fish and Wildlife Service

Date	Description	ADAMS Accession No.[a]
June 27, 2023	Minnesota-Wisconsin Ecological Services Field Office (FWS) to B. Arlene (NRC), List of threatened and endangered species for proposed Monticello SLR	ML24016A229
June 27, 2023	Minnesota-Wisconsin Ecological Services Field Office (FWS) to B. Arlene (NRC), Federal agency coordination under ESA Section 7 and concurrence that the proposed Monticello SLR is not likely to adversely affect the long-eared bat	ML24016A228
June 27, 2023	Minnesota-Wisconsin Ecological Services Field Office (FWS) to B. Arlene (NRC), Verification letter for Monticello SLR concerning monarch butterfly, tricolored bat, and whooping crane consistent with the Minnesota-Wisconsin Endangered Species Determination Key	ML24016A230

ADAMS = Agencywide Documents Access and Management System; Duke Energy = Duke Energy Carolinas, LLC; ESA = Endangered Species Act; FWS = U.S. Fish and Wildlife Service; NRC = U.S. Nuclear Regulatory Commission; SLR = subsequent license renewal.
(a) Access these documents through the NRC's ADAMS at http://adams.nrc.gov/wba/.

Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

As discussed in Section 3.8.1 and 3.8.4.2 of this EIS, no federally listed species or critical habitats under NMFS's jurisdiction occur within the action area. Therefore, the NRC staff did not engage the NMFS pursuant to ESA Section 7 for the proposed Monticello SLR.

C.3 Magnuson–Stevens Act Essential Fish Habitat Consultation

The NRC must comply with the Magnuson–Stevens Fishery Conservation and Management Act of 1996 (MSA), as amended (16 U.S.C. 1801 et seq.-TN7841), for any actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect any essential fish habitat (EFH) identified under the MSA. In Sections 3.8.3 and 3.8.4.4 of this EIS, the NRC staff concludes that the NMFS has not designated any EFH under the MSA within the action area and that the proposed Monticello SLR would have no effect on EFH. Thus, the MSA does not require the NRC to consult with the NMFS for the proposed action.

C.4 National Marine Sanctuaries Act Consultation

The National Marine Sanctuaries Act of 1966, as amended (16 U.S.C. § 1431 et seq.-TN7197), authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities as national marine sanctuaries. Under Section 304(d) of the act, Federal agencies must consult with the

National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries if a Federal action is likely to destroy, cause the loss of, or injure any sanctuary resources.

In Sections 3.8.3 and 3.8.4.5 of this draft EIS, the NRC staff concludes that no coastal or marine waters or Great Lakes occur near Monticello and that the Monticello SLR would have no effect on sanctuary resources. Thus, the NMSA does not require the NRC to consult with the National Oceanic and Atmospheric Administration for the proposed action.

C.5 National Historic Preservation Act Section 106 Consultation

The National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), requires Federal agencies to consider the effects of their undertakings on historic properties and consult with applicable State and Federal agencies, Tribal groups, individuals, and organizations with a demonstrated interest in the undertaking before taking action. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places. The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800, "Protection of Historic Properties" (TN513). In accordance with 36 CFR 800.8(c), "Use of the NEPA Process for Section 106 Purposes," the NRC has elected to use the NEPA process to comply with its obligations under Section 106 of the NHPA.

Table C-3 lists the chronology of consultation and consultation documents related to the NRC's NHPA Section 106 review of the Monticello SLR.

Table C-3 National Historic Preservation Act Correspondence

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
03/13/2023	T. Smith (NRC) to R. Nelson, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A274
03/13/2023	T. Smith (NRC) to A. Spong, D-SHPO, Minnesota State Historic Preservation Office	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A278
03/13/2023	T. Smith (NRC) to D. Copper, Tribal Chairman, Apache Tribe of Oklahoma	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
03/13/2023	T. Smith (NRC) to M. Wiggins, Jr., Chairman, Bad River Tribe	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to C. Chavers, Tribal Chairwoman, Bois Forte Band of Chippewa	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to R. Wassana, Governor, Cheyenne and Arapaho Tribes	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to A. Reider, President, Flandreau Santee Sioux Tribe	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to K. DuPuis, Sr., Tribal Chairperson, Fond du Lac Band of Lake Superior Chippewa	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to J. Stiffarm, President, Fort Belknap	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to R. Deschampe, Tribal Chair, Grand Portage Band of Lake Superior Chippewa	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to T. Rhodd, Chairman, Iowa Tribe of Kansas and Nebraska	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
03/13/2023	T. Smith (NRC) to D. Blaker, President, Keweenaw Bay Indian Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to L. Taylor, Chairman, Lac Courte Oreilles Band of Lake Superior Chippewa Indians	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to J. Johnson, President, Lac du Flambeau Band of Lake Superior Chippewa Indians	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to J. Williams, Jr., Chairman, Lac Vieux Desert Band of Lake Superior Chippewa Indians	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to F. Jackson, Sr., Chairman, Leech Lake Band of Ojibwe	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to R. Larsen, President, Lower Sioux Indian Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to M. Benjamin, Chairwoman, Mille Lacs Band of Ojibwe	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to C. J. Chavers, President, Minnesota Chippewa Tribe	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
03/13/2023	T. Smith (NRC) to J. Johnson, President, Prairie Island Indian Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to C. Boyd, Chairman, Red Cliff Band of Lake Superior Chippewa	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to D. Seki, Chairman, Red Lake Nation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to A. Denney, Chairman, Santee Sioux Nation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to K. B. Anderson, Chairman, Shakopee Mdewakanton Sioux Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to J. G. Renville, Tribal Chairman, Sisseton Wahpeton Oyate of the Lake Reservation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to R. Vanzile, Jr., Chairman, Sokaogon Chippewa Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to D. Yankton, Sr., Chairperson, Spirit Lake Nation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
03/13/2023	T. Smith (NRC) to W. Reynolds, Chairman, St. Croix Chippewa of Wisconsin	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to R.J. Corn, Sr., Chairman, The Menominee Indian Tribe of Wisconsin	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to J. Azure, Chairman, Turtle Mountain Band of Chippewa Indians	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to K. Jensvold, Tribal Chairman, Upper Sioux Community	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
03/13/2023	T. Smith (NRC) to M. Fairbanks, Chairman, White Earth Nation	Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23069A280
04/12/2023	K. Applegate, Commissioner of Natural Resources, Mille Lacs Band of Ojibwe to N. Martinez (NRC)	Response to NRC Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23117A313
07/03/2023	S. Beimers, Environmental Review Program Manager, Minnesota State Historic Preservation Office to NRC	Response to NRC Request for Scoping Comments Concerning the Environmental Review of Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	ML23199A280
06/20/2023	Memorandum to T. Smith (NRC) from N. Martinez (NRC)	Teleconference Summary Between NRC and Minnesota State Historic Preservation Office	ML23156A234
08/21/2023	S. Beimers, Environmental Review Program Manager, Minnesota State Historic	Response to NRC Request for Scoping Comments Concerning the Environmental Review of	ML23241A973

Table C-3 National Historic Preservation Act Correspondence (Continued)

Date	Sender and Recipient	Description	ADAMS Accession No.[(a)]
	Preservation Office to N. Martinez (NRC)	Monticello Generating Plant, Unit 1, Subsequent License Renewal Application	
08/29/2023	Memorandum to T. Smith (NRC) from N. Martinez (NRC)	Summary of Visit to Minnesota State Historic Preservation Office	ML23228A096
08/30/2023	Memorandum to T. Smith (NRC) from N. Martinez (NRC)	Teleconference Summary Between NRC and The Mille Lacs Band of Ojibwe	ML23222A126
09/07/2023	Memorandum to T. Smith (NRC) from N. Martinez (NRC)	Teleconference Summary Between NRC and The Mille Lacs Band of Ojibwe	ML23237A264
12/22/2023	Memorandum to T. Smith and S. Koenick (NRC) from N. Martinez (NRC)	Teleconference Summary Between NRC, The Mille Lacs Band of Ojibwe, Minnesota State Historic Preservation Office, and Xcel Energy	ML23345A012
01/30/2024	Memorandum to M. Rome (NRC) from N. Martinez (NRC)	Teleconference Summary Between the NRC and The Mille Lacs Band of Ojibwe	ML24023A090
02/23/2024	Memorandum to	Teleconference Summary Between the NRC and Xcel Energy	ML24039A180

ADAMS = Agencywide Documents Access and Management System; NRC = U.S. Nuclear Regulatory Commission; SHPO = State Historic Preservation Officer.
(a) Access these documents through the NRC's ADAMS at https://adams.nrc.gov/wba/.

C.6 References

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties." TN513.

50 CFR Part 402. *Code of Federal Regulations,* Title 50, *Wildlife and Fisheries*, Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended." TN4312.

51 FR 19926. 1986. "Interagency Cooperation - Endangered Species Act of 1973, as amended." Final Rule, *Federal Register*, Fish and Wildlife Service, Interior; National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Commerce. TN7600.

16 U.S.C. § 1536. Endangered Species Act, Section 7, "Interagency Cooperation." TN4459.

Endangered Species Act of 1973. 16 U.S.C. § 1531 et seq*.* TN1010.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Minnesota-Wisconsin Ecological Services Field Office, to B. Arlene, dated June 27, 2023, regarding "Federal agency coordination under the Endangered Species Act, Section 7 for 'Monticello Subsequent License Renewal'." Bloomington, Minnesota. ADAMS Accession No. ML24016A228. TN9082.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Minnesota-Wisconsin Ecological Services Field Office, to B. Arlene, dated June 27, 2023, regarding "Verification letter for 'Monticello Subsequent License Renewal' for specified threatened and endangered species that may occur in your proposed project location consistent with the Minnesota-Wisconsin Endangered Species Determination Key (Minnesota-Wisconsin DKey)." Bloomington, Minnesota. ADAMS Accession No. ML24016A230. TN9081.

FWS and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 1998. *Endangered Species Act Consultation Handbook, Procedures for Conducting Section 7 Consultation and Conference*. Washington, D.C. ADAMS Accession No. ML14171A801. TN1031.

Magnuson Stevens Fishery Conservation and Management Reauthorization Act of 2006. 16 U.S.C. 1801 Note. Public Law 109-479, January 12, 2007, 120 Stat. 3575. TN7841.

NMSA (National Marine Sanctuaries Act). 2000. "National Marine Sanctuaries Act, Title 16, Chapter 32 § 1431 et seq. United States Code as amended by Public Law 106-513." Silver Spring, M.D. Available at https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/library/national/nmsa.pdf. TN7197.

APPENDIX D

CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of the agency's environmental review of the Monticello Nuclear Generating Plant, Unit 1, subsequent license renewal application. This appendix does not include the consultation correspondence or comments received during the scoping process. For a list and discussion of consultation correspondence, see Appendix C of this environmental impact statement. For scoping comments, see Appendix A of this site-specific environmental impact statement and the NRC's, "Scoping Summary Report" (Agencywide Documents Access and Management System [ADAMS] Accession No. (ML24059A342; NRC 2024-TN9817). All documents are available electronically from the NRC's Public Electronic Reading Room found at: http://www.nrc.gov/reading-rm.html. From the site, the public can gain access to ADAMS, which provides text and image files of the NRC's public documents. The ADAMS accession number for each document is included in the following table.

D.1 Environmental Review Correspondence

Table D-1 lists the environmental review correspondence, by date, beginning with the request by Xcel Energy for subsequent license renewal of the operating license for Monticello.

Table D-1 Environmental Review Correspondence

Date	Correspondence Description	ADAMS Accession No. or Federal Register Citing
01/09/2023	Monticello Nuclear Generating Plant Docket No. 50-263, Renewal License Number DPR-22 Application for Subsequent Renewal Operating License	ML23009A352
01/24/2023	Monticello Nuclear Generating Plant, Unit 1 – Receipt and Availability of the Subsequent License Renewal Application	ML23010A007
01/31/2023	Northern States Power Company – Minnesota; Xcel Energy; Monticello Nuclear Generating Plant, Unit 1; Subsequent license renewal application; receipt	88 FR 6327
02/23/2023	Monticello Nuclear Generating Plant, Unit 1 – Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Northern States Power Company–A Minnesota Corporation's, Application for Subsequent License Renewal	ML23047A175
02/28/2023	Monticello Nuclear Generating Plant, Unit 1 – Subsequent License Renewal Application Online Reference Portal	ML23048A037
03/03/2023	Northern States Power Company – Minnesota; Xcel Energy; Monticello Nuclear Generating Plant, Unit 1; Subsequent license renewal application; opportunity to request a hearing and petition for leave to intervene	88 FR 13474
03/10/2023	Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Northern States Power Company – Minnesota; Monticello Nuclear Generating Plant, Unit 1	88 FR 15103

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession No. or Federal Register Citing
03/14/2023	Public Meeting Announcement for March 22, 2023: Environmental Scoping Meeting Related to the Monticello Nuclear Generating Plant Subsequent License Renewal Application (In-person)	ML23073A041
03/22/2023	March 22, 2023, Monticello, Unit 1 Subsequent License Renewal Application Public Environmental Scoping Meeting Presentation Slides	ML23081A039
03/27/2023	March 29, 2023, Monticello, Unit 1, Subsequent License Renewal Application Public Scoping Webinar Presentation Slides	ML23086C072
03/28/2023	Public Meeting Announcement for March 29, 2023: Environmental Scoping Meeting Related to the Monticello Nuclear Generating Plant Subsequent License Renewal Application (Webinar)	ML23087A102
04/18/2023	March 22, 2023, Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application Public Environmental Scoping Meeting Transcript	ML23108A313
04/18/2023	March 29, 2023, Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application Public Environmental Scoping Webinar Teams Transcript	ML23108A318
05/01/2023	Memo, March 22, 2023, Meeting Summary: Public Scoping Meeting for the Environmental Review of the Subsequent License Renewal Application for Monticello Nuclear Generating Plant, Unit 1	ML23110A014
05/01/2023	Meeting Summary for March 22, 2023, Environmental Scoping Meeting Related to the Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application	ML23110A015
05/01/2023	Memo, March 29, 2023, Meeting Summary: Public Scoping Meeting for the Environmental Review of the Subsequent License Renewal Application for Monticello Nuclear Generating Plant, Unit 1	ML23115A438
05/01/2023	Meeting Summary for March 29, 2023, Environmental Scoping Meeting Related to the Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application	ML23115A464
06/02/2023	Letter to Christopher P. Domingos, Monticello Nuclear Generating Plant, Unit 1 - Notice of Intent to Conduct Scoping Process and Prepare an Environmental Impact Statement	ML23047A118
08/09/2023	Monticello Nuclear Generating Plant, Unit 1 – License Renewal Regulatory Audit regarding the Environmental Review of the Subsequent License Renewal	ML23215A131
10/23/2023	Monticello Nuclear Generating Plant, Unit 1, Summary of the Environmental Hybrid Audit Related to the Review of the Subsequent License Renewal Application	ML23291A110
10/23/2023	Monticello Nuclear Generating Plant, Unti 1, Subsequent License Renewal Application Request for Confirmation of Information and Requests for Additional Information	ML23291A109

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession No. or Federal Register Citing
11/21/2023	Monticello Nuclear Generating Plant, Subsequent License Renewal Application Response to Request for Additional Information and Request for Confirmation of Information - Set 1	ML23332A182
12/18/2023	Subsequent License Renewal Application Response to Request for Additional Information and Request for Confirmation of Information – Set 1 Part 2	ML23352A081
02/24/2024	Subsequent License Renewal Application Response to Request for Additional Information and Request for Confirmation of Information – Supplement to Set 1 Part 1	ML24088A215

D.2 References

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from S. Koenick, Chief Environmental Project Management Branch 1, to S. Hafen, Site Vice President Northern States Power Company, dated March 18, 2024, regarding "Issuance of Environmental Scoping Summary Report Associated with the U.S. Nuclear Regulatory Commission Staff's Review of the Monticello Nuclear Generating Plant, Unit 1, Subsequent License Renewal Application (EPID Number: L-2023-Sle-0000) (Docket Number: 50-263)." Washington, D.C. ADAMS Accession No. ML24059A288. TN9817.

