(see Section 9.2.2) and that extending the life of existing generating plants would not be a reasonable alternative to the proposed action.

Similar to older operating plants, retired generating plants, predominantly coal-fired and natural-gas-fired plants that could be reactivated, would ordinarily require extensive refurbishment prior to reactivation. Such plants would typically be old enough that refurbishment would be very costly, and the refurbished plants would likely be viewed as new sources, subject to the current-day complement of regulatory controls on air emissions and waste management. The environmental impacts of any reactivation scenario would be bounded by the impacts associated with coal-fired and natural-gas-fired alternatives (see Section 9.2.2). The staff concludes that reactivating retired generating plants would not be a reasonable alternative to the proposed action.

Detroit Edison already offers several conservation and DSM programs to its customers to reduce peak electricity demands and daily power consumption. In its Renewable Energy and Energy Optimization filings to the Michigan Public Service Commission (MPSC) in March 2009 (MPSC Case U-15806-EO and Case U-15806-RPS, respectively), Detroit Edison summarized its energy optimization plan and renewable energy plan and demonstrated both plans' conformance with the relevant MPSC Temporary Order (MPSC Case 15800) implementing State law. MPSC approved both the renewable energy plan and the energy optimization plan in an order issued June 2, 2009, but required Detroit Edison to amend certain portions of its plan after consultation with MPSC staff (MPSC Order in Case U-15806). Orders subsequently issued on August 25 and September 29, 2009, approved amended portions of the initially filed plans.[(a)]

Based on the preceding discussion, as well as on information and discussions provided in the need for power analysis in Chapter 8, the review team concludes that the options of purchasing electric power from other suppliers, reactivating retired power plants, extending the operating life of existing power plants, and implementing conservation and DSM programs are not reasonable or sufficient alternatives in and of themselves to providing new baseload power generation in the amounts represented in the proposed project or amounts sufficient to satisfy projected future power needs.

9.2.2 Alternatives Requiring New Generating Capacity

This section discusses the environmental impacts of energy alternatives to the proposed action that would require Detroit Edison to build new generating capacity. Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In its *Annual Energy Outlook 2010, With Projections to 2035*

(a) All related electronic filings to the MPSC as well as MPSC orders can be accessed at http://efile.mpsc.state.mi.us/efile/viewcase.php?casenum=15806&submit.x=21&submit.y=16.

(DOE/EIA 2010c), the EIA reference case projects that electricity demand will increase by 30 percent from 3873 billion kWh in 2008 to 5021 billion kWh in 2035. Based on the assumption that no greenhouse gas (GHG) emission regulations are in place, while coal still represents the largest percentage among generating technologies, its share would drop from 48 percent in 2008 to 44 percent in 2035. The natural gas share is expected to fall in the near term but then steadily rise, so that over the period 2008 to 2035, it remains essentially constant at 21 percent. Although generation from nuclear actually increases, its share falls from 20 percent in 2008 to 17 percent in 2035. Finally, renewable generation technologies are projected to enjoy the largest growth, from 9 percent in 2008 to 17 percent in 2035. However, the capacity factors of key renewable energy sources (e.g., wind and solar) are too low to satisfy a need for baseload power when acting separately as discrete alternative technologies.

In keeping with the NRC's evaluation of alternatives to operating license renewal for nuclear power plants, a reasonable set of energy alternatives to the construction and operation of a new nuclear unit at the Fermi site should be limited to an analysis of discrete power generation sources and those power generation technologies that are technically reasonable and commercially viable (NRC 1996). In 2009, total net generation of electricity in Michigan (from industrial and commercial generation sources) was 101,202,605 MWh (DOE/EIA 2011b). Of the in-state generation amount, 82,787,341 MWh (81.8 percent) was produced in the Electric Power Sector (DOE/EIA 2011b). Coal is the predominant fuel for production of electricity in Michigan. The energy sources and their contributions to electricity produced in Michigan in 2009 include: coal (66,847,683 MWh, 66 percent), nuclear (21,851,009 MWh, 22 percent), natural gas (8,419,551 MWh, 8.3 percent), hydroelectric (1,371,926 MWh, 1.4 percent), and petroleum (399,249 MWh, 0.4 percent).[(a)] Other renewable sources (other than large hydroelectric), including biomass (municipal solid waste, wood wastes, and agricultural products), geothermal, solar thermal, or solar photovoltaic, accounted for only 2,623,184 MWh of power, 2.6 percent. The three primary energy sources for generating electric power in the United States in 2009 and their relative percentages were coal (44 percent), natural gas (23 percent), and nuclear energy (20 percent) (DOE/EIA 2011a).

For both the United States and Michigan, the three primary energy sources for generating electric power are coal, nuclear, and natural gas. It is reasonable to assume that these same energy sources would be the most viable discrete alternatives to the proposed introduction of baseload power that would be produced by Fermi 3. The discussion in Section 9.2.2 is therefore limited to coal and natural gas, which the review team considers to be viable discrete alternatives to the proposed Fermi 3 reactor.

The review team assumed that new coal-fired or natural-gas-fired alternative generation capacity would be located on the Fermi site and that Lake Erie would provide water for the steam cycle, for steam condensate heat rejection in a wet closed cycle cooling system using a

(a) Totals do not equal 100 percent due to independent rounding.

natural draft cooling tower (NCDT), and for ancillary industrial applications. The review team also assumed that the same transmission infrastructure planned to support Fermi 3 would also serve the coal-fired or natural-gas-fired alternatives with no substantive modifications to either technical parameters or route.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired generation alternative, the review team assumed construction and operation of supercritical pulverized coal (SCPC) units with a net electricity generation equivalent to Fermi 3. The review team also assumed that new transmission lines would be needed to deliver power from the alternative coal-fired plant and that these lines would be identical in both capacity and location to the lines being proposed to support Fermi 3. The coal plant is assumed to have an operating life of 60 years.

The review team also investigated an integrated gasification combined cycle (IGCC) coal-fired plant. IGCC is an emerging technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. However, IGCC plants are expensive to build and operate, and the technology continues to be plagued by reliability problems, relatively high parasitic loads (primarily associated with operation of the gasifiers), and low-capacity factors. Therefore the review team determined that, at this time, IGCC is unsuitable as a baseload power alternative.

Finally, the review team also considered fluidized bed designs for the coal-burning alternative. However, while fluidized beds are the technology of choice for fuels that are difficult to burn or that have great variability in critical parameters, wall-fired pulverized coal boilers are the preferred technological approach for combustion of bituminous and subbituminous coals. Because Detroit Edison already has the infrastructure in place to receive, handle, and distribute substantial quantities of subbituminous coals and lesser but still significant amounts of bituminous coals for burning in its existing coal-fired units, these are coals likely to be used for a coal-fired alternative built at the Fermi site, thus favoring pulverized coal boiler technology. Finally, fluidized bed boilers are available in much smaller sizes than pulverized coal boilers, making them less attractive for baseload units.

Various sizes of pulverized coal boilers and steam turbine generators (STGs) are available; however, the review team recognizes that no single boiler/STG combination could match the net electrical generation capacity of the proposed Fermi 3 reactor. Clearly, multiple units would be required. To complete this analysis, the review team has elected not to specify the number or discrete sizes of the coal-fired units that could collectively serve as an alternative, but instead presumes that all units, regardless of size, would have the same features, operate at generally the same conditions, affect the environment to an extent proportional to their power capacity, and be equipped with the same pollution control devices, such that once all parasitic loads are

overcome, the net power collectively produced would be equivalent to the power expected from a nuclear reactor with a nameplate rating of 1535 MW(e) net (1605 MW(e) gross).

Current regulations require that these coal-fired generating units be fitted with pollution control equipment to control criteria pollutants (e.g., particulates, sulfur oxide, and nitrogen oxide emissions). Recently proposed EPA regulations (EPA 2011) would require such plants to be outfitted with equipment to control hazardous air pollutants (including mercury, acid gases, and other toxic pollution), and considerations have been given to promulgation of regulations that would require the capture and sequestration of CO_2 from the power plant's exhaust gas stream. All such pollution controls will impose parasitic loads such that the net electric power available will be reduced from gross nameplate values. The review team has accounted for the impact of those parasitic loads in estimating the gross nameplate capacity of fossil fuel alternatives necessary to allow for production of amounts of power equivalent to those of the proposed Fermi 3 reactor. Gross nameplate adjustments are reflected in calculations of environmental impacts from fossil fuel plant operation.

To compare a coal-fired alternative to the proposed Fermi 3 plant, the review team selected an SCPC plant. Supercritical steam technologies[(a)] are increasingly common in new coal-fired plants installed to deliver baseload power. Supercritical plants operate at higher temperatures and pressures than older subcritical coal-fired plants and therefore can attain higher thermal efficiencies. While supercritical facilities are more expensive to construct, they consume less fuel for a given output, reducing environmental impacts throughout the fuel life cycle. Based on technology forecasts from EIA, the review team expects that a new, supercritical coal-fired plant beginning operation in 2014 would operate at a heat rate of 9069 Btu/kWh,[(b)] or approximately 38 to 39 percent thermal efficiency.

The review team also assumed that a closed loop cooling system of the type proposed for Fermi 3 would be used to support the coal-fired alternative, with Lake Erie as the source of cooling water. Because nuclear plants require somewhat more cooling capacity per megawatt-hour generated than comparably sized SCPC plants (because of the difference in thermal

(a) "Supercritical" refers to the thermodynamic properties of the steam being produced. Steam whose temperature and pressure is below water's "critical point" (3200 psia and 705°F) is subcritical. Subcritical steam forms as water boils and both liquid and gas phases are observable in the steam. The majority of coal boilers that currently operate in the United States produce subcritical steam with pressures of about 2400 psia and temperatures as high as 1050°F. Above the critical point pressure, water expands rather than boils, and the liquid and gaseous phases of water are indistinguishable in the supercritical steam that results. Newer model boilers are likely to use pulverized coal instead of the lump coal used in older boilers. More than 150 pulverized coal boilers currently operating in the United States produce supercritical steam with pressure between 3300 and 3500 psia and temperatures between 1000 and 1100°F.

(b) Heat inputs could be less, depending on the fuel source. A coal-fired alternative would likely burn subbituminous western coal, which generally has a slightly lower average heat content.

efficiency), a lesser amount of water would be required for the SCPC plant than projected for Fermi 3.

The boilers constituting the supercritical coal-fired alternative are presumed to have the following characteristics and be equipped with the following pollution control devices:

- Dual wall-fired, dry bottom boilers, configured to be New Source Performance Standard- (NSPS) compliant
- Overall thermal efficiency of 39 percent
- Capacity factor of 79 percent
- Collective nameplate rating of 1788 MW(e) (net)[(a)]
- Supercritical steam
- Powder River Basin (PRB) coal; caloric value 8820 Btu/lb, ash 6.44 percent, sulfur 0.48 percent, pulverized to greater than 70 percent passing a 200-mesh sieve[(b)]
- Fabric filter for particulate control operating at 99.9 percent efficiency
- Wet calcium carbonate sulfur dioxide (SO_2) scrubber operating at 95 percent efficiency
- Low-nitrogen oxide (NO_x) burners with overfire air and selective catalytic reduction for NO_x controls capable of attaining an NO_x removal of 86 percent (an emission rate less than or equal to 2.5 parts per million by volume [dry basis]).

Air Quality

The following sections provide a brief discussion of the status of ambient air quality in that portion of Michigan that includes the Fermi site and an overview of the Federal and State regulations in effect in Michigan that would be applicable to a coal-fired alternative built on the Fermi site. Nothing in these sections is meant to preempt the interpretation of their regulations by Federal or State authorities or to usurp the authorities to include specific provisions and emission limitations in construction or operating permits that would be required.

(a) A higher net nameplate rating is required to account for the differences in expected capacity factors between an SCPC boiler and the Fermi 3 reactor, 79 percent versus 92 percent, respectively.

(b) Detroit Edison already uses PRB coal in its existing coal-fired power plants. To meet environmental regulations and limitations, some eastern bituminous coals are also blended with PRB coal. Such blending may also be required for a new coal-fired alternative to Fermi 3, but the extent of any required blending would be difficult to precisely determine at this time. Nevertheless, coal transportation and handling infrastructures are already in place and would be able to meet the fuel demands of this coal-fired alternative with only minor modifications. Average coal characteristics of PRB coal were used in this analysis as per Stricker and Ellis (1999).

Air Pollution Control Regulations in Michigan Applicable to a Coal-Fired Alternative

The Fermi site is located in Monroe County, Michigan. Monroe County is in nonattainment of the $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than or equal to 2.5 μm) National Ambient Air Quality Standards (NAAQS) and a maintenance area for the 8-hr ozone NAAQS. In July 2011, the Michigan Department of Environmental Quality (MDEQ) submitted a request asking the EPA to redesignate Southeast Michigan as being in attainment with the $PM_{2.5}$ NAAQS (MDEQ 2011). In July 2012, the EPA issued a proposed rule designating southeastern Michigan as having attained both the 1997 annual $PM_{2.5}$ NAAQS and the 2006 24-hour $PM_{2.5}$ NAAQS, based on 2009–2011 ambient air monitoring data (77 FR 39659, dated July 5, 2012), but the final determination has yet to be made. A new coal-fired generating plant would qualify as a new major source of criteria pollutants and would be subject to Prevention of Significant Deterioration of Air Quality Review under requirements of the Clean Air Act (CAA) and to Michigan State regulations. A new coal-fired generating plant would need to comply with the NSPS for coal-fired plants set forth in 40 CFR 60 Subpart Da: particulate matter and opacity (40 CFR 60.42(a)); SO_2 (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)). The new coal-fired generating plant would qualify as a major source because of its potential to emit (PTE) greater than 100 tons/yr of criteria pollutants and would be required to secure a Title V operating permit from MDEQ.

Section 169A of the CAA (42 USC 7401) establishes a national goal of preventing future, and remedying existing, impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The Regional Haze Rule, promulgated by EPA in 1999 and last amended in October 2006 (71 FR 60612), requires States to demonstrate reasonable progress toward the national visibility goal for Class I areas established in 1977. The only Class I areas in Michigan are the Isle Royale National Park (about 500 mi from the site) and the Seney National Wildlife Refuge (about 340 mi from the site), both located in the Upper Peninsula of Michigan. Neither of these Class I areas could reasonably be expected to be adversely affected by the operation of a coal-fired plant at the Fermi site. There are no Class I areas in the neighboring State of Ohio.

Michigan is one of 28 States whose stationary sources of criteria pollutants would have been subject to revised emission limits for SO_2 and NO_x under the Clean Air Interstate Rule (CAIR). The Federal rule was vacated by the D.C. Circuit Court on February 8, 2008; however, in December 2008, the U.S. Court of Appeals for the D.C. Circuit reinstated the rule, but required EPA to revise both the rule and its implementation plan. However, on July 6, 2010, EPA instead proposed replacing CAIR with the Transport Rule for control of SO_2 and NO_x emissions that cross state lines.[(a)] Regulations implementing the Transport Rule would be promulgated starting in 2011 and finalized in 2012. Michigan stationary sources of SO_2 and NO_x would be subject to this rule, as well as complementary regulatory controls developed at the State level

(a) See this EPA Web site for additional details regarding the Transport Rule: http://www.epa.gov/airtransport/actions.html#jul10.

(EPA 2010a).[a] On July 6, 2011 EPA announced the finalization of the Cross-State Air Pollution Rule (CSAPR, previously referred to as the Transport Rule) as a response to previous court decisions and as a replacement to the CAIR.[b] Fossil fuel power plants in Michigan would be subject to the CSAPR and would be required to reduce emissions of SO_2 and NO_x to help reduce downwind ambient concentrations of fine particulates ($PM_{2.5}$) and ozone. Because drafts of the Michigan rules are not available, their impacts on a coal-fired alternative cannot be assessed at this time. However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from Fermi 3, even after application of the CSAPR.

Sulfur Oxides

A new coal-fired power plant at the Fermi site would likely use wet limestone-based scrubbers to remove SO_2. EPA indicates that this technology can remove more than 90 percent of SO_2 from flue gases (EPA 2002). SO_2 emissions from a new coal-fired power plant would be subject to the requirements of Title IV of the CAA. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances but must secure allowances (or offsets) from existing sources to cover their SO_2 emissions. Owners of new units must therefore purchase allowances from owners of other power plants or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, provided a new coal-fired power plant is able to purchase sufficient allowances to operate, Title IV ensures that the new source of pollution would not add to net regional SO_2 emissions, although it might do so locally.

Nitrogen Oxides

A coal-fired power plant at the Fermi site would most likely employ various available NO_x control technologies, which can include combustion modifications and postcombustion processes. Combustion modifications include low-NO_x burners, over-fire air, and operational modifications. Postcombustion processes include selective catalytic reduction and selective noncatalytic reduction. A combination of the combustion modifications and postcombustion processes may allow the reduction of NO_x emissions by up to 95 percent (EPA 1998). The most likely NO_x control would involve a combination of low-NO_x burners and selective catalytic reduction technologies in order to reduce NO_x emissions from this alternative. For the coal-fired alternative, the review team assumed a more likely reduction of 86 percent.

(a) Additional details regarding the CAIR program in Michigan can be found at the MDEQ Web site: http://www.michigan.gov/deq/0,1607,7-135-3310-122941--,00.html.
(b) Details of the CSAPR can be found on the EPA Web site, http://www.epa.gov/crossstaterule/.

Section 407 of the CAA establishes technology-based emission limitations for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants as indicated in 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453), limits the discharge of any gases that contain NO_x to 1.6 lb/MWh of gross energy output, based on a 30-day rolling average.

Particulates

A new coal-fired power plant would use fabric filters to remove particulates from flue gases with an expected 99 percent removal efficiency. When present, wet SO_2 scrubbers further reduce particulate matter emissions (EPA 2008a). Coal-handling equipment would introduce fugitive dust emissions when fuel is being transferred to onsite storage and then reclaimed from storage for use in the plant. Coal preparation activities (e.g., cleaning, pulverizing) would be additional sources of fugitive dust. The onsite management of coal combustion residuals (CCR) and scrubber sludge may be additional sources of fugitive dust during operation.

The review team also presumed that the coal-fired alternative would use a closed cycle cooling system with an NCDT. The cooling tower would also be a source of particulate matter through salt drift. In addition, smaller mechanical draft cooling towers (MCDTs) are used to support plant operations. Detroit Edison estimated the total drift from the cooling towers to be 8.47 tons/year (Detroit Edison 2011a, 2009b). Because heat rejection demands for a nuclear reactor can be expected to be greater than the demands of a coal-fired power plant of equivalent capacity, these estimates of drift are considered to be bounding conditions for any thermoelectric power generating technology relying on fossil fuels.

Carbon Monoxide

Based on firing conditions and the boiler's overall firing efficiency, SCPC boilers would emit CO in limited quantities. Emission limits for CO would be based on heat input and typically expressed as pounds per million Btu input.

Hazardous Air Pollutants

EPA determined that coal-fired and oil-fired electric utility steam-generating units are significant emitters of the following hazardous air pollutants (HAPs): arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (65 FR 79825). EPA concluded that mercury is the HAP of greatest concern and that (1) a link exists between coal combustion and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects resulting from mercury exposures caused by the consumption of contaminated fish (65 FR 79825). EPA is developing mercury emission

standards for power plants under the CAA Section 112 authority (EPA 2011). On March 16, 2011, EPA proposed a rule to control mercury and other toxic pollutants from power plants (see http://www.epa.gov/airquality/powerplanttoxics for additional details and the rule's implementation schedule). However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from Fermi 3, even after application of any new mercury emissions standards.

Carbon Dioxide

Historically, CO_2, an unavoidable byproduct of combustion of carbonaceous fuels, has not been regulated as a pollutant. However, regulations are now under development for CO_2 and other GHGs. In response to the Consolidated Appropriations Act of 2008 (Public Law 110-161), EPA promulgated final mandatory GHG reporting regulations[(a)] in October 2009, effective in December 2009 (74 FR 56260) (see also http://www.epa.gov/climatechange/emissions/ghgrulemaking.html). The rules are applicable to major sources of CO_2 (those emitting greater than 25,000 tons/yr). New utility-scale coal-fired power plants would be subject to those regulations.

The coal-fired alternative plant would qualify as a major generator of GHGs under the "Tailoring Rule" recently promulgated by EPA (see 75 FR 31514). Beginning January 2, 2011, operating permits issued to major sources of GHG under the Prevention of Significant Deterioration (PSD) or Title V Federal permit programs must contain provisions requiring the use of best available control technology (BACT) to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons/yr of CO_2 equivalent (CO_2-e).[(b)] The amount of CO_2 released per unit of power produced would depend on the quality of the fuel and the firing conditions and overall firing efficiency of the boiler. Subbituminous coal from the Powder River Basin has an average CO_2 emission factor of 212.7 lb/million Btu of coal input (Hong and Slatick 1994). Meeting permit limitations for GHG emissions may require installation of carbon capture and sequestering (CCS) devices on any new coal-fired power plant, which could add substantial power penalties. However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from Fermi 3, even after application of any new GHG emissions standards.

(a) The GHGs covered by the final rule are CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), SF_6, and other fluorinated gases including NF_3 and hydrofluorinated ethers (HFEs).
(b) Full text of the Tailoring Rule can be found at http://www.gpo.gov/fdsys/pkg/FR-2010-06-03/pdf/2010-11974.pdf.

Estimated Impacts on Air Quality from the Construction of a Coal-Fired Alternative

Construction of a coal-fired power plant would result in the release of various criteria pollutants from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce. Volatile organic chemical releases will also result from the onsite storage and dispensing of vehicle and equipment fuels. Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction best management practices (BMPs, such as development and execution of an appropriate fugitive dust control plan) would mitigate such impacts. Construction-related impacts on air quality from a coal-fired alternative would be of relatively short duration and would be SMALL.

Estimated Impacts on Air Quality from the Operation of a Coal-Fired Alternative

NRC (1996) did not quantify emissions from coal-fired power plants but suggested that air impacts would be substantial. During operation, a coal-fired power plant would emit criteria pollutants, as well as hazardous pollutants such as mercury.[(a)] Detroit Edison (2011a) provided estimates of emissions from a coal-fired plant alternative with a capacity of 1600 MW(e) and a design that would minimize air emissions through a combination of boiler technology and postcombustion pollutant removal. Detroit Edison's estimates of emissions from a coal-fired alternative are as follows:

- SO_2, 2260 tons/yr
- NO_x, 1330 tons/yr
- PM_{10}, 48 tons/yr
- CO_2, 17,750,000 tons/yr
- Mercury, 0.1 tons/yr.

Although the review team has identified the primary features and operating parameters of the supercritical pulverized coal boiler represented in this coal-fired power plant alternative, many additional aspects of system design, boiler firing conditions, and operating procedures can influence the amount of criteria pollutants ultimately released to the environment. Further, because any new coal-fired power plant constructed in Monroe County would be subject to NSPS and PSD controls, any new operating permit will likely require the application of BACT. However, the performance metrics for BACT would change over time as real-world experience

(a) Depending on the coal source, precombustion coal cleaning, and boiler firing conditions, many other pollutants can be emitted, including acid gases such as hydrogen chloride, various heavy metals besides mercury, a wide array of organic compounds, and various GHGs, including (especially) CO_2. However, because neither the coal source nor the firing conditions can be precisely specified, except for CO_2, this assessment does not extend to quantifying those other pollutant emissions.

grew, and the ultimate performance requirements contained in any operating permit would be subject to negotiations among the EPA and/or State permit writers and the applicant. Consequently, the quantifications of pollutant emissions appearing below should be considered only as estimates. Algorithms and emission coefficients developed by EPA (EPA 1998) were used to estimate the amounts of pollutants that would result from operation of the coal-fired power plant alternative.

Operating at a capacity factor of 92 percent, the proposed 1535 MW(e) (net) Fermi 3 reactor can be expected to produce 12.4 million MWh of power annually. To produce a more or less equivalent amount of power, an SCPC boiler operating at a capacity factor of 79 percent would need to have a rated capacity of approximately 1788 MW(e) (net). The review team assumes that approximately 5.2 percent of the boiler's gross megawatt capacity is needed to supply typical parasitic loads (i.e., plant operation, including control devices for limiting emissions of criteria and hazardous air pollutants to meet NSPS). Introducing controls for GHG emissions (i.e., CCS) would cause the parasitic load to increase to 17.8 percent of the boiler's gross rated capacity (NETL 2010). However, given the significant uncertainty regarding the details of any CCS and when such controls might be required, the review team has elected to include parasitic losses from conventional pollution control devices and plant operation, but to not include parasitic losses from CCS in its calculations of environmental impacts. Based on a parasitic load of 5.2 percent, the coal plant would have a gross electrical generation capacity of 1886 MW(e).

To produce the required amount of power, the SCPC boilers described above, operating at a capacity factor of 79 percent, would burn 6.5 million tons of PRB coal annually (5.9 MMT/yr).

Applying EPA emission factors and reasonably expected pollution control equipment efficiencies results in the estimated annual pollutant releases shown in Table 9-1.

While the GEIS analysis mentions global warming from unregulated CO_2 emissions and acid rain from SO_2 and NO_x emissions as potential impacts, it does not quantify emissions from the operation of coal-fired power plants. However, the GEIS analysis does indicate that air impacts would be substantial (NRC 1996). The above analysis shows that emissions of air pollutants, including sulfur oxides (SO_x), NO_x, CO, particulates, HAPs, and CO_2, exceed those that would result from operation of the proposed Fermi 3 nuclear power plant by significant margins (see Section 5.7.2), as well as those of the other alternatives considered in this section.

The analysis for an SCPC power plant at the Fermi site indicates that air quality impacts from the operation of an SCPC power plant alternative would be clearly noticeable, but with the expected application of regulatory requirements, permit limitations, and emissions controls, would not destabilize air quality. Participation in emissions trading schemes may also be required. Therefore, because of these expected controls, the review team concludes that air impacts from an SCPC power plant alternative located at the Fermi site would be MODERATE.

Table 9-1. Estimated Emissions (in tons/yr) of Criteria Pollutants and Carbon Dioxide from the Coal-Fired Power Generation Alternative

Pollutant	Annual Uncontrolled Emissions	Annual Controlled Emissions	Notes
SO_2	54,381	2719	Assumes PRB coal at 0.48 percent sulfur and a 95 percent efficient limestone scrubber. Emission factor: 35× (percent sulfur) lb/ton of coal
NO_x	23,953	3353	Assumes 86 percent efficient pre- and postcombustion NO_x controls. Emission factor: 7.4 lb/ton of coal
CO	1618	1618	Assumes typical NSPS-compliant firing conditions. Emission factor: 0.5 lb/ton of coal
Particulates (filterable)	208,459	208	Assumes PRB coal at 6.44 percent ash and a 99.9 percent efficient fabric filter control device. Emission factor: 10× (percent ash) lb/ton of coal
Particulates (filterable PM_{10})[(a)]	47,829	48	Assumes 99.9 percent efficient fabric filter control device. Emission factor: 2.3× (percent ash) lb/ton of coal
CO_2	12.1 million	12.1 million	Assumes no CO_2 capture. Emission factor: 212.7 lb/million Btu

(a) PM_{10} = particulate matter with an aerodynamic diameter of less than or equal to 10 µm.

Waste Management

Construction Waste Management

Both sanitary wastes resulting from support of the construction crew and industrial wastes (some with hazardous character) would be generated during the construction of the coal-fired power plant alternative from activities such as clearing the construction site of vegetation, excavating and preparing the site surface before other crews begin actual construction of the plant, modifying existing infrastructure, and constructing any additionally required infrastructure. Minor amounts of industrial wastes will result from the onsite management of construction vehicles and equipment, the use of cleaning solvents, and the application of corrosion control coatings. Construction-related wastes are expected to be properly characterized and initially managed onsite and eventually removed to properly permitted offsite treatment or disposal facilities. New transmission lines identical to those proposed for the Fermi 3 reactor would be constructed to connect to the ITC*Transmission* Milan Substation. The existing rail spur would be sufficient to support both construction and operation of a coal-fired plant. Waste impacts from construction are expected to be SMALL.

Operational Waste Management

Coal combustion generates several waste streams, including ash (a dry solid recovered from both pollution control devices [fly ash] and from the bottom of the boiler [bottom ash]) and sludge (a semisolid byproduct of emission control system operation, in this case, primarily calcium sulfate from the operation of the wet calcium carbonate SO_2 scrubber). Combustion of 6.5 million tons/yr of PRB coal would result in substantial amounts of CCR recovered from the fabric filter and from the bottom of the boiler. Recycling options that may exist for some of the CCR generated include road sub-base fill material, an admixture in lightweight concrete products, and highway embankment stabilization. However, much of the CCR would require disposal. Although EPA has not declared CCR as hazardous (65 FR 32214), it does contain hazardous constituents that may leach from improperly designed or operated disposal cells and that may threaten surface or groundwater resources. Coal-fired power plant operation would also result in substantial quantities of calcium sulfate recovered from the SO_2 scrubber. Most such sludge may be recycled for use in production of gypsum wallboard for the construction industry. However, temporary holding facilities as well as drying facilities may need to be constructed. Spent catalysts from NO_x catalytic reduction would also be produced. Scrubber sludge and CCR may have beneficial uses, but, in the worst case, all solid wastes resulting from operation would require disposal. Wastes typical of the construction of large industrial facilities would also be generated.

The review team estimates that 416,918 tons/yr of ash would be either recovered from the boiler as bottom ash or captured as fly ash in the fabric filter,[(a)] and the remainder, 208 tons/yr, released to the atmosphere. Detroit Edison notes that approximately 40 percent of CCR is currently recycled and that the published EPA goal is to increase this amount to 50 percent (Detroit Edison 2011a). The review team assumes that the EPA goal of recycling 50 percent of CCR would be realized, leaving about 208,251 tons/yr requiring disposal. Disposal of this amount of ash annually by landfilling over the expected 40-year lifetime of the coal-fired plants could noticeably affect land use and groundwater quality. Landfill locations would require proper siting in accordance with State solid waste regulations,[(b)] and leachate from the disposal cells would need to be monitored and possibly captured for treatment, because of leaching of toxic components (including heavy metals) in the ash. The review team has not presumed the location of this ash disposal landfill, but presumes that insufficient area would be available on

(a) Some additional fly ash may also be captured in the SO_2 scrubber downstream of the fabric filter. However, that amount has not been quantified.

(b) In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (EPA 2000a) stating that it would issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act. EPA has not yet issued these regulations. Until such rules are issued at the Federal level, State regulations concerning solid waste disposal are the primary controls.

the Fermi site to accommodate any onsite disposal. After closure of the waste site and revegetation, the land could be available for other uses.

Combustion of 6.5 million tons/yr of PRB coal with 0.48 percent sulfur would result in the generation of 51,914 tons/yr of SO_2, 95 percent of which would be captured in the wet scrubber and converted to an equimolar amount of calcium sulfate, or 110,310 tons/yr (dry basis). Although Detroit Edison notes that 77 percent of scrubber sludge is currently put to beneficial use (Detroit Edison 2011a), the review team presumes that as much as 90 percent of the scrubber sludge could be recycled in the future for such applications as gypsum wallboards and that the remainder, 11,031 tons/yr, would be codisposed with the CCR that is not recycled.

The review team has not made an estimate of the amount of spent catalysts that would be produced, but presumes that the entire amount would have no recycling potential and thus would require disposal. Depending on the catalysts used, special handling might also be required to address the potential hazardous character of these spent catalysts.

The impacts from waste generated during operation of this coal-fired power plant alternative would be MODERATE; the impacts would be clearly noticeable but, with proper design and operation of waste management systems, would not destabilize any important resource.[(a)] The extent of the impacts of disposal would depend on the percentage of the CCR and scrubber sludge that could be recycled.

Therefore, the review team concludes that the overall impacts of wastes resulting from the construction and operation of the coal-fired alternative would be MODERATE.

Human Health

Coal-fired power plants introduce worker risks from coal and limestone mining, from coal and limestone transportation, and from disposal of CCR and scrubber wastes. In addition, there are public risks from inhalation of stack emissions and the secondary effects of eating foods grown in areas subject to deposition of pollutants emitted from plant stacks.

Human health risks of coal-fired power plants are described in general in Table 8-2 of the GEIS (NRC 1996). Cancer and emphysema resulting from the inhalation of toxins and particulates are identified as potential health risks to occupational workers and members of the public (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a coal-fired power generation plant

(a) The NRC is aware of the significant environmental impacts that resulted from recent failures of coal waste ponds in Alabama and Tennessee (see *http://www.msnbc.msn.com/id/28579190/ns/us_news-environment/t/utility-waste-pond-ruptures-time-ala/).* However, NRC believes that such wholesale failures are rare and preventable with proper design and maintenance of CCR impoundments and other waste management facilities.

located at the Fermi site would be regulated by MDEQ. In addition, natural uranium and thorium contained in routine air emissions from coal-fired power plants could result in radiological doses that could be in excess of those from nuclear power plant operations (Gabbard 1993).

Regulations restricting emissions enforced by either EPA or delegated State agencies have reduced potential health effects but have not entirely eliminated them. These agencies also impose site-specific emissions limits as needed to protect human health. Even if the coal-fired power plant alternative were located in a nonattainment area, emission controls and trading or offset mechanisms could prevent further regional degradation; however, local effects could be visible. Many of the byproducts of coal combustion responsible for health effects are largely controlled, captured, or converted in modern power plants, although some level of health effects may remain.

Aside from emission impacts, the coal-fired alternative would introduce the risk of coal pile fires and, if lined impoundments were used to contain CCR and scrubber sludge, the risk of accidental release of the waste due to a failure of the impoundment[(a)] or leaching of hazardous constituents due the impoundment liner's failure.[(b)]

Overall, given health-based regulation and controls likely to be imposed as permit conditions by either EPA or delegated State agencies, the review team concludes that human health impacts of a coal-fired power plant alternative would be SMALL.

Climate Change-Related Impacts

Climate changes are under way in the United States and globally, and these are projected to continue to grow substantially over the next several decades unless intense, concerted measures are taken to reverse this trend. Many of the projected climate changes are believed to be the result of the release of GHGs. The primary GHG of concern for global climate change because of its global warming potential as well as the amounts being emitted worldwide is CO_2 and the major anthropogenic source of CO_2 is the combustion of fossil fuels. Climate-related changes include rising temperature and sea level; increased frequency and intensity of extreme weather conditions (e.g., heavy snows and downpours, floods, and droughts); earlier snowmelts and associated frequent wildfires; and reduced snow cover, glaciers, permafrost, and sea ice. After a thorough examination of the scientific evidence and careful consideration of public comments, the EPA officially announced on December 15, 2009, that GHGs threaten the public health and welfare of the American people and fit the CAA definition of air pollutants (74 FR 66496). The coal-fired power plant alternative would contribute GHG emissions to

(a) Although there have been incidents in recent years of waste impoundment failures, such incidents are nevertheless considered rare.
(b) Leachate capture and recycling or treatment would typically be required to reduce the probability of such occurrences.

climate change. This section presents an assessment of the potential impacts that construction and operation of the coal-fired power plant alternative would have on climate.