APPENDIX E

PROJECTS AND ACTIONS CONSIDERED IN THE CUMULATIVE IMPACTS ANALYSIS

The cumulative impacts analysis has been provided in Section 3.15 of this environmental impact statement (see Section 3.15, Cumulative Effects).

APPENDIX F

ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This appendix describes the environmental impacts from postulated accidents that may occur at Monticello Nuclear Generating Power Station, Unit 1 (Monticello) during the subsequent license renewal (SLR) period. The term “accident” refers to any unintentional event outside the normal nuclear power plant operational envelope that could result in either: (1) an unplanned release of radioactive materials into the environment; or (2) the potential for an unplanned release of radioactive materials into the environment. Postulated accidents include design-basis accidents and severe accidents (e.g., those involving core damage).

This environmental impact statement (EIS) considers the impacts of SLR issues applicable to the Monticello SLR on a site-specific basis. The U.S. Nuclear Regulatory Commission (NRC) staff prepared this site-specific EIS in accordance with Commission Legal Issuance (CLI)-22-03 (NRC 2022-TN9844), that references CLI-22-02 (NRC 2022-TN8182).

NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (LR GEIS) (NRC 1996-TN288, NRC 2013-TN2654), evaluates in detail the following two classes of postulated accidents as they relate to license renewal (LR). The LR GEIS conclusions are codified in Title 10 of the *Code of Federal Regulations* 10 CFR Part 51-TN250, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”:

- Design-Basis Accidents (DBA): Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than DBAs because they could result in substantial damage to the reactor core, with or without serious offsite consequences.

The original LR GEIS, NUREG-1437, published in 1996 (NRC 1996-TN288), contains the analysis for the determination of environmental impacts related to postulated accidents (NRC 1996-TN288). NUREG-1437 was updated to evaluate any new information related to the 1996 LR GEIS analysis and site-specific severe accident mitigation alternatives (SAMA) analysis and is referred to as the “2013 LR GEIS.” (NRC 2013-TN2654) Recently, NUREG-1437 was updated with newer information and was published in draft form for public comment, and is referred to here as the “2023 draft LR GEIS.” (NRC 2023-TN9172)

On March 21, 2022, the Commission issued CLI-22-02 (NRC 2022-TN8182) when considering the appeals of Natural Resources Defense Council, Friends of the Earth, and Miami Waterkeeper, in the *Turkey Point* SLR proceeding, and reconsidered the Commission’s earlier decision in CLI-20-3 (NRC 2022-TN9844, NRC 2020-TN9570). The Commission reversed CLI-20-3 (NRC 2022-TN9844), which addressed the referred ruling from the Atomic Safety and Licensing Board. In CLI-20-3 (NRC 2022-TN9844), the Commission had held that, when considering the environmental impacts of SLR, the NRC staff may rely on the 2013 LR GEIS (LR GEIS NRC 2013-TN2654) and 10 CFR Part 51 (TN250) Subpart A, Appendix B, Table B-1, “Summary of Findings on National Environmental Policy Act (NEPA) Issues for License Renewal of Nuclear Power Plants,” to evaluate the environmental impacts of Category 1 issues for SLR. For the reasons described in CLI-22-02 (NRC 2022-TN8182), the Commission reversed that decision and held that the 2013 LR GEIS did not address SLR. The Commission stated, “that the staff may not exclusively rely on the 2013 LR GEIS and Table B-1 for the evaluation of environmental impacts of Category 1 issues” (NRC 2022-TN8182).

The applicant submitted an application for SLR along with an environmental report, by letter dated January 9, 2023 (Xcel 2023-TN9084). Xcel Energy, the owner-licensee for Monticello, submitted this application on behalf of itself and Northern States Power Company–Minnesota, the operator-licensee, for Monticello. Northern States Power Company−Minnesota was incorporated as a wholly-owned subsidiary of Xcel Energy, Inc. effective August 18, 2000. The application is for the SLR of Renewed Facility Operating License Number DPR-22 for Monticello Unit 1. An audit of this environmental report was conducted the week of July 31, 2023 (NRC 2023-TN9794). As a result of the Commission’s decision in CLI-22-02, in this draft EIS, the NRC staff has conducted a site-specific evaluation of the environmental impacts of Monticello’s SLR application.

This appendix describes (1) the NRC staff’s evaluation of new and significant information related to design-basis accidents at Monticello, (2) the staff’s evaluation of new and significant information for postulated severe accidents at Monticello, and (3) the staff’s evaluation of new and significant information related to the Monticello SAMA evaluation performed during initial LR. The NRC staff conducted this site-specific new and significant evaluation to verify that the environmental impacts of DBAs and the probability-weighted consequences of postulated severe accidents for Monticello continue to be SMALL.

F.1 Background for Design-Basis Accidents

Although this EIS documents the NRC staff’s review of an SLR application, it should be noted that long before any LR actions, an operating reactor has already completed the NRC licensing process for the original 40-year operating license. To receive a license to operate a nuclear power reactor, an applicant must submit to the NRC an operating license application that includes, among many other requirements, a safety analysis report. The applicant’s safety analysis report (Xcel 2021-TN9633) presents the design criteria and design information for the proposed reactor and includes comprehensive data on the proposed site. The applicant’s safety analysis report also describes various design-basis accidents and the safety features designed to prevent or mitigate their impacts. The NRC staff reviews the operating license application to determine if the nuclear power plant’s design—including designs for preventing or mitigating accidents—meets the NRC’s regulations and requirements. At the conclusion of that review, an operating license would be issued only if the NRC finds, in part, reasonable assurance that the activities authorized by the license can be conducted without endangering the health and safety of the public and that the activities will be conducted in accordance with the NRC’s regulations.

F.1.1 Design-Basis Accidents

DBAs are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. Planning for design-basis accidents ensures that the proposed nuclear power plant can withstand normal transients (e.g., rapid changes in the reactor coolant system temperature or pressure, or rapid changes in reactor power), as well as a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. Many of these design-basis accidents may occur but are unlikely to occur even once during the life of the nuclear power plant; nevertheless, carefully evaluating each design-basis accident is crucial to establishing the design-basis for the preventive and mitigative safety systems of the proposed nuclear power plant. The regulations in 10 CFR Part 50 (TN249), “Domestic Licensing of

Production and Utilization Facilities," and 10 CFR Part 100 (TN282), "Reactor Site Criteria," describe the NRC's acceptance criteria for design-basis accidents.

Before the NRC issues an operating license for a new nuclear power plant, the applicant must demonstrate the ability of its proposed reactor to withstand all design-basis accidents. The applicant and the NRC staff evaluate the environmental impacts of design-basis accidents for the hypothetical individual exposed to the maximum postulated amount of radiation (maximum exposed individual member of the public). The results of these evaluations of are found in the applicant's final safety analysis report (see Xcel 2021-TN9633). Once the NRC issues the operating license for the new reactor, the licensee is required to maintain the acceptable design and performance criteria throughout the operating life of the nuclear power plant; including any LR periods of extended operation. The consequences of design-basis accidents are evaluated for the hypothetical maximum exposed individual taking into consideration any changes in the nuclear power plant environment over time; as such, any changes in the nuclear power plant environment over time will have been accounted for and will not significantly impact these evaluations.

The NRC regulation in 10 CFR 54.29(a) (TN4878), "Standards for Issuance of a Renewed License," requires LR applicants to demonstrate that identified actions have been, or will be taken, to manage the effects of aging and perform any required time-limited aging analyses such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the nuclear power plant's current licensing basis (CLB), as defined in 10 CFR 54.3(a), "Definitions." Furthermore, the applicant must show that any changes made to the nuclear power plant's CLB are in accordance with the Atomic Energy Act of 1954, as amended, and applicable NRC regulations. As previously discussed, since the regulatory requirements for the plant's existing design-basis and aging management programs will be in effect for LR, the environmental impacts of design-basis accidents, as calculated for the original operating license application, should not differ significantly from the environmental impacts for any other time during nuclear power plant operations, including during the initial LR and the subsequent license renewal periods. Accordingly, the design of the nuclear power plant, relative to design-basis accidents during the period of extended operation, is considered to remain acceptable.

Consistent with Regulatory Issue Summary (RIS)-2014-06, "Consideration of Current Operating Issues and Licensing Actions in License Renewal," (NRC 2014-TN7851), the early and adequate identification of design-basis accidents and mitigation (before SLR) makes them a part of the CLB of the nuclear power plant as defined at 10 CFR 54.3(a) (TN4878), "Current licensing basis (CLB)." The NRC requires licensees to maintain the CLB of the nuclear power plant under the current operating license, as well as during any LR period. Therefore, under the provisions of 10 CFR 54.30, design-basis accidents are not subject to a safety review under LR.

F.1.2 Evaluation of Design-Basis Accidents Specific to Monticello

In Section 4.15.1.2, "Site-Specific Analysis for Monticello SLR," of the Monticello SLR Environmental Report (ER), Xcel Energy summarized the licensing basis and site-specific NRC approval needed to operate a nuclear power facility, such as described in the Monticello safety analysis report (SAR) (Xcel 2021-TN9633, Xcel 2023-TN9084). The Monticello SAR presents the design and performance criteria for the proposed reactor and comprehensive data on the proposed site. The environmental impacts of design-basis accidents were evaluated during the initial licensing process, and the ability of the plant to withstand these accidents was demonstrated to be acceptable before issuance of the operating license. The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant including any extended-life operation.

The Monticello SAR also discusses various hypothetical design-basis accidents and the safety features designed to prevent and mitigate accidents. A number of the postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design-basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for design-basis accidents are described in 10 CFR Part 50 and 10 CFR Part 100.

The NRC has reviewed Monticello's design-basis on several occasions following the issuance of the initial operating licenses. An example of NRC's continued review of Monticello design-basis include a December 7, 2006 "Issuance of an Amendment Regarding the Alternative Source Term." in which the NRC staff determined that the radiological consequences estimated by the licensee for Monticello (various DBAs) will comply with the requirements of 10 CFR 50.67, "Accident Source Term," and the guidelines of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating DBAs at Nuclear Reactors," and are therefore acceptable (NRC 2006-TN9797). The radiological consequences for design-basis accidents were also evaluated for the hypothetical maximum exposed individual (NRC 2006-TN9797), with the consideration that changes in the plant environment will not affect these evaluations. The environmental impacts during a LR term do not differ significantly from those calculated for the design-basis accident assessments conducted as part of the initial plant licensing process. Impacts from design-basis accidents are not affected by changes in plant environment because such impacts (1) are based on calculated radioactive releases that are not expected to appreciably change, (2) are not affected by changes in the plant environment because they are evaluated for the hypothetical maximally exposed individual under expected environmental parameters and conditions, and (3) have been previously determined to be acceptable (NRC 1996-TN288, NRC 2013-TN2654).

Another example of NRC's review of Monticello design-basis include its review of external hazards information for all operating power reactors, including Monticello, as ordered by the Commission following the Fukushima accident. For Monticello, the NRC staff concluded that no further regulatory actions were needed to ensure adequate protection or compliance with regulatory requirements, including site-specific external hazards information, re-confirming the acceptability of Monticello's design-basis (NRC 2020-TN9695).

Under the NRC's LR rules in 10 CFR Part 54 (TN4878), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," applicants for initial LR and SLR must take adequate steps to account for aging during the period of extended operation either through updates to the time-limited aging analyses or implementation of aging management plans. Based on these activities, the NRC expects that operation during an initial LR or SLR term would continue to provide an equivalent level of safety as during the operating period. Furthermore, as provided in the statement of considerations for Part 54, the Commission believes that considerable experience has demonstrated that its regulatory process, including the performance-based requirements of the maintenance rule, provide adequate assurance that degradation due to aging of structures, systems, and components that perform active safety functions will be appropriately managed to ensure their continued functionality during the period of extended operation. Furthermore, although the definition of CLB in 10 CFR Part 54 is broad and encompasses various aspects of the NRC regulatory process (e.g., operation and design requirements), the Commission concluded that a specific focus on functionality is appropriate for performing the LR review. Reasonable assurance that the function of important structures, systems, and components will be maintained throughout the renewal period, combined with the rule's stipulation that all aspects of a plant's CLB (e.g., technical specifications) and the NRC's regulatory process carry forward into the renewal period, are viewed as sufficient to conclude that the CLB (which represents an acceptable level of safety) will be maintained. Functional capability is the principal emphasis for much of the CLB and is the focus of the maintenance rule and other regulatory requirements to ensure that aging issues are appropriately managed in the current license term. The LR rule assures this management continues into any subsequent term.

Consistent with 10 CFR Part 54 (TN4878), the applicant performed an integrated plant assessment for the SLR application. This was done by its SLR team which evaluated Monticello systems, structures, and components and conducted time-limited aging analyses. These evaluations and analyses ensure that systems, structures, and components remain capable of performing their functions consistent with existing plant design and performance criteria specified in the Monticello licensing basis. The applicant found that the current Monticello design- and performance criteria will be maintained during the subsequent period of extended operation (Xcel 2023-TN9084).

As stated in Section 5.3.2 of the 1996 LR GEIS (TN288), the NRC staff assessed the environmental impacts from design-basis accidents in individual nuclear power plants at the time of the initial license application review. The licensee is required to maintain the nuclear power plant within acceptable design and performance criteria, including during any LR term. As such, the NRC staff would not expect environmental impacts to change significantly. The 1996 LR GEIS concluded that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants, because the nuclear power plants were designed to withstand these accidents.

For this SLR, the environmental impacts of design-basis accidents continue to be of SMALL significance for Monticello because the plant was designed to successfully withstand these accidents. As previously discussed, this is due to the requirements for Monticello to maintain the current licensing basis and implement appropriate aging management programs during the SLR term.

The impacts of design-basis accidents were also evaluated in the NRC staff's environmental impact statement for Monticello's initial LR. As stated in the Monticello NRC LR EIS (NRC 2006-TN7315, ADAMS Accession No. ML062490078):

> "The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal."

Furthermore, the Staff concluded in the Monticello LR EIS (NRC 2006-TN7315, ML062490078),

> "The staff has not identified any new and significant information during its independent review of the NMC [Nuclear Management Company] ER, the staff's site visit, the scoping process, its evaluation of other available information, or

public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to design basis accidents beyond those discussed in the GEIS."

The environmental impacts during the SLR term are not expected to differ significantly from those calculated for the design-basis accident assessments conducted as part of the initial plant licensing process or as part of the initial license renewal process. Xcel Energy stated, and the staff confirmed, that impacts due to design-basis accidents are SMALL. Based on the discussion above, the NRC staff concludes that the impacts for this issue, with respect to an SLR term for Monticello, are SMALL.

In its ER for the Monticello SLR application, Xcel Energy did not identify any new and significant information related to design-basis accidents at Monticello (Xcel 2023-TN9084). The NRC staff also did not identify any new and significant information related to design-basis accidents during its independent review of Xcel Energy's ER, through the scoping process, or in its evaluation of other available information. Therefore, the NRC staff concludes that there are no environmental impacts related to design-basis accidents at Monticello during the SLR period beyond those already discussed in the EIS for Monticello's initial license renewal or generically for all nuclear power plants in the 2013 LR GEIS.

F.1.3 Severe Accidents

Severe accidents are postulated accidents that are more severe than design-basis accidents because they can result in substantial damage to the reactor core, with or without serious offsite consequences. Severe accidents entail multiple failures of equipment or functions.

F.1.4 Severe Accidents and License Renewal

Chapter 5 of the 1996 LR GEIS (NRC 1996-TN288) conservatively predicted the environmental impacts of postulated severe accidents on a plant-specific basis that may occur during the period of extended operations at nuclear power plants. Since that time, the NRC staff's prediction for Monticello has been confirmed to be conservative and the environmental impacts determined to remain SMALL by a plant specific severe accident Level 3 probabilistic risk assessment (PRA) consequence analysis. The results of the consequence analysis are found in the Monticello initial license renewal application that was reviewed by the NRC staff (NRC 2006-TN7315).

In the 1996 LR GEIS, the NRC considered impacts of severe accidents including the following:

- dose and health effects of accidents
- economic impacts of accidents
- effect of uncertainties on the results

The NRC staff calculated these estimated impacts by studying the risk analysis of severe accidents that the NRC staff had prepared in support of several nuclear power plant's original reactor operating license review. Not all original operating reactor licenses contained a severe accident analysis because the NRC had not always required them. When the NRC staff prepared the 1996 LR GEIS, 28 nuclear power plant sites (44 units) had EISs or Final Environmental Statements that contained a severe accident analysis. The 1996 LR GEIS relied on severe accident analyses provided in the plant-specific EISs where available. Table 5-1 in the 1996 LR GEIS lists the 28 nuclear power plants, representing 44 units, that included severe accident analyses in their plant-specific EISs. These plant-specific EISs used site-specific meteorology, land topography, population distributions, and offsite emergency response parameters, along with generic or plant-specific source terms, to calculate offsite health and economic impacts. The offsite health effects included those from airborne releases of radioactive material and contamination of surface water and groundwater. Table 5.6 of the 1996 GEIS present the Monticello values for the predicted early- and latent fatalities as well as dose estimates per reactor-year (RY) to determine that the impacts are SMALL. For completeness, the 1996 LR GEIS results for Monticello are provided in Table F-1 below.

Table F-1 Predicted Early and Latent Fatalities and Dose Estimates per Reactor-Year for Monticello at the Middle Year of the License Renewal Period (1996 GEIS)

Predicted UCB Total Early Fatalities/RY (95% UCB)	Non-Normalized Predicted Latent Total Fatalities/RY (95% UCB)	Non-Normalized Predicted Total Dose (person-rem/RY) (95% UCB)
4.1×10^{-3}	5.0×10^{-2}	730

RY = reactor year; UCB = upper-confidence bound.

The 1996 LR GEIS used very conservative 95th-percentile upper-confidence bound (UCB) estimates for its severe accident environmental impact whenever available. As described in Section 5.3.3.2.2 of the 1996 LR GEIS, this approach provides inherent layers of conservatism to cover uncertainties (TN288). The 1996 LR GEIS concluded that the probability-weighted consequences of severe accidents, as related to LR, are SMALL compared to other risks to which the populations surrounding nuclear power plants are routinely exposed. As listed in Table 5.6 of the 1996 LR GEIS, the range of predicted population dose risk varied from 48 person-rem/RY at Big Rick Point to 9,727 person-rem/RY at Indian Point. The published result for Monticello predicted a total population dose risk of 730 person-rem/RY which is on the lower range of Table 5.6.

The 2013 LR GEIS (NRC 2013-TN2654) assessed more recent information and developments in severe accident analyses and how they might affect the conclusions in Chapter 5 of the 1996 LR GEIS. The 2013 LR GEIS also provides comparative data where appropriate. Based on information in the 2013 LR GEIS, the NRC staff determined that for all nuclear power plants, the probability-weighted consequences of severe accidents are SMALL. However, the 2013 LR GEIS determined that alternatives to mitigate severe accidents must be considered as a Category 2 issue for all nuclear power plants that have not considered such alternatives. Category 2 issues, presented in Table B-1, “Summary of Findings on NEPA [National Environmental Policy Act] Issues for License Renewal of Nuclear Power Plants,” of Appendix B to Subpart A of 10 CFR Part 51 (TN250), states:

> 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.

The 1996 LR GEIS used the environmental impact information from the 28 plant-specific EISs and a metric called the exposure index (EI) to (1) scale up the radiological impact of severe accidents on the population due to demographic changes from the time the original EIS was performed until the year representing the mid-LR period, and (2) estimate the severe accident environmental impacts for the other plants (whose EISs did not include a quantitative assessment of severe accidents). The EI method is a measure of the degree to which the population would be exposed to the release of radioactive material resulting from a severe accident. The method uses the projected population distribution around each nuclear power plant site at the middle of its LR period with site-specific meteorology data. By using this information, it weights the population in each of 16 sectors around a nuclear power plant by the fraction of time the wind blows in that direction on an annual basis. The EI metric was also used to project economic impacts at the mid-year of the LR period. A more detailed description of the EI method is contained in Appendix G of the 1996 LR GEIS.

The plant-specific EIs, in conjunction with the plant-specific total probability-weighed consequences, or risk values, from the Final Environmental Statements, were used to predict the 95 percent UCB consequences. This was performed for 74 nuclear power plants (including Monticello), representing 118 units, from atmospheric releases due to severe accidents. Predicted 95 percent UCB values were developed for early fatalities per RY, latent fatalities per RY, and total population dose risk per RY. The results of this assessment are provided in 1996 LR GEIS Table 5.10, Table 5.11, and Table 5.6, respectively. These results are repeated in Table F-1 for Monticello (recited above) in the columns titled “Predicted Total Early Fatalities/RY (95 percent UCB),” “Non-Normalized Predicted Latent Total Fatalities/RY (95 percent UCB),” and “Non-Normalized Predicted Total Population Dose Risk (person-rem/RY) (95 percent UCB),” respectively. In Section 5.5.2.5 of the 1996 LR GEIS, the NRC staff concluded that the generic analysis summarized in the 1996 LR GEIS “applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts of severe accidents are of small significance for all plants.”

Per the Commission’s regulations, applicants are required to include a plant-specific SAMA analysis in the ER for license renewal if one has not been previously considered. The NRC staff documented its review of the Monticello SAMA analysis in NUREG-1437 Supplement 26, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Monticello Unit 1,” (NRC 2006-TN7315) during Monticello initial LR. The SAMA analysis included a Level 3 PRA consequence analysis that calculated the population dose risk or probability-weighted consequences to the environment. The consequence analysis software that was used for the Level 3 PRA consequence analysis was the MELCOR Accident Consequence Code System (MACCS) code (SNL 2021-TN7810).[1] Thus, Xcel Energy submitted an initial LR application that included a plant-specific estimate of the total population dose risk due to severe accidents using a Level 3 PRA consequence analysis. The Monticello Level 3 PRA consequence analysis provided a more refined plant specific Monticello calculation of population dose risk for comparison to the non-normalized predicted total population dose risk per RY (person-rem/RY) consequences, at the 95 percent UCB, provided for Monticello in the 1996 LR GEIS. It included Monticello updated core damage frequencies (CDFs) for internal and external event hazards, plant-specific updated analyses of containment performance under severe accident conditions, and updated consequence analyses using Monticello plant-specific information about radionuclide source terms, radionuclide releases, projected population distribution during the LR period, meteorological data, and emergency response.

[1] MACCS was developed at and continues to be maintained by Sandia National Laboratories for the NRC. It is used to model estimates of the health risks and economic impacts of offsite radiological releases from potential severe accidents at nuclear facilities. See the description of SOARCA in this appendix for a relatively recent application by the NRC of the MACCS code for performing a state-of-the art assessment of the consequences of severe accidents at nuclear power plants.

The population dose risk calculated in the Monticello Level 3 PRA consequence analysis for initial LR included the contribution from severe accidents due to internally initiated events, which also included events initiated by internal flooding. Xcel Energy accounted for externally initiated events by using the best available information at the time. The Monticello external events multiplier was calculated explicitly based on the Individual Plant Examination – External Events (IPEEE). The use of external events multipliers were later included in the methodology provided in NEI 05-01 (NEI 2005-TN1978), which has been endorsed by the NRC (2013-TN4791). The external events multiplier is the ratio of the total plant CDF (both internally initiated and externally initiated) to the CDF for internally initiated events. This multiplier is multiplied by the estimated population dose risk for internally initiated events to develop the estimate of the Monticello total plant population dose risk. The external event multiplier for Monticello was calculated to be 3.4 in its PRA analysis during initial LR (NRC 2006-TN7315).

The calculated total population dose risk of 76 person-rem/RY from the Monticello initial LR SAMA analyses Level 3 PRA consequence analysis is near a factor of 10 less than the corresponding 1996 LR GEIS value of 730 person-rem/RY. The smaller Monticello initial LR calculated value of population dose risk in comparison to the value in the 1996 GEIS demonstrate the magnitude of conservatism used in the 1996 LR GEIS predicted values. This is from both the standpoint of reduced consequences using more recent plant-specific information and the conservatism built into the 1996 LR GEIS methodology which reinforces the conclusion that the probability-weighted consequences due to severe accidents are small.

Since publication of the 1996 LR GEIS and 2013 LR GEIS, and the completion of numerous plant-specific LR SAMA analyses, developments in plant operation and accident analysis have occurred that could affect the assumptions made in these analyses. These changes are grouped into the following areas which correspond with the section (in parentheses) of the 2013 GEIS.

- internal event risk (2013 GEIS, Section E.3.1)
- external event risk (2013 GEIS, Section E.3.2)
- updates in the quantification of accident source terms (2013 GEIS, Section E.3.3)
- increases in licensed reactor power levels, i.e., power uprates (2013 GEIS, Section E.3.4)
- increases in fuel burnup levels (2013 GEIS, Section E.3.5)
- consideration of reactor accidents at low power and shutdown conditions (2013 GEIS, Section E.3.6)
- consideration of accidents in Spent Fuel Pools (SFPs) (2013 GEIS, Section E.3.7)
- the Biological Effects of Ionizing Radiation (BEIR) VII report on the risk of fatal cancers posed by exposure to radiation (2013 GEIS, Section E.3.8)
- Sections discussing uncertainties (2013 GEIS, Section E.3.9), SAMAs (2013 GEIS, Section E.4), and conclusions are also provided.

The 2023 draft revised LR GEIS evaluates new information regarding severe accidents for each of the above topics (for both initial LR and SLR) and considers whether the information would, collectively, change the conclusions in the 1996 LR GEIS and 2013 LR GEIS that the impacts of severe accidents are small. As explained below, while several of these factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. As a result, the following analysis, based on the analysis presented in the draft 2023 LR GEIS, further supports the findings from the 1996 and 2013 LR GEIS, and the Monticello initial LR EIS that the probability-weighted impacts of severe accidents for Monticello would be small.

The NRC's regulations in 10 CFR Part 51 (TN250), which implement Section 102(2) of NEPA, require that all applicants for LR must submit an ER to the NRC, in which they identify any "new and significant information regarding the environmental impacts of LR of which the applicant is aware" (see 10 CFR 51.53(c)(3)(iv)). Accordingly, in its SLR application ER, Xcel Energy evaluates areas of new and significant information that could affect the environmental impact of postulated severe accidents during the SLR period of extended operation and possible new and significant information as it relates to SAMAs.

In the 2013 LR GEIS, the NRC staff evaluated the NRC's severe accident environmental impact assessments in 1996 LR GEIS considering new information that might affect the evaluation and confirmed that the determination regarding probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and socioeconomic impacts from severe accidents are small for all plants (NRC 2013-TN2654, Appendix E).

This EIS for Monticello evaluates new information regarding severe accidents using a similar approach as that in the 2013 LR GEIS and considers whether the new information would, collectively, change the conclusion that the probability-weighted consequences of a severe accident at Monticello are small. As explained below, while several factors at Monticello may result in modest increases in severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. As a result, the following NRC staff review and independent analysis overall further supports the findings from the 1996 and 2013 LR GEIS, as well as the initial LR EIS for Monticello, that the probability-weighted impacts of severe accidents would be SMALL.

F.2 Severe Accident Analysis (Probability-Weighted Consequences)

In a SAMA analysis, the NRC requires LR applicants to consider the environmental impacts of severe accidents, their probability of occurrence, and potential means to mitigate those accidents. As quoted above, 10 CFR Part 51 (TN250), Table B-1 states, "Alternatives to mitigate severe accidents must be considered for all nuclear power plants that have not considered such alternatives." This NRC requirement to consider alternatives to mitigate severe accidents can be fulfilled by a SAMA analysis. The purpose of the SAMA analysis is to identify design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents at nuclear power plants and that are also potentially cost-beneficial to implement. The SAMA analysis includes the identification and evaluation of SAMAs that may reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment if substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 2013-TN2654). The regulation at 10 CFR 51.53(c)(3)(ii)(L), states that each LR applicant must submit an ER that considers alternatives to mitigate severe accidents "[i]f the staff has not previously considered [SAMAs] for the applicant's plant in an [EIS] or related supplement or in an environmental assessment."