Impacts on climate change from the construction of a coal-fired power plant alternative would result primarily from the consumption of fossil fuels in reciprocating internal combustion engines (RICE) of construction vehicles and equipment, workforce vehicles used in commuting to and from the work site, and delivery vehicles. As noted elsewhere, construction-related releases of criteria pollutants and GHGs such as CO_2 would be temporary. Estimates of CO_2 emissions related to the building of Fermi 3 are provided in Section 4.7.1. Overall, impacts of constructing a new coal-fired power plant would be expected to have a lesser impact on climate change than the building of Fermi 3, because of both a smaller workforce and a shorter construction period. Overall, as with the impact on air quality from releases of criteria pollutants, the impact on climate change from the releases of GHGs during construction would be SMALL.

A comprehensive inventory of Michigan GHG emissions was published in 2008 with projections from the 2005 "business as usual" base case through the year 2025 (CCS 2008). In 2005 (the latest year for which data were available at the time of publication of the Michigan inventory), all anthropogenic sources of GHGs in Michigan accounted for the generation of approximately 248 million MMT of CO_2-e gross emissions (excluding Michigan forests that serve as GHG sinks and emissions associated with exported electricity). Energy-related emissions of GHG totaled 214.7 MMT of CO_2-e (CO_2, CH_4, and N_2O emissions combined).[(a)] Of that amount, 70.8 MMT was related to in-state electricity production using coal (67.7 MMT), natural gas (2.38 MMT), or oil (0.71 MMT). The U.S. total GHG emissions and total emissions of CO_2 from coal combustion for electricity production in 2005 were 7108.6 MMT and 2381 MMT, respectively (EPA 2009a). Thus, the Michigan total GHG emissions accounted for 0.99 percent of the nationwide total GHG emissions and 2.8 percent of the nationwide total GHG emissions related to coal-fired electricity production. Although Michigan's GHG emissions are rising more slowly than the U.S. average, they nevertheless rose by 12 percent over the period 1990 to 2005 (versus a national GHG growth rate of 16 percent) (CCS 2008).

As discussed above, the review team estimates that the emission of 12.1 million tons/yr (11.0 MMT/yr) of CO_2 would result from the operation of a coal-fired power plant alternative to produce the amount of power equivalent to that expected annually from Fermi 3. Consequently, operation of Fermi 3 instead of a coal-fired power plant would represent an avoidance of these

(a) The total CO_2-e emissions reported represent a total of the three primary GHG emissions related to fossil fuel combustion: CO_2, CH_4, and N_2O. However, of these three, CO_2 is by far the largest source. For simplicity, the percentages that follow disregard the contributions of CH_4 and N_2O to statewide energy-related GHG totals.

CO_2 emissions.[(a)] A coal-fired alternative would represent approximately 16 percent and 0.46 percent of the GHGs emitted in Michigan and in the United States, respectively, in 2005 from coal-fired power plant operations. While any single project would be inconsequential when compared to global GHG emissions, the review team doesn't believe that this is the correct way to measure the impacts. A 16 percent increase in emissions from coal plants within the State cannot be construed as undetectable. The review team concludes, therefore, that the impact of the operation of a coal-fired power plant at the Fermi site on global climate change would be MODERATE.

Groundwater Use and Quality

Impacts on groundwater from construction and operations of the coal-fired power plant alternative would be minimal. Except for potable uses, the immediate availability of lake water suggests that groundwater resources would not likely be utilized to support operation of the coal-fired plant. Total usage for potable purposes would likely be less for operations of a coal-fired power plant than for reactor operation because of a smaller operating workforce. No effect on groundwater quality would be apparent.

Construction of a coal-fired plant may have a limited and minor impact on groundwater due to changes to surface drainage patterns during construction and operation, and the onsite storage of coal and CCR. However, no onsite disposal of CCR would occur, and controls to capture and treat any hazardous leachate from coal and CCR piles would limit impacts. The review team concludes that the impact on groundwater from the coal-fired power plant alternative would be SMALL.

Surface Water Use and Quality

Minor impacts on surface water would occur during construction of a new coal-fired power plant because of ground disturbances, alteration of natural drainage patterns, and potential increases in sediment loadings in surface drainage. A site-wide stormwater pollution prevention plan (SWPPP) would be established for the construction period and would include controls and mitigations that would limit adverse impacts on surface water quality. The elements of that plan would be incorporated into a General Stormwater Permit, enforceable under the MDEQ's National Pollutant Discharge Elimination System (NPDES) program authority. The relatively small amount of water withdrawn from Lake Erie for cooling purposes would not cause a destabilizing effect on other potential uses of Lake Erie water. The review team therefore concludes that impacts on surface water use and quality would be SMALL.

(a) Figures presented here represent CO_2-e emissions directly related to energy production. Although it is estimated that a nuclear reactor will generate 7700 tons/yr of CO_2-e (see Table 5-22), those releases are the result of routine preventive maintenance of fossil-fueled emergency generators and routine operation of ancillary equipment using fossil fuels and not the direct result of the operation of the reactor. No GHGs are emitted from reactor operation.

Aquatic Ecology

Lake Erie would be the primary source of water to support the construction and operation of the coal-fired alternative. Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required (compared to the volume of water in Lake Erie) and controls on the quality of surface water discharges imposed by a SWPPP permit issued by MDEQ. Impacts on aquatic ecosystems during operation would be virtually equivalent to projected impacts from Fermi 3 operation and would take the form of both impingement and entrainment impacts associated with water withdrawals to support the cooling system, as well as thermal impacts associated with blowdown discharges from that cooling system (which may be required to undergo treatment prior to discharge).[(a)] All such impacts would be controlled by an NPDES permit issued by MDEQ. The review team concludes, therefore, that impacts on aquatic ecology from the construction and operation of the coal-fired alternative would be SMALL.

Terrestrial Ecology

Detroit Edison estimates a 1600-MW(e) coal-fired plant would require approximately 2720 ac. As discussed earlier, a coal-fired alternative of equivalent power producing capability would have a gross nameplate rating of 1886 MW(e) to account for differences in capacity factors between the proposed nuclear reactor and the coal-fired alternative and to accommodate parasitic loads. By simple proportioning, a 1886 MW(e)-plant would require 3210 ac. The entire Fermi site including the existing facilities occupies only 1260 ac. Utilizing the Fermi site to the fullest possible extent to build a coal-fired plant and ancillary activities would not be possible without disturbing substantially greater areas of wetlands, including forested wetlands, than would be necessary for a nuclear facility. To avoid extensive wetland impacts, Detroit Edison would have to acquire additional contiguous parcels of land. Those parcels would most likely consist of a mix of land uses including agriculture and could include wetlands (Detroit Edison 2011a).

Onsite impacts on terrestrial ecology would generally be as described in Sections 4.3.1 and 5.3.1 for a nuclear project but would be substantially more extensive. Additional impacts would result from development of newly acquired parcels adjacent to the site, but terrestrial ecology impacts on those parcels could be limited because they consist largely of agricultural land. The review team assumes that a coal plant on the Fermi site would require building and operating the same new transmission lines described for the Fermi 3 nuclear project.

Coal-mining operations would also disturb terrestrial habitats in offsite coal-mining areas. Detroit Edison estimates that 35,200 ac would be required to mine the amount of coal needed to

(a) Because of differences in operating temperatures, cooling demands for coal-fired plants are slightly smaller than cooling demands for similarly sized nuclear plants.

support a 1600-MW(e) plant. Using a 1886 MW(e) gross nameplate rating and a 79 percent capacity factor, the review team estimates that a coal-fired alternative would require 41,492 ac to mine the coal. For comparison, uranium mining to support a 1600-MW(e) nuclear reactor is estimated to require a 1600-ac uranium mine (Detroit Edison 2011a).

Onsite temporary storage of coal, CCR, spent catalysts, and scrubber sludge, as well as any offsite waste disposal by landfilling of CCR, would also affect terrestrial ecology by requiring conversion of existing habitat. Deposition of acid rain resulting from NO_x or SO_x emissions and deposition of other pollutants could also affect terrestrial ecology. Considering the emission controls discussed previously, air deposition impacts might noticeably affect terrestrial vegetation and wildlife but would likely not be regionally destabilizing. Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift; however, these impacts would be generally be minimal, about the same as those that are now occurring from the operation of Fermi 2.

Primarily because of the potential disturbances to offsite habitats from coal mining and onsite and offsite impacts on wetlands caused by building the coal plant and associated facilities, impacts on terrestrial resources from a coal-fired power plant would be MODERATE. While the greatest impacts would result from the offsite coal mining, wetland losses resulting from building the onsite facilities would also be noticeable, although it might be possible to reduce the impacts through wetland mitigation. Impacts on terrestrial habitats caused by air emissions could also be noticeable.

Noise

Coal-fired power generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and MCDTs. Intermittent sources include the equipment related to coal handling, solid waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly increases noise levels near the rail corridor, the short duration of the noise reduces the impacts. Nevertheless, given the expected frequency of coal and limestone deliveries, the potential impacts of noise on residents in the vicinity of the facility and the rail line are considered MODERATE. Noise and light from the plant would be detectable offsite.

Land Use

The following analysis of land use impacts focuses on land requirements for construction and operation of a new supercritical coal-fired power plant on the Fermi site. The review team

assumes that situating such a plant on the Fermi site would require building and operating the same new transmission lines described for the Fermi 3 nuclear project.

Detroit Edison indicated that approximately 1700 ac of land would be needed to support a 1000-MW(e) coal-fired plant (Detroit Edison 2011a). The review team has reviewed these estimates and found them to be reasonable and consistent with the GEIS (NRC 1996). Although the power blocks of a nuclear plant and a similarly sized coal plant are approximately the same size, the coal plant would require additional land to support ancillary activities such as onsite storage and handling of coal (including sizing and blending, when required) and lime (or limestone) and temporary onsite storage of CCR and scrubber sludge. As discussed earlier, a coal-fired alternative of equivalent power-producing capability would have a gross nameplate rating of 1886 MW(e) to account for differences in capacity factors between the proposed nuclear reactor and the coal-fired alternative and to accommodate parasitic loads. By simple proportioning, a 1886-MW(e) plant would require 3210 ac.[(a)]

The Fermi site is approximately 1260 ac, including wetland areas. As noted earlier, new land parcels would need to be acquired to support a new coal-fired power plant on the Fermi site. Offsite land acquisition would likely involve mostly agricultural or forest land and may affect prime farmland.

Depending on how much offsite adjacent land can be obtained, development of the coal plant would almost certainly cause the loss of much of the land on the Fermi site that is managed as part of the Detroit River International Wildlife Refuge (DRIWR), especially upland areas that are not subject to wetland permitting limitations.

Offsite land use impacts would occur from coal mining. However, most of the land in existing coal-mining areas has already experienced some level of disturbance. Detroit Edison estimates that 35,200 ac would be required to mine the amount of coal needed to support a 1600-MW(e) plant. Using a 1886-MW(e) gross nameplate rating and a 79 percent capacity factor, the review team estimates that a coal-fired alternative would require 41,492 ac to mine the coal. Uranium mining to support a 1600-MW(e) nuclear reactor is estimated to require a 1600-ac uranium mine. The elimination of the need for uranium mining to supply fuel for the proposed reactor would partially offset the impact of this offsite land use. Additional land areas would be required for disposal of CCR, scrubber sludge (gypsum), and other operational solid wastes, although the land areas requirements for disposal would be affected by the extent to which operational wastes could be recycled.

(a) Increasing the nameplate capacity of the boiler can be expected to result in only incremental changes in land requirements for the power block, supporting infrastructures, and ancillary activities such as coal and waste storage or onsite fuel blending. Consequently, using a simple ratio to calculate resulting increases in land area requirements is expected to produce a conservative result.

Based on this information, land use impacts of the coal-fired alternative would be MODERATE. Even without consideration of the land demands for coal mining, the land use impacts from building and operating the coal plant facilities would be MODERATE.

Socioeconomics

Socioeconomic impacts are defined in terms of changes to the baseline demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the construction and operation of a new coal-fired power plant could affect regional employment, income, and expenditures. The socioeconomic baseline discussed for the Fermi 3 plant in Section 2.5 of this EIS serves as the baseline for this alternative analysis.

Detroit Edison projected a peak employment construction workforce of 2900 workers (an average employment level of 1000 workers) for the building of Fermi 3. The review team anticipates that the majority (about 85 percent) of the workforce would come from a three-county economic impact area comprising Monroe and Wayne County in Michigan (which includes the Detroit Metropolitan Statistical Area [MSA]) and Lucas County in Ohio (which includes the Toledo MSA). Because the majority of the workforce would already live in the region, the relative economic contributions of these workers to local business and tax revenues in the region would remain generally the same. The review team expects the remainder of the building-related workforce would in-migrate from outside the 50-mi region in the same residential distribution as the current operations workers at the Fermi site (see Section 4.2.2 for a detailed discussion of these assumptions). About 87 percent of the in-migrating construction workers would settle with their families in Monroe or Wayne County in Michigan or Lucas County in Ohio.

Detroit Edison estimates that 2500 workers would be required for the construction of a coal-fired alternative. For comparative purposes, the review team applied the same residential distribution assumptions used for the analysis of Fermi 3 to the 2500 construction workers for the alternative coal-fired electrical generating units.

The review team does not expect many in-migrating construction workers will permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Based on the site's proximity to the Detroit and Toledo MSAs and expected limited worker relocation, the review team concludes that construction impacts on the local infrastructures and services would be SMALL and adverse.

Section 4.4.2.3 discusses the impact on the regional tax base from the construction and operation of Fermi 3. Impacts from construction of the coal-fired alternative would also occur in each of the four categories discussed in Section 4.4.2.3 but would be proportionally smaller, based on the projected differences in construction workforce sizes, 2900 for the nuclear reactor and 2500 for the coal fired alternative. Once operational, the coal-fired alternative would

provide a beneficial impact on the regional tax base comparable to that of Fermi 3. To the extent to which local suppliers are used to provide necessary materials for construction and operations of the alternative plant and members of the local workforce are employed at the plant, local sales taxes would increase. Impacts on the local tax base would result primarily from the property taxes that would be paid for the new alternative coal-fired units. Because coal-fired plants are not subject to the safety requirements necessary for the construction and operation of a nuclear power plant, the review team expects the cost of construction of the alternative coal-fired plants would be somewhat less than for Fermi 3, but still would result in a substantial increase in Monroe County property tax revenues. However, the construction period for the coal-fired alternatives would be shorter, and therefore the assessment of property taxes during operations would begin sooner than for Fermi 3. As would be the case for the proposed action of constructing and operating Fermi 3, the review team concludes that impacts on the regional and local tax bases from construction and operation of the coal-fired alternative would be SMALL and beneficial, with the exception of property taxes to Monroe County, Michigan, which would be LARGE and beneficial.

Traffic

During construction, 2500 workers would be commuting to the plant site, most coming primarily from the Detroit and Toledo MSAs. The review team assumes for this comparison that all the traffic-related conditions described in Sections 4.4 and 5.4 for the Fermi 3 project would also apply to the alternative coal-fired power plants, with the following exceptions:

- The construction workforce for the alternative coal-fired plants would be smaller (2500 employees at peak employment versus 2900 employees for Fermi 3).
- The operations and maintenance workforce for the coal-fired plants would be smaller than that for Fermi 3.
- The construction phase for the coal-fired plants would be shorter.
- Fewer truck deliveries would be made for the coal-fired plants.

As described in Section 4.4.4.1, the review team determined that traffic-related impacts from the construction of Fermi 3 would be short term, MODERATE, and adverse, occurring only during peak construction employment periods. Given the conditions discussed above, the review team concludes that traffic-related impacts associated with a coal-fired alternative constructed on the Fermi site are likely to also be short term, MODERATE, and adverse. The mitigation opportunities that resulted from the transportation study commissioned by Detroit Edison in coordination with the State would also apply to the coal-fired alternative, and a commitment by Detroit Edison to work with the Michigan Department of Transportation (MDOT) and the Monroe County Road Commission (MCRC) to identify and execute appropriate mitigations would reduce

transportation impacts to manageable levels. Traffic impacts would be greatly reduced after construction but would not disappear during plant operations.

Operations-related traffic impacts would result from (1) the commuting of the operating workforce, (2) rail deliveries of coal and limestone, and (3) large vehicles transporting CCR, scrubber sludge, and spent catalyst to recycling and/or disposal sites. Onsite coal storage facilities would be designed to have the capacity to receive several trainloads per day. Limestone delivered by rail could also add traffic, but it would be less than that generated by coal deliveries. By comparison, transportation-related impacts from the operation of a nuclear plant would be considerably smaller due to less frequent deliveries; however, transportation impacts from the commuting workforce would be greater due to the expected larger operating workforce for the reactor. The review team determines that because of the scale of deliveries of coal and limestone, combined with the large number of disposal truckloads leaving the plant, operating a new coal-fired power plant would result in MODERATE and adverse impacts on transportation. These impacts would be reduced by mitigation measures still in place after the construction period, but their presence would not reduce the assessed impact from MODERATE and adverse.

Aesthetics

Aesthetic impacts result primarily from the degree of contrast between the coal-fired power plant and the surrounding rural landscape, as well as the visibility of the coal-fired power plant in offsite areas. However, because there is industrial activity already on the site associated with operation of Fermi 2, the contrast between a coal plant at the site and the rural surroundings would be dramatically reduced.

Each power block building of a new coal-fired power plant would be up to 200-ft tall, which is somewhat taller than the proposed Fermi 3 reactor building. Each power block would also have an exhaust stack up to 500 ft in height, which would likely be taller and more prominent than the reactor's offgas stack and, during some weather conditions, release a visible plume resulting from water vapor and combustion gases. These structures would be high enough to require illumination, which would exacerbate their visibility in the night. The cooling towers would generate a condensate plume, but this would be no more noticeable than the plume expected from a similarly sized cooling system for the Fermi 3 reactor. The transmission lines supporting the coal-fired plant would be the same as those proposed for Fermi 3 and would, therefore, have identical aesthetic impacts. In Section 4.4.1.6 and 5.4.1.6, the review team concludes that visual impacts from the construction and operation of Fermi 3 would be SMALL and adverse. Given the similar appearance of a coal-fired alternative to a nuclear plant and the industrial character of the existing viewscape because of Fermi 2, the review team determined the aesthetic impacts associated with the construction and operation of the coal-fired power plant alternative at the Fermi site would be SMALL and adverse.

Environmental Justice

This environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of a new coal-fired power plant. The minority and low-income demographic characterization of the 50-mi region surrounding the proposed Fermi 3 site is discussed in Section 2.6 of this EIS. The characterization of minority and low-income populations for Fermi 3 is the same as that for the alternative coal-fired power plant. In Section 4.4.3 and 5.4.3 the review team concludes that there are no pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of Fermi 3. Since the construction of a coal-fired power plant system of comparable size to the Fermi 3 plant would have very similar physical and socioeconomic impacts, the review team determines that the impacts on minority or low-income populations from the construction of a coal-fired alternative would also be similar. Therefore, the review team determines the environmental justice impacts on minority or low-income populations of interest from constructing a coal-fired plant would be SMALL.

Although many of the characteristics of operating a coal-fired power plant system would be similar to those for operating Fermi 3, there is one significant difference: a coal-fired plant emits substantially more air pollution and produces substantially more solid waste (some of which are heavy metals or hazardous wastes) than its nuclear powered analog. Therefore, while emission limits imposed by operating permits would help ensure the general population would not receive adverse air quality and noise impacts from emission levels beyond those permitted by environmental standards from the operation of the coal-fired alternative, the general population would experience increased environmental impacts from the byproducts of operating a coal-fired power plant. However, the review team did not identify any pathway or circumstance through which any minority or low-income population might experience a disproportionately high and adverse impact, relative to the general public. Therefore, the review team concludes that the environmental justice impacts on minority and low-income populations of interest from operating a coal-fired alternative plant would be SMALL.

Historic and Cultural Resources

The Fermi site contains one *National Register of Historic Places*- (NRHP-) eligible historic property, the nonoperating Fermi Unit 1 (Fermi 1). In Section 7.5, the review team concludes that impacts on onsite historic and cultural resources from building and operating Fermi 3 would be MODERATE, because portions of the Fermi 3 plant would be located on the land currently occupied by Fermi 1, and if demolition of Fermi 1 were necessary, the adverse impacts of demolition would be mitigated in accordance with measures stipulated in a Memorandum of Agreement (MOA) between the NRC, the Michigan State Historic Preservation Officer (SHPO), and Detroit Edison. Similar adverse impacts on the NRHP-eligible Fermi 1 historic property would result from construction of a coal plant on the same footprint that was proposed for

Fermi 3. In addition, because the land area requirements for a coal-fired alternative are greater than those for a nuclear reactor, impacts on disturbed and undisturbed land parcels may occur both on the Fermi site and on adjacent offsite properties for support of ancillary activities such as fuel and waste storage. While surveys of previously undisturbed land parcels would provide a basis for mitigation of impacts on historic and cultural resources, the review team nevertheless concludes that impacts on historic and cultural resources from construction and operation of a new coal-fired power plant at the Fermi site would be MODERATE, primarily due to the demolition of the NRHP-eligible Fermi 1 and the implementation of mitigation measures for the adverse impacts of demolition that would be similar to those developed for a new nuclear reactor.

Summary of the Construction- and Operation-Related Impacts of the Coal-Fired Power Generation Alternative

The construction and operation impacts of coal-fired power generation at the Fermi site are summarized in Table 9-2.

9.2.2.2 Natural Gas-Fired Power Generation

In this section, the review team evaluates the environmental impacts of natural gas combined-cycle (NGCC) generation at the Fermi site.

In 2009, natural gas was responsible for 8.3 percent of electricity generated by all sources within the electric industry (utilities, combined heat and power, independent power producers) in Michigan, 8,419,551 MWh of the statewide total of 101,202,605 MWh (DOE/EIA 2011b), but only 0.7 percent, 563,510 MWh, of the 82,787,341 MWh of electricity generated by electric utilities. Like coal-fired power plants, natural gas-fired plants are sources of criteria pollutants and GHGs and are subject to emission-limiting regulations promulgated under the CAA and analogous State legislative directives, although they emit markedly fewer criteria pollutants and GHGs per unit of energy produced than comparably sized coal-fired plants. The technology most likely to be employed in a natural gas-fired alternative is “combined cycle.”

NGCC power plants differ significantly from coal-fired and existing nuclear power plants. They derive the majority of their electrical power output in the primary power cycle, a gas combustion turbine (CT), without the production of steam. Additional power is generated by recovering latent heat from gases exiting the CT delivered to a heat recovery steam generator (HRSG), with the resulting steam subsequently directed to a conventional Rankine cycle STG set, the secondary power cycle. Power resulting from this secondary cycle is completely pollution-free since it involves no fuel combustion, although management of the steam cycle does introduce a small internal load. This “combined cycle” approach provides significantly greater thermal efficiency than any single cycle system, with overall thermal efficiencies routinely attaining 60 percent (as compared to typical thermal efficiencies of coal-fired plants using only Rankine

Table 9-2. Summary of Environmental Impacts of a Coal-Fired Power Generation Alternative

Impact Category	Impact	Comment
Air Quality	MODERATE	SO_2, 2719 tons/yr
		NO_x, 3353 tons/yr
		CO, 1618 tons/yr
		$PM_{filterable}$, 208 tons/yr
		$PM_{2.5}$, 48 tons/yr
		Small, unquantified amounts of hazardous air pollutants, including mercury.
		CO_2, 12.1 million tons/yr (without CO_2 removal).
		Air quality impacts will be mitigated by emission limits contained in operating permits.
Waste Management	MODERATE	CCR waste volume projections include 416,918 tons/yr of ash that would be recovered as bottom ash or fly ash; with 50 percent of the recovered amount (208,251 tons/yr) recycled and an equal amount requiring disposal annually.
		SO_2 scrubber sludge projected generation of 110,310 tons/yr, 90 percent of which is projected for recycling, leaving 11,031 tons/yr requiring disposal.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Water Use and Quality	SMALL	Impacts would be less than the impacts for Fermi 3 due to lesser heat rejection demands.
Ecology	SMALL (aquatic) to MODERATE (terrestrial)	Expected to require disturbance of substantially greater areas of natural habitat, including wetlands, on the Fermi site, as well as result in habitat losses in offsite areas on contiguous parcels.
		Offsite areas used for CCR disposal are expected to be already in use as disposal facilities to which the local ecology has already adjusted.

Table 9-2. (contd)

Impact Category	Impact	Comment
Ecology (contd)		Impacts on aquatic ecology from operation of the cooling system would be comparable to those anticipated from Fermi 3 and would be SMALL. Impacts on terrestrial ecology from cooling tower drift would be comparable to those anticipated from Fermi 3. Additional impacts on terrestrial ecosystems are associated with coal mining and construction of onsite areas for temporary storage of CCR and other operation-related solid wastes.
Noise	MODERATE	Continuous and intermittent noise would be created by mechanical equipment associated with normal plant operations, mechanical cooling towers, coal handling, solid waste disposal, and coal and limestone deliveries.
Land Use	MODERATE	Onsite land requirements for the power block and cooling system would be substantially greater than the requirements for Fermi 3. Additional onsite and possibly some offsite land areas would be required for storage of coal and temporary storage of CCR and other operation-related wastes. Approximately 41,492 ac would be required to mine the required amount of coal. Substantial land areas may be required for the permanent disposal of CCR and scrubber sludge that cannot be recycled. Offsite land requirements for transmission would be comparable to or the same as those for Fermi 3.
Socioeconomics (economy and taxes)	SMALL to LARGE (beneficial)	Increased economic activity from new jobs and spending in the region would stimulate economic growth and tax revenues. Local property tax base would benefit mainly during operations to an extent slightly less than is expected for Fermi 3, due to the smaller operating workforce expected. This stimulus would be SMALL beneficial for all areas except for property tax impacts in Monroe County, which would be LARGE beneficial.

Table 9-2. (contd)

Impact Category	Impact	Comment
Socioeconomics (all other areas)	SMALL to MODERATE	Construction-related impacts would be limited and temporary. Construction workforce projected at 2500; likely to originate primarily from the Detroit and Toledo MSAs. Impacts on local communities with regard to housing and services are expected to be short term, SMALL and adverse for construction and SMALL and adverse for operation. Traffic-related impacts will be greatest during peak construction employment periods, which the review team has determined would constitute a short-term, MODERATE, adverse impact. Cumulative impacts from traffic result from the simultaneous commuting to the site by three separate workforces during certain periods: coal plant construction, Fermi 2 operation, and Fermi 2 refueling, as well as from non-Fermi-related traffic. The plant and new transmission line would have aesthetic impacts comparable to those anticipated for Fermi 3. The aesthetic impact would be SMALL and adverse, since the Fermi site is already industrialized.
Environmental Justice	SMALL	Impacts are expected to be similar to those evaluated for the nuclear alternative. No disproportionate adverse impacts were identified.
Historic and Cultural Resources	MODERATE	Impacts onsite would be similar to the nuclear alternative. Demolition of the NRHP-eligible Fermi 1 would result in adverse impacts on a historic resource, which would be mitigated. Some of the facility and supporting infrastructure would be built on previously disturbed ground onsite, but additional previously undisturbed onsite and offsite areas that may be required may not have been surveyed for resources.

cycle STGs of 39 percent) (Siemens 2007; NETL 2010). Because the natural gas-fired power plant alternative derives much of its power from a gas turbine without production of steam and because it has greater thermal efficiency than either the coal-fired power plant alternative or the proposed Fermi 3 reactor, it requires significantly less cooling.

Typical powertrains for large-scale NGCC power generation would involve one, two, or three CTs operating simultaneously, with the heat extracted from each directed to one HRSG

(commonly known as a "1 × 1," "2 × 1," or "3 × 1" configuration, respectively). CTs, HRSGs, and STGs are available in a wide variety of sizes and can be configured in a variety of powertrain configurations to attain virtually any desired level of net power production. To complete the assessment of an NGCC alternative, the review team presumed that appropriately sized CTs HRSGs, and STGs would be assembled in appropriate powertrain configurations to produce net electrical power virtually equivalent to the 1535 MW(e) proposed for Fermi 3. Because NGCC plants can be expected to operate at a capacity factor of 85 percent, power equivalency to the Fermi 3 reactor in terms of the equivalent amount of electricity delivered to the grid would be 1661 MWe.

Although operation of the NGCC plant introduces some parasitic loads, unlike coal-fired plants, the resulting performance penalty is relatively minor, and no adjustments have been made to calculations of NGCC operational impacts to account for parasitic loads. In addition, given the significant uncertainty regarding the details of any CCS and when such controls might be required, the review team did not include parasitic losses from CCS in its calculations.

The review team further assumed that 75 percent of the net power produced (1246 MW) would result from the operation of the CTs, with the remainder (415 MW) resulting from operation of the HRSG-STG powertrains; the CTs are Advanced F-Class designs equipped with water or steam injection as a precombustion control to suppress NO_x formation and selective catalytic reduction (SCR) (ammonia introduction) for postcombustion control of NO_x emissions.[(a)] The facility would use natural gas meeting interstate pipeline specifications[(b)] and would operate at a capacity factor of 85 percent, with load factors for the CTs greater than 80 percent, thermal efficiencies of the CTs of 42 percent, and an overall facility thermal efficiency of 60 percent. The facility would consume 73,900 million ft^3 of natural gas to produce 12,400 GWh of power annually.

Air Quality

A review of the status of ambient air quality at the Fermi site is provided in Section 9.2.2.1. The following sections provide brief overviews of the Federal and State regulations that would apply to the NGCC alternative operating at the Fermi site and also evaluate the impacts of construction and operation of a NGCC alternative.

(a) SCR involves introducing ammonia into the exhaust ducts of the CTs, where it combines with NO_x in a nickel catalyst bed to form zero-valent nitrogen and water. Referring to data provided by the Institute of Clean Air Companies, EPA acknowledges that typical SCR devices can demonstrate removal efficiencies of between 70 and 90 percent (EPA 2000b).

(b) Interstate pipeline specifications for natural gas include chemical composition (volume percent): CH_4, 93.9; ethane, 3.2; propane, 0.7; *n*-butane, 0.4; CO_2, 1.0; and nitrogen, 0.8; and higher heating value, 22,792 Btu/lb (1040 Btu/standard ft^3); lower heating value, 20,552 Btu/lb (939 Btu/ standard cubic foot); and average value, 1020 Btu/standard ft^3. EPA further defines "pipeline natural gas" as having sulfur content less than 0.6 grains/100 standard ft^3.

Air Pollution Controls Regulations in Michigan Applicable to an NGCC Alternative

Federal and State regulations in Michigan are discussed in Section 9.2.2.1 with respect to a coal-fired alternative. Except as noted below, the majority of those requirements would also apply to a NGCC alternative operating at the Fermi site. A new natural gas-fired generating plant would qualify as a new major source of criteria pollutants and would be subjected to Prevention of Significant Deterioration of Air Quality Review under requirements of CAA and Michigan State regulations. As such, it would need to comply with the NSPS for NGCC plants set forth in 40 CFR 60 Subpart Da: particulate matter and opacity (40 CFR 60.42(a)), SO_2 (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)). The new NGCC generating plant would qualify as a major source because its PTE is greater than 100 tons/yr of criteria pollutants and its CO_2 is greater than 75,000 tons/yr, and would be required to secure a Title V operating permit from MDEQ. However, although new permits issued after January 2011 must address GHG emissions and require the permittee to report them, regulations specifically requiring carbon capture and sequestration have not been promulgated. A new NGCC plant in Michigan would also be subject to the CSAPR finalized by EPA on July 6, 2011.

The combustion turbines of the combined cycle plant would be subject to EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR 63, Subpart YYYY) if the NGCC was a major source of HAPs (having the potential to emit 10 tons/yr or more of any single HAP or 25 tons/yr or more of any combination of HAPs (40 CFR 63.6085(b)). In December 2000, EPA published its determination that HAPs such as arsenic, formaldehyde, and nickel could be emitted from natural gas-fired electric utility-scale steam generating units (i.e., natural-gas-fired boilers), but that such emissions were negligible, making regulations directed at their control neither appropriate nor necessary (65 FR 79825). However, this interpretation does not automatically extend to natural-gas-fired combustion turbines.

Estimated Impacts on Air Quality from the Construction of a NGCC Alternative

Construction of a NGCC power plant would result in the release of various criteria pollutants from the operation of internal combustion engines in construction vehicles and equipment, delivery vehicles, and vehicles used by the commuting construction workforce. Volatile organic chemical releases will also result from the onsite storage and dispensing of vehicle and equipment fuels. Onsite and offsite (e.g., pipeline) activities would also generate fugitive dust and equipment-related criteria pollutants. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction industry best practices (including development and execution of an appropriate fugitive dust control plan) would mitigate such impacts. Construction-related impacts on air quality from an NGCC alternative would be of relatively short duration and would be SMALL.

Estimated Impacts on Air Quality from the Operation of a NGCC Alternative

Operation of the NGCC alternative would result in the release of modest amounts of criteria pollutants, hazardous air pollutants, and GHGs, principally CO_2. As with the coal-fired alternative discussed above, particulate drift would also be released from either an NDCT or an MDCT that would provide cooling for the steam in the secondary power cycle. As noted in Section 9.2.2.1, Detroit Edison estimates drift releases from plant cooling towers that would support the proposed reactor to be 8.47 tons/yr. Because the cooling demands of a NGCC facility of equivalent capacity are significantly lower than those of a nuclear reactor, those estimates represent a bounding condition for either cooling tower alternative of a NGCC alternative.

In its application, Detroit Edison identified a 1500-MW(e) natural-gas-fired alternative and estimated that such a plant equipped with appropriate pollution control technology would have approximately the following emissions:

- SO_2, 41 tons/yr
- NO_x, 3800 tons/yr
- CO, 1600 tons/yr
- PM, 290 tons/yr
- CO_2, 4,800,000 tons/yr (without CCS).[(a)]

The review team's estimates of emissions from a 1661-MW(e) NGCC facility, based on emissions factors provided in EPA AP-42 (EPA 1998), are shown in Table 9-3.

The emissions from the NGCC alternative would be significantly less than those from the coal-fired alternative. The impact of the emissions from the NGCC plant would be noticeable but would not be sufficient to destabilize air resources. Overall, the review team concludes that the air quality impacts resulting from the construction and operation of a new NGCC plant located at the Fermi site would be SMALL to MODERATE.

Waste Management

In the GEIS for license renewal, the staff concluded that waste generation from natural-gas-fired technology would be minimal (NRC 1996). During construction of a new natural-gas-fired power plant, land clearing and other construction activities would generate waste that could be

(a) The Detroit Edison analysis defined a different nameplate capacity and a different configuration for the natural gas alternative evaluated in the ER than the review team presents here. Consequently, Detroit Edison's projected air emissions are not directly comparable to those presented in this analysis.