F.2.1 Monticello Initial License Renewal Application and SAMA Analysis

As part of its initial LR application submitted in 2006, Nuclear Management Company (NMC), a subsidiary of Xcel Energy, (hereafter referred to as Xcel Energy) included a SAMA analysis for Monticello in its LR ER (NMC 2005-TN9345). Xcel Energy based that SAMA analysis on: (1) the Monticello PRA for total accident frequency, CDF, and containment large early release frequency (LERF); and (2) a supplemental analysis of offsite consequences and economic impacts for risk determination. The Monticello PRA included a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to determine containment performance during severe accidents. The offsite consequences and economic impacts analyses were assessed though a Level 3 PRA which used site-specific data for meteorology, population, and economics estimates, as well as evacuation modeling to determine the offsite risk impacts on the surrounding environment and the public. Projected population distribution estimates were based on 1990 census data projected out to 2030.

As part of its review of the initial Monticello LR application, the NRC staff reviewed Xcel Energy's 2006 analysis of SAMAs, as documented in Supplement 26 to NUREG-1437 (NRC 2006-TN7315). Supplement 26 to NUREG-1437 contains the NRC staff's evaluation of the potential environmental impacts of nuclear power plant accidents and examines each SAMA both individually and, in some cases, in combination, to determine the SAMA's potential risk reduction. To quantify each SAMA's cost-benefit value, the NRC staff then compared this potential risk reduction against the cost of implementing the SAMA.

During its review of the initial LR application, the staff reviewed the NMC analysis and concluded that the applied methods and their implementation was comprehensive. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by NMC are reasonable and sufficient for the LR submittal (NRC 2006-TN7315).

F.2.2 Subsequent License Renewal Application and New and Significant Information as it Relates to the Probability-Weighted Consequences of Severe Accidents

As discussed above, a LR application must include an ER that describes SAMAs if the NRC staff has not previously evaluated SAMAs for that nuclear power plant in an EIS, in a related supplement to an EIS, or in an environmental assessment. As also discussed above, the NRC staff performed a site-specific analysis of Monticello SAMAs in NUREG-1437, Supplement 26 (NRC 2006-TN7315). Therefore, in accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250), Xcel Energy was not required to provide another SAMA analysis in its ER for the Monticello SLR application, other than addressing any new and significant information that might affect its previous analyses and conclusions. Below, the NRC staff summarizes possible areas of new and significant information and assesses Xcel Energy's conclusions.

F.3 Evaluation of New Information Concerning Severe Accident Consequences for Monticello as It Relates to the LR GEIS and the 2006 Initial LR SEIS

The 2013 LR GEIS considers developments in nuclear power plant operation and accident analysis that could have changed the assumptions made in the 1996 LR GEIS concerning severe accident consequences. The 2013 GEIS confirmed the 1996 LR GEIS determination that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants. Appendix E of the 2013 LR GEIS provides the NRC staff's evaluation of the environmental impacts of postulated accidents. Table E-19, "Summary of Conclusions," shows the developments that the NRC staff considered, as well as the NRC staff's conclusions. That table serves as the basis for the 2013 conclusion that the probability-weighted consequences of severe accidents remain SMALL for all nuclear power plants.

The NRC staff's evaluation for this Monticello SLR application followed the generic approach provided in the 2013 GEIS using Monticello site-specific information. The site-specific analysis evaluates the impact of any relevant new Monticello information on the environmental consequences of continued plant operation during the subsequent period of extended operation.

For Monticello SLR, the NRC staff confirmed from this analysis that there is no new and significant information that would change the 2013 LR GEIS conclusions, or the conclusions in the initial LR SEIS for Monticello, regarding the probability-weighted consequences of severe accidents. The NRC staff evaluated Xcel Energy's new information during the Monticello audit (NRC 2023-TN9794), during the scoping process, and through the evaluation of other available information. The results of that review follow.

F.3.1 New Internal Events Information (Section E.3.1 of the 2013 LR GEIS)

The purpose of this section is to consider updated information since Monticello initial license renewal regarding the contribution to CDF from accidents initiated by internal events and potential internal event impacts. The LR SAMA analyses submitted for initial LR and reviewed by the NRC staff explicitly considered the impact of internal events in the assessment of SAMAs and the determination of population dose risk for Monticello initial LR.

The Monticello internal events CDF in the initial LR SAMA was 4.5×10^{-5}/year (NRC 2006-TN7315). The Monticello internal events CDF provided in the ER for SLR is approximately 1.3×10^{-5}/year (Xcel 2023-TN9084). Specifically, the current internal events CDF of 1.3×10^{-5}/year represents approximately 71 percent reduction or about a factor of 3.5 reduction from the initial LR SAMA analysis.

As discussed above, the assessed impacts from the 1996 LR GEIS were based on the original license EISs for the 28 nuclear power plant sites listed in Table 5.1 of the GEIS. Monticello was not one of the original 28 nuclear power plant sites, however a comparison with the original internal event CDF values that the 1996 LR GEIS analysis is shown in Figure F-2. Specifically, The Monticello internal events CDF provided in the SLR ER (1.3×10^{-5}/year) is more than a factor of 4.2 lower than the 1996 LR GEIS mean CDF for boiling water reactors (BWRs) of 5.4×10^{-5}/yr. This represents a factor of 1.8 lower from the 1996 LR GEIS median value. Likewise, The Monticello internal events CDF provided in the SLR ER (1.3×10^{-5}/year) is more than a factor of 3.5 lower than the Monticello LR SAMA internal events CDF of 4.5×10^{-5}/yr.

In summary, the updated accident frequencies from the Monticello initial LR and SLR ER are lower than the mean and median values of the BWR internal event accident frequencies that form the basis for the environmental impacts shown in the 1996 LR GEIS. Furthermore, the SLR internal event accident frequency for Monticello has decreased since the Monticello initial LR SAMA analysis.

Table F-2 Boiling Water Reactor Internal Event (Full Power) Core Damage Frequency Comparison

Nuclear Power Plant	1996 LR GEIS Estimated CDF[(a)]	IPE CDF[(b)]	SAMA Internal Event CDF[(c)]
Monticello	N/A	2.6×10^{-5}/yr[(d)]	4.5×10^{-5}/yr[(d)]
Mean value	5.4×10^{-5}/yr	1.5×10^{-5}/yr	8.7×10^{-6}/yr
Median value	2.4×10^{-5}/yr	1.45×10^{-5}/yr	3.1×10^{-6}/yr

CDF = core damage frequency; IPE = Individual Plant Examination; LR GEIS = Generic Environmental Impact Statement for License Renewal of Nuclear Plants; N/A = not available; SAMA = severe accident mitigation alternative.

(a) The estimated CDF was obtained by summing individual atmospheric release sequences, including intact containment sequences.
(b) Data were obtained from NRC 1997-TN7812, unless otherwise noted.
(c) Data were obtained from the applicable plant-specific supplement to NUREG-1437, unless otherwise noted.
(d) The internal events initiated CDF value includes contribution from internal flooding events.

Therefore, considering the site-specific internal event CDF reduction in Monticello's risk profile, the NRC staff concludes that the probability-weighted offsite consequences of severe accidents initiated by internal events during the SLR term at Monticello would be SMALL. For these issues, the 1996 LR GEIS and 2013 LR GEIS predicted that the probability-weighted consequences of severe accidents would be SMALL for all nuclear plants. The Monticello initial LR SEIS reached the same conclusion. The NRC staff's site-specific analysis identified no new and significant information regarding internal events during its review of Xcel Energy's ER, during the SAMA audit, through the scoping process, or through the evaluation of other available information. Thus, the NRC staff finds Xcel Energy's conclusion acceptable that no new and significant information exists for Monticello concerning offsite consequences of severe accidents initiated by internal events that would alter the conclusion that for Monticello, the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents remains SMALL for the SLR period.

Therefore, considering the CDF reduction in Monticello's risk profile and the new information evaluated in the 2013 LR GEIS, the NRC staff concludes that the offsite consequences of severe accidents initiated by internal events during the SLR term at Monticello would not exceed the impacts predicted in the 1996 or 2013 LR GEIS. For these issues, the LR GEIS predicted that the probability-weighted consequences of severe accidents would be SMALL for all nuclear power plants. The Monticello SEIS for initial LR (NRC 2006-TN7315) reached the same conclusion. The NRC staff identified no new and significant information regarding internal events during its review of Xcel Energy's ER, during the SAMA audit, through the scoping process, or through the evaluation of other available information. Thus, the staff concludes using plant-specific information that no new and significant information exists for Monticello during the SLR term concerning the offsite consequences of severe accidents initiated by internal events that would alter the conclusions reached in the 1996 or 2013 LR GEIS, or the initial LR SEIS for Monticello.

F.3.2 External Events (Section E.3.2 of the 2013 LR GEIS)

The purpose of this section is to consider updated information regarding the contribution to CDF from accidents initiated by external events and potential external event impacts. The 1996 LR GEIS included a qualitative assessment of the environmental impacts of accidents initiated by external events (see Section 5.3.3.1 of the 1996 LR GEIS). The sources of information used in this assessment for SLR are the 2006 Monticello SAMA analyses provided in the ER and the plant-specific SEIS to NUREG-1437, Supplement 26. The LR SAMA analyses submitted and reviewed by the NRC staff explicitly considers the impact of external events in the assessment of SAMAs.

The 2013 LR GEIS expanded the scope of the evaluation in the 1996 LR GEIS and used more recent technical information that included both internally and externally initiated event core damage frequencies. Section E.3.2.3 of the 2013 LR GEIS concludes that the CDFs from severe accidents initiated by external events, as quantified in NUREG-1150, “Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants” (NRC 1990-TN525), and other sources documented in the GEIS, are comparable to CDFs from accidents initiated by internal events, but lower than the CDFs that formed the basis for the 1996 LR GEIS.

The assessment in this section of the site-specific EIS is based on the cumulative assessment of the risks and environmental impacts of severe accidents initiated by external events and those initiated by internal events, based on the aforementioned information sources. As with the previous section that addressed updated information with regard to internal events risk, the evaluation contained in this section compares the CDFs that formed the basis for the 1996 LR GEIS, and offsite population dose risks directly from the 1996 LR GEIS, to the information submitted in the Monticello SLR ER (Xcel 2023-TN9084).

The first step in the NRC staff’s evaluation is to compare the BWR internal event-initiated CDFs presented in the 1996 LR GEIS to those reported in both the Monticello LR ER and the Monticello SLR ER. For BWRs, the 1996 LR GEIS estimated CDFs used to determine the probability-weighted consequences ranged from 2.4×10^{-5}/RY (several plants) to 1.1×10^{-4}/RY (Nine Mile Point 2) with a mean of 5.4×10^{-5} and median 2.4×10^{-5}/RY. Note that CDF estimates in the 1996 LR GEIS were obtained by summing individual atmospheric release sequences, including intact containment sequences, provided in the original (plant-specific) EISs. The specific internal event CDF for Monticello was not used in the 1996 GEIS because the original Monticello operational final environmental statement was not available when the 1996 GEIS evaluation was performed. Thus, in this SLR EIS, the NRC staff compares the range of BWR internal event-initiated CDFs available for the 1996 LR GEIS evaluation to the BWR internal event-initiated CDFs reported in both the Monticello LR ER and the Monticello SLR ER.

For the 2023 SLR application, the licensee reported the sum of the fire and seismic CDFs (2.3×10^{-5}/RY, 6.4×10^{-6}/RY, respectively) in the Monticello ER to be 2.94×10^{-5}/RY. This sum (2.94×10^{-5}/RY) is less than 5.4×10^{-5}/RY which is the internal events mean value CDF for BWRs that the 1996 LR GEIS used to estimate the probability-weighted, offsite consequences for airborne, surface water and groundwater pathways, as well as the resulting economic impacts for such pathways. This sum (2.94×10^{-5}/RY) is greater than the Monticello internal event CDF (1.3×10^{-5}/RY) reported in the ER, but lower than the internal events mean value CDF for BWRs that the 1996 LR GEIS used to estimate the probability-weighted, offsite consequences for airborne, surface water and groundwater pathways, as well as the resulting economic impacts for such pathways. Since Monticello fire and seismic PRA models and estimates were developed at Monticello since the time of the initial LR, these models were considered new information by Xcel Energy. Xcel Energy used this information in its quantitative PRA calculation to evaluate each SAMA’s potential for significance. This information is presented in Table 4.15-2 of the ER. The findings of the NRC staff’s review are presented below.

Similarly, the result of the Monticello SAMA Level 3 PRA consequence analysis was within the bounds of the 1996 LR GEIS estimate regarding probability-weighted consequence results considering external events. In the Monticello LR ER, the applicant estimated the population dose risk within 50 mi (80 km) of the Monticello site to be approximately 38 person-rem per year. The breakdown of these results by containment release mode is summarized in Table 5-4 of the staff's EIS for initial LR. Considering the new CDF information regarding seismic and fire in the Monticello SLR ER, another external event multiplier was calculated by the NRC staff and also presented in Table F-3 below. The external event multiplier was calculated by dividing the Monticello total CDF of 4.3×10^{-5}/RY) by the Monticello internal events CDF of 1.3×10^{-5}/RY to compute an external event multiplier of 4. Using 6 as a conservative multiplier, the new Monticello population dose risk is 228 person-rem/RY (38 × 6). This new value of 228 person-rem/RY that considers the new external event information continues to be much lower than the 1996 LR GEIS estimated predicted total population dose risk (95 percent UCB) value of 730 person-rem/RY for Monticello.

As provided in Table F-3, with the newer external events multiplier of 6, the calculated total population dose risk of 228 person-rem/RY is about a factor of 3 (calculated 730/228) less than the corresponding 1996 LR GEIS value for Monticello of 730 person-rem/RY used to make the initial environmental impact determination of SMALL.

Table F-3 Monticello All Hazards (Full Power) Population Dose Risk Comparison with Newer External Events Multiplier

Nuclear Power Plant	1996 LR GEIS Estimated Predicted Total Population Dose – Non-normalized 95% UCB (person-rem/RY)[(a)]	New SAMA All Hazards PDR (person-rem/RY)[(b)]
Monticello	730	228
Mean value	2,718	41.0
Median value	2,636	37.3

LR GEIS = Generic Environmental Impact Statement for License Renewal of Nuclear Plants; PDR = population dose risk; RY = reactor-year; SAMA = severe accident mitigation alternative; UCB = upper-confidence bound.

(a) Data were obtained from NRC 1996-TN288.