Table 9-3. Estimated Emissions (in tons/yr) from a 1661-MW(e) (net) NGCC Alternative[(a)]

Pollutant	Annual Uncontrolled Emissions	Annual Controlled Emissions	Notes
SO_2	128	128	Emission factor of 0.0034 lb/MMBtu; 99 percent SO_2 and trace amounts of SO_3;assumes no H_2S formation.
NO_x	4900	490	Emission factor of 0.13 lb/MMBtu; assumes water-steam injection and 90 percent conversion in SCR.
Particulate[(b)]	249	249	Emission factor of 0.0066 lb/MMBtu, all as PM_{10}
CO	1130	1130	Emission factor of 0.03 lb/MMBtu; assumes 95 percent conversion of carbon in fuel.
N_2O	113	113	Emission factor of 0.003 lb/MMBtu
VOC	79	79	Emission factor of 0.0021 lb/MMBtu
CO_2	4.15 million	4.15 million	Emission factor of 110 lb/MMBtu; assumes 95 percent conversion of carbon in the fuel and no CCS in place.

(a) Combustion of natural gas also releases other GHGs, such as CH_4 and N_2O, so that the total GHG emission is typically represented as CO_2-e. However, CO_2 predominates, and for simplicity, contributions of CH_4 and N_2O were ignored in the calculations.

(b) Although expected to be relatively minor, particulate emissions from the CT cannot be specified with precision at this time. Consequently, the estimates presented do not include CT particulate emissions.

recycled or shipped to an offsite waste disposal facility. A small fraction of the anticipated construction-related wastes would exhibit hazardous characteristics that would require special handling, treatment, or disposal. Because Detroit Edison believes that the NGCC alternative and ancillary facilities could be constructed largely on previously disturbed portions of the Fermi site, the amounts of wastes produced during land clearing of native vegetation would be minimal.

During NGCC operation, spent SCR catalysts used to control NO_x emissions from the CTs would make up the majority of the waste generated under this alternative. Such wastes might exhibit hazardous characteristics that dictate special handling and disposal. All disposals of spent catalysts would be expected to occur at existing offsite facilities. Small amounts of wastes would result from the treatment of cooling water in circulating systems and from typical maintenance and cleaning operations. Overall, the review team concludes that waste impacts from natural gas-fired power generation would be SMALL.

Human Health

Like the coal-fired power plant alternative discussed above, an NGCC plant would emit criteria air pollutants but in lesser quantities. Human health effects of gas-fired generation are generally low, although in Table 8-2 of NRC (1996), the NRC staff identified cancer and emphysema as

potential health risks from gas-fired plants. NO_x emissions contribute to ozone formation, which in turn contributes to human health risks. Emission controls on this gas-fired alternative can be expected to maintain NO_x emissions well below air quality standards established for the purposes of protecting human health (the primary NAAQS), and emissions trading or offset requirements mean that overall NO_x releases in the region would not increase. Health risks to workers might also result from handling spent catalysts that might contain heavy metals.

Overall, human health risks to occupational workers and to members of the public from gas-fired power plant emissions sited at the Fermi site would be less than the risks described for the coal-fired power plant alternative and would likely be SMALL.

Climate Change-Related Impacts

This section presents anticipated impacts on climate change from the construction and operation of the NGCC alternative.

Because construction of an NGCC alternative would occur over a shorter period of time and involve a smaller workforce than Fermi 3, the construction-related GHG emissions for Fermi 3 (see Section 4.7.1) are considered to be a bounding condition, and there would be fewer GHG emissions from construction of the NGCC alternative. The impact on climate change from the construction of a NGCC alternative would be SMALL.

Of the 214.7 MMT of energy-related CO_2-e emissions in Michigan in 2005, 2.38 MMT was related to in-state electricity production using natural gas (CCS 2008). The U.S. total GHG emissions and total emissions of CO_2 from combustion of fossil fuels for electricity production in 2005 were 7108.6 MMT and 2381 MMT, respectively (EPA 2009a). Thus, the Michigan total GHG emissions from combustion of natural gas for electricity production accounted for 0.033 percent of the nationwide total GHG emissions and approximately 0.10 percent of the nationwide total CO_2 emissions related to electricity production using fossil fuels.

EIA reports that the total GHG emissions in the United States in 2007 were 7282.4 MMT of CO_2 equivalents ($MMTCO_2$-e), a growth of 1.4 percent from 2006. Of this amount, 5916.7 $MMTCO_2$-e (81.2 percent) was CO_2, 699.9 $MMTCO_2$-e (9.6 percent) was CH_4, and 383.9 $MMTCO_2$-e (5.3 percent) was N_2O (DOE/EIA 2008). CO_2, CH_4, and N_2O emissions would all result from the operation of an NGCC facility. Both N_2O and CH_4 (which is the primary component of pipeline natural gas) are also potent GHGs with global warming potentials in a 20-year time horizon that are 310 and 21 times as great as CO_2, respectively (EPA 2009a). However, only insignificant amounts of N_2O are released from CT operation, and significant emissions of natural gas would result only through incomplete combustion and/or fuel supply system leaks and are therefore presumed to be improbable. As noted above, an estimated 95 percent of the carbon contained in the natural gas being combusted would be converted to CO_2.

As discussed above, the review team estimates that 4.15 million tons/yr (3.76 MMT/yr) of CO_2 would result from the operation of a natural-gas-fired alternative. The power produced by the Fermi 3 reactor that might otherwise have been generated by a natural-gas-fired alternative represents GHG emissions avoided. Consequently, operation of the Fermi 3 reactor instead of a natural-gas-fired alternative would result in the net savings of 4.15 million tons/yr (3.76 MMT/yr) of CO_2.[(a)] This amount represents approximately 3.04 percent and 0.02 percent of the total anthropogenic GHGs related to electricity production emitted in Michigan and in the United States, respectively, in 2005.

Although any single project would be inconsequential when compared to global GHG emissions, the review team doesn't believe that this is the correct way to measure the impacts. A 3 percent increase in emissions from electricity production within the State cannot be construed as undetectable. The review team concludes that the impacts on GHG concentrations in the atmosphere from the operation of an NGCC alternative would be SMALL to MODERATE.

Groundwater Use and Quality

No groundwater is expected to be used in the construction or operation of the NGCC alternative. Some foundation excavations may intrude on groundwater zones and require dewatering while they are being constructed. Surface water drainage from active construction sites could contain contaminants that could affect groundwater, but major construction sites would be required to have an SWPPP general permit that would preempt such adverse impacts. Otherwise, no impacts on groundwater quality would be expected. The impact of the natural gas-fired alternative on groundwater would be SMALL.

Surface Water Use and Quality

During construction, production of concrete and other construction activities would result in consumption of minimal amounts of surface water, presumably acquired from Lake Erie. Ground disturbance might result in some impacts on surface water quality in the form of increased sediment loading to stormwater runoff from active construction zones; however, an SWPPP general permit is expected to require BMPs that would prevent or significantly mitigate such impacts. The impacts on water quality from sedimentation during construction of a natural-gas-fired plant were characterized in NUREG-1437 as SMALL (NRC 1996).

The NGCC alternative would be expected to use a closed loop cooling system virtually identical to the one proposed for Fermi 3, employing either MDCTs or NDCTs. During operation, Lake

(a) Figures presented here represent CO_2 emissions directly related to energy production. Although it is estimated that a nuclear reactor will generate 7700 tons/yr of CO_2-e (see Table 5-22), those releases are the result of routine preventive maintenance of fossil-fueled emergency generators and routine operation of ancillary equipment using fossil fuels and not the direct result of the operation of the reactor. No GHGs are emitted from reactor operation.

Erie would provide the water source for cooling and other industrial applications and would receive blowdown from the cooling tower, while industrial wastewaters would be discharged to the sanitary sewer under a treatment agreement with the municipal treatment facility that currently serves the Fermi site. Discharges to Lake Erie would be controlled by an NPDES permit. Discharges to the sanitary sewer would be controlled by a pretreatment agreement with the operator of the sewage treatment plant accepting the discharges. However, only the steam produced in the HRSGs and exhausted from the Rankine cycle STGs would require cooling. Consequently, because the majority of power would be produced by the CTs, which require no cooling, the cooling system would use less water than has been projected for Fermi 3. The slightly lower operating temperatures and relatively high thermal efficiencies of an NGCC plant would also result in smaller cooling water requirements than those of the comparably sized nuclear plant. NRC also noted in NUREG-1437 that the impacts on water quality from operations would be similar to, or less than, the impacts from other generating technologies. The review team concludes the impact on surface water from construction and operation of a NGCC alternative would be adequately controlled by permits and would, therefore, would be SMALL.

Aquatic Ecology

As noted above, Lake Erie would be the primary source of water to support the construction and operation of the NGCC alternative. Impacts on aquatic ecosystems during construction would be minimal due to the relatively small amount of water required (compared to the volume of water in Lake Erie) and controls on the quality of surface water discharges imposed by a SWPPP permit issued by MDEQ. Impacts on aquatic ecosystems during operation would be less than the projected impacts from Fermi 3 operation because of expected smaller heat rejection demands, and would take the form of both impingement and entrainment impacts associated with water withdrawals to support the cooling system, as well as thermal impacts associated with blowdown discharges from that cooling system (which may be required to undergo treatment prior to discharge). All such impacts would be controlled by an NPDES permit issued by MDEQ. The review team concludes, therefore, that impacts on aquatic ecology from the construction and operation of a NGCC alternative would be SMALL.

Terrestrial Ecology

Detroit Edison estimates that a 1600-MWe natural-gas-fired (closed cycle) alternative would require approximately 176 ac of land for permanent structures, not substantially different than the estimated 155 ac of land required for a nuclear facility.[(a)] It is unclear whether permanent or temporary wetland impacts would be necessary on the site, but the review team believes that

(a) As noted above, Detroit Edison estimates for impact land area were based on a hypothetical 1600-MW(e) plant, rather than the 1661-MW(e) plant assumed for this assessment. The differences in land requirements are, however, negligible.

the onsite wetland impacts would be similar to those for a nuclear facility. The review team believes that the footprint of the natural gas plant considered here would be generally the same size as the conventional natural gas boiler envisioned by Detroit Edison, and therefore concludes that sufficient land area would available on the Fermi site to accommodate its natural gas alternative. Although the review team does not know exactly how much natural habitat on the Fermi site would have to be disturbed, it expects that the overall onsite terrestrial ecological impacts would be generally similar to those resulting from a nuclear facility.

The transmission line for a gas facility on the Fermi site would result in the same forest and wetland impacts as a transmission line for a nuclear facility. However, Detroit Edison estimates that an additional 200 ac would be disturbed to build the 10-mi natural gas pipeline needed to connect the Fermi site to the existing natural gas pipeline infrastructure. Although some of the affected land would be agricultural fields, where impacts would be largely temporary, installing the gas pipeline could require some forest clearing and fragmentation, as well as temporary disturbance of wetlands. Forest cover in the pipeline corridor, including wetlands in the corridor, would have to be kept clear during operation of the pipeline. The forest and wetland impacts from the gas pipeline would not be necessary for a nuclear facility.

Detroit Edison offered no estimates for additional land potentially needed for a new or upgraded compressor station. Given the large amount of agricultural land in the area, it is reasonable to conclude that a compressor station could be located on agricultural land, thereby minimizing terrestrial ecological impacts. Additional offsite impacts would occur at the locations where natural gas is extracted. In NRC (1996), the NRC staff estimated that approximately 3600 ac would be needed for a natural gas well field of sufficient size to support a 1000-MW(e) gas-fired plant. Correspondingly, a 1661-MW(e) facility would require approximately 6000 ac of gas well field. Existing natural gas fields would initially be expected to provide the necessary amount of gas for this facility. However, operation of the NGCC plant would contribute to a cumulative increase in the demand for gas, thereby contributing to a need to develop and exploit new gas sources.

Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. These impacts would be similar to but somewhat less than those that are now occurring from the operation of Fermi 2 and those that would result from operation of Fermi 3. As noted in Section 5.3.1, the terrestrial ecological impacts from cooling tower drift from Fermi 3 would be minimal.

Based on the above analysis, the review team concludes that impacts on terrestrial resources from the construction and operation of a NGCC alternative would be SMALL to MODERATE, similar to the impacts for the proposed nuclear unit. In addition to the onsite and transmission line impacts, as well as impacts from gas field development, impacts would also result from installation and maintenance of a new gas supply pipeline along an as-yet-unspecified route.

Noise

The construction-related noise sources for an NGCC alternative would be virtually the same as those for construction of the coal-fired alternative. However, the construction period for the NGCC alternative would be shorter and the construction less extensive (i.e., no facilities needed for management of coal and only limited facilities needed for management of operational wastes). Consequently, with construction-related noise for the coal-fired alternative as a bounding condition, the review team concludes that construction-related noise associated with the NGCC alternative would be SMALL.

Operation-related noise for the NGCC would be less than operation-related noise for the coal-fired alternative, because outdoor fuel-handling activities would not occur, outdoor waste-handling activities would be limited and there would be few, if any, rail deliveries of emissions control materials. Pipelines delivering natural gas fuel could be audible offsite near gas compressor stations, but such sound impacts would be similar to impacts already occurring in the vicinity of the existing pipeline to which the Fermi site would connect. The review team concludes that operation-related noise from the NGCC alternative would be SMALL.

Land Use

The analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a NGCC power plant at the Fermi site.

Detroit Edison estimated that approximately 176 ac of land would be permanently needed to support a natural-gas-fired alternative to Fermi 3, not substantially different than the 155 ac required for Fermi 3 (but presumably in approximately the same location).[(a)] Detroit Edison also indicated that an area of sufficient size in a previously disturbed area of the site was available for the natural gas plant, thus minimizing the amount of disturbance in undeveloped portions of the site (Detroit Edison 2011a). Detroit Edison stated, however, that it could not estimate the additional land requiring temporary disturbance during construction of the gas-fired plant (Detroit Edison 2011a). The review team does not believe that the additional land temporarily required would be substantially greater than that estimated for the nuclear Fermi 3 plant. The resulting onsite land use impacts from construction would therefore be minor. Impacts on wetlands and prime farmland on the Fermi site, as well as on lands on the site managed as part of the DRIWR, would likely be no greater than described for Fermi 3, and hence minor.

In addition to onsite, land would be required offsite for natural gas pipelines and gas wells. This would include land for a new 10-mi-long pipeline segment connecting the site to existing natural

(a) Detroit Edison land estimates were based on a hypothetical 1600-MW(e) plant, rather than the 1661-MW(e) plant assumed for this assessment. The differences in land requirements are, however, negligible.

gas distribution infrastructure. A new or expanded compressor station may also be required. Detroit Edison estimates offsite land impacts from the gas pipeline and compressor station to total 200 ac (Detroit Edison 2011a). The review team expects that at least some wetlands and prime farmland would be temporarily disturbed to install the pipeline.

In the GEIS (NRC 1996), the staff estimated that approximately 3600 ac would be needed for a natural gas well field of sufficient size to support a 1000-MW(e) gas-fired plant (NRC 1996). The 1661-MWe NGCC plant considered here would require more gas than the 1000-MWe reference plant evaluated in the GEIS, although that may not necessarily result in a proportional increase in land area for the gas field. Detroit Edison estimates that 5760 ac would be required to support the 1600-MWe natural gas alternative it evaluated. Although natural gas is widely available throughout the Detroit Edison service territory, it represented only 8.3 percent of the electricity generated in the State in 2009 (DOE/EIA 2011b).[(a)] The 12.4 million MWh of electricity that would be produced by a 1661-MWe NGCC power plant would be a substantial increase over the 8.4 million MWh of electricity produced from natural gas in 2009. The review team concludes that the impacts on land use from onsite activities and the 10-mi pipeline would be minor. It isn't clear to what extent well fields might have to be expanded. However, inasmuch as most of the land around wells can be used for other purposes (e.g., grazing livestock), the review team concludes that these impacts may also be minor.

The EIA reported that flow of natural gas into Michigan through 2007 amounted to 4820 million ft^3/day , but delivery capacity into Michigan by existing interstate transmission pipelines was 9347 million ft^3/day (through 2008), an unused delivery capacity of 4527 million ft^3 (DOE/EIA 2011c). As noted earlier, the NGCC alternative is projected to consume 73,900 million ft^3 of natural gas annually, or a daily average of 202 million ft^3. The NRC review team concludes, therefore, that the existing interstate natural gas pipeline transmission infrastructure has sufficient, uncommitted capacity to accommodate a new NGCC facility without significant expansion. The review team further concludes that regardless of the interstate pipeline by which natural gas enters Michigan, the interstate and intrastate transmission pipeline infrastructures in Michigan are sufficiently complex that the required amount of gas could be delivered to the Fermi site. However modifications to the existing network (increasing flow capacity in certain segments, adding compressor stations) may nevertheless be required to ensure natural gas is provided to the Fermi site with sufficient flow and pressure to support the NGCC alternative.

Offsite land impacts for transmission lines would be minimal, since the NGCC plant is expected to connect to the ITC*Transmission* Milan Substation in existing transmission corridors owned by ITC*Transmission*. The review team expects that a gas-fired power plant at the Fermi site would require building the same transmission lines following the same route proposed for Fermi 3.

(a) However, Detroit Edison notes in its ER that natural gas power plants represent as much as 29 percent of the State's generating capacity (Detroit Edison 2011a).

The transmission line impacts would be equivalent to those anticipated from the proposed Fermi 3 reactor.

Overall land use impacts from construction of a gas-fired power plant on the Fermi site would be SMALL; modifications to the existing pipeline infrastructure would also result in minor offsite land impacts; however, offsite land impacts would increase if expanded natural gas extraction activities were necessary to meet increased demand of the NGCC alternative.

Socioeconomics

Socioeconomic impacts are defined in terms of changes to the baseline demographic and economic characteristics and social conditions of a region, especially resulting from the creation of new jobs. Three types of job creation would result: (1) direct construction-related jobs, which are short term and less likely to have a long-term socioeconomic impact; (2) direct operation-related jobs in support of power plant operations and maintenance, which have the greater potential for permanent, long-term socioeconomic impacts; and (3) indirect jobs created by the economic stimulus of new workers and new jobs during the building and operation of the new plant. For the NGCC alternative, Detroit Edison estimates a peak employment construction workforce that would be less than the 2900 required for Fermi 3 and an operations workforce of 150. The review team finds both of these estimates to be reasonable and has used them to support its own analysis of socioeconomic impacts.

The review team expects the construction and operations workforces for an NGCC alternative at the Fermi site would be drawn from the same communities as those for the coal-fired alternative. The review team expects that the impacts on the local economy from construction and operation of an NGCC alternative would be less than the impacts for the proposed Fermi 3 reactor, because the NGCC alternative would require smaller construction and operations workforces and a shorter construction period, and have a much lower construction cost. Impacts on local tax bases, including property taxes, are expected to be SMALL and beneficial, except that the property tax impacts in Monroe County would be MODERATE and beneficial. Likewise, given the review team's assumptions regarding the distribution of construction and operations workers, the review team also expects the impacts on local infrastructure (e.g., housing, schools, and utilities) are likely to be SMALL and adverse for all areas in the 50-mi region.

Traffic

Traffic impacts associated with construction of the NGCC alternative would result from commuting construction and operating workforces and truck and rail deliveries of construction materials to the Fermi site. As noted above, the construction workforce for the NGCC alternative would be smaller than that projected for Fermi 3, and the construction period would be substantially shorter. Some major NGCC plant components, such as CTs and STGs, are

likely to be delivered by rail via the existing onsite rail spur. Pipeline construction and modification of existing natural gas pipeline systems could also have a temporary impact on local traffic, especially if the new pipeline segment crosses existing road or rail infrastructure. The review team determined that in aggregate, all the traffic-related impacts for the NGCC alternative during construction would be SMALL and adverse. The operating workforce for the NGCC alternative, estimated by Detroit Edison to be approximately 150 full-time workers, would be substantially smaller than the workforce projected for Fermi 3 operation. Some equipment and material deliveries are expected to continue throughout operation, but traffic-related impacts from such deliveries would be negligible. The review team therefore concludes that the overall traffic-related impacts during operation would be SMALL and adverse.

Aesthetics

The aesthetics impact analysis focuses on the degree of contrast between the natural-gas-fired alternative and the surrounding landscape and the visibility of the natural-gas-fired plant. However, because there already is industrial activity on the site associated with operation of Fermi 2, the contrast between a natural-gas-fired power plant at the site and the rural surroundings is dramatically reduced.

The power block of the NGCC alternative (the turbine building) would have an appearance similar to the power block and containment building of the existing nuclear plant. Likewise, the NGCC NDCT, which is expected to be similar in appearance to that proposed for Fermi 3 cooling towers, would generate a condensate plume visible from great distances during certain meteorological conditions. The plume's visual impact would be additive to a similar plume emanating from the existing NDCTs for Fermi 2.

The NGCC cooling towers would each have an exhaust stack (or might share a common stack) that would be higher and more prominent than the offgas stack for the proposed Fermi 3. Given their expected height, the exhaust gas stacks of the NGCC alternative would also likely require lighting to comply with Federal Aviation Administration (FAA) regulations. The transmission lines supporting the NGCC plant would be the same as those proposed for Fermi 3 and would, therefore, have identical aesthetic impacts. Because transmission lines run from the Fermi site to support Fermi 2, the impacts of the NGCC alternative's transmission lines would be minimal.

In general, aesthetic changes would be limited to the immediate vicinity of the Fermi site and would likely be generally similar to impacts already occurring as well as similar to those expected from the proposed nuclear plant. Given the current industrial character of the Fermi site, aesthetic impacts of an NGCC alternative would be SMALL and adverse.

Environmental Justice

The review team expects the environmental justice impacts of construction and operation of a NGCC power plant at the Fermi site would be similar to, but smaller than, those resulting from the construction and operation of Fermi 3 (see Sections 4.5 and 5.5 of this EIS for a detailed discussion of these impacts) or the coal-fired alternative discussed in the previous section. These impacts are judged to be SMALL.

Historic and Cultural Resources

As is the case for the coal-fired alternative, impacts on historic and cultural resources would occur because of the presence of the NRHP-eligible Fermi 1 property onsite and if previously undisturbed areas of the site were disturbed during construction without having first been surveyed and any identified resources evaluated for NRHP eligibility. The review team concludes, therefore, that impacts on historic and cultural resources on the Fermi site would be MODERATE, as is the case for the coal-fired alternative. A ROW for the required new 10-mi pipeline segment has not been specified, so it is impossible to determine whether historic or cultural resources would be present along that path. The review team assumes that appropriate surveys would be completed prior to commencement of construction of a supporting natural gas pipeline segment. However, because of the adverse impacts on the NRHP-eligible Fermi 1 property, the review team concludes that impacts on cultural, historic, and archaeological resources from construction and operation of the NGCC alternative would be MODERATE, as is the case for the coal-fired alternative.

Summary of the Construction- and Operation-Related Impacts of a Natural Gas-Fired Generation Alternative

The construction and operation impacts of a natural gas-fired power generation alternative at the Fermi nuclear site are summarized in Table 9-4.

9.2.3 Other Alternatives

This section discusses other electricity-generating alternatives that have been considered by the review team for possible application as a baseload power alternative to Fermi 3. The review team's evaluation of the overall technical feasibility of such applications, as well as its conclusions about the overall environmental impacts, of each alternative are provided here. Detroit Edison has proposed a new nuclear reactor at the Fermi site for the generation of baseload electricity with a target of 1535 MW(e) net. Any feasible alternative to the proposed new reactor would also need to be capable of generating an equivalent amount of baseload power with reliability and capacity factors similar to those expected from a nuclear reactor. In performing its initial evaluation for the ER, Detroit Edison relied on the GEIS for license renewal (NRC 1996). The review team reviewed the information submitted by Detroit Edison; however,

Table 9-4. Summary of Environmental Impacts of a Natural Gas-Fired Power Generation Alternative

Impact Category	Impact	Comment
Air Quality	SMALL to MODERATE	SO_x, 128 tons/yr NO_x, 490 tons/yr CO, 1130 tons/yr Particulates, 249 tons/yr N_2O, 113 tons/yr VOC, 79 tons/yr CO_2, 4.15 million tons/yr (without CCS) The NGCC facility is a major source of NO_x, a precursor to photochemical smog; however, emission controls (water injection and selective catalytic reduction) are expected to reduce emissions to acceptable levels.
Waste Management	SMALL	Minimal construction- and operation-related wastes are projected.
Human Health	SMALL	NGCC is a source of NO_x, a precursor to photochemical smog. However, regulatory controls and oversight would reduce emissions to a level protective of human health.
Water Use and Quality	SMALL	Impacts would be smaller than the impacts for Fermi 3, due to reduced cooling demands.
Ecology	SMALL (aquatic) and SMALLL to MODERATE (terrestrial)	Potential MODERATE impacts limited to effects on eastern fox snake Impacts on terrestrial ecology and wetlands on the Fermi site would generally be similar to those from Fermi 3. Offsite parcels would be affected by construction of 10-mi natural gas pipeline. Impacts on terrestrial and aquatic ecology from operation of the cooling system would be minimal. Additional impacts would be associated with natural gas extractions if expansions of gas fields were determined to be necessary.

Table 9-4. (contd)

Impact Category	Impact	Comment
Noise	SMALL	Most noise-producing equipment is located inside the power block buildings. No outside fuel-handling activities will occur. Minor offsite noise source could be pipeline compressor stations.
Socioeconomics (economy and taxes)	SMALL to MODERATE (beneficial)	Increased economic activity from new jobs and spending in the region would stimulate economic growth and tax revenues. Local property tax base would benefit Monroe County during construction and operations, but at a lower level than the impacts characterized for Fermi 3 because of the lower property values associated with the NGCC alternative. All beneficial tax-related impacts elsewhere in the 50-mi region would also be less than for the Fermi 3 plant because of the smaller workforce needed to operate the NGCC alternative. This stimulus would be SMALL beneficial for all areas except for property tax impacts in Monroe County, which would be MODERATE beneficial.
Socioeconomics (all other categories)	SMALL (adverse)	Construction-related impacts would be limited and temporary. Construction workforce projected to be less than the 2500 required for the coal-fired alternative and the 2900 required for the Fermi 3 reactor. Operating workforce projected to be approximately 150, less than expected for the coal-fired alternative and substantially less for Fermi 3 operation. Construction workforce would be likely to originate primarily from the Detroit and Toledo MSAs.

Table 9-4. (contd)

Impact Category	Impact	Comment
Socioeconomics (all other categories) (contd)		Impacts on local communities with regard to housing and services would be expected to be short-term, SMALL, and adverse for construction and SMALL and adverse for operation. Construction-related traffic impacts will be temporary and less than those expected for Fermi 3 due to a smaller workforce and an expected shorter construction period; operation-related transportation impacts will be less due to a smaller workforce than for Fermi 3 and relatively few deliveries required to support operation. The plant and new transmission line would have aesthetic impacts comparable to those anticipated for Fermi 3. Overall increase in adverse impact on aesthetics is SMALL, because Fermi site is already industrialized.
Environmental Justice	SMALL	Impacts are expected to be similar to those evaluated for the nuclear alternative. No disproportionate adverse impacts were identified.
Historic and Cultural Resources	MODERATE	Construction activities would involve removal of some portions of NRHP-eligible Fermi 1 and would thus have a MODERATE impact on historic and cultural resources. Most of the facility and infrastructure would be built on previously disturbed ground onsite, but additional offsite areas that might be required to support a new natural gas pipeline might not have been surveyed for resources.

through an independent review, the review team has utilized information contained in the GEIS as well as more recently developed information on certain electricity-generating technologies and has determined that the other energy alternatives discussed here are not reasonable alternatives to a new nuclear unit for provision of reliable baseload power.

The review team has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the proposed site. Any attempt to assign significance levels would require speculation about the unknown site.

9.2.3.1 Oil-Fired Power Generation

In its *Annual Energy Outlook 2010*, EIA projects that electricity from oil-fired power plants will remain essentially unchanged through 2035, rising by only 0.4 percent (DOE/EIA 2010c). Oil-fired generation is more expensive than nuclear, natural-gas-fired, or coal-fired generation

options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive. The high cost of oil has resulted in a decline in its use for electricity generation. In Section 8.3.11 of the GEIS for license renewal, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land and further concluded than an oil-fired power plant would have environmental impacts that would be similar to those of a comparably sized coal-fired plant (NRC 1996).

For the preceding economic and environmental reasons, the staff concludes that an oil-fired power plant at or in the vicinity of the Fermi site would not be a reasonable alternative to construction of a 1535-MW(e) nuclear power generation facility that would be operated as a baseload plant.

9.2.3.2 Wind Power

All renewable energy accounted for 7.3 quadrillion Btu, approximately 7 percent of the 99.3 quadrillion Btu of energy consumed, in the United States in 2008. Wind accounted for 0.49 quadrillion Btu, approximately 7 percent of the total contribution of all renewable energy sources. The American Wind Energy Association (AWEA) reported that a total of 25,369 MW of wind energy capacity had been installed in the United States by the end of 2008, with 8545 MW installed just in 2008 (AWEA 2009). Texas is by far the leader in installed capacity with 2671.3 MW, followed by Iowa (1599.8 MW), Minnesota (455.65 MW), Kansas (450.3 MW), and New York (407 MW). At the end of 2008, Michigan had three operating wind farms with a collective wind energy generating capacity of 129.6 MW (AWEA 2009). AWEA also reported that in 2008, four manufacturing facilities for various wind turbine components were established in Michigan. EIA reports that the net summer capacity for wind-generated electricity in Michigan in 2008 was 124 MW and that the total amount of electricity generated by wind in 2008 was 117,000 MWh, approximately 3.1 percent of the 3,800,000 MWh of power generated from all renewables in Michigan in 2008 (DOE/EIA 2009a). Comparing the installed capacity to the amount of electricity generated yields a capacity factor of about 11 percent for the wind turbines.

At the current state of wind energy technology development, wind resources of Category 3 or better[(a)] are required to produce utility-scale amounts of electricity. Maps of wind resources produced by the DOE Office of Energy Efficiency and Renewable Energy (EERE) and its National Renewable Energy Laboratory (NREL) (DOE/EERE 2010) indicated that a large geographic area of the State along the western shore of Lake Erie, in Huron, Tuscola, and Sanilac Counties, known as the “Thumb,” possesses wind resources of sufficient value to

(a) By industry convention, wind resource values are categorized on the basis of the power density and speed of the prevailing wind at an elevation of 50 meters, from Category 1 with wind power densities of 200 to 300 W/m^2 (typically existing with constant wind speeds between 12.5 and 14.3 mph) through Category 7 with power densities of 800 to 1800 W/m^2 (wind speeds of 19.7 to 24.8 mph). Category 3 wind has a power density of 300 to 400 W/m^2 with wind speeds of 15.7 to 16.8 mph.

support utility-scale wind generation. Similarly valued wind resource areas also exist in the western part of the State along the eastern shoreline of Lake Michigan; however, only the Thumb is within the Detroit Edison service area.

Detroit Edison undertook a study to identify wind resources of sufficient strength and accessibility within its service area with which it could expand its energy generation portfolio and comply with the then-proposed Michigan Renewal Portfolio Standard (RPS) (Detroit Edison 2009a). Comparing existing wind energy maps with exclusionary factors that could preempt wind farm development, Detroit Edison determined that 500 MW of wind energy potential could be realized and economically delivered to its major load centers over the existing transmission network, but a theoretical maximum development capacity of 2800 MW could be realized with appropriate upgrades and expansions to the transmission network. As discussed below, a 2009 collaborative study by ITC*Transmission* and Wolverine Power Supply Cooperative confirmed the inadequacy of the existing 120-kV transmission system in the Thumb and estimated the costs of various options for the major upgrades to transmission system capacity that would be required to effectively exploit wind resources in the Thumb (ITC and WPSCI 2009). Detroit Edison further anticipates a 30 percent capacity factor and 95 percent turbine availability factor, suggesting reasonably attainable estimates for maximum and minimum power outputs of 7000 GWh and 1300 GWh. (For comparison, the proposed 1535-MW(e) Fermi 3 reactor, operating at an expected capacity factor of 92 percent, would be expected to produce 12,400 GWh of baseload electricity each year.)

The MPSC Wind Energy Resource Zone Board undertook its own independent assessment of wind resources within the Thumb and concluded in its final report that potential generating capacity for land-based wind farms in the Thumb was between 2367 MW and 4236 MW (depending on how exclusionary siting criteria were applied) and that maximum buildout would result in potential annual electricity production of 12,000 GWh (Michigan Wind Energy Resource Zone Board 2009). In response to a legislative directive in Michigan's Clean, Renewable and Efficient Energy Act (295 MCL 1-6) and MPSC Order U-15899,[(a)] ITC Holdings Corporation's subsidiary, ITC*Transmission*, and Wolverine Power Supply Cooperative, Inc. (WPSCI) completed a joint transmission planning study for the Thumb, concluding that the two existing relatively low-capacity 120-kV transmission lines in the Thumb were inadequate to deliver wind-generated electricity to the grid for delivery to other portions of the Michigan's lower peninsula (ITC and WPSCI 2009). On August 19, 2010, the Midwest Independent System Operator (MISO) approved a proposal by ITC*Transmission* to expand the transmission infrastructure in the Thumb by construction of approximately 140 mi of double-circuit 345-kV transmission lines and three new 345-kV substations, forming a loop through the Thumb region (ITC Holdings 2010). Under the provisions of the Clean, Renewable and Energy Efficiency Act,

(a) All documents filed with the MPSC relating to Order U-15899 are available through the MPSC Electronic Docket Web site at http://efile.mpsc.state.mi.us/efile/viewcase.php?casenum=15899&submit.x=21&submit.y=13.

ITC*Transmission* was authorized to apply to MPSC for expedited siting approval of the project (which must be accomplished within 6 months of the application date). On August 30, 2010, ITC submitted its application to MPSC for an expedited siting certificate (see MPSC case U-16200).[(a)] The Commission granted the certificate on February 25, 2011.[(b)] ITC has targeted completion of the upgrade project by 2015 but has published no firm schedules.

The Wind Energy Resource Zone Board's estimate of 12,000 GWh, together with the announced and MISO-approved plans of ITC*Transmission* to upgrade the transmission infrastructure in the Thumb and the MPSC's Expedited Siting Certificate for that upgrade, promise improved efficiency of power distribution throughout the ITC*Transmission* grid in the lower peninsula and improved viability of wind energy in the Thumb. However, the Bureau of Energy Systems of the Michigan Department of Energy, Labor and Economic Growth (MDELEG) has reported that, as of the close of 2009, only two wind farms were operative in the Thumb, with a capacity of 122 MW of wind-generated electricity (MDELEG 2010).

The lack of a firm schedule for transmission infrastructure enhancements in the Thumb, the limited generating potential in the Thumb projected by MDELEG, the uncertainty about the extent to which that potential would ultimately be realized by yet-to-be-built wind farms, the anticipated relatively low capacity factors for the turbines of those future wind farms, and the substantial land requirements for utility-scale wind farms all contribute to a conclusion by the review team that wind farms in the Thumb area would not be a feasible discrete alternative to the Fermi 3 reactor.

Wind energy technology can also be deployed in offshore locations. Land-based wind turbines have individual capacities as high as 3 MW, with the 1.67-MW turbine being the most popular size installed in 2008 (offshore wind turbines have capacities as high as 5 MW).[(c)] The capacity factors of wind farms primarily depend on the constancy of the wind resource, and although offshore wind farms can have relatively high capacity factors due to high-quality winds throughout much of the day (resulting primarily from differential heating of land and water areas), land-based wind farms have capacity factors less than 40 percent, with 30 percent typically used for planning purposes.

The Great Lakes Wind Council (GLWC), an advisory body within the then-Michigan Department of Energy, Labor and Economic Growth, was charged with providing recommendations to State

(a) All documents related to Case U-16200 can be accessed electronically at http://efile.mpsc.state.mi.us/efile/viewcase.php?casenum=16200.
(b) Three parties filed motions for stay of the Commission's February 25 Order. All three motions were denied by the Commission's Order of April 12, 2011.
(c) To date, the great majority of offshore turbine installations have occurred on the shallow continental shelves of Europe and the United States; however, it is feasible that turbines designed for offshore locations could also be installed off the shores of the Great Lakes, although current foundation technology would limit the depth of the water that could be tolerated at offshore locations.

policymakers with respect to wind energy development in Michigan. The GLWC's October 2010 report identified prime offshore locations for wind farms (Wind Resource Areas, WRAs) and provided recommendations on model legislation that would authorize implementing regulations for an offshore wind energy program in Michigan (GLWC 2010). Five WRAs were identified in the Great Lakes bordering Michigan, two of which are adjacent to the Detroit Edison service area: Central Lake Huron, out from Saginaw Bay, and southern Lake Huron, near Sanilac County. All WRAs are in waters with depths of 148 ft or less. To support mapping of the WRAs, the GLWC established 22 evaluation criteria, including sensitive or important biological habitats, commercial fishing areas, scenic vistas, military operations, national park lakeshores, State bottomland preserves, shoreline parks and wilderness, shipping lanes, underwater archaeological sites, harbors and marinas, and underwater power cables. Appropriate buffer zones were then established for each criterion.

The GLWC's recommendations for supporting legislation were submitted to the State legislature in March 2010. As of April 2012, no legislation had been proposed.[(a)]

Despite the relatively high availability factors for wind turbines, there are shortcomings to the use of wind energy as an alternative to Fermi 3; these include the following: capacity factors are much lower than desirable for baseload power; many hundreds of turbines would be required to provide equivalent amounts of power; wind farms would occupy very large areas to avoid inter-turbine interferences to wind flow through the wind farm[(b)]; and there is often poor time-of-day correlation between the periods when meteorological conditions produce high-value winds and periods of peak loads.[(c)]

One way to better ensure that maximum power production coincides with peaks in demand is to couple conventional wind technology with energy storage technologies. Pumped storage and compressed air energy storage (CAES) are two energy storage technologies that have been independently developed and that could be paired with wind energy to improve the availability and dispatchability of wind energy. Detroit Edison is co-owner (with Consumers Energy) of the Ludington Hydroelectric plant, the largest pumped storage facility in the State. During off-peak

(a) However, on March 30, 2012, representatives of various Federal agencies entered into a Memorandum of Understanding (MOU) with governors and heads of relevant agencies from the States of Illinois, Michigan, Minnesota, and New York and the Commonwealth of Pennsylvania, the main purpose of which is facilitation of offshore wind development in the Great Lakes. The MOU is designed to enhance collaboration between Federal and State authorities to speed review of offshore wind projects. The MOU can be accessed through the DOE Web site http://energy.gov/articles/obama-administration-and-great-lakes-states-announce-agreement-spur-development-offshore.

(b) However, the permanent components of wind farms, the individual turbines, electrical substations, and maintenance/control/storage buildings, occupy roughly five percent of the area of a typical wind farm, with the remaining land areas available for most other nonintrusive land uses once construction is completed.

(c) In a typical diurnal cycle, strong winds are generally not available during hot summer afternoons when peaks in power demand occur to support air conditioning loads.

periods, Ludington uses grid power to pump Lake Michigan water through six reversible turbines to a 27-billion-gal, 842-ac reservoir located on a bluff over 350 ft above the plant. Water is released during peak demand through the six turbines for a maximum capacity of 1,870 MW at a generation efficiency of more than 70 percent (Bernier 2010). However, because the Ludington facility is already part of Detroit Edison's generating portfolio and routinely provides power to Detroit Edison and Consumers Energy customers, it cannot be claimed as an alternative to Fermi 3.[(a)]

EIA reports that the Ludington pumped storage facility had an effective capacity of 1872 MW in 2009 and was responsible for 100 percent of the state's electricity from pumped storage (DOE/EIA 2011d). Section 9.2.3.4 provides additional details on hydroelectric facilities in Michigan and the potential for further development. As discussed in that section, there is limited potential for expansion of hydroelectric power, and EIA isn't projecting any growth in this energy alternative. The review team concludes that pumped storage is not likely to be available as an energy storage mechanism to couple with wind energy.

A CAES plant uses motor-driven air compressors powered by low-cost off-peak electricity to compress air, storing it in a suitable underground repository such as a salt cavern or a porous rock formation. When coupled with wind, power from the wind turbines at off-peak times would be used to drive the compressors. During high-electricity-demand periods, the potential energy contained in the compressed air is recovered by using it to support operation of a combustion turbine or using it directly to generate electricity. Experience with utility-scale CAES is limited. Only two large-scale CAES plants are currently in operation; a 290-MW facility near Bremen, Germany, and a 110-MW plant in McIntosh, Alabama, which has been operating since 1991. Both facilities use salt caverns for storage (Succar and Williams 2008), and both use the compressed air to enhance the performance of modified combustion turbines in combined cycle configurations. A number of CAES facilities have been proposed, including the Iowa Stored Energy Park near Des Moines, Iowa, a 268-MW plant that would operate in conjunction with a wind farm. The facility would use a porous rock storage reservoir for the compressed air it produces (Succar and Williams 2008). However, this project has been terminated (ISEPA 2011). Other pilot, demonstration, prototype, and research projects involving CAES have been announced, including projects in California, New York, and Texas.

At its current state of technological advancement and limited real-world experiences, CAES has been proven capable of producing fully dispatchable electricity in the range of hundreds of

(a) Consumers Energy and Detroit Edison recently announced plans for an $800 million maintenance and upgrade project for the Ludington facility that will replace existing turbines, increasing capacity to 2,172 MW. The project is expected to be completed by 2019. Consumers also announced plans for a land-based 56-turbine Lake Winds Energy Park to be located near the Ludington facility; however, necessary permits for the wind farm have not yet been secured from Mason County. For more details, see: http://www.mlive.com/business/west-michigan/index.ssf/2011/02/ludington_pumped_storage_plant.html.

megawatts consistently over tens of hours, but long-term reliability and costs are as yet undetermined. Higher levels of power generation are technically feasible with CAES but have not yet been proven. Further, the overall technical and economic feasibility of CAES is highly dependent on the existence of conveniently located appropriate geologic formations in which to store the compressed air. The review team is not aware of any evaluations of Michigan geology in areas of highest wind value for that purpose. Although CAES can enhance the value of wind as a source of baseload power, the review team concludes that the use of CAES in combination with wind turbines to reliably generate 1535 MW(e) net at an effective capacity factor of 92 percent in the Detroit Edison service territory is technically unproven at this time.

For the preceding reasons, the review team concludes that wind power is not capable of supplying baseload capacity of 1535 MW(e) net and is therefore not a reasonable alternative to the proposed project.

9.2.3.3 Solar Power

Solar technologies use the sun's energy to produce electricity. Solar power technologies include photovoltaic (PV) and concentrated solar power (CSP). In PV systems, sunlight incident on special photovoltaic materials results in the direct production of direct current (DC) electricity. Two types of CSP technology that have enjoyed the greatest technological development are the parabolic trough and the power tower. Both involve using the sun's energy to produce steam to power a conventional Rankine cycle STG. The Solar Energy Generating System (SEGS), a collection of nine parabolic trough plants in three locations in the Mojave Desert in California with a combined nameplate capacity of 310 MW, represents the earliest utility-scale solar plants in the United States (The Energy Library 2009). However, in recent years, many utility-scale CSP plants have been proposed, primarily for the desert southwest areas of southern California.[(a)] Typical solar-to-electric power plants require 5 to 10 ac for every megawatt of generating capacity (TSECO 2008). Thus, approximately 8000 to 16,000 ac would be needed for a hypothetical 1600-MW(e) solar power plant. To increase their value as baseload power sources, CSP facilities can also be equipped with thermal storage that allows production of electricity during periods when the sun is not shining. However, the addition of thermal storage capabilities dramatically increases the required size of the solar field.

All renewable energy accounted for 7.3 quadrillion Btu, approximately 7 percent of the 99.3 quadrillion Btu of energy consumed in the United States in 2008. Solar accounted for 1 percent of that total (0.0703 quadrillion Btu). Currently, the Fermi site receives approximately 4.0 kWh of solar insolation per square meter per day (kWh/m^2/day) for fixed-plate solar collectors oriented at an angle equal to the installation's latitude (NREL 2008). This is a

(a) Additional information regarding utility-scale CSP plants proposed for the desert regions of southern California can be obtained from the California Energy Commission Web site at http://www.energy.ca.gov/siting/solar/.

relatively modest value for a solar resource. Although adequate to support off-grid applications or even distributed energy systems, Michigan's solar resource would be insufficient for cost-effective generation of baseload power using PV technologies, given the current state of PV technology development and operational conversion efficiencies averaging 25 percent (although that is expected to improve with the development of inexpensive, more efficient photocells). EIA reports that in 2008 no electricity was generated in Michigan by the electric power industry using solar PV technology (DOE/EIA 2009b). As noted above, significant land areas would be required for a utility-scale PV power plant while virtually preempting all other uses for that land. In the GEIS, the NRC staff noted that, by its nature, PV solar power is intermittent (i.e., it does not work at night and cannot serve baseload when the sun is not shining), and the efficiency of collectors varies greatly with weather conditions. The PV alternative would require energy storage or backup power supply to provide electric power at night. Although development of battery storage options is ongoing, none is currently available that would provide baseload amounts of power. Given the challenges and requirements in meeting baseload requirements, the review team believes that because of its intrinsic limitation, PV solar power is not qualified as a reasonable alternative to Fermi 3.

Where PV technology captures the light energy of the sun and converts it directly to electricity, CSP typically transfers the sun's heat energy to a heat transfer fluid, subsequently using that heat to produce steam to power a conventional STG. Because CSP technology is based on heat capture and transfer, it has the intrinsic potential to store some of the captured heat in such materials as molten salt for delayed production of electricity. Thus it has the potential to overcome some of PV's inherent intermittency and is better suited to meeting the demands of baseload power. However, to do so without sacrificing nameplate capacity requires a CSP with thermal storage to have a substantially greater solar field area to allow the heat captured in that additional field area to be stored in the salt rather than used immediately to produce electricity. To improve power availability, CSP facilities often employ small-scale boilers or heaters burning conventional fossil fuels to maintain the sensible heat in the heat transfer fluid system, thus overcoming thermal inertia and allowing the CSP facility to begin producing power at or near its nameplate rating earlier in the day. CSP also relies on direct normal radiation from the sun and is therefore generally more immune to reduced capacity as a result of cloud cover than is PV technology, with capacity factors slightly greater than PV. However, because it is a thermoelectric technology, CSP requires a cooling system similar in function to those used at nuclear or fossil fuel power plants. At its current state of technology development, CSP requires approximately 5 ac of land for every megawatt of power produced. If wet closed loop cooling is used to cool the steam cycle, an amount of water equal to or greater than the amount now projected for the Fermi 3 reactor (as much as 15 ac-ft/yr/MW, or approximately 4.89 million gal/yr/MW) would also be required. The relatively modest value of solar resources within the Detroit Edison service area, the exceptionally large land area required for utility-scale power, power intermittency, and expected capacity factors all contribute to the review team's

conclusion that solar power technologies do not present a reasonable alternative to the proposed nuclear reactor.

9.2.3.4 Hydropower

Three technology variants of hydroelectric power exist in Michigan: dam-and-release, run-of-the-river, and pumped storage. Dam-and-release facilities affect large amounts of land behind the dam to create man-made reservoirs but can provide substantial amounts of power at capacity factors greater than 90 percent. Power-generating capacities of run-of-the-river dams fluctuate with the flow of water in the river, and the operation of such dams is typically constrained so as not to create undue stress on the aquatic ecosystems present. Pumped storage facilities pump water from surface water features such as lakes or rivers to higher elevations during off-peak load periods, in order to release the water during peak load periods through turbines to generate electricity.

The latest and only comprehensive statewide study of hydropower resources in Michigan, published in 1998 by the DOE Idaho National Engineering and Environmental Laboratory (now Idaho National Laboratory) (INEEL 1998), indicated that there was an estimated 613 MW of developable hydroelectric resources in Michigan at the time of the study. The INEEL study identified 86 sites on 11 major river basins: 11 with dams producing power, 53 with dams (for flood control) that were not producing power, and 22 undeveloped sites with favorable characteristics. The INEEL study determined that 64 percent of the undeveloped hydropower resources were in the St. Mary's River Basin, but that all potential sites had relatively low Project Environmental Suitability Factors, a dimensionless value calculated by a model developed for the study, which took into account the various environmental impacts that could result from development of each identified site for hydropower production. A map of hydroelectric dams in Michigan published by the Michigan Department of Natural Resources (MDNR) shows a number of hydroelectric dams within the Detroit Edison service area, but many of them have since been retired (MDNR 2003).

All three hydropower technologies are technically possible for development in Michigan; however, river characteristics, topography, and existing land uses favor run-of-the-river hydropower facilities. As stated in Section 8.3.4 of the GEIS for license renewal (NRC 1996), the percentage of U.S. generating capacity supplied by hydropower is expected to decline, because dam-and-release hydroelectric facilities have become difficult to site as a result of public concerns about flooding, destruction of natural habitat, and alteration of natural river courses. In the GEIS, the staff estimated that land requirements for dam-and-release hydroelectric power are approximately 1 million ac per 1000 MW(e) (NRC 1996). Similar land requirements can be anticipated for pumped storage facilities of equivalent capacities. Although run-of-the-river hydroelectric facilities avoid concerns for excessive land use and widespread habitat alteration, their productivity is directly affected by a number of factors; seasonal low-flow

conditions and sustenance requirements of the rivers' aquatic ecosystems can lead to temporary or extended interruptions in power production.

The resulting low annualized capacity factors suggest marginal suitability of these technologies as discrete baseload power sources. EIA's reference case in its *Annual Energy Outlook 2010* projects that U.S. electricity production from hydropower plants will remain essentially stable through the year 2035 (DOE/EIA 2010c). EIA reports that in 2008, conventional hydroelectric power in Michigan had a collective net summer capacity of 249 MW and generated 1,280,978 MWh of power, approximately 34 percent of power from all renewables in Michigan in 2008 (DOE/EIA 2009a).

Existing conventional dam-and-release and run-of-the-river hydroelectric facilities in Michigan have limited capacities compared to the Ludington Pumped Storage facility discussed above, and many in the Detroit Edison service territory have been retired. Few if any new hydroelectric facilities are expected to be built, and even with repowering of existing facilities to improve efficiency and performance, hydroelectric resources in Michigan are not sufficient to serve as a replacement for Fermi 3.

Because of the relatively low amount of undeveloped hydropower resources in Michigan, the large land use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 1535 MW(e), and the absence of announced plans for construction of new large pumped storage or dam-and-release facilities that could match Fermi 3's expected production, the review team concludes that hydropower is not a feasible alternative to the proposed Fermi 3 reactor.

9.2.3.5 Geothermal Energy

As with most renewable energy sources, value, accessibility, and availability within a geographic area determine the feasibility of geothermal energy for baseload power generation. Two geothermal energy generation technologies have been developed: "hydrothermal technology" and "hot dry rock" (HDR) technology. Hydrothermal technology involves extracting heat from hot, pressurized groundwater located in readily accessible formations relatively close to the surface. Either the heated water is pumped to the surface, where the sharp reduction in pressure allows it to flash into steam that is directed to an STG, or a heat transfer fluid is pumped into the formation in a closed loop system, where it is heated by the groundwater before being returned to the surface and its latent heat used to produce steam. The water must be at least 302°F for such systems to run efficiently. HDR, also known as engineered geothermal systems (EGS), extracts heat from dry, hot formations, first by fracturing those formations and then by circulating water through those fractures and extracting heat.

A comprehensive study by the Massachusetts Institute of Technology (MIT) concluded that geothermal energy has an average capacity factor of 90 percent and a relatively small

environmental footprint (MIT 2006). Geothermal resources can be used for baseload power generation where sufficient geothermal resources are available, but the MIT study concluded that a $300- to $400-million investment over 15 years would be needed to make early-generation EGS power plant installations competitive in the evolving U.S. electricity supply markets (MIT 2006). However, geothermal technology is not widely used as baseload power generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (DOE 2010). No geothermal energy generation currently occurs in Michigan (DOE/EIA 2009b). A map of geothermal resources in Michigan developed by the DOE shows geothermal resources exist at nominal depths of 3.7 mi and at temperatures between 212 and 302°F, marginally adequate for efficient production of baseload amounts of power. HDR geothermal resources do not exist in Michigan. Given the low quality of geothermal resources and the current stage of geothermal technology development, the review team has concluded that extant geothermal resources in Michigan cannot support utility-scale electricity generation and would therefore be an infeasible alternative to the proposed Fermi 3 reactor.

9.2.3.6 Wood Waste

In the GEIS, the staff determined that a wood-burning facility could provide baseload power and operate with an average annual capacity factor of about 70 to 80 percent and with 20 to 25 percent thermal efficiency (NRC 1996). The fuels required are variable and site-specific. Wood-to-energy technologies include direct combustion in boilers and combustion of fuels derived through gasification and pyrolysis of cellulosic materials. A significant impediment to the use of wood waste to generate electricity is the high cost of fuel delivery and high construction cost per megawatt of generating capacity. The fuel delivery impediment is being addressed by technologies that convert wood residue into high-density pellets. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Similar to coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment (plants have been constructed that simultaneously burn coal and pelletized wood wastes in the same boiler). The greatest commercial success for wood-to-energy plants has been in distributed energy production geographically close to the wood residue sources. In 2008, net generation from renewable energy technologies (excluding large hydroelectric) increased 19.9 percent, following a 9.0 percent increase in 2007. In 2008, for the first time, wind surpassed biomass (including wood) in representing the largest share of renewable generation. Wood and wood-derived fuels represented 0.9 percent of net renewable generation, accounting for 37 million MWh, down 4.4 percent from 2007 (DOE/EIA 2010d).

A study completed in 2006 by the Michigan Biomass Energy Program (Michigan Department of Labor and Economic Growth 2006) concluded that Michigan has ample wood residue resources to support wood-to-energy facilities, but determined that the most significant wood resources are located in the northern portions of the State, far removed from the Detroit Edison load centers. As of 2006, there were six combustion-based wood-to-energy utilities operating in Michigan with a combined capacity of 173 MW. Of the six wood-to-energy utilities located in the Lower Peninsula, only the Genesee Power Station in Flint, Michigan, with a rated capacity of 39.5 MW, is located close to major Detroit Edison load centers. EIA reported that in 2008, the net summer capacity for wood and wood-derived power plants in Michigan was 231 MW, accounting for the generation of 1,682,504 MWh of power, approximately 44 percent of the 3,793,896 MWh of power from all renewable sources in Michigan in 2008 (DOE/EIA 2009a).

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload power plant, the location of the majority of high-value wood resources in the State (relative to Detroit Edison's major load centers of Detroit and Ann Arbor), the typical capacities of wood-to-electricity facilities, and the ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), the review team determined that wood waste would not be a reasonable alternative to the proposed Fermi 3 reactor.

9.2.3.7 Municipal Solid Waste

In 2008, municipal solid waste (MSW) generation in the United States totaled 249.6 million tons. Of that amount, 31.6 million tons (12.7 percent) was combusted for energy recovery. The percentage of solid wastes burned for energy recovery has remained generally constant since 1990 (EPA 2009b). MSW combustors incinerate the waste and use the resulting heat to produce steam, hot water, or electricity. The combustion process reduces the volume of waste and subsequently the need for new solid waste landfills. MSW combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (RDF). Approximately one-fifth of the facilities burning MSW burn RDF (EPA 2008b). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw MSW "as is," with little or no sizing, shredding, or separation before combustion. In the GEIS for license renewal, the staff determined that the initial capital cost for municipal solid-waste plants is greater than that for comparable steam-turbine technology at wood-waste facilities because of the need for specialized waste-separation and -handling equipment for MSW (NRC 1996).

EPA estimates that, on average, air impacts from MSW-fired power plants are 3685 lb/MWh of CO_2, 1.2 lb/MWh of SO_2, and 6.7 lb/MWh of NO_x.[(a)] However, depending on the composition of the municipal waste stream, air emissions can vary greatly (EPA 2010c). MSW combustors generate an ash residue that is buried in landfills. Similar to coal combustion, both bottom ash

(a) Assumes 0.535 MWh/ton of MSW feed combusted, based on EPA emission factors contained in *Compilation of Air Pollutant Emission Factors* (AP-42) (EPA 1998).

and fly ash are formed. Pollution control equipment similar to that used in coal-fired boilers (fabric filters and/or scrubbers) is used to capture fly ash from the boiler exhaust gases, but with unsorted MSW fuel, the ash produced may exhibit hazardous characteristics and require special treatment and handling (EPA 2010c).

Estimates in the GEIS suggest that the overall level of impact from construction of a waste-fired plant would be approximately the same as that for a coal-fired power plant. In addition, waste-fired plants have the same or greater operational impacts as coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal).

The decision to burn MSW to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term as energy prices increase (and especially since landfills of sufficient size and maturity can be sources of easily recoverable methane fuel); however, it is possible that MSW combustion facilities may become attractive again.

Regulatory structures that once supported MSW incineration no longer exist. For example, the Tax Reform Act of 1986 made capital-intensive projects such as MSW combustion facilities more expensive relative to less-capital-intensive waste disposal alternatives such as landfills. Also, the 1994 Supreme Court decision *C&A Carbone, Inc. v. Town of Clarkstown, New York* struck down local flow-control ordinances that required waste to be delivered to specific MSW combustion facilities rather than to landfills that may have had lower fees. In addition, environmental regulations have increased the capital cost necessary to construct and maintain MSW combustion facilities.

Currently, approximately 86 waste-to-energy (WTE) plants operate in 24 States, processing 97,000 tons of MSW per day. Latest estimates are that 26 million tons of trash was processed in 2008 by WTE facilities. With a reliable supply of waste fuel, WTE plants have an aggregate capacity of 2572 MW and can operate at capacity factors greater than 90 percent (ERC 2010). Three MSW plants are operational in Michigan: the 68-MW Greater Detroit Resource Recovery Facility in Detroit, Michigan; the 3.7-MW Jackson County Resource Recovery Facility in Jackson, Michigan; and the 18-MW Kent County Waste-to-Energy Facility in Grand Rapids, Michigan (ERC 2010).

Given the level of WTE facility penetration into the commercial electric utility market, the small average installed size of MSW plants, and the unfavorable regulatory environment, the review team does not consider MSW combustion to be a feasible alternative to the proposed Fermi 3 reactor.

9.2.3.8 Other Biomass-Derived Fuels

In addition to wood and MSW fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). The NRC staff determined that none of these technologies have progressed to the point of being competitive on a large scale or of being reliable enough to replace a large baseload generating plant (NRC 1996). In 2008, 353 facilities were operational nationwide that burned wood and wood-derived fuels for electricity production, representing a collective nameplate capacity of 7730 MW, while 1412 facilities burned other biomass energy sources (MSW, landfill gas, sludge waste, agricultural byproducts, other biomass solids, other biomass liquids, and other biomass gases [including digester gases, methane, and other biomass gases]) for electricity production with a collective nameplate capacity of 4854 MW, an average of 3.4 MW per facility (DOE/EIA 2010e). Co-firing with coal is the most economic option for the near future to introduce new biomass power generation (presuming the infrastructure necessary to deliver biomass fuel sources to coal-fired facilities already exists). These projects require small capital investments per unit of power generation capacity. Co-firing systems can produce from 3 to 20 percent of their heat from combustion of biomass, with biomass representing from 3 to 15 MW of the facility's nameplate capacity (DOE/EERE 2004).

The review team concludes that given the relatively small capacity of biomass generation facilities and the lack of a well-developed biomass infrastructure, biomass-derived fuels (besides wood, wood-derived fuels, and MSW discussed separately above) do not offer a reasonable alternative to the proposed Fermi 3 reactor.

9.2.3.9 Fuel Cells

Fuel cells oxidize fuels without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich gas over an anode and air (or oxygen) over a cathode and separating the two by an electrolyte. The only byproducts (depending on fuel characteristics) are heat, water, and CO_2. Hydrogen can be produced from a variety of hydrocarbon resources by subjecting them to steam under pressure. Steam reforming of natural gas is the most likely source of hydrogen for fuel cells. However, steam reforming of CH_4 results in the formation of significant quantities of CO_2; the amount of CO_2 produced from steam reforming of pipeline specification natural gas would be 2.51 times the amount of hydrogen produced (NYSERDA 2010).

At the present time, fuel cells are not economically or technologically competitive with other alternatives for electricity generation. EIA projects that electricity from a 10-MW central station fuel cell power plant whose construction was begun in 2009 and that is scheduled to come on-line in 2012 will have an total overnight cost (in 2008 dollars) of $5478/kWh, compared to $3820/kWh for new nuclear, $1749/kWh for geothermal, $1966/kWh for wind (onshore),

$5132/kWh for solar thermal, and $6171/kWh for solar photovoltaic (DOE/EIA 2010a). While it may be possible to use a distributed array of fuel cells to provide an alternative to the proposed Fermi 3 reactor, it would be extremely costly to do so and would require many units and wholesale modifications to the existing transmission system. Accordingly, the review team does not consider fuel cells to be a feasible alternative to the proposed Fermi 3 reactor.

9.2.4 Combination of Alternatives

The coal-fired power plant alternative and the natural gas-fired power plant alternative discussed above are the only alternatives that individually could be reasonably expected to produce the amount of baseload power represented by the proposed Fermi 3 reactor. As discussed in Section 9.2.3, other alternatives individually would not be a reasonable alternative to the Fermi 3 plant. Nevertheless, it is conceivable that a combination of alternatives might be both technically feasible and environmentally preferable to the proposed action. There are many possible combinations of alternatives. As part of the license renewal process and pursuant to 10 CFR Part 54, NRC has already determined that comprehensive consideration of all possible combinations would be too unwieldy, given the purposes of the alternative analysis. However, the analysis of combinations of alternatives should be sufficiently complete to aid the Commission in its analysis of alternative sources of energy pursuant to NEPA. Examining every possible combination of energy alternatives in an EIS would also be counter to the CEQ's direction that an EIS be analytically (rather than encyclopedically) concise and no longer than absolutely necessary to comply with NEPA and CEQ's regulations (40 CFR 1502.2(a)(b)).

As a basis for developing the combination alternative, the review team considered the availability and technical feasibility of all alternatives evaluated in previous sections. Of the renewable technologies considered, facilities utilizing wood-derived fuel would have the greatest potential to provide a baseload replacement power source to Fermi 3. However, the locations of the highest valued wood residues are far removed from the major load centers served by Detroit Edison. Transportation costs associated with delivering wood residues to generating facilities closer to those load centers would be significant. Likewise, the existing transmission system in the areas of highest value wood resources would make long-distance transfer of power from wood-burning facilities operating close to those high-value resources to Detroit Edison load centers inefficient and costly. In addition, the EIA is not projecting any growth in electricity production from wood waste in Michigan through 2035 (DOE/EIA 2009b). Thus, the review team did not include the power generation from wood in the combination alternative.

Of the remaining renewable energy alternatives, wind would have the highest power generation capacity, but because of its intermittent nature, it would have to be coupled with an energy storage technology or quick-response natural-gas-fired plants to be a viable baseload generation alternative. The highest value wind resources in Michigan are in the Thumb and offshore of Lake Michigan. Although the Thumb is within the Detroit Edison service area, the transmission infrastructure in that area is operated at only 120 kV, and substantial costs and

inefficiencies would be associated with upgrading that system and linking it to major Detroit Edison load centers. While there is currently considerable enthusiasm within the Great Lakes States to develop offshore wind power, that initiative is in its infancy and the review team does not have evidence on which to base a conclusion that significant amounts of wind power will be available in the near term. Further, delivering the power from any such offshore wind resources would introduce added costs and complexity and would argue against what the review team believes is a reasonable Detroit Edison preference that any alternative be located within the Detroit Edison service area.

In addition to new generation, an energy conservation and demand side management alternative would have limited capability to singly offset the power that would be produced by the proposed Fermi 3 reactor, but nevertheless would avoid the adverse impacts associated with energy-generating options and would allow reduced reliance on those energy-generating sources, resulting in the avoidance of some environmental impacts.

As discussed in detail in Section 8.2.2, a national assessment of demand response potential published by the Federal Energy Regulatory Commission (FERC) in June 2009 (FERC 2009) determined that under the most aggressive scenario of DSM program implementation possible, Michigan could realize a maximum reduction in demand of 4409 MW.[(a)] The net generating capacity of all the State's electric utilities is 21,894 MW. Of the total 94,503,953 MWh of power generated by electric utilities in Michigan in 2008, Detroit Edison was responsible for 47,499,119 MWh, or approximately 50.3 percent of the total (DOE/EIA 2010b). Based on the assumption that Detroit Edison's energy conservation programs account for 50 percent of the DSM reductions projected in FERC's maximum-reduction scenario, Detroit Edison would be able to reduce its systemwide generating capacity by 2205 MW. However, in its February 20, 2008, testimony to the MPSC for Docket U-15244 (Detroit Edison 2008), Detroit Edison estimated an increase in systemwide savings from interruptible load programs to total 156 MW by 2018. In addition, in its application to the MPSC for Docket U-16358, Detroit Edison included as Exhibit A-5 its Energy Optimization Annual Report for 2009 (Detroit Edison 2010b) in which it estimated additional savings from energy efficiency programs to total about 500 GWh per year by 2015, equivalent to a reduction of 62 MW of demand. Based on the assumption that all the estimated capacity savings of 218 MW from conservation and demand side management were attributable to Fermi 3, the new reactor would need to produce only 1317 MW of power to meet

(a) In its report, FERC states, "It is important to note that the results of the four scenarios are in fact estimates of potential, rather than projections of what is likely to occur. The numbers reported in this study should be interpreted as the amount of demand response that could potentially be achieved under a variety of assumptions about the types of programs pursued, market acceptance of the programs, and the overall cost-effectiveness of the programs. This report does not advocate what programs/measures should be adopted/implemented by regulators; it only sets forth estimates should certain things occur. As such, the estimates of potential in this report should not be interpreted as targets, goals, or requirements for individual states or utilities."

anticipated demand (with all other parameters influencing supply and demand remaining unchanged).

Detroit Edison is also working to increase the power available from renewable resources. In its March 4, 2009, testimony to the MPSC under Docket U-15806 (Detroit Edison 2009d), Detroit Edison projected that by 2029 it could have installed 565 MW of wind energy capacity and 15 MW of solar energy capacity. Using capacity factors of 31 percent for wind and 13 percent for solar (Detroit Edison 2009d), these capacities would equate to 190 MW from wind and 2 MW from solar (baseload equivalent, considering the nuclear plant capacity factor of 92 percent). Including these in addition to the conservation and DSM contributions, the nuclear plant would need to generate 1125 MW. Considering the capacity factors for nuclear and NGCC, this would equate to an NGCC plant with a capacity of 1218 MW.

The review team notes that, in order to be considered as baseload power, the wind and solar installations would have to be coupled with some energy storage mechanism such as CAES. The CAES facility would have a capacity of about 192 MW.

Given the above, the review team concludes that a reasonable combination alternative would consist of the NGCC option, energy conservation and DSM, and wind and solar power coupled with energy storage. Specifically, a combination alternative could involve operation of a NGCC facility with the capacity of 1218 MW, together with aggressive conservation and DSM programs that would reduce demand by 218 MW and installation of 565 MW of wind and 15 MW of solar. A new 10-mi natural gas pipeline would still need to be constructed connecting the NGCC plant at the Fermi site with existing infrastructure. The wind and solar facilities would have impacts on the resources at the locations in which they were built.

Section 9.2.2.2 identifies the impacts of a 1661-MW NGCC facility. Disregarding any different dividends from economies of scale, the projected operational impacts of a 1218-MW NGCC facility, configured the same as the 1661-MW facility assessed in Section 9.2.2 and operating at a capacity factor of 85 percent, would be either essentially the same or less by simple ratio. The NGCC portion of the combination alternative would consume 54,190 million ft^3 of natural gas per year to produce 9,070 GWh of power. The CTs are presumed to operate at a thermal efficiency of 42 percent and at load factors always greater than 80 percent, while the overall thermal efficiency of the NGCC facility would be 60 percent. Table 9-5 provides a summary of the impacts associated with the combination of alternatives.

9.2.5 Summary Comparison of Alternatives

Table 9-6 contains a summary of the review team's environmental impact characterizations for constructing and operating new nuclear (Fermi 3), coal-fired, and NGCC generating units at the Fermi site, and a combination of alternatives. For the combination of alternatives, the review

Table 9-5. Summary of Environmental Impacts of a Combination Alternative

Impact Category	Impact	Comment
Land Use	MODERATE	A natural-gas-fired plant would have land use impacts for a power block, new transmission line corridor, cooling towers and support systems, and connection to a natural gas pipeline. The footprint of the NGCC facility in the combination would be somewhat smaller than the discrete NGCC facility evaluated in Section 9.2.2.2 but would still have onsite land demands not substantially different from those of the proposed Fermi 3. Some expansion of gas well fields and modifications to the existing pipeline infrastructure may be necessary. No land use impacts would result from implementation and/or expansions of DSM programs. The wind power portion of this alternative has the potential to affect substantial areas of land, although most of that land could still be used for purposes such as farming. The small solar component would also have land use impacts.
Air Quality	SMALL to MODERATE	Emissions from the natural-gas-fired plant would be approximately: SO_2, 93.9 tons/yr NO_x, 359 tons/yr Particulate, 183 tons/yr (all as PM_{10}) CO, 829 tons/yr N_2O, 82.9 tons/yr VOC, 58 tons/yr CO_2, 3.04 million tons/yr (without CCS) No air impacts are projected from any of the energy conservation and DSM programs or from the wind and solar power generation.
Water Use and Quality	SMALL	Impacts would be less than those of the proposed Fermi 3 nuclear plant located at the proposed site.

Table 9-5. (contd)

Impact Category	Impact	Comment
Ecology	SMALL (aquatic) and SMALL to MODERATE (terrestrial)	Potential MODERATE impacts limited to effects on eastern fox snake Impacts on terrestrial ecology and wetlands at the Fermi site would be generally similar to Fermi 3. In addition, the wind farms and solar facilities could have some impacts on terrestrial ecology. Offsite parcels may also be affected by construction of a 10-mi natural gas pipeline. Impacts on aquatic ecology from operation of the cooling system would be smaller than those anticipated from Fermi 3. Impacts on terrestrial ecology from cooling tower drift would be smaller than those anticipated from Fermi 3. Additional impacts are associated with natural gas extractions, which are expected to occur on gas fields.
Waste Management	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Socioeconomics (economy and taxes)	SMALL to MODERATE (beneficial)	Increased economic activity from new jobs and spending in the region would stimulate economic growth and tax revenues. The local property tax base would benefit Monroe County during construction and operations, but to a lower level than the impacts characterized for Fermi 3 because of the lower property values associated with the combination of technologies alternative. All beneficial tax-related impacts elsewhere in the 50-mi region would also be less than for the Fermi 3 plant because of the smaller workforce needed to operate the combination of technologies alternative. This stimulus would be SMALL beneficial for all areas except for property tax impacts in Monroe County, which would be MODERATE beneficial.