(b) Data were obtained from the applicable plant-specific supplement to NUREG-1437 and multiplied by the external events multiplier from the same plant-specific SEIS to NUREG-1437, if applicable (NRC 2022-TN7857). For Monticello, the staff developed a conservative external event multiplier with the new Monticello SEISMIC and FIRE PRA information.

Source: NRC 2022-TN7857, unless otherwise.

The 1996 LR GEIS did not quantitatively consider severe accidents initiated by external events when assessing environmental impacts. However, the application for the Monticello SLR period does consider external events. Xcel Energy indicated the PRA models in the Monticello SLR ER reflected the most up-to-date understanding of nuclear power plant risk at the time of analysis The new CDF estimates, which are dominated by fire, have increased since the Monticello initial LR SAMA. However, these higher CDF values are within the range of those forming the basis of the 1996 LR GEIS. Furthermore, the environmental impact, population dose risk, adjusted for external events is lower than those predicted for Monticello in the 1996 LR GEIS. Therefore, the offsite consequences of severe accidents initiated by external events during the subsequent LR term would not exceed the impacts predicted in the 1996 GEIS. Therefore, the staff concludes that no new and significant information exists for Monticello concerning offsite consequences of severe accidents initiated by external events.

In addition, on November 25, 2020, the NRC staff completed its review of external hazards information for all operating power reactors (as ordered by the Commission following the Fukushima accident). For Monticello, the staff concluded that no further regulatory actions were needed to ensure adequate protection or compliance with regulatory requirements, including site-specific external hazards information, thus re-confirming the acceptability of Monticello's external hazard information (NRC 2020-TN9695).

In conclusion, there was an 8 percent decrease in the Monticello internal events CDF since the initial ER. Monticello provided commitments, or implemented safety enhancements mandated by the NRC, based on the lessons learned from the Fukushima accident. As predicted in the 2013 LR GEIS, the sum of the Monticello external events CDFs was within the range of BWR CDFs that formed the basis for the 1996 LR GEIS. Therefore, the NRC staff concludes that the probability-weighted offsite consequences of severe accidents initiated by external events during the SLR term would not exceed the consequences predicted in the 1996 or 2013 LR GEIS. For these issues, the LR GEIS predicts that the probability-weighted consequences would be SMALL for all nuclear power plants. The NRC staff identified no new and significant information regarding external events during its review of Xcel Energy's ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes using plant-specific information that no new and significant information exists for Monticello and the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents remains SMALL for the SLR period.

F.3.3 New Source Term Information (Section E.3.3 of the 2013 LR GEIS)

The source term refers to the magnitude and mix of the radionuclides released from the fuel (expressed as fractions of the fission product inventory in the fuel), as well as their physical and chemical form, and the timing of their release following an accident. The 2013 LR GEIS concludes that, in most cases, more recent estimates give significantly lower release frequencies and release fractions than was assumed in the 1996 LR GEIS. Thus, the environmental impacts of radioactive materials released during severe accidents, used as the basis for the 1996 LR GEIS (i.e., the frequency-weighted release consequences), are higher than the environmental impacts using more recent source term information. The predicted early and latent fatalities and population dose risk estimates per RY for Monticello are provided in Table 5.6 of the 1996 LR GEIS. The very conservatively predicted 1996 LR GEIS 95 percent UCB total early fatalities/RY and 95 percent latent total fatalities/RY were determined to be 4.1×10^{-3} and 5.0×10^{-2}, respectively. Similarly, the 1996 LR GEIS very conservatively predicted 95 percent UCB population dose/RY to be 730 person-rem/RY. In the Monticello initial LR ER, the population dose risk was calculated to be 76 person-rem/RY which is a factor of 10 improvement.

Peach Bottom Atomic Power Station was evaluated in NUREG/CR-7110 (NRC 2013-TN4592) in the state-of-art reactor consequence analysis (SOARCA), published in 2013. This analysis updated the NRC's severe accident studies of the Peach Bottom Atomic Power Station (i.e., NUREG-1150), incorporating state-of-the-art analyses to evaluate offsite risk. The SOARCA was not a complete analysis of all scenarios in the PRA, but it supports the conclusion that the offsite effects from a severe accident would be small. While the Monticello design is not identical to Peach Bottom Atomic Power Station, both are BWRs with MARK I containments, and the general conclusions of lower offsite consequences from the SOARCA apply to Monticello as well (Xcel 2023-TN9084).

The SOARCA report presents the results of an earthquake and station blackout in terms of individual latent cancer fatality risk and early (or prompt) fatality risk. In summary, the mitigated scenarios show essentially zero risk of early fatalities from radiation exposure and result in very small risk of a long-term cancer fatality (NRC 2012-TN3092). As indicated in the SOARCA report:

> "The individual early fatality risk from SOARCA scenarios is essentially zero. Individual latent cancer fatality (LCF) risk from the selected specific, important scenarios is thousands of times lower than the NRC Safety Goal and millions of times lower than the general cancer fatality risk in the United States from all causes, even assuming the linear no-threshold (LNT) dose-response model. Using a dose-response model that truncates annual doses below normal background levels (including medical exposures) results in a further reduction to the LCF risk (by a factor of 100 for smaller releases and a factor of 3 for larger releases). LCF risk calculations are generally dominated by long-term exposure to small annual doses (about 500 mrem per year) corresponding to evacuees returning to their homes after the accident and being exposed to residual radiation over a long period of time." (NRC 2012-TN3092)

The unmitigated scenarios from SOARCA result is essentially zero risk of early fatality for an individual. Although these unmitigated scenarios result in core damage and release of radioactive material to the environment, the release is often delayed, which allows the population to take protective actions such as evacuation and sheltering. Therefore, the public would not be exposed to concentrations of radioactive material in excess of NRC regulatory limits. This result holds even when uncertainties are considered—all three uncertainty analyses continued to show extremely low risk of early fatalities. For the unmitigated scenarios, the individual risk of a long-term cancer fatality is calculated to be very small, regardless of which distance interval (e.g., 0–10 mi, 0–20 mi, 0–50 mi) is considered. This result holds even when uncertainties are considered (NRC 2022-TN8182).

In conclusion, more recent source term information indicates that the timing from dominant severe accident sequences, as quantified in the SOARCA (NRC 2012-TN3092), comes much later than the timing assumed in the analysis forming the basis of the 1996 LR GEIS. In most cases, the release frequencies and release fractions are significantly lower for the more recent estimates. Specifically, the SOARCA results show essentially zero early fatality risk for Peach Bottom, a BWR similar to Monticello, and show a very low individual risk of cancer fatalities for the populations close to the nuclear power plants (i.e., well below the NRC Safety Goal of two long-term cancer fatalities annually in a population of one million individuals). Thus, the probability-weighted impacts estimated using the more recent and realistic source term information are much lower than the probability-weighted impacts used as the basis for the 1996 LR GEIS (i.e., the frequency-weighted consequences).

None of the SAMAs evaluated in the Monticello ER were found to reduce source term category group frequency by at least 50 percent. Therefore, the offsite consequences of severe accidents initiated by the new source term during the SLR term would not exceed the impacts predicted in the 1996 or 2013 LR GEIS. For these issues, the LR GEIS predicts that the probability-weighted consequences of severe accidents would be SMALL for all nuclear power plants. The Monticello SEIS for initial LR reached the same conclusion. The NRC staff identified no new and significant information regarding the source term during its review of Xcel Energy's ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Monticello concerning the source term that would alter the conclusions reached in the 1996 or 2013 LR GEIS or the Monticello SEIS for initial LR.

F.3.4 Power Uprate Information (Section E.3.4 of the 2013 LR GEIS)

Operating at a higher reactor power level results in a larger fission product radionuclide inventory in the core than if the reactor were operating at a lower power level. In the event of an accident, the larger radionuclide inventory in the core would result in a larger source term. If the accident is severe, the release of radioactive materials from this larger source term could result in higher doses to offsite populations.

LERF represents the frequency of event sequences that could result in early fatalities. The impact of a power uprate on early fatalities can be measured by considering the impact of the uprate on the LERF calculated value. To this end, Table E-14 of the 2013 LR GEIS presents the change in LERF calculated by each licensee that has been granted a power uprate of greater than 10 percent. Table E-14 shows that the increase in LERF ranges from a minimal impact to an increase of about 30 percent (with a mean of 10.5 percent). The 2013 LR GEIS, Section E.3.4.3, “Conclusion,” determines that a power uprate will result in a small to (in some cases) moderate increase in the environmental impacts from a postulated accident. However, taken in combination with the other information presented in the LR GEIS, the increases would be bounded by the 95 percent UCB values in Table 5.10 and Table 5.11 of the 1996 LR GEIS. Taken in combination with the other information presented in the 2013 LR GEIS, the NRC staff concluded that effects of such increases on risk and environmental impacts of severe accidents would be bounded by the 1996 LR GEIS which used the 95 percent UCB values as the basis for estimating offsite consequences.

Monticello was originally designed for operation at power levels up to 1,670 megawatts thermal (MWt) and an electrical output of up to 545 megawatts electric (MWe). Since being placed into commercial operation, an uprate license amendment was approved by the NRC on January 21, 1998. This power uprate increased the power output by 6.3 percent to 1,775 MWt and an electrical output of up to 600 MWe (NRC 2006-TN7315, NRC 2013-TN9799). Then, in 2013, an EPU was approved. The EPU increased licensed reactor thermal power by approximately 13 percent to 2,004 MWt and an electrical output of up to 691 MWe. For the 2013 EPU, several modifications were made, including, but not limited to, modifications to main steam transmitters and valves, both high- and low-pressure turbines, instrumentation and controls, and the associated steam, condensate, and feedwater paths, reactor feed pump, power range neutron monitoring system, and main generator transformer (NRC 2006-TN7315; Xcel 2008-TN9821; NRC 2013-TN9799; Xcel 2023-TN9084).

The Monticello PRA was updated to include impacts related to EPU changes since they are considered new information in the quantitative SLR evaluation. The result of the PRA updates resulted in an increase in the internal events CDF by approximately 7.8 percent and LERF by approximately 8.2 percent. In a 2013 NRC staff Monticello EPU evaluation, the NRC staff concurred that the EPU change in power represent a relatively small change to the overall challenge to containment under severe accident conditions (NRC 2013-TN9799).

Therefore, the NRC staff finds that the offsite consequences from the power uprates would not exceed the consequences predicted in the 2013 LR GEIS or the Monticello SEIS for initial LR. The NRC staff has identified no new and significant information regarding power uprates during its review of Xcel Energy’s ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes using plant-specific information that no new and significant information exists for Monticello concerning offsite consequences due to power uprates that would alter the conclusions reached in the 1996 or 2013 LR GEIS or the Monticello SEIS for initial LR.

F.3.5 Higher Fuel Burnup Information (Section E.3.5 of the 2013 LR GEIS)

According to the 2013 LR GEIS, increased peak fuel burnup from 42 to 75 gigawatt days per metric ton uranium (GWd/MTU) for PWRs, and 60 to 75 GWd/MTU for boiling water reactors, results in small-to-moderate increases (up to 38 percent) in population dose in the event of a severe accident. However, taken in combination with the other information presented in the 2013 LR GEIS, the increases would be bounded by the 95 percent UCB values in Table 5.10 and Table 5.11 of the 1996 LR GEIS.

There has been continued movement toward higher fuel burnup, to allow for more efficient utilization of the fuel and longer operating cycles. The purpose of Section E.3.5 of the 2013 LR GEIS was to account for the effect of current and possible future increased fuel burnup on postulated accidents. Future peak burnups considered were 62 gigawatt days per metric ton uranium GWd/MTU for PWRs and 70 GWd/MTU for boiling water reactors.

As discussed in Section 2.2.1 of the Monticello SLR ER, average peak rod fuel burnup limit for Monticello during the terms of the extended licenses is not expected to exceed 62 GWd/MTU. Therefore, the offsite consequences from higher fuel burnup would not exceed the 70 GWd/MTU consequences predicted in the 2013 LR GEIS. For these issues, the LR GEIS predicted that the probability-weighted consequences would be SMALL for all nuclear power plants. The Monticello SEIS for initial LR reached the same conclusion The NRC staff identified no new and significant information regarding higher fuel burnup during its review of Xcel Energy's ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Monticello concerning offsite consequences due to higher fuel burnup that would alter the conclusions reached in the 2013 LR GEIS. Thus, the staff concludes using plant-specific information that no new and significant information exists for Monticello concerning offsite consequences due to higher fuel burnup that would alter the conclusions reached in the 1996 or 2013 LR GEIS or the Monticello SEIS for initial LR.

F.3.6 Low Power and Reactor Shutdown Event Information (Section E.3.6 of the 2013 LR GEIS)

The 2013 LR GEIS states the environmental impacts from accidents at low power and shutdown conditions are generally comparable to those from accidents at full power when comparing the values in NUREG/CR-6143, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1" (NRC 1995-TN8976), and NUREG/CR-6144, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1" (BNL 1995-TN7776), with the values in NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NRC 1990-TN525). The 2013 LR GEIS further indicates that although the impacts for low power and shutdown conditions could be somewhat greater than for full power (for certain metrics), the 1996 LR GEIS's very conservative estimates of the environmental impact of severe accidents (using 95th UCBs) bound the potential impacts from accidents at low power and shutdown with margin.

Monticello and Grand Gulf are not identically designed plants, but they are both BWRs. Also, Peach Bottom was one of the five plants analyzed in NUREG/CR-1150 (NRC 1990-TN525).

While the Monticello design is not identical to Peach Bottom Atomic Power Station, both are BWRs with MARK I containments. Based on the similarities between Monticello and Peach Bottom and Grand Gulf, the NRC staff finds that the general conclusions regarding plant configurations in low power and shutdown conditions evaluated in the GEIS apply to Monticello as well. Additionally, as discussed in SECY-97-168, existing regulatory controls for shutdown operations have evolved through a series of industry actions that have been successful in achieving an acceptable level of safety for low power and shutdown operation (NRC 1997-TN7621). Therefore, the offsite consequences of severe accidents, considering low power and shutdown events, would not exceed the impacts predicted in either the 1996 or 2013 GEIS. At Monticello, low power and shutdown events are in line with the conclusions in the GEIS. Xcel Energy concludes that no new and significant information exists for Monticello concerning lower power and shutdown events.

Peach Bottom was evaluated in NUREG-1150 and Grand Gulf was evaluated in NUREG/CR-6143 (SNL 1995-TN7783) for low power and reactor shutdown event information. Monticello is a similarly designed nuclear power plant (i.e., they are all boiling water reactors); thus, the NRC staff concludes that there are likely to be no significant nuclear power plant configurations in low power and shutdown conditions likely to distinguish Monticello from the evaluated nuclear power plants. Thus, the staff concludes that the environmental impact of Monticello from accidents at low power and shutdown conditions are generally comparable to the impacts from accidents at full power, which is consistent with the 2013 and 1996 LR GEIS.