Table 9-5. (contd)

Impact Category	Impact	Comment
Socioeconomics (all other categories)	SMALL to MODERATE	Construction-related impacts would be limited and temporary (4 years for the NGCC plant). The construction workforce for the NGCC plant is projected to be less than the 2500 required for the coal-fired alternative and the 2900 required for the Fermi 3 reactor. The operating workforce for the NGCC plant is projected to be approximately 150, less than that expected for the coal-fired alternative and substantially less than would be required for Fermi 3 operation. The construction workforce is likely to originate primarily from the Detroit and Toledo MSAs. Impacts on local communities with regard to housing and services would be expected to be small and temporary for construction and small for operation. The NGCC plant and new transmission line would have aesthetic impacts comparable to those anticipated for Fermi 3. Wind turbines (565 MW(e)) would have noticeable aesthetic impacts. Overall increase in adverse impact on aesthetics is MODERATE.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and Cultural Resources	MODERATE	Construction activities would involve removal of some portions of the NRHP-eligible Fermi1 and would thus have a MODERATE impact on historic and cultural resources. Any other potential impacts could likely be managed effectively. The NGCC power block and ancillary facilities would likely be built on previously disturbed ground on the Fermi site. Newly disturbed ground would result from construction of the necessary natural gas pipeline, transmission lines, wind turbines, and solar facilities. Surveys prior to construction and archiving of any identified resources would preempt adverse impacts.
Environmental Justice	SMALL	Population density around the site is low, and the closest Census Block Group to the Fermi site that qualifies as a minority or low-income population of interest is about 8 mi from the site, which is beyond the distance the review team expects for physical pathways to environmental justice impacts. Emission limits imposed by operating permits would ensure that those populations would not receive adverse air quality and noise impacts from the operation of the NGCC alternative. In Section 4.4.3 the review team concludes that there are no disproportionately large adverse impacts on minority or low-income populations from the construction and operation of Fermi 3, which serves as a bounding case for establishing environmental justice impacts for the NGCC alternative.

team assumes the siting of the NGCC units at the Fermi site and siting of other generating facilities elsewhere within Detroit Edison's ROI.

The review team reviewed the available information on the environmental impacts of power generation alternatives compared to building a new nuclear unit at the Fermi site. Based on this review, the review team concludes that, from an environmental perspective, none of the viable energy alternatives are clearly preferable to building a new baseload nuclear power generation plant at the Fermi site.

It is appropriate to specifically discuss the differences among the alternative energy sources regarding CO_2 emissions. The CO_2 emissions for the proposed action and energy generation alternatives are discussed in Sections 5.7.2, 9.2.2.1, 9.2.2.2, and 9.2.4. Table 9-7 summarizes the CO_2 emissions estimates for a 40-year period for the alternatives considered by the review team to be viable for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, building, fuel cycle, or decommissioning. Among the viable energy generation alternatives, the CO_2 emissions for nuclear power are a small fraction of the emissions of the other viable energy generation alternatives.

On June 3, 2010, EPA issued a rule tailoring the applicability criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the Clean Air Act (75 FR 31514). According to the source permitting program, if the source (1) is otherwise subject to PSD (for another regulated NSR pollutant) and (2) has a GHG PTE equal to or greater than 75,000 tons/yr of CO_2-e (adjusting for different global warming potentials for

Table 9-6. Summary of Environmental Impacts of Construction and Operation of Nuclear (Fermi 3), Coal-Fired Alternative, Natural Gas-Fired Alternative, and a Combination Alternative

Impact Category	Nuclear (Fermi 3) (proposed action)	Coal	Natural Gas	Combination of Alternatives
Land Use	SMALL	MODERATE	SMALL	MODERATE
Air Quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Water Use and Quality	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL (aquatic) and SMALL to MODERATE (terrestrial)	SMALL (aquatic) to MODERATE (terrestrial)	SMALL (aquatic) and SMALL to MODERATE (terrestrial)	SMALL (aquatic) and SMALL to MODERATE (terrestrial)
Waste Management	SMALL	MODERATE	SMALL	SMALL
Socioeconomics (economy and taxes)	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL to MODERATE (beneficial)	SMALL to MODERATE (beneficial)
Socioeconomics (all other categories)	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE
Environmental Justice	SMALL	SMALL	SMALL	SMALL

different GHGs), such sources would be subject to BACT. The use of BACT has the potential to reduce the amount of GHGs emitted from stationary source facilities. The implementation of this rule could reduce the amount of GHGs from the values indicated in Table 9-7 for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled GHG emissions. The emission of GHGs from the production of electrical energy from a nuclear power source is orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-7 would not change meaningfully because GHG emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project.

Table 9-7. Comparison of CO_2 Emissions from the Proposed Action and Energy Alternatives

Generation Type	Years	CO_2 Emissions[(a)] (MMT)
Nuclear power[(b)]	40	0.29
Coal-fired generation[(c)]	40	440
Natural-gas-fired generation[(d)]	40	166
Combination of alternatives[(e)]	40	122

(a) All values without CCS; CO_2 directly related to electricity production only.
(b) From Appendix L, using a scaling factor of 1.79 as discussed in Section 5.7.2.
(c) From Section 9.2.2.1 (12.4 MMT/yr).
(d) From Section 9.2.2.2 (4.15 MMT/yr).
(e) From Section 9.2.4 (3.04 MMT/yr) (assuming only natural gas generation has significant CO_2 emissions).

Considering the addition of life-cycle GHG emissions from the production of electricity from a nuclear power source, that is, those from the fuel cycle and transportation of workers, total emissions for plant operation over a 40-year period would increase to about 25.7 MMT. This amount is still significantly lower than the emissions from any of the other alternatives; such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls.

The CO_2 emissions for generation alternatives such as wind power, solar power, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these generation alternatives do not involve combustion, the review team considers the GHG emissions to be minor and concludes that the GHG emissions would have a minimal cumulative impact. Other energy-generation alternatives involving combustion of oil, wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil fuel alternatives considered in Sections 9.2.2.1, 9.2.2.2, and 9.2.4. However, because the review team determined that these alternatives do not meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively.

As discussed in Chapter 8, the review team concludes that the need for additional baseload power generation has been demonstrated. Also, as discussed earlier in this chapter, the review team concludes that the viable alternatives to the proposed action all would involve the use of fossil fuels (coal or natural gas). Consequently, the review team concludes that the proposed action results in the lowest level of emissions of GHGs among the viable alternatives.

9.3 Alternative Sites

NRC EISs prepared in response to an application for a COL must analyze alternatives to the proposed action (10 CFR 51.71(d)). NRC guidance in the ESRP (NRC 2000) states that the ER submitted in conjunction with an application for a COL should include an evaluation of alternative sites. In Section 9.3 of the ESRP, NRC's site selection process guidance calls for identification of an ROI, followed by successive screening of candidate areas, potential sites, candidate sites, and the proposed site. This section presents a discussion of Detroit Edison's ROI for possible siting of a new nuclear power plant and describes its alternative site selection process. This is followed by the review team's evaluation of Detroit Edison's process, a description of the alternative sites selected, and the review team's evaluation of the environmental impacts of locating a new nuclear generating unit at each alternative site. And finally, the impacts at the proposed and alternative sites are compared to determine whether any alternative sites are environmentally preferable or obviously superior to the proposed site.

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area are assessed. For this alternative sites evaluation, impacts evaluated include NRC-authorized construction and operation and other cumulative impacts including preconstruction activities. Sections 9.3.3 through 9.3.6 provide a site-specific description of the environmental impacts at each alternative site, based on issues such as land use, air quality, water resources, terrestrial and aquatic ecology, socioeconomics and environmental justice, and historic and cultural resources. Section 9.3.7 contains a table with the staff's characterization of the impacts at the alternative sites and comparison to the proposed site to determine whether there are any alternative sites that are environmentally preferable or obviously superior to the proposed Fermi site.

The review of alternative sites consists of a two-part sequential test (NRC 2000). The first part of the test determines whether any environmentally preferred sites are among the candidate sites. The staff considers whether the applicant has (1) reasonably identified candidate sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to the applicant's selection of the proposed site. Based on its own independent review, the review team then determines whether any of the alternative sites are environmentally preferable to the applicant's proposed site. If the review team determines that one or more alternative sites are environmentally preferable, then it would proceed with the second part of the test. The second part of the test determines whether an alternative site is obviously superior to the proposed site. The review team must determine that (1) one or more important aspects, either singly or in combination, of an acceptable and available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site, and (2) the alternative site does not have offsetting deficiencies in other important areas. Included in this part of the test is the consideration of estimated costs (i.e., environmental, economic, and time of building the proposed plant) at the proposed site and

at the environmentally preferable site or sites (NRC 2000). A staff conclusion that an alternative site is obviously superior to the applicant's proposed site would normally lead to a recommendation that the application for the COL(s) be denied.

9.3.1 Alternative Site Selection Process

The review team's evaluation of Detroit Edison's alternative site selection process began with an evaluation of Detroit Edison's stated ROI. Within that ROI, the review team evaluated the results of the application of screening criteria applied sequentially to establish candidate areas, potential sites, and finally candidate sites, leading to the selection of alternative sites. The process Detroit Edison used to select its alternative sites is described in the following sections.

9.3.1.1 Detroit Edison's Region of Interest

In general, the ROI is the geographic area considered in searching for candidate sites (NRC 2000). The ROI is typically the State in which the proposed site is located or the relevant service area for the proposed plant (NRC 2000).

Detroit Edison selected its traditional service area as its ROI (see Figure 8-1). The ROI consists of approximately 7600 mi^2 in 11 counties within southeastern Michigan, including the City of Detroit. Major water features within the ROI that could provide cooling water include Lake Erie, Lake Huron, and the interconnecting St. Clair River. In addition to numerous State routes, major transportation routes within the ROI include Interstates 96, 275, 94, and 75. Rail and water transportation infrastructures also exist throughout the ROI.

9.3.1.2 Detroit Edison's Site Selection Process

Candidate Areas

As the initial step of its alternative site selection process, Detroit Edison identified candidate areas within the ROI. Detroit Edison referred to these as "greenfield areas" (Detroit Edison 2011a, b). Detroit Edison identified these candidate (greenfield) areas based on proximity to transmission lines, rail, transportation corridors, and water supply. A commercial database provided by EnergyVelocity was consulted by Detroit Edison to identify the candidate areas.

Potential Sites

Detroit Edison next searched the candidate areas for locations for potential sites. The search involved a review of publicly available sources of data such as 7.5-min U.S. Geological Survey (USGS) quadrangle maps, aerial photographs, atlases, and road maps, review of Google Earth images, and searches of the Internet. The general criteria used to identify potential sites within the ROI included the following:

- Proximity to transmission lines and rail and road and water transportation infrastructures
- Adequate supplies of water for cooling and industrial applications
- No obvious environmental concerns such as large expanses of wetlands and the absence of sensitive areas such as natural resource conservation areas
- The absence of complex terrain that would require substantial modification before facility construction could begin
- Few residences/sensitive receptors (Detroit Edison 2011a).

Detroit Edison also identified potential "brownfield" sites (i.e., sites with prior or current industrial or commercial development) using two methods. One method involved a review of the MDEQ database of formerly utilized industrial sites. The MDEQ database is comprehensive and includes brownfield sites of all sizes and conditions. The brownfield sites in the database were evaluated by using the same general criteria used to identify greenfield sites (e.g., proximity to transmission, rail, roads, and water). Detroit Edison also considered its existing sites for inclusion in the list of potential sites. Of its existing sites, nine were retained as potential sites: Belle River-St. Clair, River Rouge, Trenton Channel, Fermi, Greenwood, Monroe, Harbor Beach, Conners Creek, and Marysville.

In all, Detroit Edison identified 24 potential sites. A variety of existing land uses was represented in the potential sites selected: sites currently in use for industrial purposes (including power generation), greenfield sites, and brownfield sites (i.e., formerly used industrial sites).

Candidate Sites

The 24 potential sites were subjected to additional research as well as high-level site reconnaissance visits by Detroit Edison staff and its contractors. During this stage, Detroit Edison eliminated 16 sites (Detroit Edison 2011a, b). Of these, 13 sites were eliminated based on a failure to meet criteria for minimum property size (500 ac) and/or minimum cooling water supply (40,000 gpm). Detroit Edison eliminated the other three potential sites because of proximity to major resort areas (two of the sites) and because a new power plant would significantly change the character of the area (all three sites).

Proposed and Alternative Sites

To identify the proposed and alternative sites, Detroit Edison evaluated each candidate site against more specific criteria from both technical and environmental perspectives. For each criterion, each site was given a score of 1, 3, or 5, reflecting a decreasing potential for adverse impact, with a score of 5 representing the most favorable score for each criterion evaluated (Detroit Edison 2011a). Environmental criteria and subcriteria included the following:

- Ecology and natural resources: threatened and endangered species; wetlands/waters of the United States; impacts on designated scenic, natural, recreational, or wildlife areas; disruption of natural habitat; impacts on water quality
- Land use: existing land ownership, existing land use within 1 mi (industrial, agricultural, open space/parks, residential areas), nearby airports, extent of buffer zones for potential offsite receptors
- Socioeconomics: impacts on resources such as traffic, demographics, employment and housing, noise levels, cultural resources and viewshed
- Potential for hazardous material contamination
- Associated linear facilities: for transmission line and water line routes
- Community perception/receptivity to new facilities; based on Detroit Edison's judgment of probable resistance to new nuclear facilities by residents of the site area.

Technical review criteria included the following:

- Site development issues: topography; subsurface conditions that affect foundations, earthwork, and pipe installation; construction impacts on groundwater; flood potential; geological/seismic activity; need for extensive relocation of existing utilities; cogeneration potential
- Transmission system development: distance to adequate transmission; transmission system reliability/available current-carrying capacity
- Transportation development: proximity to highway network; extent of required road displacement/replacement
- Water resources development: adequacy of water source for baseload plant needs; distance to adequate water resources; groundwater static head (as it affects construction dewatering); quality of makeup water (affecting the life of plant components); groundwater quality and accessibility
- Security conditions: logistics associated with making the site secure against intrusion
- Economics of the site: development costs, including major actions such as cut-and-fill to alter grade; delivered fuel costs; costs of linear facilities such as pipelines and transmission lines
- Waste disposal: dry spent fuel storage capacity.

All eight candidate sites were evaluated by using all the criteria itemized above and given relative scores, with the highest score representing the most desirable site. Based on the individual weights of the criteria, environmental factors carried a total weight of 41 percent and

technical criteria, 59 percent. After an initial score for each candidate site from both environmental and technical perspectives was established, Detroit Edison conducted a sensitivity analysis to identify any biases that may have been inadvertently introduced during the scoring process. Weightings of both 30 percent and 70 percent were applied to the scores of each site for both environmental factors and technical factors, and the sum of the weighted environmental and technical scores was used to ultimately rank the sites (Detroit Edison 2011a).

Scores assigned to each of the eight candidate sites for each of the evaluation criteria discussed above were provided in tabular form in Chapter 9 of the ER, as was the basis for elimination of some of those sites (Detroit Edison 2011a). Table 9-8 shows the overall results of the evaluation exercise for the eight candidate sites.

Table 9-8. Scores and Relative Rankings of Detroit Edison's Candidate Sites

Candidate Site	County	Existing Use	Weighted Environmental Score	Weighted Technical Score	Weighted Total (Overall Rank)
Site M: Fermi nuclear site	Monroe	Detroit Edison power plant	1.75	2.11	3.86 (1)
Site N: Belle River-St. Clair Energy Facility	St. Clair	Detroit Edison power plant	1.63	2.07	3.70 (2)
Site F: Greenwood Energy Center	St. Clair	Detroit Edison power plant	1.39	2.17	3.56 (3)
Site A: Petersburg	Monroe	Greenfield site	1.13	2.31	3.44 (4)
Site C: South Britton	Lenawee	Greenfield site	1.15	2.19	3.34 (5)
Site W3	Huron	Greenfield site	1.09	2.03	3.12(6)
Site W2	Huron	Greenfield site	1.09	1.81	2.90 (7)
Site W1	Huron	Greenfield site	0.87	1.85	2.72 (8)

Source: Detroit Edison 2011a

Based on the scores from its site selection process, Detroit Edison proposed construction of the Fermi 3 reactor on the existing Fermi site in Monroe County, Michigan, and also considered two alternative sites.

9.3.1.3 Conclusions about Detroit Edison's Site Selection Process

The review team evaluated Detroit Edison's methodology for selecting its ROI, identifying candidate areas, and evaluating potential sites, candidate sites, and alternative sites. The results of the review team's evaluation follow.

For its ROI, Detroit Edison chose its traditional service territory. The designated ROI is consistent with the guidance in NRC's ESRP for review of ERs for nuclear power stations

(NRC 2000). The review team concludes that the ROI used in Detroit Edison's COL application is reasonable for consideration and analysis of potential sites. The review team also finds that Detroit Edison's basis for defining its ROI did not arbitrarily exclude desirable candidate locations.

Detroit Edison next identified candidate areas (which it referred to as greenfield areas). Detroit Edison employed criteria based on proximity to transmission lines, rail, transportation corridors, and water supply (i.e., inclusionary criteria). This is the inverse of the approach described in the ESRP, but it would be expected to yield the same results. Therefore the review team concludes that the method used to identify candidate areas is reasonable.

In order to identify potential sites, Detroit Edison used a process in which it avoided areas of potential concern (e.g., natural resource conservation areas, areas with complex terrain). After eliminating those areas, it identified parcels of land that could be developed for a new nuclear plant. Detroit Edison also looked for brownfield sites and considered its own existing sites in this step. In all, Detroit Edison identified 24 potential sites. Here again, the Detroit Edison process is rather like an inverse of that described in the ESRP (i.e., Detroit Edison used exclusionary criteria, while the ESRP envisioned inclusionary criteria). But, again, the Detroit Edison approach would be expected to yield similar results. The review team notes that the 24 sites cover a wide geographic area and range of environmental conditions. The process used by Detroit Edison did identify sites that would be too small for a new nuclear plant. However, these would be eliminated in the next step (Candidate Sites), leading to the same result. The review team concludes that the Detroit Edison process for identifying potential sites is reasonable.

Detroit Edison reviewed the potential sites in more detail to narrow the list to a group of candidate sites. This portion of its review included visits to all 24 potential sites. In this step Detroit Edison eliminated 16 of the potential sites, with most of these (13) eliminated because of lack of adequate site size (500 ac) or adequate water supply (40,000 gpm) (Detroit Edison 2011b). Detroit Edison eliminated the other three sites because it determined that a new nuclear plant at these locations would significantly change the character of the area. Detroit Edison also considered a number of other attributes in this step, as mentioned in the notes in Table 9.3-2 of the ER (Detroit Edison 2011a). One consideration noted in the table (i.e., private ownership as a disadvantage) would not be considered under the guidance in the ESRP. But this consideration appears not to have been the deciding factor and so would not affect the results. The process used by Detroit Edison at this stage does not appear to be as detailed as the process described in the ESRP. However, the review team concludes that this lack of depth would lead Detroit Edison to identify more candidate sites than the ESRP process. Because the process used by Detroit Edison would not improperly eliminate sites from consideration, the review team concludes that it is reasonable.

Detroit Edison then evaluated the remaining eight candidate sites using 40 criteria. Each criterion was given its own weighting factor, and each site was scored for each criterion. Detroit Edison took the total scores for each site and determined that the Fermi site was the most suitable. It also identified the Belle River-St. Clair and Greenwood sites as alternatives.

The ESRP guidance indicates that the identification of three to five alternative sites could, in general, be viewed as adequate. Because Detroit Edison identified only two alternative sites in its ER (Detroit Edison 2011a), the review team requested additional information (NRC 2009) for Site A (Petersburg) and Site C (South Britton), which were ranked fourth and fifth by Detroit Edison, with similar overall scores. Detroit Edison provided its response on August 25, 2009 (Detroit Edison 2009c). The review team considered all four alternative sites in its evaluation. The locations of the four alternative sites are shown in Figure 9-1.

Detroit Edison considered both environmental criteria and technical criteria in its scoring of the sites. But the ESRP guidance considers only environmental factors in the comparison of the sites to determine whether any is environmentally preferable. Technical and cost factors would be considered only if an alternative site was determined to be environmentally preferable (NRC 2000). However, even if only environmental criteria are considered, the top five sites remain unchanged and Fermi remains the highest ranked site.

In the Detroit Edison analysis, the criterion “Public Receptivity” was given a high weight of 10 percent of the total. Because of the relatively high uncertainty involved in measuring public acceptance, the review team requested Detroit Edison to perform a sensitivity analysis regarding the weight of this criterion (NRC 2011b). Detroit Edison’s response to that request (Detroit Edison 2011b) provides the site scores for various weights for Public Receptivity, from 0 percent to 10 percent. At a weight of 2 percent (approximately the average weight for all criteria), the top five sites remain unchanged and the top three sites (Fermi, Belle River-St. Clair, and Greenwood) are essentially tied. The review team concludes that the high weight of this criterion did not skew the outcome of the analysis.

Overall, the review team determines that Detroit Edison used a logical approach that adequately satisfied applicable NRC guidance for the identification of sites that are among the best in the ROI. Consequently, in addition to Fermi, the review team has chosen the top four alternative sites identified by Detroit Edison for its independent analysis.

9.3.2 Review Team Alternative Site Evaluation

In accordance with Section 9.3 of the ESRP (NRC 2000), the review team performed an independent comparison of the proposed and alternative sites. The four alternative sites (Belle

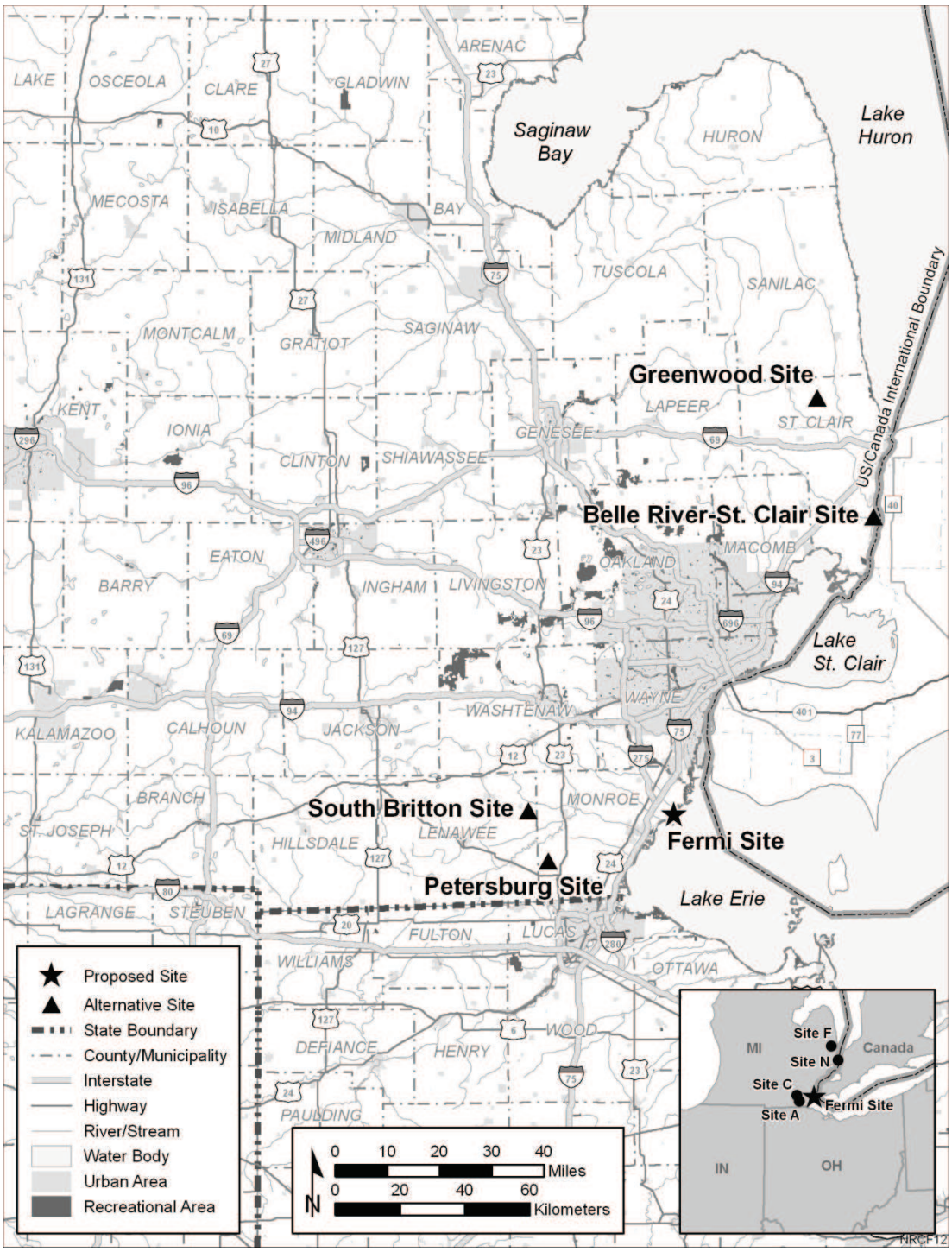

Figure 9-1. Locations of the Proposed Site and Alternative Sites for Fermi 3

River-St. Clair, Greenwood, Petersburg, and South Britton) are examined in detail in Sections 9.3.3 through 9.3.6 in the following subject areas: land use, water resources, terrestrial and aquatic ecology, socioeconomics and environmental justice, historic and cultural resources, air quality, nonradiological health, radiological health, and postulated accidents. The review team visited each alternative site as well as the proposed site in January 2009. Section 9.3.7 contains a table with the review team's characterization of the cumulative impacts of the proposed action at the proposed and alternative sites.

Following the guidance promulgated in Section 9.3 of the ESRP, the review team collected and analyzed reconnaissance-level information for each site. The review team then used the information provided in the ER (Detroit Edison 2011a), a request for additional information (RAI) response (Detroit Edison 2009c), information from other Federal and State agencies, and information gathered during the visits to each alternative site to evaluate the cumulative impacts of building and operating a new nuclear power plant at those sites. The analysis therefore included the impacts of NRC-authorized construction and operation as well as potential impacts associated with other actions affecting the same resources. Cumulative impacts occur when the effects of an action are added to or interact with other effects in a particular place and within a particular time; as a result, the cumulative impact assessment entails a more extensive and broader review of possible effects of the action beyond the site boundary.

The cumulative analysis for the impacts at the alternative sites was performed in the same manner as discussed in Chapter 7 for the proposed site, except, as specified in Section 9.3 of the ESRP (NRC 2000), a reconnaissance-level analysis was conducted for the alternative sites. To inform the cumulative impacts analysis, the review team researched EPA databases for recent EISs within the State, used an EPA database for permits for water discharges in the geographic area to identify water use projects, and used www.recovery.gov to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The review team developed tables of the major projects near each alternative site that were considered relevant in the cumulative analysis. The review team used the information to perform an independent evaluation of the direct and cumulative impacts of the proposed action at the alternative sites to determine whether one or more of the alternative sites were environmentally preferable to the proposed site.

Included are past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts together with the proposed action. For the purposes of this analysis, the past is defined as the time period prior to receipt of the COL application. The present is defined as the time period from the receipt of the COL application until the beginning of activities associated with building Fermi 3. The future is defined as the beginning of building activities (construction and preconstruction activities) associated with Fermi 3 through operation and eventual decommissioning.

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were identified. The affected environment that serves as the baseline for the cumulative impacts analysis is described for each alternative site, and a qualitative discussion of the general effects of past actions is included. The geographic area over which past, present, and future actions could reasonably contribute to cumulative impacts is defined and is described in later sections for each resource area. The analysis for each resource area at each alternative site concludes with a cumulative impact finding (SMALL, MODERATE, or LARGE). For those cases in which the impact level on a resource was greater than SMALL, the review team also discussed whether building and operating a nuclear unit would be a significant contributor to the cumulative impact. In the context of this evaluation, "significant" is defined as a contribution that is important in reaching that impact level determination.

Cumulative impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area. The findings for each resource area at the Fermi site and each alternative site are then compared in Table 9-44. The results of this comparison are used to determine whether any of the alternative sites is environmentally preferable to the proposed site. If any alternative site is determined to be environmentally preferable, the review team would evaluate whether that alternative site was obviously superior.

The impacts described in Chapter 6 of this EIS (e.g., nuclear fuel cycle; decommissioning) would not vary significantly from one site to another. This is true because all the alternative sites and the proposed site are in low population areas and because the review team assumes the same reactor design (therefore, the same fuel cycle technology, transportation methods, and decommissioning methods) for all the sites. As such, these impacts would not differentiate between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

Similarly, the nonradiological waste impacts described in Sections 4.10 and 5.10 would not vary significantly from one site to another. The types and quantities of nonradiological and mixed waste would be approximately the same as those for the construction and operation of an Economic Simplified Boiling Water Reactor (ESBWR) at any of the alternative sites. For each alternative, all wastes destined for land-based treatment or disposal would be transported offsite by licensed contractors to existing, licensed disposal facilities operating in compliance with all applicable Federal, State, and local requirements, and all nonradioactive liquid discharges would be discharged in compliance with the provisions of an applicable NPDES permit. Also, the amount of nonradioactive, nonhazardous municipal solid waste generated annually at the Fermi site would be roughly equivalent to the small percentage of total solid waste generated in the geographic area of influence of the alternative sites. Finally, as stated in Section 7.9, the

Fermi site would generate a very small percentage of hazardous waste produced in Michigan, and no known capacity constraints exist for the treatment or disposal of hazardous wastes either within Michigan or for the nation as a whole. For these reasons, these impacts are not discussed separately in the evaluation of each alternative site.

9.3.3 Belle River-St. Clair Site

This section presents the review team's evaluation of the potential environmental impacts of siting a nuclear reactor at the Belle River-St. Clair site. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the Belle River-St. Clair site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action, if implemented at the Belle River-St. Clair site. Other actions and projects considered in this cumulative analysis are described in Table 9-9. The location and vicinity of the Belle River-St. Clair alternative site are shown in Figure 9-2.

Referred to by Detroit Edison in its site selection process as Site N, the Belle River-St. Clair property contains two Detroit Edison-owned power plants on contiguous parcels of 1860 ac and 226 ac. The site is approximately 1 mi west of the United States–Canada border, 4 mi north of Marine City, 4 mi south of St. Clair, and 8 mi south of Port Huron, the largest population center in the area. The site occupies Sections 13, 18, 19, 30, and 31 of Township 4 North and Ranges 18 East and 17 East in the China and East China Townships. Other than the industrial footprints of the power plants, the site is composed of agricultural land and some wooded areas.

Small portions of the site may be inside the Belle River floodplain. Five residences are within 2 mi of the site. The East China Fractional District No. 2 School is located about 1.5 mi southeast of the site.

Access to the site is provided by State Route 29, which runs through the site; by barge via the St. Clair River; and by rail via the CSX rail line that runs along the eastern border of the site.

The nearest sensitive environmental area is East China Township Park to the south of the site. Other small parks are also located in the area.

While the industrial areas of the site are generally free of vegetation, the wooded areas are composed of cottonwoods (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*). Diversity in understory areas and open areas is low, with the plant communities composed largely of weedy, nonnative plants. There is also limited wildlife habitat diversity on the site.

Table 9-9. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Belle River-St. Clair Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
Belle River Power Plant	1664-MW coal-fired plant	On Belle River-St. Clair site	Operational
St. Clair Power Plant	1929-MW coal-fired plant	On Belle River-St. Clair site	Operational
Fermi Unit 2	1098-MW nuclear power plant, including recently completed Independent Spent Fuel Storage Installation (ISFSI) and decommissioned Fermi 1 collocated on site	68 mi southwest of Belle River St. Clair site on Lake Erie	Operational
Davis-Besse Nuclear Plant Unit 1	925-MW nuclear power plant	86 mi southwest of Belle River St. Clair site on Lake Erie	Operational
Greenfield Energy Centre LP	1005-MW natural-gas-fired combined cycle electricity-generating facility	1 mi east of Belle River-St. Clair site across the St. Clair River	Operational
Lambton Generating Station	1920-MW coal-fired power plant	1 mi northeast of Belle River-St. Clair site across the St. Clair River	Operational
Dawn Gateway Pipeline	Operation of 30-km, 610-mm international natural gas transmission pipeline system (construction of 1-km new pipeline)	4 mi east of Belle River-St. Clair site in Lambton County, Ontario	Proposed
Marysville Power Plant	200-MW coal-fired plant	10 mi north of Belle River-St. Clair site on St. Clair River	Operational
Greenwood Energy Center	Oil-fired peaking unit and three natural gas CTs with 1071 MW of combined capacity	24 mi northwest of Belle River-St. Clair site	Operational
Suncor Ethanol Plant Phase II Project	Expansion of existing St. Clair Ethanol Plant to increase the supply of ethanol for blending with gasoline. The expansion will increase the plant's production capacity from 200 million to 400 million L/yr.	11 mi north of Belle River-St. Clair site in St. Clair Township, Ontario, Canada	Recently completed

Table 9-9. (contd)

Project Name	Summary of Project	Location	Status
Suncor Ethanol Production Project	Ethanol production facility with production capacity of 200 million L/yr	16 mi north of Belle River-St. Clair site in Sarnia, Ontario, Canada	Recently completed
Diesel Fuel and Hydrogen Pipelines	3.3 km of one 10-in. hydrogen pipeline and two 8-in. diesel fuel pipelines from the Shell Canada Refinery in Corunna to the Suncor Refinery in Sarnia	16 mi north of Belle River-St. Clair site in Sarnia, Ontario, Canada	Recently completed
St. Clair Liquid Petroleum Gas Terminal	Liquid petroleum gas terminal	2.4 mi north of Belle River-St. Clair site located near confluence of Pine and St. Clair Rivers	Operational
Dome Petroleum Corporation	Petroleum bulk station and terminal with discharge to Jordan Creek	2.4 mi north of Belle River-St. Clair site	Operational
Mining Projects			
Cross Sand and Gravel Inc.	Construction sand and gravel mine	17 mi northwest of Belle River-St. Clair site	Operational
Transportation Projects			
I-94 Black River Bridge Replacement in Port Huron	First phase of the Blue Water Bridge plaza expansion, a project to modernize and improve capacity at the nation's second-busiest U.S.-Canadian truck border crossing	15 mi north of Belle River-St. Clair site in Port Huron	Proposed; schedule undetermined
Parks and Recreation Facilities			
St. Clair County Trail System	Proposed upgrades and extensions of an existing offroad and onroad bike route network	Throughout St. Clair County	Proposed construction through 2024
Other Actions/Projects			
Algonac Water Filtration Plant	Water filtration plant that discharges to the St. Clair River	9.6 mi. south of Belle River-St. Clair site on St. Clair River	Operational
Marine City Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair and Black Rivers	4 mi south of Belle River-St. Clair site on St. Clair River	Operational

Table 9-9. (contd)

Project Name	Summary of Project	Location	Status
City of St. Clair Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair River	2.4 mi north of Belle River-St. Clair site on St. Clair River	Operational
City of Port Huron Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair and Black Rivers	17 mi north of Belle River-St. Clair site on St. Clair River	Operational
St. Clair County-Algonac Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair River	10 mi south of Belle River-St. Clair site on St. Clair River	Operational
Detroit Water and Sewerage District Lake Huron Water Treatment Plant	Water treatment plant	22 mi north of Belle River-St. Clair site on Lake Huron	Operational
Indian Trail North Mobile Home Park Wastewater Sewage Lagoon	Wastewater sewage lagoon located on Lake Huron	22 mi north of Belle River-St. Clair site on Lake Huron	Operational
Cargill Salt	Manufactures salt as food additive	2.4 mi north of Belle River-St. Clair site	Operational
Courtright Sewage Treatment Plant Upgrades	Upgrade and expansion of the Sewage Treatment Plant	3 mi north of Belle River-St. Clair site on St. Clair River in Ontario, Canada	Recently completed
Marysville Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair River	10 mi north of Belle River-St. Clair site on St. Clair River	Operational
Dunn Paper Company	Paper mill that discharges to St. Clair River	17 mi north of Belle River-St. Clair site	Operational
E B Eddy Paper, Inc.	Paper mill that discharges to St. Clair and Black Rivers	17 mi north of Belle River-St. Clair site	Operational
Sarnia Combined Sanitary/Storm Sewer Separation	The combined sewer separation project proposed will halt the Combined Sewer Overflow to the St. Clair River	25 mi north of Belle River-St. Clair site in Sarnia, Ontario, Canada	Recently completed
Sarnia Wastewater System Improvements	Trunk sanitary sewer expected to reduce the number of combined sewer overflows to the St. Clair River	25 mi north of Belle River-St. Clair site in Sarnia, Ontario, Canada	Recently completed

Table 9-9. (contd)

Project Name	Summary of Project	Location	Status
Dry Hydrant Installation, North Slip, Sarnia Harbor	Construction, installation, and maintenance of a dry hydrant and protection bollards along the North Slip embankment in Sarnia Harbor	25 mi north of Belle River-St. Clair site in Sarnia, Ontario, Canada	Recently completed
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; construction of water and/or wastewater treatment and distribution facilities and associated pipelines, as described in local land use planning documents. No specific data found concerning development/ expansion of the towns within 20 mi of site.	Throughout region	Construction would occur in the future, as described in State and local land use planning documents
Great Lakes Restoration Initiative	Restoration activities to address toxic substances, invasive species, nearshore health and non-point-source pollution, and habitat and wildlife protection	Great Lakes watershed	Start in FY2011
Global Climate Change/Natural Environmental Stressors	Short- or long-term changes in precipitation or temperature	Throughout region	Impacts would occur in the future

Source: Modified from NRC 2010a, b

The site is located approximately 50 mi from Detroit. St. Clair County has a population of approximately 164,200 (2000 data) and the nearest towns, St. Clair and Marine City, have populations of 5800 and 4650, respectively (2000 data).

9.3.3.1 Land Use

The following impact analysis includes impacts on land use from building and operating the proposed nuclear project at the Belle River-St. Clair site. The analysis also considers past, present, and reasonably foreseeable future actions that affect land use, including other Federal and non-Federal projects, and those projects listed in Table 9-9 within the geographic area of interest.

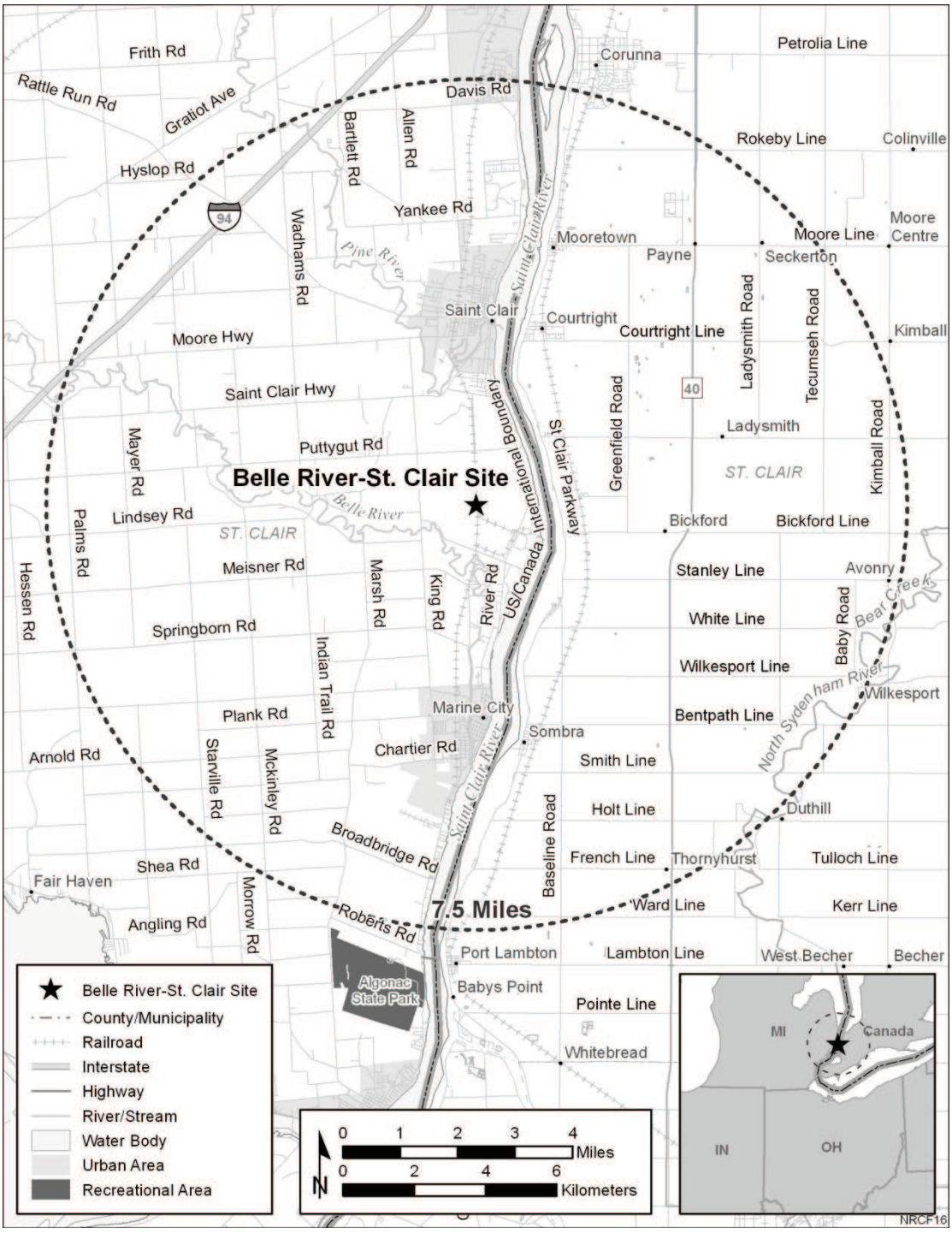

Figure 9-2. The Belle River-St. Clair Alternative Site and Vicinity

The site is owned by Detroit Edison, is zoned industrial, and hosts the existing Belle River and St. Clair power plants (Detroit Edison 2011a). There are a number of buildings onsite associated with the power plants. The proposed location for the new facility is approximately 1200 ac, located in the northwestern part of the existing site (Detroit Edison 2009b). Within the 1200 ac, the conceptual plant layout suggests that permanent land disturbance would be as much as 95 ac, and temporary land disturbance would be as much as 200 ac. There are no residential areas on the site, although there are a few residences within 2 mi (Detroit Edison 2011a). Topography is flat with very little variation, and outside of the developed areas around the existing coal plants, the site is primarily agricultural land (including possibly some prime farmland), grassland, and young mixed deciduous forest. There are 37 wetlands on the site, and several former utility ponds may have been abandoned for a sufficient period to be considered waters of the United States (see Section 9.3.3.3). Some parts of the site are within the Belle River floodplain (Detroit Edison 2011a). If the facilities associated with this alternative would extend into the Coastal Zone defined by the State of Michigan under the Coastal Zone Management Act, Detroit Edison would have to obtain a coastal zone consistency determination from the MDEQ.

National Wetland Inventory (NWI) maps suggest that a substantial area of wetlands, perhaps several hundred acres of mostly forested and scrub-shrub wetlands, lies within the 1200 ac. Drainage connections between the site and the St. Clair River could also be disturbed. The river is an adequate water source for the proposed plant and already supplies the existing Belle River and St. Clair power plants. No new offsite roadway would likely be needed during development or operation of the proposed facility (Detroit Edison 2011a).

The nearest recreational area to the site is East China Township Park, south of the site near the intersection of Recor Road and River Road (Detroit Edison 2011a). A number of smaller parks are present in the surrounding area, while Algonac State Park is approximately 8 mi south of the site. These recreational resources may be affected by increased user demand, by views of the proposed 600-ft cooling tower and condensate plume, or by access delays associated with increased traffic.

One or more new transmission line corridors would likely be needed to connect a new power plant at the Belle River-St. Clair site to the grid (Detroit Edison 2011a). Although a 345-kV transmission line already crosses the site, it is fairly congested, partly because of the recent loss of a critical double-circuit tower. Although transmission capacity and reliability in the area are considered to be fair, a load flow study of the transmission line is recommended (Detroit Edison 2011a). Environmental conditions along the transmission line corridor are similar to those of the site, with a mixture of cropland, wooded areas, and some wetlands. Because the transmission interconnection would be on the site, the review team concludes that the land use impacts of building and operating transmission lines for a new nuclear plant at the Belle River-St. Clair site would be minor.

For cumulative land use analysis, the geographic area of interest is the 15-mi region surrounding the Belle River-St. Clair site. This geographic area of interest includes the primary communities (China Charter Township and East China Charter Township) that would be affected by the proposed project if it were located at the Belle River-St. Clair site.

A number of offsite projects identified in Table 9-9 would likely affect land use in the geographic area of interest around the Belle River-St. Clair site. The two Suncor Ethanol projects in St. Clair Township and the I-94 Black River bridge replacement project in Port Huron are all more than 10 mi from the proposed site but, along with other projects identified in Table 9-9, have contributed or would contribute to some decreases in open lands, wetlands, and forested areas and generally result in increased urbanization and industrialization. However, existing parks, reserves, and managed areas would help preserve open lands, wetlands, and forested areas. The projects within the geographic area of interest identified in Table 9-9 appear to be generally consistent with applicable land use plans and control policies.

As discussed in Section 7.1 for the Fermi site, climate change could increase precipitation and flooding, while increased lake evaporation and reduced lake ice accumulation could reduce lake levels and thereby increase the extent of low-lying lakeshore areas (USGCRP 2009). Forest growth may increase as a result of more CO_2 in the atmosphere (USGCRP 2009). In addition, climate change could reduce crop yields and livestock productivity (USGCRP 2009), which might change portions of agricultural land uses in the area of interest.

Based on the information provided by Detroit Edison and the review team's independent evaluation, the review team concludes that the cumulative land use impacts associated with siting a reactor on the Belle River-St. Clair site would be SMALL, and further mitigation would not be warranted.

9.3.3.2 Water Use and Quality

The predominant surface water feature near the Belle River-St. Clair site is the St. Clair River, which is 2 mi east of the site, connects Lake Huron with Lake Erie, and has an average daily flow of 188,000 ft^3/sec (approximately 121 billion gpd) (Neff and Nichols 2005). The river supports multiple uses from industry to commerce to recreational boating. Surface water quality is moderate to poor. The two existing power plants at the site currently use the St. Clair River as a source of cooling water and for industrial purposes. There are 37 wetlands on the site, and several utility ponds may have been abandoned for a sufficient period to be considered waters of the United States (see Section 9.3.3.3). During a site visit in January 2009, terrain at the proposed site was observed to be flat with forested wetlands in undeveloped areas.

Water for a reactor at the Belle River-St. Clair Power Plant site would most likely be obtained from the St. Clair River, which is used for once-through cooling by the two existing power plants and also for cooling by the Canadian power industry. The flow of the St. Clair River is large

enough to support the closed cycle cooling system of the proposed plant. New intake and discharge structures would be necessary (constructed under USACE and MDEQ permits), because the current power plants do not have enough additional capacity. Discharge would include cooling tower blowdown at an elevated temperature relative to the river, treated process wastewater, and liquid radwaste. Discharges would be controlled by an NPDES permit issued by MDEQ.

Water wells locally support domestic use of groundwater, but low yields and moderate quality limit the potential usefulness of this resource for the proposed facility. Groundwater could possibly be used during the building phase. Groundwater resources in the area are described as marginal. Most wells access the surficial aquifer, which is between 200 and 400 ft thick, with well yields in the 10 to 15 gpm range.

Building activities, including site grading and dewatering, would have the potential to affect water quality through increased erosion by stormwater, increased turbidity in surface water, and possible spills or leaks of fuel and other liquids. These changes would be expected to be limited by following appropriate BMPs. Surface water quality may be affected by discharges, but the discharges should be controlled by NPDES and stormwater permits.

For the cumulative analysis of impacts on surface water, the geographic area of interest for the Belle River-St. Clair site is the St. Clair River (which connects Lake Huron with Lake Erie) and downstream Lake Erie itself, because these are the areas potentially affected by the proposed project. Key actions that have current and reasonably foreseeable potential impacts on water supply and water quality in this area of interest include coal- and natural-gas-fired power plants, proposed and recently completed ethanol plants, proposed and recently completed pipeline construction projects, wastewater treatment plants, paper mills, and other industries. For the cumulative analysis of impacts on groundwater, the geographic area of interest is the thick surficial aquifer in the vicinity of the site.

Water Use

Operational cooling water requirements would be the major demand of a new nuclear power plant on surface water resources. As described above, the water availability of the St. Clair River would be sufficient to support the makeup water needs of a new reactor in addition to the cooling water needed by existing U.S. and Canadian power plants and other projects listed in Table 9-9. The maximum consumptive loss anticipated from Fermi 3 is 24.6 MGD, or approximately 0.02 percent of the river's average flow rate of over 121,000 MGD. The cumulative consumptive use of surface water is anticipated to have a small effect on the resource.

As described in Section 7.2.1, the greatest potential future impact on the Great Lakes water availability is predicted to be from climate change. The impact predicted for the lowest-

emissions scenario discussed in the USGCRP report (2009) and by Hayhoe et al. (2010) would not be detectable or would be so minor that it would not noticeably alter the availability of water from the Great Lakes. However, if CO_2 emissions follow the trend evaluated in the highest-emissions scenario, the effect of climate change could noticeably increase air and water temperatures and decrease the availability of water in surface water resources in the Great Lakes region. As a result, the review team concludes that the potential impacts of use and climate change on surface water quantity would be SMALL to MODERATE. Based on its evaluation, the review team concludes that building and operating a nuclear plant at the Belle River-St. Clair site would not be a significant contributor to the cumulative impact on surface water use.

Groundwater withdrawals associated with site dewatering during construction or preconstruction of a new nuclear power plant would be temporary and localized. As noted above, groundwater usage in the Belle River-St. Clair vicinity is generally limited to withdrawals by domestic wells. The review team concludes that cumulative groundwater impacts associated with withdrawals while building a new nuclear power plant at this site and with projects identified in Table 9-9 would be SMALL.

Water Quality

An NPDES permit from the MDEQ would be required for discharges from a new nuclear power plant at the Belle River-St. Clair site as well as for discharges to surface waters from the other projects identified in Table 9-9. Such permits would limit both chemical and thermal discharges. Construction activities associated with the proposed facilities in Table 9-9 and urbanization in the vicinity have the potential to degrade surface water quality, but adhering to BMPs would limit this impact.

The EPA's Great Lakes National Program Office has initiated the Great Lakes Restoration Initiative, a consortium of 11 Federal agencies that developed an action plan to address environmental issues. These issues fall into five areas: cleaning up toxics and areas of concern, combating invasive species, promoting nearshore health by protecting watersheds from polluted runoff, restoring wetlands and other habitats, and tracking progress and working with strategic partners. The results of this long-term initiative would presumably address water quality concerns of Lake Erie.

Climate change, as described in Section 7.2.1, has the potential to affect water quality within the Great Lakes, including Lake Huron, which discharges via the St. Clair River, leading to a MODERATE cumulative impact on surface water quality. Reduced lake levels and reduced flow in the river could increase the impact of permitted discharges. However, the high flow rate of the St. Clair River and associated mixing would limit the influence of chemical and thermal discharges on downstream surface water bodies (e.g., Lake St. Clair, the Detroit River, and Lake Erie). The review team concludes that building and operating a nuclear plant at the

Belle River-St. Clair site would not be a significant contributor to the MODERATE cumulative impact on surface water quality.

Groundwater in the region, which is generally of moderate chemical quality, could be affected by a new nuclear power plant at the Belle River-St. Clair site and the other past, present, and reasonably foreseeable actions in the region identified in Table 9-9. These impacts would be expected to be localized in extent and may be avoided or minimized through adherence to BMPs. The review team concludes that cumulative groundwater quality impacts would be SMALL.

9.3.3.3 Terrestrial and Wetland Resources

The parts of the site that would be developed are a mix of agriculture used for row crops and hay, old field, and young forest stands composed of green ash and early successional species such as cottonwood. The forested areas had been disturbed historically by farming or other land management activities. Species diversity in the understory and more open areas is low and composed largely of weedy nonnative plants (Detroit Edison 2011a).

The species of wildlife in the project vicinity is typical of partially urbanized areas in the region: whitetail deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), and various rodents. Various songbirds, raptors such as the red-tailed hawk (*Buteo jamaicensis*), and game birds such as ring-necked pheasant (*Phasianus colchicus*) use the site (Detroit Edison 2011a). Some amphibians and reptiles are probably present, but unusual species would not be expected due to the disturbed character of the area. Wildlife in the project area is limited by habitat diversity and the proximity of the site to industrial development.

The NWI identifies 37 wetlands on the site (Detroit Edison 2009b). NWI maps suggest a substantial area of wetlands, perhaps several hundred acres of mostly forested and scrub-shrub wetland. Several utility ponds onsite may have been abandoned for a sufficient period to be considered waters of the United States (Detroit Edison 2011a). The ponds are dominated by cattail (*Typha* sp.) and common reed (*Phragmites australis*) and could meet the criteria for regulation as waters of the United States if they have been abandoned for more than 5 years. If there are drainage ditch connections to the St. Clair River (a navigable water body under Section 10 of the Rivers and Harbors Act) that would be disturbed, the ditches also could be regulated. It is possible, but uncertain at this time, that other areas on this site contain wetlands, since most soils on the site are mapped as hydric soils (USDA 2010). A more definitive evaluation of possible wetland resources on the site would require a wetland delineation.

Two terrestrial species listed as threatened or endangered under the Endangered Species Act (ESA) are known to occur or could occur in St. Clair County. The eastern prairie fringed orchid

(*Platanthera leucophaea*) is Federally listed as endangered and is known mostly from lakeplain prairies around Saginaw Bay and western Lake Erie (MNFI 2007a). No lakeplain prairie habitat occurs on the site or in the surrounding area, but fallow agricultural fields with hydric soil are present and the orchid could occur there (MNFI 2007a). The Indiana bat (*Myotis sodalis*) is Federally listed as endangered. It occurs in southern Michigan when it is not hibernating (wintering) in caves and other hibernacula (wintering sites) located in southern Michigan and other states (MNFI 2007b). The bats generally require large trees (greater than 9-in. diameter) with exfoliating bark for summer roosting. According to the FWS (2009), however, trees as small as 5 in. in diameter should be considered as potential habitat. The emerald ash borer (*Agrilus planipennis*) is active in the project area (MDA 2009). Ash (*Fraxinus* spp.) trees onsite have died from the borer, creating the potential for dead trees with loose bark and resulting in potential roosting habitat for the Indiana bat.

The bald eagle (*Haliaeetus leucocephalus*) is no longer on the Federal endangered species list, although it is protected under the Bald and Golden Eagle Protection Act (BGEPA) and Migratory Bird Treaty Act (MBTA) (MNFI 2007c). The bald eagle was also recently removed from the State list of threatened and endangered species but is still considered a species of concern. Although bald eagles are known to occur in the region, they usually nest and roost closer to fish-bearing waters. The potential for any impacts on protected species appears to be minimal due to the type of habitat present.

More than 50 State-listed species occur in St. Clair County (see Table 9-10). Among the State-listed species is the eastern fox snake. Four other species formerly present in the county are presumed extirpated (locally extinct). Detroit Edison has not consulted with the MDNR on potential impacts on State-listed species that could result from siting the power plant at the Belle River-St. Clair site.

Building Impacts

Agricultural land, old field, and forest land would have to be cleared and converted to industrial use in order to build a new reactor and associated facilities at the Belle River-St. Clair site. According to Detroit Edison, the total area of the site would be approximately 1200 ac (Detroit Edison 2011a). Detroit Edison did not provide detailed data on the size of the areas or specific locations that would be used to build the power plant. Its conceptual plan layout (Detroit Edison 2009b), however, suggests that the permanently disturbed area could be as much as 95 ac, and the temporarily disturbed area could be as much as 200 ac. Conversion of agricultural land would have minimal impact on wildlife and habitat. Conversion of forested areas would have some impact on most of the common species present onsite by removing habitat used for shelter or other functions. Furthermore, NWI maps suggest that many of the forested areas on the site are wetlands. With the possible exception of the Indiana bat, adverse impacts on Federally listed species are not anticipated. The forested areas of the site have the potential to provide roosting, foraging, and breeding habitat for the Indiana bat in the form of

Table 9-10. Federally and State-Listed Terrestrial Species That Occur in St. Clair County and May Occur on the Belle River-St. Clair Site or in the Immediate Vicinity

Common Name	Scientific Name	Federal Status[(a)]	State Status[(a)]
Amphibians			
Blanchard's cricket frog	*Acris crepitans blanchardi*	NL	T
Birds			
Cerulean warbler	*Dendroica cerulea*	NL	T
Common moorhen	*Gallinula chloropus*	NL	T
Common tern	*Sterna hirundo*	NL	T
Forster's tern	*Sterna forsteri*	NL	T
Henslow's sparrow	*Ammodramus henslowii*	NL	E
King rail	*Rallus elegans*	NL	E
Least bittern	*Ixobrychus exilis*	NL	T
Louisiana waterthrush	*Seiurus motacilla*	NL	T
Peregrine falcon	*Falco peregrinus*	NL	E
Red-shouldered hawk	*Buteo lineatus*	NL	T
Mammals			
Indiana bat	*Myotis sodalis*	E	E
Plants			
American chestnut	*Castanea dentata*	NL	E
Beak grass	*Diarrhena obovata*	NL	T
Beard tongue	*Penstemon calycosus*	NL	T
Bog bluegrass	*Poa paludigena*	NL	T
Broad-leaved sedge	*Carex platyphylla*	NL	E
Carey's smartweed	*Polygonum careyi*	NL	T
Chestnut sedge	*Fimbristylis puberula*	NL	PE
Creeping whitlow grass	*Draba reptans*	NL	T
Eastern prairie fringed orchid	*Platanthera leucophaea*	T	E
Few-flowered nut rush	*Scleria pauciflora*	NL	E
Frost grape	*Vitis vulpina*	NL	T
Gattinger's gerardia	*Agalinis gattingeri*	NL	E
Ginseng	*Panax quinquefolius*	NL	T
Goldenseal	*Hydrastis canadensis*	NL	T
Heart-leaved plantain	*Plantago cordata*	NL	E
Large toothwort	*Dentaria maxima*	NL	T
Large water starwort	*Callitriche heterophylla*	NL	T
Leiberg's panic grass	*Dichanthelium leibergii*	NL	T
Limestone oak fern	*Gymnocarpium robertianum*	NL	T
Narrow-leaved puccoon	*Lithospermum incisum*	NL	PE
Northern prostrate clubmoss	*Lycopodiella margueritae*	NL	T
Orange- or yellow-fringed orchid	*Platanthera ciliaris*	NL	E

Table 9-10. (contd)

Common Name	Scientific Name	Federal Status[(a)]	State Status[(a)]
Painted trillium	*Trillium undulatum*	NL	E
Pine-drops	*Pterospora andromedea*	NL	T
Pink milkwort	*Polygala incarnata*	NL	PE
Prairie buttercup	*Ranunculus rhomboideus*	NL	T
Purple milkweed	*Asclepias purpurascens*	NL	T
Purple prairie clover	*Dalea purpurea*	NL	PE
Scirpus-like rush	*Juncus scirpoides*	NL	T
Short-fruited rush	*Juncus brachycarpus*	NL	T
Showy orchis	*Galearis spectabilis*	NL	T
Skinner's gerardia	*Agalinis skinneriana*	NL	E
Slough grass	*Beckmannia syzigachne*	NL	T
Spearwort	*Ranunculus ambigens*	NL	T
Stiff gentian	*Gentianella quinquefolia*	NL	T
Sullivant's milkweed	*Asclepias sullivantii*	NL	T
Three-awned grass	*Aristida longespica*	NL	T
White gentian	*Gentiana flavida*	NL	E
White goldenrod	*Solidago bicolor*	NL	E
White lady slipper	*Cypripedium candidum*	NL	T
Wild rice	*Zizania aquatica* var. *aquatica*	NL	T
Reptiles			
Eastern fox snake	*Pantherophis gloydi*	NL	T
Spotted turtle	*Clemmys guttata*	NL	T

Source: MNFI 2010a

(a) E = listed as endangered, NL = not listed, PE = presumed extirpated, T = listed as threatened.

dead ash trees. If the bat uses the areas that would be disturbed, impacts could be kept to minimal levels by limiting tree clearing to the times of year when the bats are not in the region.

The agricultural land is not likely to provide habitat for State-listed species. An additional study would be necessary to adequately assess potential impacts on State-listed species, including the eastern fox snake.

Detroit Edison's plan layout for the new reactor avoids disturbing any known wetlands on the site (Detroit Edison 2009b), although considering the prevalence of hydric soils on the site, the layout likely affects unmapped wetlands.

Detroit Edison's ER states that studies would be needed to determine whether more transmission capacity would have to be to be built for a new power plant at this site. It is likely, however, that a new transmission line would be necessary for a number of reasons. A reactor built on the Belle River-St. Clair site would still be expected to serve the same load centers as if

it were at the Fermi site, and the existing non-nuclear power plants on the site would continue operating, resulting in a low likelihood that sufficient uncommitted carrying capacity remains on the existing lines.

No information was provided on where a possible transmission line would be routed, how long it would be, or what terrestrial ecological resources might be affected by development or operation of such a transmission line. It may be possible, however, that new transmission lines could share or adjoin an existing transmission line corridor for some of its length and might use existing substations, thereby resulting in less ecological impact than completely new corridors and substations. The vicinity of the Belle River-St. Clair site is largely agricultural, with some forested areas. A complete assessment would require defining a route and obtaining site-specific information about wildlife and habitat. It is likely that building a new transmission line on any route would require clearing trees from substantial areas of forested wetlands.

Operational Impacts

During plant operation, wildlife, including the eastern fox snake, would be subjected to increased mortality from traffic, but it is not expected that such effects would destabilize the local or regional populations of the common species of the site (Forman and Alexander 1998). Information about the local occurrence of important species and habitats would be needed to conduct a more complete assessment of potential project effects on those resources at the Belle River-St. Clair site.

Direct mortality resulting from birds colliding with tall structures has been observed (Erickson et al. 2005). Factors that appear to influence the rate of bird impacts with structures are diverse and related to bird behavior, structure attributes, and weather. Migratory flight during darkness by flocking birds has contributed to the largest mortality events. Tower height, location, configuration, and lighting also appear to play a role in bird mortality. Weather, such as low cloud ceilings, advancing fronts, and fog, also contribute to this phenomenon (NRC 1996).

There would be a potential for bird mortality from collisions with the nuclear power plant structures at this site. Typically, the cooling tower and the meteorological tower are the structures likely to pose the greatest risk. The potential for bird collisions increases as structure heights and widths increase. MDCTs are of little concern because of their relatively low height compared with existing and proposed structures onsite. An NDCT, however, would be on the order of 600 ft high. Nonetheless, the NRC concluded that effects of bird collisions with existing cooling towers “involve sufficiently small numbers for any species that it is unlikely that the losses would threaten the stability of local populations or would result in a noticeable impairment of the function of a species within local ecosystems” (NRC 1996). Thus, the impacts on bird populations from collisions with the cooling tower are expected to be minimal.

Impacts of the transmission system on wildlife (e.g., bird collisions and habitat loss) resulting from the addition of new lines and towers cannot be fully evaluated without additional information on the length and location of any new transmission facilities. Nonetheless, Section 4.5.6.2 of the GEIS for license renewal (NRC 1996) provides a thorough discussion of the topic and concludes that bird collisions associated with the operation of transmission lines would not cause long-term reductions in bird populations. The same document also concludes that once a transmission corridor has been established, the impacts on wildlife populations from continued transmission line corridor maintenance are not significant (NRC 1996).

Other potential impacts associated with transmission line operation would consist of habitat loss due to corridor maintenance, noise, and electromagnetic field (EMF) effects on flora and fauna.

ITC*Transmission* operates in accordance with industry standards for vegetation management (NERC 2010), including seasonal restriction on activities that could adversely affect important wildlife (Detroit Edison 2010a). According to ITC*Transmission*'s vegetation management policy, wetland areas within the corridor would be manually cleared of woody vegetation periodically for line safety, thereby keeping them in a scrub/shrub or emergent wetland state (ITC*Transmission* 2010). Other forested areas would be managed similarly to prevent tree regrowth that could present safety or transmission reliability problems. Access to these areas for maintenance would likely be on foot or by the use of matting for vehicles so as not to disturb the soil. Pesticides or herbicides would be used only occasionally in specific areas where needed. It is expected that the use of such chemicals in the transmission line corridor would be minimized to the greatest extent possible in wetland areas to protect these important resources (Detroit Edison 2010a). The impacts associated with corridor maintenance activities are loss of habitat, especially forested habitat, from cutting and herbicide application. The maintenance of transmission line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments. Detroit Edison provided no data on noise for the possible new reactor on the Belle River-St. Clair site, but it is likely that impacts would be minimal and similar to those of the Fermi 3 project.

EMFs are unlike other agents that have adverse biological impacts (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NIEHS 2002). A review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures (NIEHS 2002). At a distance of 300 ft, the magnetic fields from many lines are similar to typical background levels in most homes (NIEHS 2002). Thus, impacts of EMFs from transmission systems with variable numbers of power lines on terrestrial flora and fauna are of small significance at operating nuclear power plants (NRC 1996). Since 1997, more than a dozen studies have been published that looked at cancer in animals that were exposed to EMFs for all or most of their lives (Moulder 2007). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2007). A review of the literature on health effects of electric and

magnetic fields conducted for the Oregon Department of Energy looked at the effects of strong electric and magnetic fields on various bird species. While some studies concluded that some species of birds exhibited changes in activity levels and some physiological metrics, no studies demonstrated adverse effects on health or breeding success (Golder Associates, Inc. 2009).

Cumulative Impacts

Several past, present, and reasonably foreseeable projects could affect terrestrial resources in ways similar to siting a new reactor at the Belle River-St. Clair site (see Table 9-9). The geographic area of interest for the following analysis is defined by a 25-mi radius extending out from the site

Past projects include, among others, the Belle River and St. Clair Power Plants, which are major coal-fired generating facilities belonging to Detroit Edison that occupy hundreds of acres on the east side of the site bordering the St. Clair River. Future activities in the region that could noticeably contribute to wildlife and habitat impacts in the geographic area of interest include the proposed Suncor Ethanol Projects in Sarnia and St. Clair Townships, Ontario, Canada; and future urbanization in the region. Although information on the area of land that would be converted to industrial and urban use is lacking, it is reasonable to conclude that such area would be substantial.

Urbanization would likely result in conversion of agricultural land, forest land, wetlands, and other habitat to urban uses. Urbanization would involve some of the same activities as building a new reactor, including land clearing and grading (temporary and permanent), increased human presence, heavy equipment operation, traffic (including resulting wildlife mortality), noise from construction equipment, and fugitive dust. Some of the effects of these activities, such as noise and dust, are short term and localized. The cumulative impacts of noise and dust from building a new reactor would be brief and negligible. Other effects, such as clearing wildlife habitat that will not be restored, would be permanent. The urbanization effects of land clearing and grading, filling of wetlands, increased human presence, and increased traffic would occur over a period of several years and in several locations.

Development of new energy facilities could result in increased employment and population within the geographic area of concern, which, in turn, could indirectly result in additional urbanization. Given the current populations of St. Clair County, Michigan, and Lambton County, Ontario, approximately 164,000 and 127,000, respectively, the additional impacts on ecological resources from urbanization indirectly resulting from a new nuclear power plant at the Belle River-St. Clair site and reasonably foreseeable projects are expected to be minor.

Summary of Impacts on Terrestrial and Wetland Resources at the Belle River-St. Clair Site

Impacts on terrestrial ecological resources and wetlands were estimated based on the information provided by Detroit Edison and the review team's independent review. Impacts at this site combined with past, present, and reasonably foreseeable future activities in the geographic area of interest are expected to be noticeable. Based on the conceptual layout (Detroit Edison 2009b), the permanently disturbed area could be as much as 95 ac and the temporarily disturbed area could be as much as 200 ac. Most of the project area is currently used for row crops and hay and provides relatively low wildlife habitat value. After construction and preconstruction at the site, habitat in temporarily disturbed areas would be expected to naturally regenerate. Wildlife would also recover but might not use the regenerated habitat to the same degree. Permanently disturbed areas would be converted to industrial use for the indefinite future. However, the presence of hydric soils on the site suggests that substantial impacts on wetlands might be unavoidable. Because the review team has no definitive information on the routing and length of a new transmission corridor, it cannot definitively evaluate impacts.

The review team concludes that the cumulative impacts on terrestrial ecological resources would be MODERATE for a new reactor at the Belle River-St. Clair site. Building and operating a new nuclear unit at the Belle River-St. Clair site would be a significant contributor to the MODERATE impact.

9.3.3.4 Aquatic Resources

Aquatic habitats associated with the Belle River-St. Clair site include 37 onsite wetlands, several small utility ponds, the St. Clair River, and the Belle River (Section 9.3.3.2). No information was available regarding the aquatic organisms in the onsite wetlands and utility ponds, and surveys would be needed to characterize the aquatic communities present. However, a variety of aquatic macroinvertebrates, such as mayflies, stoneflies, caddisflies, isopods, and chironomids, are likely to be present, along with fish common to Great Lakes coastal habitats, such as sunfishes (Family Centrarchidae), shiners (Family Cyprinidae), suckers (Family Catostomidae), and catfish (Family Ictaluridae) (Bolsenga and Herdendorf 1993).

The St. Clair River, which connects Lake Huron with Lake St. Clair, would likely serve as the source of cooling water intake and discharge for a new reactor on the Belle River-St. Clair site. The St. Clair River is 44 mi long and 833 ft to 3000 ft wide and is east of the site. Surface water quality in the St. Clair River is currently considered moderate to poor (see Section 9.3.3.2). The two existing power plants on the site (Belle River Power Plant and St. Clair Power Plant) employ once-through cooling systems, use the St. Clair River as a source of cooling water, and also discharge heated effluent into the river (Section 9.3.3.2).