Additionally, as discussed in SECY-97-168, “Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation” (NRC 1997-TN7621), industry initiatives taken during the early 1990s have also contributed to the improved safety of low power and shutdown operations for all nuclear power plants. Promulgation of 10 CFR 50.65(a)(4) to require licensees to assess and manage the increase in risk that may result from the proposed maintenance activities and industry’s implementation of NUMARC 93-01 have further enhanced the NRC staff’s ability to oversee licensee activities related to shutdown risk. The NRC staff concludes low power and shutdown risk is effectively managed by NRC required maintenance rule programs, and that, therefore low power and shutdown risk is not expected to challenge the 1996 LR GEIS 95 percent UCB risk metrics during the SLR period.

Therefore, the offsite consequences of severe accidents, considering low power and reactor shutdown events, are in line with the conclusions in the 1996 or 2013 LR GEIS. For these issues, the LR GEIS predicts that the probability-weighted consequences of severe accidents would be SMALL for all nuclear power plants. The NRC staff identified no new and significant information regarding low power and reactor shutdown events during its review of Xcel Energy’s ER, through the NRC staff’s SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Monticello concerning low power and reactor shutdown events that would alter the conclusions reached in the 1996 or 2013 LR GEIS.

F.3.7 Spent Fuel Pool Accident Information (Section E.3.7 of the 2013 LR GEIS)

The 2013 LR GEIS concludes that the environmental impacts from accidents involving SFPs, as quantified in NUREG-1738, “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants” (NRC 2001-TN5235), can be comparable to those from reactor accidents at full power (as estimated in NUREG-1150 (NRC 1990-TN525). The 2013 LR GEIS further indicates that subsequent analyses performed, and mitigative measures employed since 2001, have further lowered the risk of accidents involving SFPs. In addition, the

LR GEIS notes that even the conservative estimates from NUREG-1738 (published in 2001) are much lower than the impacts from full power reactor accidents estimated in the 1996 LR GEIS. Therefore, the LR GEIS concludes, the environmental impacts stated in the 1996 LR GEIS bound the impact from Spent Fuel Pool accidents for all nuclear power plants. For these issues, the LR GEIS predicts that the impacts would be SMALL for all nuclear power plants.

There are no spent fuel configurations that would distinguish Monticello from the evaluated nuclear power plants such that the assumptions in the 2013 and 1996 LR GEIS would not apply. Consistent with NUREG-1738, the impacts of accidents in SFPs at Monticello is comparable to or lower than those from reactor accidents and are bounded by the 1996 LR GEIS. In addition, two orders were issued by the NRC in March 2012, Mitigating Strategies (EA-12-049) and Spent Fuel Pool Instrumentation (EA-12-051). Monticello implemented both of these orders in 2016 and 2017, respectively (NRC 2017-TN9795). Mitigation strategies implemented after September 11, 2001 and diverse and flexible coping strategies, provide additional resources to maintain SFP water inventory and risk reduction. The 2013 LR GEIS (NRC 2013-TN2654) indicates that analyses performed and mitigative measures employed since 2001 have further lowered the risk of accidents involving SFPs. As a result of post-Fukushima Near-Term Task Force 2.1 recommendations, the implementation of diverse and flexible coping strategies provides additional resources to maintain SFP water inventory and risk reduction (NRC 2017-TN9795). The NRC staff identified no new and significant information regarding Spent Fuel Pool accidents during its review of Xcel Energy's ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Monticello concerning Spent Fuel Pool accidents that would alter the conclusions reached in the 1996 or 2013 LR GEIS.

F.3.8 Use of Biological Effects of Ionizing Radiation VII Risk Coefficients (Section E.3.8 of the 2013 LR GEIS)

In 2005, the NRC staff completed a review of the National Academy of Sciences report, "Health Risks from Exposure to Low Levels of Ionizing Radiation: Biological Effects of Ionizing Radiation (BEIR) VII, Phase 2." The NRC staff documented its findings in SECY-05-0202, "Staff Review of the National Academies Study of the Health Risks from Exposure to Low Levels of Ionizing Radiation (BEIR VII)" (NRC 2005-TN4513). The SECY paper states that the NRC staff agrees with the BEIR VII report's major conclusion—namely, the current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold, dose-response relationship between exposure to ionizing radiation and the development of cancer in humans. The BEIR VII conclusion is consistent with the hypothesis on radiation exposure and human cancer that the NRC uses to develop its standards of radiological protection. Therefore, the NRC staff has determined that the conclusions of the BEIR VII report do not warrant any change in the NRC's radiation protection standards and regulations because the NRC's standards are adequately protective of public health and safety and will continue to apply during Monticello's SLR term. This general topic is discussed further in the NRC's 2007 denial of Petition for Rulemaking -51-11 (72 FR 71083-TN7789), in which the NRC stated that it finds no need to modify the 1996 LR GEIS considering the BEIR VII report. For these issues, the LR GEIS predicts that the impacts of using the BEIR VII risk coefficients would be SMALL for all nuclear power plants. Because the Monticello SAMA analysis does not find any SAMAs that reduced the risk metrics by at least 50 percent, no offsite doses are computed as part of a full Level 3 evaluation. Therefore, BEIR VII risk coefficients have no impact on the Monticello SAMA Stage 1 analysis. Further, the plant internal events risk has been reduced by approximately 75 percent since the initial LR review, therefore the impact from consideration of the BIER VII report would be insignificant (Xcel 2023-TN9084).

The NRC staff identified no new and significant information regarding the risk coefficient used in the BEIR VII report during its review of Xcel Energy's ER, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Monticello concerning the biological effects of ionizing radiation that would alter the conclusions reached in the 1996 or 2013 LR GEIS.

F.3.9 Uncertainties (Section E.3.9 of the 2013 LR GEIS)

The 1996 LR GEIS used 95th percent upper-confidence bound estimates whenever available for its estimates of the environmental impacts of severe accidents, which applies conservatism to cover uncertainties (NRC 1996-TN288). The 1996 LR GEIS used a Monticello specific predicted upper-confidence bound total population dose risk value of 730 person-rem/RY (NRC 1996-TN288, Table 5-9). This can be compared to the Monticello initial LR specific population dose risk calculation of 38 person-rem/RY (using internal event CDF only) (NRC 2006-TN7315, Table 5-4). For Monticello, this factor of population dose reduction from newer information is on the order of a factor of 19.

As listed in Table 5.6 of the 1996 LR GEIS, the Monticello predicted total population dose risk of 730 person-rem/RY is in the lower range of predicted population dose risks in the 1996 LR GEIS. These values ranged from the Big Rock Point facility at 48 person-rem/RY to the Indian Point facility at 9727 person-rem/RY. The newer Monticello internal event CDF information accounts for a decrease in CDF by a factor of 3.5. When external events are considered, the regional population dose risk reduction based on Monticello specific newer information is on the order of a factor of 3.2 when compared to the upper bound estimates utilized in the 1996 LR GEIS. When these factors are applied, the net change in risk for Monticello is a reduction by a factor of about 2 (3.5+3.2-4.7 = 2). Further, the decrease in environmental impacts is supported by the SOARCA that found latent cancer fatality risk is reduced by a factor of 3 to 100. (NRC 2013-TN4592) Therefore, The NRC staff concludes that new Monticello SLR information is bounded by the predicted Monticello analysis in the 1996 LR GEIS.

Section 5.3.3 in the 1996 LR GEIS provides a discussion of the uncertainties associated with the analysis in the LR GEIS and in the individual nuclear power plant EISs used to estimate the environmental impacts of severe accidents. The 1996 LR GEIS used 95th percentile upper-confidence bound estimates whenever available for its estimates of the environmental impacts of severe accidents. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 LR GEIS. Many of these same uncertainties also apply to the analysis used in the 2013 LR GEIS update. As discussed in Sections E.3.1 through E.3.8 of the 2013 LR GEIS, the LR GEIS update used more recent information to supplement the estimate of environmental impacts contained in the 1996 LR GEIS. In effect, the assessments contained in Sections E.3.1 through E.3.8 of the 2013 LR GEIS provided additional information and insights into certain areas of uncertainty associated with the 1996 LR GEIS. However, as provided in the 2013 LR GEIS, the impact and magnitude of uncertainties, as estimated in the 1996 LR GEIS, bound the uncertainties introduced by the new information and considerations addressed in the 2013 LR GEIS. Accordingly, in the 2013 LR GEIS, the NRC staff concluded that the reduction in environmental impacts resulting from the use of new information (since the 1996 LR GEIS analysis) outweighs any increases in impact resulting from the new information. As a result, the findings in the 1996 LR GEIS remain valid. The NRC staff identified no new and significant information regarding uncertainties during its review of Xcel Energy's ER, the SAMA audit, the scoping process, or the evaluation of other available information. Accordingly, the

NRC staff concludes that no new and significant information exists for Monticello concerning uncertainties that would alter the conclusions reached in the 1996 or 2013 LR GEIS.

Another consideration for uncertainty is population growth. According to NEI 17-04, Rev. 1, Section 2.1 (NEI 2019-TN6815), population growth is considered new information, but is not necessarily significant for the Stage 1 analysis. For Monticello, detailed population information including population projection information is presented in Section 3.11.1 of the Monticello SLR ER. For the 50 mi (80 km) radius from the plant, the 2020 permanent population was 3,285,866, and the projected 2050 permanent and transient population is 4,387,091. Using an exponential scale, that is a 0.97 percent growth per year or a 21.3 percent growth from the beginning to the end of the 60 to 80 years renewal period. The 2013 LR GEIS indicates that given the range of uncertainty in these types of analyses, a 5 to 30 percent change is not considered significant. The Monticello projected population is within the 30 percent population increase that the 2013 LR GEIS has determined not to be significant. The staff concludes that the overall effect of projected increased population around the nuclear power plant during the SLR period of extended operation does not result in significant increases in impacts. Thus, the staff concludes using plant-specific information that no new and significant information exists for Monticello concerning population increases that would alter the conclusions reached in the 1996 or 2013 LR GEIS.

F.3.10 Summary and Conclusion (Section E.5 of the 2013 LR GEIS)

The 2013 LR GEIS categorizes “sources of new information” by their potential effect on the best-estimate environmental impacts associated with postulated severe accidents. These effects can (1) decrease the environmental impact associated with severe accidents; (2) not affect the environmental impact associated with severe accidents; or (3) increase the environmental impact associated with severe accidents.

No new and significant information regarding Monticello was identified that was above the values previously evaluated in the 1996 LR GEIS. Thus, there was no new and significant information that would significantly increase the environmental impact associated with severe accidents. However, the reduction in risk due to a better understanding of the Monticello source term provided a substantial decrease in the calculated environmental impact (consequences) that was calculated in the 1996 LR GEIS. Given the new and updated information, the reduction in estimated environmental impacts from the use of new internal event and source term information outweighs any increases from the consideration of external events, future power uprates, higher fuel burnup, low power and shutdown risk, and Spent Fuel Pool risk. Thus, the staff concludes that the overall impact of new and significant information regarding Monticello since initial LR continues to be well below the impact previously evaluated in the 1996 GEIS. Therefore, the conclusion in the 1996 LR GEIS and 2013 LR GEIS that “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” is considered appropriate for the Monticello SLR.

Other areas of new information relating to the Monticello severe accident risk, severe accident environmental impact assessment, and cost-beneficial SAMAs are described below. These areas of new information demonstrate additional conservatism in the evaluations in the LR GEIS and Xcel Energy’s ER, because they result in further reductions in the impact of a severe accident.

F.4 Other New Information Related to NRC Efforts to Reduce Severe Accident Risk Following Publication of the 1996 LR GEIS

The Commission has considered and adopted various regulatory requirements for mitigating severe accident risks at reactor sites through a variety of NRC regulatory programs. For example, in 1996, when it promulgated Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," in Appendix B to Subpart A of 10 CFR Part 51 (TN250), "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," the Commission explained in a *Federal Register* notice:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement program…and the Commission has additional ongoing regulatory programs whereby licensees search for individual plant vulnerabilities to severe accidents and consider cost-beneficial improvements (Final rule, "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses," 61 FR 28467-TN4491 [June 5, 1996]).

These "additional ongoing regulatory programs" that the Commission mentioned include the Individual Plant Examination (IPE) and the IPEEE program, which consider "potential improvements to reduce the frequency or consequences of severe accidents on a nuclear power plant-specific basis and essentially constitute a broad search for severe accident mitigation alternatives." Further, in the same rule, the Commission observed that the IPEs "resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents" (61 FR 28481-TN8474) (*Federal Register* notices are accessible and searchable at https://www.federalregister.gov). Based on these and other considerations, the Commission stated its belief that it is "unlikely that any site-specific consideration of SAMAs for LR will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences." The Commission noted that it may review and possibly reclassify the issue of severe accident mitigation as a Category 1 issue upon the conclusion of its IPE/IPEEE program but deemed it appropriate to consider SAMAs for nuclear power plants for which it had not done so previously, pending further rulemaking on this issue.

The Commission reaffirmed its SAMA-related conclusions in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250) and 10 CFR 51.53(c)(3)(ii)(L), "Postconstruction Environmental Reports," in Exelon Generation Co., LLC (Limerick Generating Station, Units 1 and 2), CLI-13-07, (October 31, 2013). In addition, the Commission observed that it had promulgated those regulations because it had "determined that one SAMA analysis would uncover most cost-beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013-TN2654).

The NRC has continued to address severe accident-related issues since the agency published the LR GEIS in 1996. Combined NRC and licensee efforts have reduced risks from accidents beyond those accidents that were considered in the 1996 LR GEIS. The 2013 LR GEIS describes many of those efforts (NRC 2013-TN2654). Each of the regulatory initiatives described in the 2013 GEIS applies to all reactors, including Monticello. These are areas of new information that reinforce the conclusion that the probability-weighted consequences of severe accidents are SMALL for all nuclear power plants, as stated in the 2013 LR GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at Monticello.

F.4.1 Conclusion

In summary, the new regulatory initiatives to reduce severe accident risk described above contribute to safety, as do safety improvements not related to LR, including the NRC and industry response to generic safety issues (NRC 2011-TN7816). Thus, the performance and safety record of nuclear power plants operating in the United States, including Monticello, support the conclusion that the probability-weighted consequences of severe accidents in the SLR period are SMALL (NRC 2013-TN2654).

F.5 Evaluation of New and Significant Information Pertaining to SAMAs Using NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA"

In its evaluation of the significance of new information, the NRC staff considers that new information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicates a given potentially cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or risk of a severe accident occurring (NRC 2013-TN2654).