Other aquatic habitats in the vicinity of the Belle River-St. Clair site include the Belle River, a tributary of the St. Clair River that drains approximately 2525 mi^2 of land. Impacts on the Belle River from preconstruction, construction, and operations of a new reactor are expected to be minimal, because the land area that would be affected by reactor construction would be located approximately 1 mi northeast of the Belle River and no water would be withdrawn from or discharged into the Belle River.

Approximately 18 mi downstream of the Belle River-St. Clair site, the St. Clair River terminates in the St. Clair River delta on the northern shore of Lake St. Clair. The St. Clair River delta is one of the most diverse and productive wetlands in the Midwest (Wildlife Habitat Council 2002). Aquatic habitats located within the St. Clair River and its tributaries include coastal marsh, bogs, fens, and swamps. Submerged macrophytes are the dominant primary producers within the St. Clair River, and they provide critical food and habitat for higher trophic levels. Beds of aquatic vegetation are particularly extensive at the St. Clair River delta. Mussels, crayfish, leeches, and aquatic insect larvae are common benthic invertebrates. Historically there was a high diversity of freshwater mussels within the St. Clair River drainage (Wildlife Habitat Council 2002).

There are 116 species of fish known to occur in the St. Clair River and its tributaries (Wildlife Habitat Council 2002). Common forage species include gizzard shad (*Dorosoma cepedianum*), killifish (*Fundulus* spp.), sticklebacks, rainbow smelt (*Osmerus mordax*), and alewife (*Alosa pseudoharengus*). Centrachids, catfish, yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), northern pike (*Esox niger*), and muskellunge (*Esox masquinongy*) and freshwater drum (*Aplodinotus grunniens*) are commercial or recreationally important species. The river also serves as an important corridor for migratory fishes such as lake sturgeon (*Acipenser fulvescens*) and several species belonging to the families Salmonidae and Clupeidae (Wildlife Habitat Council 2002). Some of the primary introduced aquatic nuisance fish species include the common carp (*Cyprinus carpio*), round goby (*Neogobius melanostomus*), and tubenose goby (*Proterorhinus semilunaris*) (Wildlife Habitat Council 2002; Fuller et al. 2012).

Federally and State-Listed Threatened and Endangered Species

Two freshwater mussels that are Federally listed as endangered, the rayed bean (*Villosa fabalis*) and snuffbox mussel (*Epioblasma triquetra*), are present in St. Clair County in the Belle River (FWS 2010; 77 FR 8632); these species are also listed as endangered by the State of Michigan (Carman 2001b). There are no designated critical habitats for any listed species in the vicinity of the Belle River-St. Clair site. In the St. Clair River and Belle River within St. Clair County, there are seven State-listed species of fish and six State-listed mussel species (Table 9-11). The St. Clair River provides suitable habitat for all seven fish species, and all seven are known to occur in the St. Clair or Belle River (Carman and Goforth 2000a; Carman 2001a; Derosier 2004a, b, c, d; Goforth 2000). The St. Clair River contains significant

Table 9-11. Federally and State-Listed Threatened and Endangered Aquatic Species That Are Known to Occur in St. Clair County and That May Occur on the Belle River-St. Clair Site or in the St. Clair River and Belle River

Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]
Fish			
Channel darter	*Percina copelandi*	NL	E
Eastern sand darter	*Ammocrypta pellucida*	NL	T
Lake sturgeon	*Acipenser fulvescens*	NL	T
Mooneye	*Hiodon tergisus*	NL	T
Northern madtom	*Noturus stigmosus*	NL	E
Pugnose shiner	*Notropis anogenus*	NL	E
Sauger	*Sander canadensis*	NL	T
Invertebrates			
Eastern pondmussel	*Ligumia nasuta*	NL	E
Pink papershell	*Potamilus ohiensis*	NL	T
Rayed bean	*Villosa fabalis*	E	E
Slippershell	*Alasmidonta viridis*	NL	T
Snuffbox mussel	*Epioblasma triquetra*	E	E
Wavyrayed lampmussel	*Lampsilis fasciola*	NL	T

(a) Federal status rankings determined by the FWS under the Endangered Species Act; NL = not listed, E = endangered. Source: FWS 2010.
(b) State species information provided by MNFI (2010b); E = endangered, T = threatened.

spawning grounds for lake sturgeon (Goforth 2000) and is the only river in Michigan for which there are recent records of mooneye (*Hiodon tergisus*) and sauger (*Sander canadensis*) (Derosier 2004a, b). Historical or recent records indicate that the wavyrayed lampmussel (*Lampsilis fasciola*), rayed bean, slippershell (*Alasmidonta viridis*), and snuffbox mussel are present or potentially present in the Belle River (Carman and Goforth 2000b; Carman 2001b; Stagliano 2001a; Carman 2002b; 75 FR 67552). Rayed bean, snuffbox mussel, and slippershell are potentially present in large rivers like the St. Clair. The eastern pondmussel (*Ligumia nasuta*) can be found in ponds, lakes, and streams (Mulcrone 2006a). The pink papershell (*Potamilus ohiensis*) is usually found in rivers and large streams (Mulcrone 2006b). Therefore, suitable habitat for both species may exist in the St. Clair River and Belle River.

Building Impacts

Impacts on aquatic habitats and biota on the Belle River-St. Clair site and on the St. Clair River could result from building the new reactor, associated transmission lines, and the cooling water intake pipeline. As identified in Section 9.3.3.1, the area of the site that would be developed if the site was chosen for a new reactor facility consists primarily of agricultural land and woodland. The expected building location is adjacent to wetland areas, but there are no

streams or ponds located directly within the construction footprint. Building a new cooling water intake and discharge pipeline would have the potential to affect aquatic habitat present along the pipeline corridor and could require dredging, pile driving, and other alterations to the shoreline and benthic habitat of the St. Clair River, potentially resulting in sedimentation, noise, turbidity, sediment removal, and accidental releases of contaminants. See Section 4.3.2 for a detailed description of potential impacts of construction activities on aquatic habitat and biota. The impacts on aquatic organisms would likely be temporary and largely mitigable through the use of BMPs. Preconstruction activities within the St. Clair River would require Section 10 and/or 404 permits from the USACE, as well as a separate permit from the MDEQ, and these permits would likely contain stipulations that would further reduce impacts. Overall, the impact of building the cooling water intake and discharge structures on aquatic resources would be minor.

As described in Section 4.3.2, building activities at the location of the new reactor, including an increase in impervious surface, vegetation removal, site grading, and dewatering, would have the potential to affect water quality and hydrology, and therefore aquatic biota in wetlands and ponds located in the vicinity. Stormwater runoff could carry soil as well as contaminants (e.g., spilled fuel and oil) from construction equipment into wetlands and ponds located onsite. Construction of the new reactor would not occur adjacent to the Belle River or the St. Clair River, making it unlikely that there would be effects of reactor facility construction on aquatic resources in these areas.

It is possible that the transmission line for a new reactor at the Belle River-St. Clair site could use existing substations and share or adjoin an existing transmission line corridor for some of its length. If so, building-related impacts on aquatic resources would be minimal. If a new transmission line is needed to service a new reactor at this site, there is the potential for the construction-related impacts described above to affect aquatic habitat and aquatic biota if the new transmission line passed near or crossed a surface water feature. Expansion of existing corridors would be expected to result in minor environmental impacts, while establishing new corridors could result in greater impacts. However, assuming required construction permits would be obtained from MDEQ and/or USACE and appropriate BMPs were implemented during building activities, the impacts on aquatic resources from development of additional transmission facilities would be temporary, easily mitigated, and minor.

NPDES and stormwater construction permits would stipulate the application of BMPs and other mitigation to reduce impacts on the St. Clair River and onsite wetlands and ponds resulting from the construction of a new reactor facility and cooling water intake structures. Adhering to appropriate BMPs would reduce the potential for sediments to enter surface water. Detroit Edison's suggested layout for a new reactor at the alternative Belle River-St. Clair site avoids disturbing any wetlands or water bodies on the site (Detroit Edison 2009b) and is located

approximately 1 mi or more from the Belle River and St. Clair River, further reducing the potential for impacts on aquatic biota.

New reactor and transmission line construction is not expected to result in impacts on Federally or State-listed species, given the lack of suitable habitat at the reactor location and the use of BMPs to minimize potential construction-related impacts. However, threatened and endangered fish and mussels found in the St. Clair River may be affected by benthic disturbance associated with the building of cooling water intake and discharge structures. Threatened and endangered mussels potentially present in the St. Clair River include the eastern pondmussel, pink papershell, slippershell, and snuffbox mussel. As discussed above, the rayed bean is not likely to be present. Additional information would need to be collected and surveys may need to be conducted to evaluate the potential for threatened and endangered mussel species to be present in areas of the St. Clair River that would be disturbed by building activities. If threatened or endangered mussels were found, it is likely that mitigation measures would need to be developed to limit potential impacts. Habitat for State-listed fish species could be disturbed by shoreline and in-water construction activities. However, fish are highly mobile and would likely avoid the affected areas during construction. On the basis of this information and because construction and preconstruction activities would be temporary and largely mitigable, the review team concludes that impacts on threatened and endangered aquatic species would be minor.

Operational Impacts

Operational impacts on aquatic resources could result from water withdrawal from the St. Clair River, impingement and entrainment of aquatic biota by the cooling water system, transmission line and cooling water system maintenance, and alteration of water quality due to cooling water discharge.

Operational cooling water requirements would be the major water demand of a new reactor on the St. Clair River. Detroit Edison has indicated a closed-cycle recirculating cooling system would be used, which could reduce water use by 96 to 98 percent of the amount that the facility would use if it employed a once-through cooling system (66 FR 65256). Assuming that cooling water needs would be similar to those identified for the proposed Fermi 3 Unit, approximately 34,000 gpm, or 49 MGD, would be needed (Detroit Edison 2011a). The daily flow in the St. Clair River is adequate to support the closed-cycle cooling system and meet the proportional flow limitations of EPA's CWA Section 316(b) Phase I requirements for new facilities. Therefore the incremental impact from operating a new power plant at the Belle River-St. Clair site would be minor (see Section 9.3.3.2, Water Use and Quality). Consequently, the hydrologic impacts on aquatic habitat in the St. Clair River from water withdrawal should be minimal.

Periodic maintenance dredging of the water intake is necessary to maintain appropriate operating conditions for cooling water intake. Such dredging would likely be managed under

permits from USACE and MDEQ and result in temporary localized increase in turbidity in the vicinity of the intake bay. Dredged material is expected to be disposed of in a spoil disposal pond, where sedimentation would occur prior to discharge of the water back into the St. Clair River. The periodic dredging of the intake bay, which would likely be similar to existing maintenance dredging activities for the existing power plants on the site, would result in minor impacts on aquatic biota and habitats in the St. Clair River.

Impingement and entrainment of organisms from the St. Clair River would be the most likely way in which populations of aquatic biota could be adversely affected by operations of a new reactor at the Belle River-St. Clair site. Particularly vulnerable are early life stages (eggs and larvae), which lack the ability to overcome intake suction and which are small enough to pass through the mesh of the intake screens. As discussed above, the St. Clair River contains a diverse aquatic biota and provides spawning habitat for several important aquatic species, particularly in the St. Clair River delta. However, the St. Clair River delta is approximately 18 mi downstream of the site, which would greatly reduce the potential for fish eggs, larvae, and juveniles to be entrained by the water intake system. A study of larval fish entrainment from the St. Clair River power station found that during spring and summer rainbow smelt, fourhorn sculpin (*Myoxocephalus quadricornis*), silver chub (*Macrohybopsis storeriana*), yellow perch, common white sucker (*Catostomus commersonii*), logperch (*Percina caprodes*), trout-perch (*Percopsis omiscomaycus*), burbot (*Lota lota*), and goldfish (*Carassius auratus*) were entrained, with rainbow smelt, accounting for approximately 96 percent of the individuals; fourhorn sculpin and silver chub each accounted for less than 2 percent of individuals (Leslie et al. 1979). Historically, larval walleye have also been entrained in great numbers by the St. Clair River Power Plant (Wapora, Inc. 1978). The closed cycle recirculating cooling system proposed by Detroit Edison would substantially reduce water withdrawal compared to a once-through cooling system, thereby decreasing the impingement and entrainment of organisms (Section 5.3.2). Assuming a closed cycle cooling system that meets the EPA's CWA Section 316(b) Phase I regulations for new facilities (66 FR 65256), the anticipated impacts on aquatic populations from entrainment and impingement are expected to be minimal.

Discharge would include cooling tower blowdown, treated process wastewater, and processed radwaste wastewater, all of which could affect aquatic biota through mortality or sublethal physiological, behavioral, and reproductive impairment (see Section 5.3.2). In addition, aquatic organisms could be affected by cold shock and the scour of benthic habitat in the vicinity of the discharge ports (see Section 5.3.2). Mixing and the high flow rate of the St. Clair River would likely limit impacts on downstream surface waters from the cooling water discharge. Proposed design features such as the presence of riprap around the submerged discharge port and orientation of the discharge ports in an upward direction are intended to reduce scouring (Detroit Edison 2011a). As identified in Section 9.3.3.2, a NPDES permit from the MDEQ would be required for discharges from a new nuclear power plant at the Belle River-St. Clair site. Such a permit would specify limits for chemical and thermal discharges in order to protect water quality,

thereby limiting the potential for impacts on aquatic organisms. As identified in Section 9.3.3.2, the high flow rate of the St. Clair River and associated mixing would limit the influence of chemical and thermal discharges on downstream surface water bodies. Assuming that NPDES permitting requirements are met, the impacts of discharges on aquatic habitats and biota would be minor.

At the Belle River-St. Clair site, impacts on aquatic resources from operation of a new reactor may include those associated with maintenance of new and existing transmission line corridors. ITC*Transmission* would be expected to construct and operate any new transmission line needed for a new reactor at the Belle River-St. Clair site, and it is assumed that it would follow existing maintenance practices designed to minimize impacts on wetlands, such as minimizing disturbance to riparian habitat and minimizing the application of pesticides and herbicides, which can enter aquatic habitat and adversely affect aquatic biota (Detroit Edison 2010a). As a result, impacts on aquatic habitats and biota from maintenance of transmission lines would likely be minor.

There is no suitable habitat for threatened and endangered mussels near the location of the reactor, but several of the species, including the rayed bean and the snuffbox mussel (both proposed for Federal listing as endangered) and the State-listed eastern pondmussel, the pink papershell, and the slippershell, are potentially found in the St. Clair River, and may therefore be vulnerable to cooling water intake and discharge operational impacts. As eggs, mussels are not likely to be affected by system operation, because they are not free-floating but rather develop into larvae within the female. The glochidial stage, during which juvenile mussels attach to a suitable fish host, is vulnerable indirectly through host impingement and entrainment. Hosts for the slippershell (johnny darter [*Etheostom anigrum*], mottled sculpin [*Cottus bairdii*]), snuffbox mussel (logperch), and rayed bean (largemouth bass [*Micropterus salmoides*]) are present in the St. Clair River and could be impinged during reactor operations. Post-glochidial and adult stages of mussels are not likely to be susceptible to entrainment or impingement because they bury themselves in sediment.

The channel darter (*Percina copelandi*) and eastern sand darter (*Ammocrypta pellucida)* are unlikely to be entrained because they bury themselves in sediment and remain near the bottom. Lake sturgeon are known to spawn in the St. Clair River near the opening into Lake St. Clair approximately 18 mi downstream of the site, and eggs or young of the State-listed mooneye and sauger could be present in the St. Clair River. A closed cycle cooling system for a new reactor on the Belle River-St. Clair site would withdraw river water at a maximum rate of 34,264 gpm, as discussed in Section 3.2.2.2. Compared to the average river flow of 121,000 MGD, this represents only 0.04 percent of the flow of the St. Clair River, and therefore early life stages of these species are not likely to be entrained or impinged in sufficient numbers to cause population-level effects.

Cumulative Impacts

For the cumulative analysis of impacts on aquatic resources, the geographic areas of interest for the Belle River-St. Clair reactor are the St. Clair River (which connects Lake Huron with Lake St. Clair) and Lake St. Clair, because these are the areas potentially affected by a new reactor. Past, present, and reasonably foreseeable projects, facilities, and other environmental changes that contribute to cumulative impacts on aquatic resources in this area of interest are existing power plants on the St. Clair River (including the Belle River Power Plant and the St. Clair Power Plant on the Belle River-St. Clair site); ethanol production facilities in Ontario, Canada; and future urbanization in the region. In addition, aquatic resources in the region have been greatly affected by ecosystem changes from introduced dreissenid mussels (*Dreissena* spp.) and recreational and commercial fishing.

As discussed above, potential building-related impacts on aquatic habitat and biota could result from altered hydrology, erosion, and stormwater runoff of soil and contaminants and disturbance or loss of benthic habitat from construction of the reactor, associated transmission lines, and water intake and discharge system. The additional impacts on aquatic resources from building new ethanol plants would be minimal due to the small areas that would be developed and the distance to the Ontario sites. Urbanization can affect aquatic resources by increasing the impervious surface, non-point-source pollution and water use, and by altering riparian and in-stream habitat and existing hydrology patterns. Development of a new reactor on the Belle River-St. Clair site and the other projects in the region could result in some increased population and additional urbanization with subsequent impacts on aquatic resources.

The primary operational impacts on aquatic habitat and biota could result from impingement and entrainment of aquatic biota during cooling water intake, makeup water needs, transmission line maintenance, and alteration in water quality from cooling water discharge. Impingement and entrainment of aquatic biota from the St. Clair River due to a new reactor must be considered along with mortality resulting from existing power plants that already withdraw water from the St. Clair River, commercial and recreational fishing, and introduced zebra mussels (*Dreissena polymorpha*) and quagga mussels (*D. rostriformis*), which have dramatically reduced plankton abundance in the region.

The St. Clair River would be sufficient to support the makeup water needs of a new reactor in addition to the cooling water needed by existing U.S. and Canadian power plants and other projects listed in Table 9-9. However, as described in Section 7.2.1, the effect of climate change could noticeably decrease the availability of surface water resources in the Great Lakes region. If such a reduction in surface water were to occur, some aquatic habitat on the reactor site and in the St. Clair River may be altered, with potentially adverse consequences for aquatic habitat and biota.

Discharges into the St. Clair River from a new nuclear power plant at the Bell River-St. Clair site must be considered along with discharges into the St. Clair River from the other projects identified in Table 9-9. NPDES permits would limit both chemical and thermal discharges into the St. Clair River. However, if climate change results in reduced water levels and increased water temperatures, impacts associated with contaminant concentrations and thermal stress from cooling water discharge into the St. Clair River could also increase. As identified in Section 9.3.3.2, the overall, cumulative surface water quality impacts associated with a new nuclear power plant at the Belle River-St. Clair site together with predicted climate change and other past, present, and reasonably foreseeable actions in the region are expected to be moderate. However, the construction and operation of a new nuclear power plant at the Belle River-St. Clair site is not expected to contribute significantly to the overall cumulative impacts on water quality in downstream surface water bodies (Section 9.3.3.2). Consequently, the incremental contribution of a new reactor at the Belle River-St. Clair site to cumulative impacts on aquatic biota from water quality changes due to operational discharges would be minor.

Based on its evaluation, the review team concludes that the cumulative impacts on aquatic resources, including threatened and endangered species, could be substantial due to the continued inadvertent introduction of invasive species, overfishing, and increased urbanization resulting in further degradation of water quality, and global climate change. However, the incremental impact from building and operating a new power plant at the Belle River-St. Clair site would not contribute measurably to the overall cumulative impacts in the geographic area of interest.

Summary of Impacts on Aquatic Resources at the Belle River-St. Clair Site

Impacts on aquatic habitats and associated biota within onsite ponds and wetlands and the St. Clair River could result from reactor, transmission line, and cooling water intake preconstruction and construction activities. However, the impacts on aquatic organisms would be temporary and could be largely mitigated by avoiding aquatic habitats during siting of facilities and activity areas and through the use of BMPs during preconstruction and construction.

Operational impacts on aquatic resources could result from cooling water withdrawal from the St. Clair River, impingement and entrainment of aquatic biota by the cooling water system, transmission line and cooling water system maintenance, and alteration of water quality by cooling water discharge. Impingement and entrainment would add to existing mortality sources for aquatic biota such as invasive species, commercial and recreational fishing, and the operation of other power plants using water from or discharging to the St. Clair River.

Impingement and entrainment of aquatic organisms in the St. Clair River would be minimized by complying with EPA's CWA Section 316(b) Phase I regulations. The St. Clair River could support the makeup water needs of a new reactor. However, climate change could noticeably

decrease the availability of surface water resources in the Great Lakes region. Similarly, while a NPDES permit would limit both chemical and thermal discharges from the Belle River-St. Clair reactor, climate change has the potential to increase impacts of the discharges on aquatic communities. Transmission line and cooling water pipeline maintenance impacts on aquatic habitat and biota could be minimized by implementing BMPs.

Although there is no suitable habitat that is likely to be present near the reactor location, State-listed fish and mussels may be present in the St. Clair River and could be vulnerable to benthic disturbance associated with the building of the cooling water intake and discharge system. State-listed mussels could be surveyed and translocated prior to construction of the intake and discharge structures. The State-listed darters are unlikely to be entrained because they prefer benthic habitats. Although lake sturgeon, mooneye, and sauger could be more vulnerable to entrainment and impingement, the use of closed cycle cooling and a properly designed intake structure would significantly reduce potential losses, and population-level effects would be minor.

The review team's conclusion, based on information provided by Detroit Edison and the review team's independent evaluation, is that the impacts on aquatic resources, including threatened or endangered species, from the Belle River-St. Clair reactor considered with cumulative impacts on aquatic resources from other activities and climate change would be MODERATE. Building and operating a new nuclear unit at the Belle River-St. Clair alternative site would not be a significant contributor to the overall cumulative impact.

9.3.3.5 Socioeconomics

The economic impact area for the Belle River-St. Clair site is St. Clair County. The site is located in St. Clair County, approximately 8 mi south of Port Huron and approximately 1 mi west of the international border crossing at Port Huron/Sarnia, Canada. St. Clair County is also part of the Detroit-Warren-Livonia MSA, which encompasses nine principal cities over a six-county area, the core of which is the City of Detroit, approximately 35 mi southwest of the site.

Because of the geographical location of the plant, members of the workforce that would be drawn from the region may live in Canada or elsewhere within the Detroit-Warren-Livonia MSA. However, the review team expects that most of the in-migrating construction and operations workers would likely relocate in or near the City of Port Huron, which is near the plant, has the highest population base, and would have the most housing and other amenities relative to the rest of the primarily rural region. Impacts beyond St. Clair County are not likely to be significant in any single jurisdiction, because the number of in-migrating workers within any single jurisdiction outside of St. Clair County would be minor. Therefore, this analysis focuses on St. Clair County.

Physical Impacts

Physical impacts include impacts on workers and the general public, noise, air quality, buildings, roads, and aesthetics. Because the physical impacts of building and operating a nuclear power plant are very similar between the proposed site and the alternative sites, the review team determined that, as assessed for the Fermi 3 site, all physical impacts related to the Belle River-St. Clair site would be minor. See Sections 4.4.1 and 5.4.1 for a detailed discussion of physical impacts for Fermi 3.

Demography

The Belle River-St. Clair site is partially within the China Charter Township and partially within East China Charter Township. Port Huron, approximately 8 mi north of the Belle River-St. Clair site, is the largest population center in the county. Other large population areas are those immediately surrounding Port Huron, including the City of Marysville and the Townships of Fort Gratiot, Port Huron, and Kimball. Historically, St. Clair County's population has been concentrated along the coast, including within Port Huron, Marysville, St. Clair, and Marine City. Table 9-12 provides the 2000 and 2010 Census population, and the projected 2020 population for the largest population areas in St. Clair County.[(a)]

Table 9-12. Demographics for St. Clair County and Local Jurisdictions

	Population		
County/City/Township	**2000**	**2010**	**2020 Projected**
St. Clair County	164,235	163,040	180,294
City of Port Huron	32,338	30,184	31,402
City of Marysville	9684	9959	10,820
Fort Gratiot Township	10,691	11,108	12,743
Port Huron Township	8615	10,654	11,995
Kimball Township	8628	9358	10,066

Source: The 2020 projections are provided by SEMCOG (2008). The 2000 and 2010 data for all areas are from the USCB (2000a, 2010a).

Between 2000 and 2010, the population in St. Clair County declined by approximately 1 percent. Population growth occurred in the City of Marysville and townships surrounding the City of Port Huron, while the population of Port Huron declined. These jurisdictions are also where future growth in the county is expected (LSL Planning Inc. undated).

(a) This section has been updated for the Final EIS to include the results of the mandated U.S. decadal census for 2010 for the data sets that have been released by the U.S. Census Bureau as of May 2012. For the data sets that have not yet been released, the review team has presented the results of the five-year estimates from the American Community Survey (i.e., 2006–2010).

Detroit Edison estimates that the size of the construction workforce needed for the nuclear power plant over a 10-year construction period would range from a minimum of 35 workers to a peak construction workforce of 2900 workers, and that the average size of the onsite workforce during the 10-year construction period would be approximately 1000 workers (Detroit Edison 2011a).

The review team's assumptions for in-migrating and local workers are similar to those for the Fermi 3 plant site. Although the plant is located in a primarily rural county, it is also within commuting distance of highly urbanized areas (i.e., within a 50-mi radius of the plant). St. Clair County is within the Detroit-Warren-Livonia MSA, and the City of Detroit is approximately 35 mi southwest of the plant. The City of Flint, Michigan, is slightly beyond the 50-mi radius of the site, but is still within a reasonable commuting distance to the plant, approximately 60 mi. Therefore, for comparative purposes between analyses of site alternatives, the review team based this analysis upon the assumptions presented in Section 4.4.2 of this EIS, with approximately 85 percent of the construction workforce drawn from within a 50-mi region or more of the plant, and 15 percent of the construction workforce (approximately 435 workers during the peak construction and 150 workers on an average annual basis) expected to relocate within the 50-mi radius of the project site.

If the facility were to be built at the Belle River-St. Clair site and operations commenced, Detroit Edison expects an operations workforce of 900 workers in 2020 (Detroit Edison 2011a). For reasons similar to those presented for the Fermi 3 site in Section 2.5 of this EIS, the review team determined that based on the analysis of impacts presented in Section 5.4.2, approximately 70 percent of the operations workforce would be drawn from the region within 50 mi of the plant, and 30 percent of the operations workforce (approximately 270 workers) would relocate within a 50-mi radius of the project site.

Using an average household size of 2.6 persons, based on the national average household size in the USCB's 2010 population data, the total in-migrating population is estimated to be approximately 1131 persons during the peak construction period and less during periods of non-peak construction. The projected population increase associated with the in-migrating operations workers is estimated to be 702 persons.

If all the in-migrating construction workers and their families settled in St. Clair County for the 2-year peak construction period, the projected increase would be less than 1 percent of the projected 2020 population for the county. Demographic impacts during periods of non-peak employment construction would be smaller. The in-migrating construction workers and their families would likely settle in various cities and townships throughout the county, and the population effects are expected to be minimal. The projected population increase for the operations workforce would be smaller than that projected for the peak construction employment period and would also be less than 1 percent of the projected 2020 population for the county.

Given the small number of in-migrating workers compared to the projected 2020 population for St. Clair County, the review team concludes that the demographic impact during peak construction and operation would be minor.

Economic Impacts on the Community

Economy

There were 77,492 employed workers in St. Clair County in 2010 (USBLS 2012) (see Table 9-13). Its unemployment rate increased from 4.2 percent in 2000 to 15.6 percent in 2010. The most recent unemployment rate of 13.1 percent in 2011 showed improvement in the job outlook (USBLS 2012). Approximately 21 percent of the workforce is employed in manufacturing, and 22 percent in educational services, health care, and social assistance (USCB 2010b). Approximately 12 percent is employed in retail trade, and 9 percent in construction (USCB 2010b). Tourism and manufacturing are large components of St. Clair's economy (St. Clair County Metropolitan Planning Commission 2009). The Blue Water Bridge international crossing at Port Huron/Sarnia is the third-busiest border crossing in the country. St. Clair's manufacturing base consists primarily of suppliers of plastics and rubber to the automotive industry, although other manufacturing establishments, including paper, fabricated metal and metal parts, and machinery, are also located in St. Clair County (St. Clair County Metropolitan Planning Commission 2009). In 2000, approximately 36 percent of St. Clair County's workers lived in the county and commuted to work outside of the county. The four largest employers in St. Clair County in 2008 were Port Huron School District, with approximately 1462 employees; Port Huron Hospital, approximately 1057 employees; Detroit Edison, approximately 1044 employees; and the K-Mart Corporation, approximately 850 employees (St. Clair Administrator/Controller's Office 2009).

Table 9-13. Labor Force Statistics for St. Clair County (2000 and 2010)

	St. Clair County	
	2000	**2010**
Total labor force	87,071	77,492
Employed workers	83,383	65,375
Unemployed workers	3688	12,117
Unemployment rate	4.2	15.6

Source: USBLS 2012

The economy of St. Clair County would benefit over the estimated 10-year construction period through direct purchase of materials and supplies and direct employment of the construction workforce. Detroit Edison estimates the size of the construction workforce would range from a minimum of 35 workers to a peak construction workforce of 2900 workers, with an average

annual onsite construction workforce of 1000 workers. The review team estimates that based on an average salary of $50,500, approximately $50.5 million would be expended directly in payroll annually during the construction period.

When the plant becomes operational, Detroit Edison expects direct employment to be 900 full-time and contract employees. In addition, Detroit Edison estimates 1200 to 1500 workers would be employed during scheduled maintenance outages, which would occur every 24 months and require workers for a period of about 30 days. Based on an average salary estimate of $63,625, approximately $57.3 million would be expended directly in payroll annually during the 40-year operating license of the plant. In addition, every 24 months, an additional $6.3 to $7.9 million in payroll would be expended for the outage workforce for the plant.

New workers (i.e., in-migrating workers and those previously unemployed) would have an additional indirect effect on the local economy, because these new workers would stimulate the regional economy with their spending on goods and services in other industries.

The review team concludes that the impact of building activities on the economy would be noticeable and beneficial in St. Clair County and minimal and beneficial elsewhere.

Taxes

Construction and operation of a plant at the Belle River-St. Clair site would result in increased tax revenues to State and local governments. State income tax revenue would accrue through income taxes on salaries of the new workers (i.e., in-migrating workers and those previously unemployed). As discussed in Section 4.4.3, based on an estimated annual average of 362 new workers (i.e., 150 in-migrating and 212 previously unemployed) during the 10-year construction period and an average salary of $50,500, the State of Michigan would receive an estimated $0.7 million in income tax revenue annually during the construction period. As discussed in Section 5.4.3, based on an estimated annual average of 327 new workers (i.e., 270 in-migrating and 57 previously unemployed) for operation of the plant and an average salary of $63,625, the State of Michigan would receive an estimated $0.8 million in income tax revenue annually during the period of the 40-year operating license. The State of Michigan would also receive tax revenue through increased sales expenditures by workers and for the plant construction, operation and maintenance, and business taxes during operation.

Property tax revenue would be the primary tax benefit to the local jurisdictions. The plant would be assessed during the construction period and be at its highest assessed value when the plant becomes operational. For analysis, the review team recognizes that the full estimated construction cost of $6.4 billion for a nuclear power plant of 1605 MW(e), as discussed in Section 4.4.3.1, may not be the actual assessed value for property tax purposes. However, for comparative purposes in the alternative sites analysis, the review team based its conclusions upon this construction cost estimate. In 2008, the taxable value of real and personal property at

Detroit Edison's existing Belle River-St. Clair Power Plants and the Greenwood Energy Center was $731 million, approximately 11 percent of the total county taxable assessed property value ($8.5 billion) (St. Clair Administrator/Controller's Office 2009). Consequently, with completion of the construction of a new nuclear plant at the Belle River site, the total assessed property value in the county would be increased by about 75 percent. The review team recognizes that this would be an upper bound to the assessed value of the property and that a fee in lieu of agreement or other considerations may significantly reduce that assessed value. However, the review team believes that the property tax impact to St. Clair County would be substantial and beneficial.

Summary of Economic Impacts and Taxes

Based on the information provided by Detroit Edison and the review team's evaluation, the review team concludes that the impact of building activities on the economy would be noticeable and beneficial in St. Clair County and minimal and beneficial elsewhere. The impact of tax revenues would be substantial and beneficial in St. Clair County and minimal and beneficial elsewhere. An annual average of 150 new construction workers would relocate into the area, and 212 workers who are currently unemployed would be employed for building activities over the 10-year construction period. A portion of the estimated $6.4 billion construction cost of the nuclear power plant would be spent on materials and supplies in the local area or would be transported into the area through the international border crossing at Port Huron/Sarnia; tax revenue to the State and local jurisdictions would accrue through personal income, sales, and property taxes and would have the largest benefit on the local jurisdictions within St. Clair County.

During operations at the Belle River plant, an estimated 270 new operations workers would relocate into the area, and 57 workers who are currently unemployed would be employed in operating the plant. Based on the information provided by Detroit Edison and the review team's evaluation, the review team concludes that the economic impact of operating the Belle River plant, including tax revenues, would be substantial and beneficial in St. Clair County and minimal and beneficial elsewhere.

Infrastructure and Community Services

Traffic

State Route 29 (M-29) separates the St. Clair plant site from the Belle River plant site and would provide direct access to the new plant site. M-29 would also be the principal route for workers commuting from communities along the shoreline and the City of Port Huron. It extends along the St. Clair River north to Marysville and south to Lake St. Clair at the southern end of St. Clair County.

Two major interstates cross the county, merging at Port Huron. Interstate 69 provides east–west access extending from the Canadian border crossing at Port Huron/Sarnia to Flint, Lansing, and Chicago. Interstate 94 extends southwest from Port Huron to the Detroit metropolitan area, approximately 35 mi southwest of Port Huron. The Blue Water Bridge crossing at Port Huron/Sarnia is a major international bridge crossing, with 4.9 million crossings in 2008 (MDOT 2009). The St. Clair River is part of the Great Lakes St. Lawrence Seaway System; the nearest port to the site is in the City of Sarnia, Canada.

Canadian National (CN) and CSX Transportation (CSX) rail systems cross St. Clair County. The CN railroad crosses the St. Clair River through an underground tunnel between Port Huron and Sarnia. A rail spur for CSX provides direct access to the plant site. The Belle River-St. Clair site can also be accessed from the St. Clair River via barge.

Most of the traffic-related concerns would be related to the commutes of the workforce. Detroit Edison's Belle River and St. Clair Power Plants already employ a large portion of the 1044 Detroit Energy employees in the county at this site, and the projected construction and operations workforces would more than double the number of employees at the site, especially during the peak construction employment period and during outages. M-29 appears to provide the most direct route for commuting between the Belle River-St Clair site and places of residence and is already a high-volume road. However, Detroit Edison, in coordination with the MDOT and St. Clair County Road Commission, would need to conduct a traffic study that would identify strategies that would mitigate the traffic to an acceptable level.