Xcel Energy stated in its ER, that it used the methodology in NEI 17-04 Revision 1, "Model SLR New and Significant Assessment Approach for SAMA," (NEI 2019-TN6815) to evaluate new and significant information as it relates to the Monticello SLR SAMAs. By letter dated December 11, 2019, the staff reviewed NEI 17-04 and found it acceptable for interim use, pending formal NRC endorsement of NEI 17-04 by incorporation in RG 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications" (NRC 2019-TN7805). In general, as discussed earlier, the NEI 17-04 methodology (NEI 2017-TN8338) does not consider a potential SAMA to be significant unless it reduces by at least 50 percent the maximum benefit as defined in Section 4.5, "Total Cost of Severe Accident Risk/Maximum Benefit," of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document." NEI 05-01 is endorsed in NRC RG 4.2, Supplement 1 (NRC 2013-TN2654).

NEI 17-04 describes a three-stage process for determining whether there is any new and significant information relevant to a previous SAMA analysis.

- **Stage 1**: The SLR applicant uses PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with: (1) all unimplemented "Phase 2" SAMAs for the analyzed nuclear power plant; and (2) those SAMAs identified as potentially cost-beneficial for other nuclear power plants in the United States and those applicable to the analyzed nuclear power plant. If one or more of those SAMAs are shown to reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 2. (Applicants that demonstrate that there is no potentially significant new information through the Stage 1 screening process are not required to perform the Stage 2 or Stage 3 assessments.)

- **Stage 2**: The SLR applicant develops updated averted cost-risk estimates for implementing those SAMAs. If the Stage 2 assessment confirms that one or more SAMAs reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 3.
- **Stage 3**: The SLR applicant performs a cost-benefit analysis for the "potentially significant" SAMAs identified in Stage 2.

Upon completion of the Stage 1 screening process, Xcel Energy determined that there is no potentially significant new information affecting its Monticello SAMA analysis; thus, Xcel Energy did not perform the Stage 2 or Stage 3 assessments. The following sections summarize Xcel Energy's application of the NEI 17-04 methodology to Monticello SAMAs.

F.5.1 Data Collection

NEI 17-04 Section 3.1, "Data Collection," explains that the initial step of the assessment process is to identify the "new information" relevant to the SAMA analysis and to collect and develop those elements of information that will be used to support the assessment. The guidance document states that each applicant should collect, develop, and document the information elements corresponding to the stage or stages of the SAMA analysis performed for the site. For Monticello SLR, the NRC staff reviewed the onsite information during an audit at NRC headquarters and determined that Xcel Energy had considered the appropriate information (NRC 2023-TN9723).

F.5.2 Stage 1 Assessment

Section E4.15.3, "Methodology for Evaluation of New and Significant SAMAs," of Xcel Energy's SLR ER describes the process it used to identify any potentially new and significant SAMAs from the Monticello SAMA analysis (Xcel 2023-TN9084). In Stage 1 of the process, Xcel Energy used PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with the following two types of SAMAs:

4. all unimplemented "Phase 2" SAMAs for Monticello
5. those SAMAs identified as potentially cost-beneficial for other U.S. nuclear power plants and that are applicable to Monticello (Xcel 2023-TN9084)

F.5.3 Xcel Energy's Evaluation of Unimplemented Monticello "Phase 2" SAMAs

As part of the SLR ER, Xcel Energy examined its initial LR SAMA analysis and the Monticello PRA again, for insights. The purpose was to determine if there is any new and significant information regarding the SAMA analyses that were performed to support issuance of the initial renewed operating licenses for Monticello. Xcel Energy reevaluated the 16 SAMAs that were considered "Phase 2" in connection with initial LR, using the NEI 17--04 process. The conclusion of the Monticello analysis was that six of the proposed SAMAs were cost-beneficial and were implemented at Monticello, and 10 SAMAs were not cost-beneficial at that time but remain for further evaluation in the SLR.

If any of the SAMAs were found to reduce the total CDF, or at least one consequential source term category frequency by at least 50 percent, then the SAMA was retained for a Stage 2 assessment (Level 3 PRA evaluation of the reduction in maximum benefit). As discussed below, all SAMAs were screened and found to be not significant without the need to go to the Stage 2 assessment or PRA Level 3 evaluation.

The list of SAMAs collected was evaluated qualitatively to screen any that are not applicable to Monticello or that already exist at Monticello. The remaining SAMAs were then grouped (if similar) based on similarities in mitigation equipment or risk reduction benefits, and all were evaluated for the impact they have on the Monticello CDF and source term category frequencies if implemented.

F.5.4 Xcel Energy's Evaluation of SAMAs Identified as Potentially Cost-Beneficial at Other U.S. Nuclear Power Plants and Which Are Applicable to Monticello

The 2013 LR GEIS considered the nuclear power plant-specific supplemental EISs that document potential environmental impacts and mitigation measures for severe accidents relevant to LR for each nuclear power plant. Some of these nuclear power plant-specific supplements had identified potentially cost-beneficial SAMAs. Xcel Energy reviewed the SEISs of nuclear power plants with a similar design to Monticello. A total of 129 industry SAMAs were collected from the 1996 LR GEIS supplements for each BWR site, of which all but 49 were qualitatively screened using the criteria discussed in Section 4.15.3.1 of the Monticello SLR ER. In addition, 10 Monticello specific SAMAs were collected for evaluation in the SLR, of which one was screened. Table 4.15-1 of the Monticello SLR ER presents the 58 SAMAs that were not qualitatively screened. A total of 21 SAMA groups were identified for quantitative screening evaluation. The current Monticello PRA models (internal events plus flooding and fire PRA models) were used in the quantitative evaluation of maximum benefit to determine the level of significance of new information.

Table 4.15-2 of the Monticello SLR ER presents the quantitative screening results from the bounding SAMA evaluations. As seen in Table 4.15-2, none of the bounding quantitative screening evaluations result in a reduction of total CDF, total LERF, or total Large Late Release Frequency (LLRF) greater than 50 percent. The staff noted that in some cases, some measures (e.g., internal flooding LERF) yield an individual reduction greater than 50 percent, but when combined with the other hazards, no SAMA results in a collective CDF or significant source term category group frequency (LERF) reduction of greater than 50 percent. None of the SAMAs considered for quantitative evaluation would reduce the Monticello maximum benefit by 50 percent or greater.

The NRC staff reviewed Monticello's onsite information and its SAMA Stage 1 process during an in-office audit at NRC headquarters (NRC 2023-TN9794). The staff found that Xcel Energy had used a methodical and reasonable approach to identify any SAMAs that might reduce the maximum benefit by at least 50 percent and therefore could be considered potentially significant. Therefore, the NRC staff finds that Xcel Energy's conclusion is in accordance with the NEI 17-04 guidance, and that it did not need to conduct a Stage 2 assessment. Thus, the NRC staff finds that there is no new and significant information that would alter the conclusions of the Monticello SAMA analysis during the SLR period.

F.5.5 Other New Information

As discussed in Xcel Energy's SLR application ER and in NEI 17-04, there are some inputs to the SAMA analysis that are expected to change, or to potentially change, for all nuclear power plants. Examples of these inputs include the following:

- updated Level 3 PRA model consequence results, which may be impacted by multiple inputs, including, but not limited to, the following:
  - population, as projected within a 50 mi (80 km) radius of the nuclear power plant

- value of farm and nonfarm wealth
- core inventory (e.g., due to power uprate)
- evacuation timing and speed
- Level 3 PRA methodology updates
- cost-benefit methodology updates

In addition, other changes that could be considered new information may be dependent on nuclear power plant activities or site-specific changes. These types of changes (listed in NEI 17-04) include the following:

- identification of a new hazard (e.g., a fault that was not previously analyzed in the seismic analysis)
- updated nuclear power plant risk model (e.g., a fire PRA that replaces the IPEEE analysis)
- impacts of nuclear power plant changes that are included in the nuclear power plant risk models will be reflected in the model results and do not need to be assessed separately
- nonmodeled modifications to the nuclear power plant
- modifications determined to have no risk impact need not be included (e.g., replacement of the condenser vacuum pumps), unless they impact a specific input to SAMA (e.g., new low-pressure turbine in the power conversion system that results in a greater net electrical output)

F.5.6 Conclusion

The NRC staff reviewed Xcel Energy's new and significant information analysis for severe accidents and SAMAs at Monticello during the SLR period and finds Xcel Energy's analysis and methods to be reasonable. As described above, Xcel Energy evaluated a total of 139 SAMAs for Monticello SLR and did not find any SAMAs that would reduce the maximum benefit by 50 percent or more. The NRC staff reviewed Xcel Energy's evaluation and concludes that Xcel Energy's methods and results were reasonable. Based on Monticello's Stage 1 qualitative and quantitative screening results, Xcel Energy demonstrated that none of the nuclear power plant-specific and industry SAMAs that it had considered constitute new and significant information that could change the conclusion of Monticello's previous SAMA analysis. Further, the NRC staff did not otherwise identify any new and significant information that would alter the conclusions reached in the previous SAMA analysis for Monticello. Therefore, the NRC staff concludes that there is no new and significant information that would alter the conclusions of the SAMA analysis performed for Monticello's initial LR.

In addition, given the low residual risk at Monticello, the decrease in internal event CDF at Monticello from the previous SAMA analysis, and the fact that no potentially cost-beneficial SAMAs were identified during Monticello's initial LR review, the staff considers it unlikely that Xcel Energy would have found any potentially cost-beneficial SAMAs for SLR. Further, the robust NRC regulatory actions, as well as the conservative assumptions used in earlier severe accident studies and SAMA analyses, also make it unlikely that Xcel Energy would have found any potentially significant cost-beneficial SAMAs during its SLR review. For all the reasons stated above, the NRC staff concludes that Xcel Energy reached reasonable SAMA conclusions in its SLR ER and that there is no new and significant information regarding any potentially cost-beneficial SAMA that would substantially reduce the risks of a severe accident at Monticello.

F.6 References

Note: All NUREG reports listed in Appendix F are available electronically from the NRC's public website found at https://www.nrc.gov/reading-rm/doc-collections/nuregs/index.html. From this site, the public can gain access to NRC's collection of technical reports by using the technical report numbers (e.g., NUREG-xxxx or NUREG/CR-xxxx).

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APPENDIX G

ENVIRONMENTAL ISSUES AND IMPACT FINDINGS CONTAINED IN THE PROPOSED RULE, 10 CFR PART 51, "ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS"

The U.S. Nuclear Regulatory Commission (NRC, the Commission) staff prepared this site-specific environmental impact statement (EIS) to evaluate the environmental impacts of subsequent license renewal (SLR) for the Monticello Nuclear Generating Plant Unit 1 (Monticello) by Xcel Energy. The NRC staff prepared the site-specific EIS in accordance with the Commission's decisions in Commission Legal Issuance (CLI) CLI-22-03 (TN9844) and CLI-22-02 (TN8182), both dated February 24, 2022. In those decisions, the Commission noted that it was directing the NRC staff to initiate rulemaking to revise the License Renewal Generic Environmental Impact Statement (LR GEIS) and the regulations in 10 CFR Part 51 (TN250) to address the environmental impacts of SLR. The Commission afforded SLR applicants an opportunity to await the issuance of a revised LR GEIS or to seek SLR based upon a site-specific evaluation of the environmental impacts of SLR for their plants.

In its SLR application, Xcel Energy submitted an environmental report that provides site-specific information concerning the environmental impacts of SLR for Monticello. Accordingly, in this draft EIS, the NRC staff presents a site-specific evaluation of the environmental impacts of SLR for Monticello. This draft EIS evaluates, on a site-specific basis, each of the environmental issues that were dispositioned as Category 1 issues (i.e., generic to all or a distinct subset of nuclear power plants) in the 2013 LR GEIS that are applicable to Monticello, as well as an evaluation of all the site-specific (Category 2) issues that are applicable to Monticello.

On March 3, 2023, the NRC published a proposed rule (88 FR 13329-TN8601) proposing to amend its environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250). Specifically, the proposed rule would update the NRC's 2013 findings concerning the environmental impacts of renewing the operating license of a nuclear power plant. The technical basis for the proposed rule would be provided by Revision 2 to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the draft 2023 LR GEIS; NRC 2023-TN7802), which would update NUREG-1437, Revision 1 (the 2013 LR GEIS NRC 2013-TN2654); the 2013 LR GEIS, in turn, was an update of NUREG-1437, Revision 0 (the 1996 LR GEIS; NRC 1996-TN288). The 2023 final LR GEIS (NRC 2023-TN7802) supports the proposed revised list of issues under the National Environmental Policy Act of 1969, as amended, and the associated environmental impact findings listed in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250). The 2023 LR GEIS and proposed rule (NRC 2023-TN7802) reflect the lessons learned and knowledge gained from the NRC staff's conduct of environmental reviews for initial license reviewal (LR) and SLR since 2013.

The 2023 proposed rule would redefine the number and scope of the environmental issues that must be addressed by the NRC during LR and SLR environmental reviews. The proposed rule identifies 80 environmental impact issues, 20 of which would require plant-specific analyses. The proposed rule would reclassify some previously site-specific (Category 2) issues as generic (Category 1) issues and would consolidate other issues. It would also add new Category 1 and

Category 2 issues to Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250). These proposed changes are summarized as follows.

- One Category 2 issue, “Groundwater quality degradation (cooling ponds at inland sites),” and a related Category 1 issue, “Groundwater quality degradation (cooling ponds in salt marshes),” would be consolidated into a single Category 2 issue, “Groundwater quality degradation (plants with cooling ponds).”
- Two related Category 1 issues, “Infrequently reported thermal impacts (all plants)” and “Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication,” and the thermal effluent component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” would be consolidated into a single Category 1 issue, “Infrequently reported effects of thermal effluents.”
- One Category 2 issue, “Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” would be consolidated into a single Category 2 issue, “Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).”
- One Category 1 issue, “Impingement and entrainment of aquatic organisms (plants with cooling towers),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” would be consolidated into a single Category 1 issue, “Impingement mortality and entrainment of aquatic organisms (plants with cooling towers).”
- One Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” would be divided into three Category 2 issues: (1) “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction,” (2) “Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction,” and (3) “Magnuson–Stevens Act: essential fish habitat.”
- Two new Category 2 issues, “National Marine Sanctuaries Act: sanctuary resources” and “Climate change impacts on environmental resources,” would be added.
- One Category 2 issue, “Severe accidents,” would be changed to a Category 1 issue.
- One new Category 1 issue, “Greenhouse gas impacts on climate change,” would be added.
- Several issue titles and findings would be revised to clarify their intended meanings.

Finalization and publication of the 2023 draft LR GEIS and the proposed rule (NRC 2023-TN7802) are expected to occur in or about August 2024. Upon being finalized, under the NRC’s environmental protection regulations, the NRC staff would have to consider and analyze in its LR and SLR environmental reviews the potential significant impacts associated with the new Category 2 issues and, to the extent that there is any new and significant information, the potential significant impacts associated with the new Category 1 issues. To account for the proposed rule and 2023 draft LR GEIS, and the possibility of their finalization in 2024, the NRC staff analyzes in this appendix, on a site-specific basis, the new and revised environmental issues as they may apply to the SLR for Monticello. Table G-1 lists the new and revised environmental issues that would apply to Monticello SLR. The sections that follow discuss how the NRC staff addressed each of these new and revised issues in this site-specific EIS and explain how this EIS covers the issues in the proposed rule and the 2023 draft LR GEIS.

Table G-1 New and Revised 10 CFR Part 51 License Renewal Environmental Issues

Issue	2023 Draft LR GEIS Section	Category
Infrequently reported effects of thermal effluents	4.6.1.2	1
Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	2
Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction	4.6.1.3.1	2
Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction	4.6.1.3.2	2
Magnuson–Stevens Act: essential fish habitat	4.6.1.3.3	2
National Marine Sanctuaries Act: sanctuary resources	4.6.1.3.4	2
Severe accidents	4.9.1.2.1	1
Greenhouse gas impacts on climate change	4.12.1	1
Climate change impacts on environmental resources	4.12.3	2

CFR = *Code of Federal Regulations*; LR GEIS = License Renewal Generic Environmental Impact Statement.
Source: 10 CFR Part 51-TN250; 2023 LR GEIS (NRC 2023-TN7802).

G.1 Infrequently Reported Effects of Thermal Effluents

The proposed rule proposes to combine two Category 1 issues, “Infrequently reported thermal impacts (all plants)” and “Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication,” and the thermal effluent component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” into one Category 1 issue, “Infrequently reported effects of thermal effluents.” This issue pertains to the interrelated and infrequently reported effects of thermal effluents, including cold shock, thermal migration barriers, the accelerated maturation of aquatic insects, and the proliferated growth of aquatic nuisance species, as well as the effects of thermal effluents on dissolved oxygen, gas supersaturation, and eutrophication. This issue also considers the sublethal stresses associated with thermal effluents that can increase the susceptibility of exposed organisms to predation, parasitism, or disease. These changes do not introduce any new environmental issues; rather, the proposed rule would reorganize existing issues. The changes are fully summarized and explained in Section 4.6.1.2 of the 2023 draft LR GEIS and in the proposed rule (NRC 2023-TN7802).

Section 3.7.3 of this EIS analyzes infrequently reported effects of thermal effluents for Monticello SLR and concludes that the impacts would be SMALL. Thus, the environmental issue of infrequently reported effects of thermal effluents is addressed in this site-specific EIS.

G.2 Impingement Mortality and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

The proposed rule proposes to combine the Category 2 issue, “Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” into one Category 2 issue, “Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).” This issue pertains to the impingement mortality and entrainment of finfish and shellfish at nuclear power plants with once-through cooling systems and cooling ponds during the LR term (either initial LR or SLR). This includes plants with helper cooling towers that are seasonally operated to reduce the thermal load to the receiving waterbody, reduce entrainment during peak spawning periods, or reduce consumptive water use during periods of low river flow.

In the 2023 draft LR GEIS (NRC 2023-TN7802), the NRC renamed this issue to specify impingement mortality, rather than simply impingement. This change is consistent with the U.S. Environmental Protection Agency (EPA) 2014 Clean Water Act Section 316(b) (TN662) regulations and the EPA’s assessment that impingement reduction technology is available and feasible and has been demonstrated to be effective. Additionally, the EPA 2014 Clean Water Act Section 316(b) regulations establish best technology available standards for impingement mortality based on the fact that survival is a more appropriate metric for determining environmental impact rather than simply looking at total impingement. Therefore, the 2023 draft LR GEIS (NRC 2023-TN7802) also consolidates the impingement component of the “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses” issue for plants with once-through cooling systems or cooling ponds into this issue.

Section 3.7.2.1 of this EIS analyzes the impacts of impingement and entrainment for Monticello SLR. The analysis considers the components of the proposed revision to this issue, impingement mortality, and the impingement component of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. In this section, the NRC staff concludes that impingement and entrainment during the SLR term on the aquatic organisms would be of SMALL significance. Thus, the environmental issue of impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) is addressed in this EIS.

G.3 Endangered Species Act: Federally Listed Species and Critical Habitats under U.S. Fish and Wildlife Jurisdiction

The proposed rule proposes to divide the Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” into three separate Category 2 issues for clarity and consistency with the separate Federal statues and interagency consultation requirements that the NRC must consider with respect to federally protected ecological resources. When combined, however, the scope of the three issues is the same as the scope of the former “Threatened, endangered, and protected species and essential fish habitat” issue discussed in the 2013 LR GEIS (NRC 2013-TN2654).

The first of the three issues, “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction,” concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on federally listed species and critical habitats protected under the Endangered Species Act (TN1010) and under the jurisdiction of the U.S. Fish and Wildlife Service.

Sections 3.8.1 and 3.8.3 of this EIS address the impacts of Monticello SLR on federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction. The NRC staff determined that Monticello SLR may affect but is not likely to adversely affect the northern long-eared bat, tricolored bat, whooping crane, and monarch butterfly. Appendix C.1 describes the staff’s Endangered Species Act consultation with the U.S. Fish and Wildlife Service. Thus, the environmental issue of “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction” is addressed in this EIS.

G.4 Endangered Species Act: Federally Listed Species and Critical Habitats under National Marine Fisheries Service Jurisdiction

As explained in the previous section, the proposed rule proposes to divide the Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” into three separate Category 2 issues. The second of the three issues, “Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction,” concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on federally listed species and critical habitats protected under the Endangered Species Act and under the jurisdiction of the National Marine Fisheries Service.

Sections 3.8.1 and 3.8.3 of this EIS find that no federally listed species or critical habitats under NMFS jurisdiction occur within the action area. Accordingly, the NRC staff concluded that the proposed action would have no effect on federally listed species or habitats under this agency’s jurisdiction. Therefore, the environmental issue of “Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction” is addressed in this EIS.

G.5 Magnuson–Stevens Act: Essential Fish Habitat

As explained above, the proposed rule proposes to divide the Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” into three separate Category 2 issues. The third of the three issues, “Magnuson–Stevens Act: essential fish habitat,” concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on essential fish habitat protected under the Magnuson–Stevens Act (TN7841).

Sections 3.8.2 and 3.8.4.4 of this EIS find that no essential fish habitat occurs within the affected area. Accordingly, the NRC staff concluded that the proposed action would have no effect on essential fish habitat. Therefore, the environmental issue of “Magnuson-Stevens Act: essential fish habitat” is addressed in this EIS.

G.6 National Marine Sanctuaries Act: Sanctuary Resources

The proposed rule proposes to add a new Category 2 issue, “National Marine Sanctuaries Act: sanctuary resources,” to evaluate the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on sanctuary resources protected under the National Marine Sanctuaries Act (16 U.S.C. § 1431 et seq.- TN7197).

Under the National Marine Sanctuaries Act, the National Oceanic and Atmospheric Administration’s Office of National Marine Sanctuaries designates and manages the National Marine Sanctuary System. Marine sanctuaries may occur near nuclear power plants located on or near marine waters as well as the Great Lakes.

Sections 3.8.3 and 3.8.4.5 of this EIS find that no national marine sanctuaries occur within the affected area. Accordingly, the NRC staff concluded that the proposed action would have no effect on sanctuary resources. Therefore, the environmental issue of “National Marine Sanctuaries Act: sanctuary resources” is addressed in this EIS.

G.7 Severe Accidents

With respect to postulated accidents, the proposed rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by reclassifying the Category 2 "Severe accidents" issue as a Category 1 issue. In the 2013 LR GEIS (NRC 2013-TN2654), the issue of severe accidents was classified as a Category 2 issue to the extent that only alternatives to mitigate severe accidents must be considered for all nuclear power plants where the licensee had not previously performed a severe accident mitigation alternative (SAMA) analysis for the plant. In the 2023 draft LR GEIS (NRC 2023-TN7802), this issue is to be resolved generically for the vast majority, if not all, expected LR applicants because the applicants who will likely reference the LR GEIS have previously completed an SAMA analysis.

As discussed in Appendix F of this EIS, an analysis of SAMAs was performed for Monticello and evaluated by the NRC staff at the time of initial license renewal (NRC 2006-TN7315). In Section 3.11.6.9 and Appendix F of this EIS, the NRC staff evaluated the significance of any new information related to the plant-specific SAMA analysis. Therefore, the environmental issue of severe accidents is addressed in this site-specific EIS.

G.8 Greenhouse Gas Impacts on Climate Change

With respect to greenhouse gas (GHG) emissions and climate change, the proposed rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding a new Category 1 issue "Greenhouse gas impacts on climate change." This new issue has an impact level of SMALL. This new issue considers GHG impacts on climate change from the routine operations of nuclear power plants and construction vehicles and other motorized equipment used during refurbishment activities. GHG emissions from the routine operations of nuclear power plants are typically very minor because such plants, by their very nature, do not normally combust fossil fuels to generate electricity. However, nuclear power plant operations do have some GHG emission sources, including diesel generators, pumps, diesel engines, boilers, refrigeration systems, and electrical transmission and distribution systems, as well as mobile sources (e.g., worker vehicles and delivery vehicles). GHG emissions from construction vehicles and other motorized equipment for refurbishment activities would be intermittent and temporary, restricted to the refurbishment period. GHG emissions from continued operations and refurbishment activities are minor.

The issue of GHG impacts on climate change associated with nuclear power plant operations was not identified as either a generic or plant-specific issue in the 1996 LR GEIS (NRC 1996-TN288) or the 2013 LR GEIS (NRC 2013-TN2654). In the 2013 LR GEIS, however, the NRC staff presented the GHG emission factors associated with the nuclear power life cycle. Following the issuance of CLI-09-21 (NRC 2009-TN6406), the NRC staff began to evaluate the effects of GHG emissions in plant-specific environmental reviews for LR and SLR applications. Accordingly, Section 3.14.3 of this EIS evaluates the GHG emissions associated with the operation of Monticello during the SLR term. Table 3-32 of this EIS presents the quantified annual GHG emissions from direct and indirect sources at Monticello for the 2017–2021 time period. Monticello's direct GHG emissions result from onsite combustion sources, and indirect GHG emissions include those from workforce commuting.

Xcel Energy has no plans to conduct major refurbishment during the Monticello SLR term, and therefore, no GHG emissions from refurbishment or increases in GHG emissions from routine operations at Monticello are anticipated. The NRC staff concludes that there would be no impacts on climate change beyond the impacts discussed in the 2023 draft LR GEIS (NRC

2023-TN7802) and in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 of the proposed rule (88 FR 13329-TN8601). Based on this information, the NRC staff concludes that GHG impacts on climate change for Monticello during the SLR term are SMALL. Therefore, the environmental issue of GHG impacts on climate change is addressed in this site-specific EIS.

G.9 Climate Change Impacts on Environmental Resources

With respect to climate change, the proposed rule proposes to amend Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding the new Category 2 issue "Climate change impacts on environmental resources." This new issue considers the additive effects of climate change on environmental resources that may also be directly affected by continued operations and refurbishment during the SLR term. The effects of climate change can vary regionally, and climate change information at the regional and local scales is necessary to assess trends and the impacts on the human environment for a specific location. The impacts of climate change on environmental resources during the LR term are location-specific and cannot be evaluated generically.

The issue of climate change impacts was not identified as either a generic or plant-specific issue in the 1996 LR GEIS (NRC 1996-TN288) or the 2013 LR GEIS (NRC 2013-TN2654). However, the 2013 draft LR GEIS described the environmental impacts that could occur on resources areas (air quality, water resources, etc.) that may also be affected by LR. In plant-specific initial LR and SLR environmental reviews prepared since issuance of the 2013 LR GEIS, the NRC staff has considered the projected differences in climate changes in the United States and the climate change impacts on the resource areas that could be incrementally affected by the proposed action as part of its cumulative impacts analysis. Accordingly, Section 3.14.3 of this site-specific EIS discusses the observed changes in climate and the potential future climate change across the Midwest region of the United States during the Monticello SLR term based on climate model simulations under future global GHG emission scenarios. The NRC staff considered regional projected climate changes from numerous climate assessment reports and data, including the U.S. Global Change Research Program (USGCRP 2009-TN18, USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847, USGCRP 2023-TN9762), the Intergovernmental Panel on Climate Change (IPCC 2000-TN7652, IPCC 2007-TN7421, IPCC 2013-TN7434, IPCC 2021-TN7435, IPCC 2023-TN8557), and the Minnesota Climate Mapping and Analysis Tool (CliMAT) (Liess et al. 2023-TN9684). Furthermore, in Section 3.14.3 of this EIS, the NRC staff evaluated the impacts from climate change on environmental resources (e.g., air quality and water resources) where there are incremental affected impacts due to Monticello by the proposed action (SLR). Therefore, this issue, "Climate change impacts on environmental resources," has been addressed in this EIS.

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NRC FORM 335 (12-2010) NRCMD 3.7 U.S. NUCLEAR REGULATORY COMMISSION **BIBLIOGRAPHIC DATA SHEET** *(See instructions on the reverse)*	1. REPORT NUMBER **(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)** NUREG-1437 Supplement 26 Second Renewal
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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

The U.S. Nuclear Regulatory Commission (NRC) prepared this site-specific environmental impact statement (EIS) as part of its environmental review of Xcel Energy’s request to renew the operating license for Monticello Nuclear Generating Plant, Unit 1 (Monticello) for an additional 20 years. This EIS includes the site-specific evaluation of the environmental impacts of the proposed action (Monticello subsequent license renewal [SLR]), and alternatives to SLR. As alternatives, the NRC considered: (1) natural gas and renewables; (2) renewables and storage; (3) new nuclear small modular reactors, and (4) the no-action alternative. Based on its evaluation of environmental impacts, the NRC staff’s preliminary recommendation is that the adverse environmental impacts of Monticello SLR are not so great that preserving the option of SLR for energy planning decisionmakers would be unreasonable. The NRC staff based its preliminary recommendation of the following (1) Xcel Energy’s environmental report, (2) consultation with Federal, State, Tribal, and local governmental agencies, (3) the NRC staff’s independent environmental review, (4) the consideration of public comments received during the scoping periods.

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Site-Specific Environmental Impact Statement for License Renewal of Nuclear Plants
Supplement 26, Second Renewal Regarding Subsequent License Renewal for
Monticello Nuclear Generating Plant, Unit 1

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