The review team expects traffic impacts from building activities and operations, including both construction workers, operations workers, and deliveries, would be noticeable but not destabilizing and would warrant mitigation in coordination with the MDOT, the Blue River Bridge Authority, and the St. Clair County Road Commission, as well as Canadian transportation agencies (i.e., Transport Canada, Ontario Ministry of Transportation, and Canadian Blue River Bridge Authority), depending on the extent of truck traffic crossing the Blue River Bridge with materials and supplies.

Recreation

St. Clair County Parks and Recreation Commission operates three parks in the county: Goodells County Park (327 ac), Fort Gratiot County Park (30 ac), and the Wadhams to Avoca Trail (12 mi). A fourth park, the Columbus County Park, is in development and will include 384 ac along the Belle River when complete. The State of Michigan owns 22,178 ac of park and conservation land in St. Clair County, including Algonac State Park (1450 ac in Cottrellville and Clay Townships), Lakeport State Park (1215 ac in Burtchville Township), Port Huron State Game Area (6627 ac in Grant, Clyde, and Kimball Townships), St. Clair Flats State Wildlife Area (10,300 ac in Clay Township), St. Johns March Recreation Area (2477 ac in Clay and Ira Townships), and Mini Game Area (109 ac in St. Clair Township) (St. Clair County Parks and

Recreation Commission 2007). In addition, numerous township parks are located throughout St. Clair County, and various beaches, marinas, and boat access points are located along the St. Clair River and Lake Huron shoreline (St. Clair County Parks and Recreation Commission 2007).

The recreational areas nearest to the Belle River-St. Clair site are East China Township Park, just south of the site; Algonac State Park, approximately 8 mi south of the site; and a portion of the 54-mi Bridge to Bay Trail, which extends along the St. Clair River shoreline and passes through East China Township Park.

Recreational resources in St. Clair County may be affected by construction and operation of a plant at the Belle River-St. Clair site. Impacts may include increased user demand associated with the projected increase in population from the in-migrating workforce and their families; an impaired recreational experience associated with the views of the proposed 600-ft cooling tower and steam plume; or access delays associated with increased traffic from the construction and operations workforce on local roadways.

Several small communities and recreational facilities are located along the St. Clair River near the Belle River-St. Clair site. Users of recreational resources in the vicinity of the site may be affected by the views of the 600-ft cooling tower and condensate plume that would occur during operation of the plant. A new nuclear power plant and 600-ft cooling tower and condensate plume would be visible in a wide area, because the topography in the vicinity of the site is flat and the plant would be located near the St. Clair River. Existing coal-fired power plant stacks and MDCTs, which are also capable of producing condensate plumes, are located at the site but are smaller than the proposed 600-ft cooling tower.

Because the construction of a nuclear plant adjacent to the coal plants would result in substantial increases in power capacity, it is likely that new or upgraded transmission lines would also be required, which could result in additional offsite construction and visual impacts.

Impacts associated with the increased use of the recreational resources in the vicinity and region would be minor. The projected increase in population in St. Clair County associated with in-migrating workers and their families for construction and operation is less than 1 percent of the projected 2020 population and would not affect the availability and use of recreational resources in the area.

People using recreational facilities near the site may experience traffic congestion on the roads during the construction period, during morning and afternoon commutes of the operations workforce, and during the scheduled maintenance and forced outage periods. Measures to mitigate traffic impacts, particularly along M-29, would be needed and would alleviate some of the impacts on users of recreational facilities as well as members of the general public.

However, even with mitigations, recreational users may be affected during the morning and afternoon commutes to and from the plant site.

Based upon the above information, the review team determined that the recreation-related impacts of building and operating at the alternative site would be minor.

Housing

As shown in Table 9-14, an estimated 72,027 housing units are located in St. Clair County, based on 2010 data for housing. The number of vacant units increased from 5035 to 7421 between 2000 and 2010. An estimated 31 percent of the vacant housing units were used for seasonal, recreational, or occasional purposes.

Table 9-14. Housing Units in St. Clair County (2010 Estimate)

Type of Housing Unit	St. Clair County
Total Housing Units	72,027
Occupied	64,606
Owner-occupied (units)	50,968
Owner-occupied (percent)	79
Renter-occupied (units)	13,638
Renter-occupied (percent)	21
Vacant	7421
Vacancy Rate	
Homeowner (percent)	2.2
Rental (percent)	11.6

Source: USCB 2010c

Demand for short-term housing is expected to be highest during the peak construction period, and demand for long-term housing is expected to be highest when operations commence.

Based on the analysis of impacts presented in Section 4.4.2, most of the construction and operations workforces would already reside in the area and would be accommodated in existing housing. Approximately 15 percent of the construction workforce (approximately 435 workers during the peak construction) and approximately 30 percent (approximately 270 workers) of the operations workforce would be expected to relocate within a 50-mi radius of the project site. Considering that the construction workforce may choose short-term accommodations such as campsites or hotels, the review team expects that the existing housing supply is sufficient to accommodate the construction workforce of 435 workers during the peak building-related

employment period and the operations workforce of 270 workers in-migrating to the area without affecting the housing supply or prices in the local area or stimulating new housing construction. Therefore, the impacts on housing would be minor.

Public Services

In-migrating construction workforce and operations workforce would increase the demand for water supply and wastewater treatment services within the communities where they choose to reside. The size of the total construction and operations workforce also would increase the demand for water supply and wastewater treatment services at the Belle River-St. Clair site. Much of the county obtains water supplies through private wells (St. Clair County Metropolitan Planning Commission 2009). Communities with water supply and wastewater treatment services in St. Clair County are shown in Table 9-15, which indicates that most areas have excess capacity, and the water supply and wastewater treatment systems should be able to accommodate the in-migrating construction and operations workforces and their families.

Increased demand for police, fire response, and health care services from the in-migrating construction and operations workforces and their families are also expected to be accommodated within the existing systems.

Therefore, the review team expects the impacts on public services to be minor.

Education

St. Clair County has seven school districts (Algonac, Anchor Bay, Capac, East China, Marysville, Port Huron, and Yale) with a combined enrollment of 32,047 for the 2007–2008 school year (U.S. Department of Education 2010). As stated in Section 4.4.4.5, approximately 202 school-age children are expected to in-migrate into the 50-mi region during building activities, and 124 school-age children are expected to in-migrate for operations. Although they could in-migrate anywhere within the 50-mi region, if they were all to go into St. Clair County schools, it would raise the county's student population by less than 1 percent. Given the number of schools in St. Clair County and the large student enrollment, it is likely that new students from building and operating a new nuclear unit at the Belle River-St. Clair site would be absorbed easily, and education impacts would be minimal for St. Clair County and the larger 50-mi region.

Table 9-15. Water Supply and Wastewater Treatment Capacity and Demand in 2005

Community	Water (MGD)		Wastewater (MGD)	
	Capacity	Demand[(a)]	Capacity	Demand[(a)]
Algonac City	2.75	1.3	–[(b)]	–
Algonac	1.0	0.46	–	–
Clay Township	1.75	0.84	–	–
St. Clair County	–	–	2.7	1.9
Algonac	–	–	0.82	0.63
Clay Township	–	–	0.94	0.63
Ira Township	–	–	0.94	0.63
Burtchville	1.0	0.22	None	None
Capac	0.4	0.2	0.24	0.21
East China	2.7	0.6	3.35	0.85
China Township	0.27	0.06	0.34	0.08
East China Township	2.43	0.54	3.01	0.77
Ira	2.25	0.7	–	–
Marine City	2.0	0.80	7.0	0.80
Cottrellville	0.05	0.02	0.175	0.02
Marine City	1.95	0.78	6.825	0.78
Marysville	7.5	2.2	6.1	2.22
Memphis	0.39	0.09	None	None
Port Huron[(c)]	30.0	7.7	20.0	11.3
Clyde Township	0.69	0.2	None	None
Ft. Gratiot Township	5.7	1.5	3.8	1.28
Kimball Township	2.01	0.4	1.4	0.34
Port Huron City	15.9	4.1	10.8	5.74
Port Huron Township	5.7	1.5	4.0	2.1
St. Clair	3.0	1.4	1.6	1.4
St. Clair County	2.42	1.15	1.28	1.12
St. Clair Township	0.58	0.25	0.32	0.28
Yale	1.65	0.23	1.8	0.35

Source: LSL Planning, Inc. undated

(a) Average daily demand is provided for all utility systems and jurisdictions except for Port Huron. Port Huron reported peak demand.

(b) A dash indicates information was not reported for these jurisdictions.

(c) Peak demand.

Summary of Impacts on Infrastructure and Community Services at the Belle River-St. Clair Site

The review team concludes from the information provided by Detroit Edison, review of existing reconnaissance-level documentation, and its own independent evaluation that the impact of

building and operations activities on regional infrastructure and community services – including recreation, housing, water and wastewater facilities, police, fire, and medical facilities, and education – would be minor. The estimated peak workforce of 2900 would have a noticeable adverse impact on traffic on local roadways near the Belle River site. These traffic-related impacts could be reduced but not eliminated with proper planning and mitigation measures.

Cumulative Impacts

The geographic area of interest for analysis of cumulative socioeconomic impacts of the Belle River-St. Clair site is St. Clair County, where most of the socioeconomic impacts of construction and operation of the Belle River-St. Clair site are expected to occur.

The impact analyses presented for the Belle River-St. Clair site are cumulative. Past and current economic impacts associated with activities listed in Table 9-9 have already been considered as part of the socioeconomic baseline or in the analyses discussed above for the Belle River-St. Clair site. Construction and operation of the Belle River-St. Clair plant could result in cumulative impacts on the demographics, economy, and community infrastructure of St. Clair County, in conjunction with those reasonably foreseeable future actions shown in Table 9-9, and generally result in increased urbanization and industrialization. However, many impacts, such as those on housing or public services, are able to adjust over time, particularly with increased tax revenues. Furthermore, State and county plans, along with modeled demographic projections, include forecasts of future development and population increases. Because the projects within the geographic area of interest identified in Table 9-9 would be consistent with applicable land use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be manageable. Physical impacts include impacts on workers and the general public, noise, air quality, buildings, roads, and aesthetics.

Based on the above considerations, Detroit Edison's ER, and the review team's independent evaluation, the review team concludes that under some circumstances, building a nuclear reactor at the Belle River-St. Clair alternative site could make a temporary small adverse contribution to the cumulative effects associated with some socioeconomic issues. Those impacts would include physical impacts (workers and the general public, noise, air quality, buildings, roads, and aesthetics), demography, and local infrastructures and community services (traffic; recreation; housing; water and wastewater facilities; police, fire, and health care services; and education) and would depend on the particular jurisdictions affected.

The cumulative effects on regional economies and tax revenues would be beneficial and SMALL, with the exception of St. Clair County, which would receive a MODERATE and beneficial cumulative effect on the economy and a LARGE and beneficial cumulative effect from property taxes. The cumulative effects on physical impacts, demography, and infrastructure and community services would be SMALL within the 50-mi region, except for a MODERATE

and adverse cumulative effect on local traffic near the Belle River-St. Clair site. Building and operating a new nuclear unit at the Belle River-St. Clair alternative site would be a significant contributor to the cumulative impacts.

9.3.3.6 Environmental Justice

The economic impact area for the Belle River-St. Clair alternative site is St. Clair County, Michigan. To evaluate the distribution of minority and low-income populations near the Belle River-St. Clair site, the review team conducted a demographic analysis of populations within the 50-mi region surrounding the proposed site in accordance with the methodology discussed in Section 2.6.1 of this EIS. The results of this analysis are displayed in Tables 9-16 and 9-17 and Figures 9-3, 9-4, 9-5, and 9-6.

In general, the review team found the population within the 50-mi region surrounding the Belle River plant to be similar in demographic distribution to the 50-mi region surrounding the proposed Fermi 3 site: rural, with few representative minority or low-income populations of interest outside the urban areas (for the Belle River site, these urban areas are near the southwestern boundary of the 50-mi region). Because the review team identified St. Clair County as the economic impact area for the Belle Rive-St. Clair alternative site, the review team focused its analysis upon the minority and low-income populations within St. Clair County. The economic impact area of St. Clair County was representative of that characterization, with only one minority population of interest (a Black or African American population between 10 and

Table 9-16. Results of the Census Block Group Analysis for Minority Populations of Interest within the Region Surrounding the Belle River-St. Clair Alternative Site (50-mi radius)

County	Total Number of Census Block Groups in the 50-mi Region	Number of Census Block Groups with Minority Populations of Interest					
		Black	American Indian	Asian	Pacific Islander	Hispanic	Aggregate
Genesee	1	0	0	0	0	0	0
Lapeer	57	1	0	0	0	3	1
Macomb	627	36	0	5	0	6	36
Oakland	771	132	0	27	0	26	156
Sanilac	33	0	0	0	0	0	0
St. Clair[(a)]	138	2	0	0	0	0	2
Tuscola	1	0	0	0	0	0	0
Wayne	1158	859	0	17	0	65	909
Total	**2786**	**1030**	**0**	**49**	**0**	**100**	**1104**

Source: USCB 2010d
(a) Shaded row indicates the economic impact area.

Table 9-17. Results of the Census Block Group Analysis for Low-Income Populations of Interest within the 50-mi Region of the Belle River-St. Clair Alternative Site

County	Total Number of Census Block Groups in the 50-mi Region	Census Block Groups with Low-Income Populations of Interest	
		Number	Percentage
Genesee	1	0	0
Lapeer	57	0	0
Macomb	627	26	4.1
Oakland	771	40	5.2
Sanilac	33	0	0
St. Clair[(a)]	138	11	8.0
Tuscola	1	0	0
Wayne	1158	453	39.1
Total	**2786**	**530**	**19.0**

Source: USCB 2010e
(a) Shaded row indicates the economic impact area.

15 mi north of the plant near the Canadian border). This was the closest population of interest to the Belle River alternative site. The four identified low-income populations of interest included that same minority Census block group, as well as three others slightly farther north of the alternative site.

Based on this analysis, the review team determines that there do not appear to be any identified minority or low-income populations of interest in St. Clair County that would be likely to experience disproportionate and adverse human health, environmental, physical, or socioeconomic effects as a result of construction or operation of a plant at the Belle River-St. Clair site. The review team did not identify any subsistence activities in St. Clair County. For the other physical and environmental pathways described in Section 2.6.1, the review team determined that impacts at the Belle River-St. Clair site would be similar to those at the Fermi 3 site. Therefore, the review team determines the environmental justice impacts of building and operating a nuclear reactor at the Belle River-St. Clair site would be SMALL

9.3.3.7 Historic and Cultural Resources

This section presents the review team's evaluation of the potential impacts of siting a new ESBWR at the Belle River-St. Clair site on historic and cultural resources. For the analysis of impacts on historic and cultural resources, the geographic area of interest is considered to be the area of potential effects (APE) that would be defined for a new nuclear power facility at the site. This includes the physical APE, defined as the area directly affected by building and

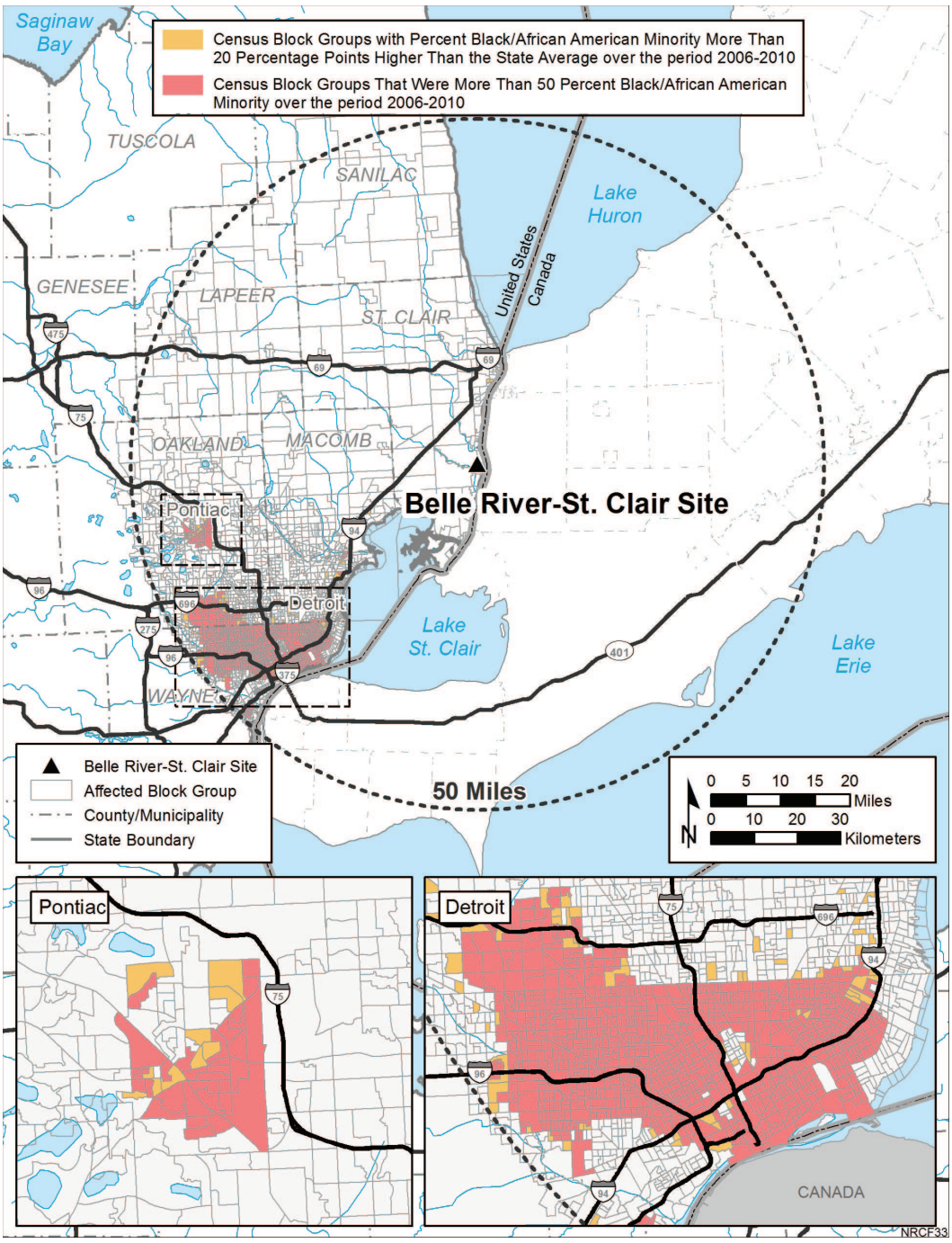

Figure 9-3. Black and African-American Minority Census Block Group Populations of Interest within a 50-mi Radius of the Belle River-St. Clair Site (USCB 2010d)

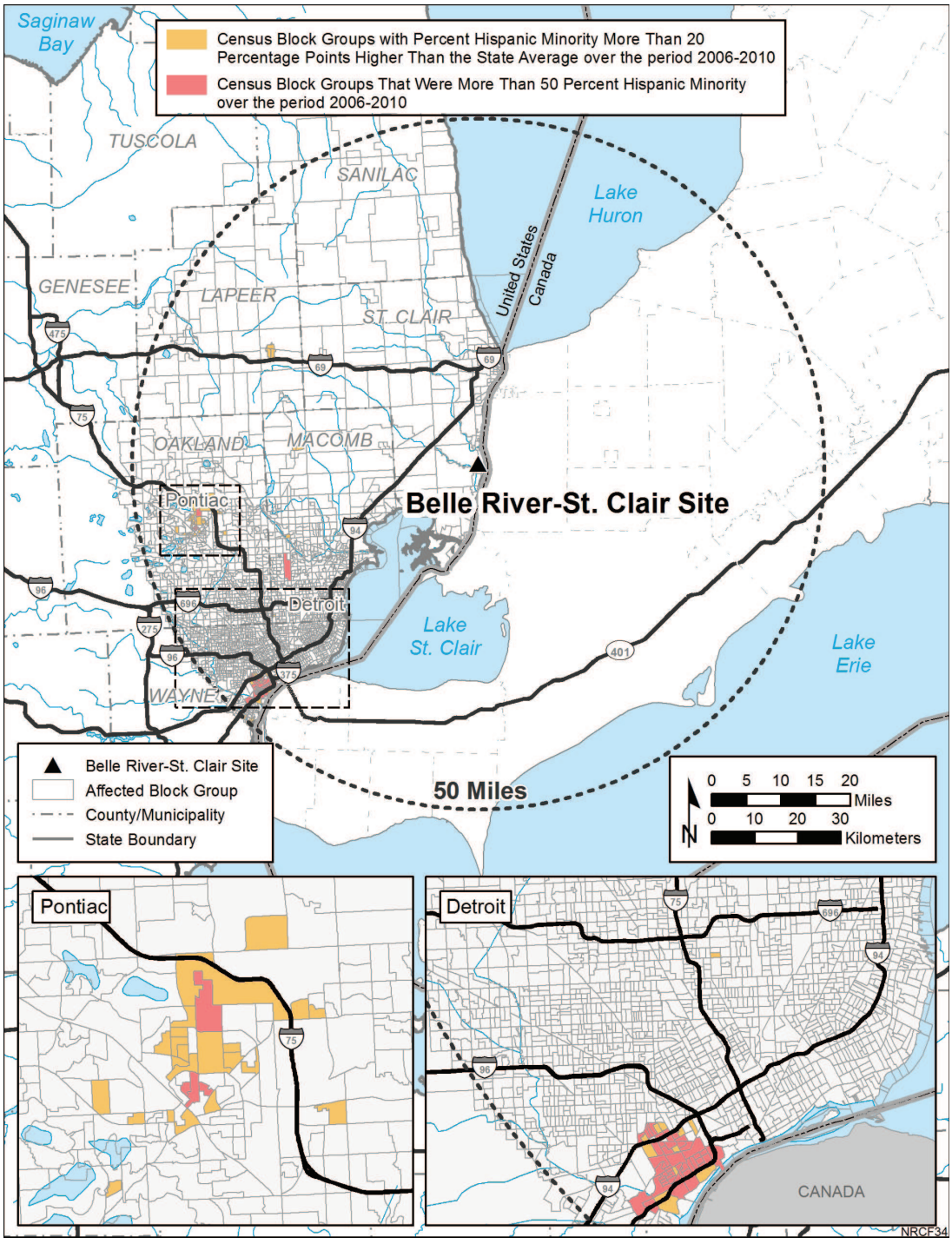

Figure 9-4. Hispanic Minority Census Block Group Populations of Interest within a 50-mi Radius of the Belle River-St. Clair Site (USCB 2010d)

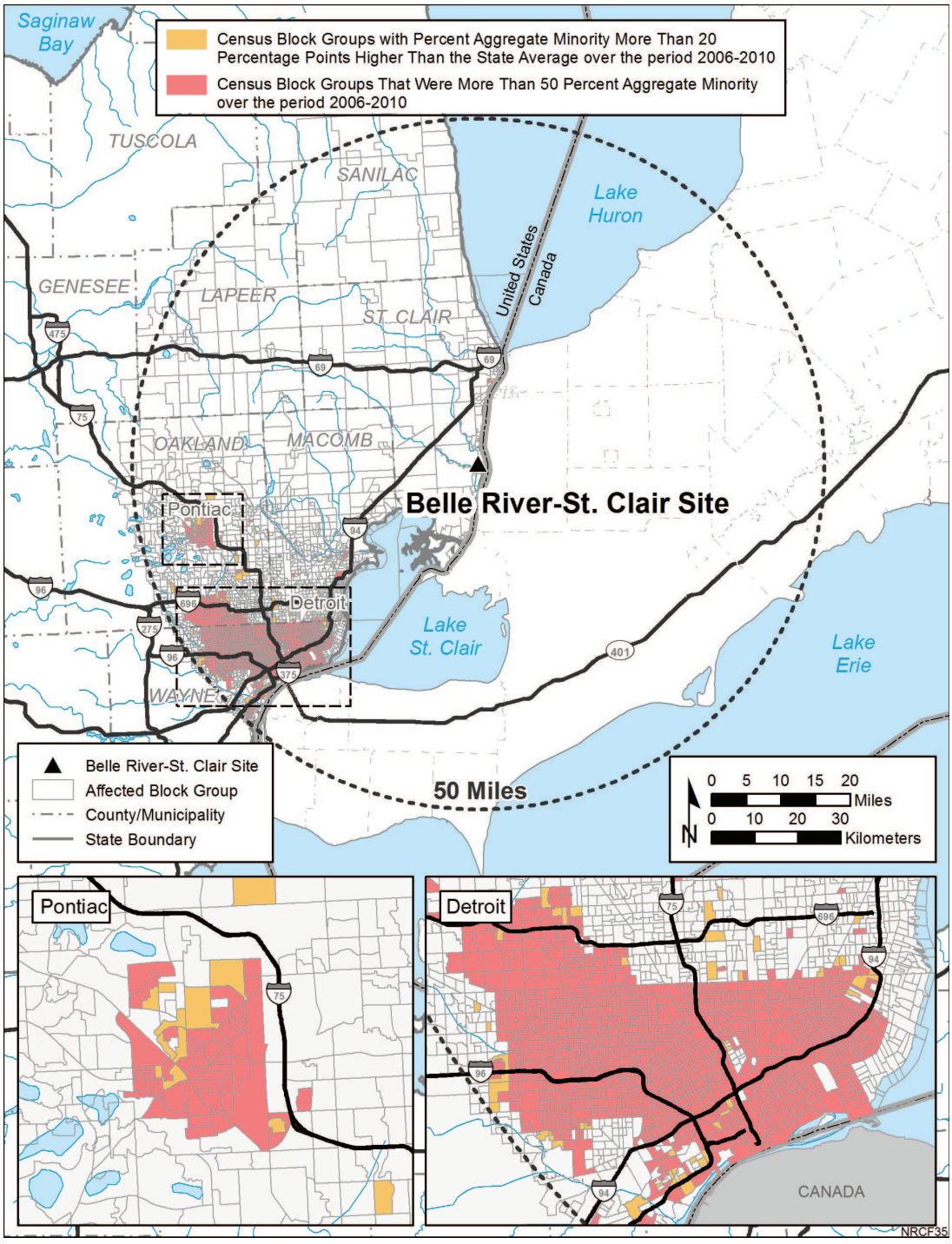

Figure 9-5. Aggregate Minority Census Block Group Populations of Interest within a 50-mi Radius of the Belle River-St. Clair Site (USCB 2010d)

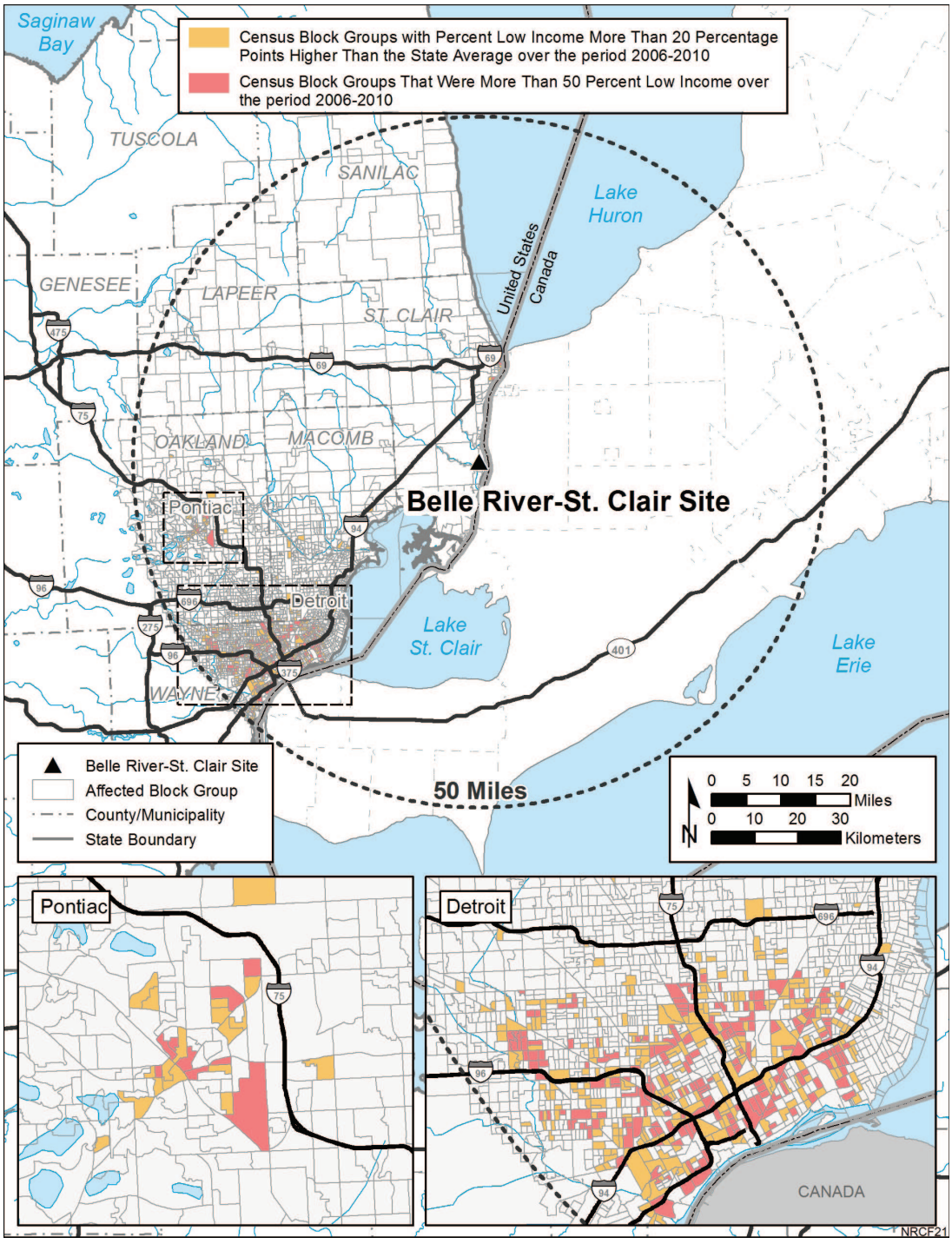

Figure 9-6. Low-Income Census Block Group Populations of Interest within a 50-mi Radius of the Belle River-St. Clair Site (USCB 2010e)

operating a new nuclear power plant and transmission lines, and the visual APE (i.e., the area from which the structures can be seen). The visual APE includes the area within 1 mi of the physical APE.

The review team relied upon reconnaissance-level information to perform the alternative site evaluation. Reconnaissance-level activities in a cultural resources review have particular meaning. For example, these activities may include site file searches, background research for environmental and cultural contexts, and preliminary field investigations to confirm the presence or absence of cultural resources in an APE or the sensitivity of an APE for cultural resources. For the preparation of this alternatives analysis, reconnaissance-level information is considered to be data readily available from Federal and State agencies and other public sources. The following sources were used to identify reconnaissance-level information on historic and cultural resources in the APE at the Belle River-St. Clair site:

- National Park Service's (NPS's) National Historic Landmarks Program database for designated National Historic Landmarks (NPS 2010a).
- NPS's NRHP database for properties listed in the NRHP (NPS 2010b).
- NationalRegisterofHistoricPlaces.com database for properties listed in the NRHP (NRHP 2010).
- Michigan's Historic Sites Online database for cultural resources significant to the State of Michigan (MSHDA 2010a).
- Parks Canada's Federal Historic Buildings Review Office Register for designated Federal Heritage Buildings (Parks Canada 2010a).
- Parks Canada's Historic Sites and Monuments Board of Canada databases for designated National Historic Sites and Monuments (Parks Canada 2010b).
- Parks Canada's Canadian Register of Historic Places for recognized historic places of local, provincial, territorial, and national significance (Parks Canada 2010c).
- Parks Canada's list of National Historic Sites of Canada administered by Parks Canada (Parks Canada 2010d).
- Ontario Ministry of Culture's Ontario Heritage Properties Database for heritage properties designated by municipal bylaw under Parts IV or V of the Ontario Heritage Act of 1975, as amended; protected by a municipal heritage easement; owned by the Ontario Heritage Trust; protected by an Ontario Heritage Trust conservation easement; listed on the Ontario Heritage Bridge List; protected by the Federal Heritage Railway Stations Protection Act of 1985, as amended; designated as a National Historic Site; or listed in the Canadian Register of Heritage Properties (Ontario Ministry of Culture 2008).
- Ontario Ministry of Culture's list of community museums (Ontario Ministry of Culture 2009).

- The Architectural Conservancy of Ontario (The Architectural Conservancy of Ontario 2010).
- Ontario Heritage Trust's Online Plaque Guide (Ontario Heritage Trust 2010).
- Detroit Edison's ER (Detroit Edison 2011a).
- *Cultural Resources Site File Review of Seven Alternative Sites in Monroe, Lenawee, St. Clair, and Huron Counties, Michigan, Fermi Nuclear Power Plant Unit 3 (Fermi 3) Project, Frenchtown and Berlin Townships, Monroe County, Michigan* (Lillis-Warwick et al. 2009).

Within the portion of the APE in Michigan, no National Historic Landmarks or other historic properties listed in the NRHP were identified (NPS 2010a, b; NRHP 2010). Three previously recorded cultural resources have been identified within the APE in Michigan (MSHDA 2010a). Two are archaeological resources (Sites 20SC153 and 20SC71); one is an architectural resource (the East China Fractional District School No. 2, Site ID#P24687). None of these previously recorded cultural resources have been included in, or determined eligible for inclusion in, the NRHP. Therefore, none of these three previously recorded cultural resources are considered a historic property, pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA).

Archaeological Site 20SC153 is a late-nineteenth to early-twentieth century farmstead located entirely within the physical APE for the Belle River-St. Clair site. It was determined not eligible for inclusion in the NRHP in 1999. Archaeological Site 20SC71 is a prehistoric archaeological site of unknown cultural affiliation and unknown function, which is located partially within the physical APE for the Belle River-St. Clair site. It has not been evaluated for NRHP eligibility (Lillis-Warwick et al. 2009).

The East China Fractional District School No. 2 (Site ID #P24687) property is a late-nineteenth century brick schoolhouse approximately 0.5 mi outside of the physical APE, within the visual APE for the Belle River-St. Clair site. It is the remaining example of only three nineteenth-century schoolhouses constructed in East China Township in St. Clair County. It is the second schoolhouse on the property, replacing an earlier frame schoolhouse, and was constructed circa 1873. The last classes were held there in 1954, and it was restored for use as a local museum between 1988 and 1991. It was listed on the *Michigan State Register of Historic Places* (SRHP) in 1991, and the State of Michigan erected a historical marker in front of it in 1993. However, it has not been evaluated for NRHP eligibility (Lillis-Warwick et al. 2009; East China Township 2010; MSHDA 2010b). Additional properties that are listed in the NRHP are located approximately 4 mi to the north in Marine City and approximately 4 mi to the south in St. Clair (Detroit Edison 2011a). These additional NRHP-listed properties are outside of the visual APE for the Belle River-St. Clair site.

No archaeological or architectural surveys have been conducted at the alternative site to identify additional cultural resources in the portion of the APE in Michigan and/or to determine or confirm the significance (NRHP-eligibility) of the previously identified cultural resources in the APE in Michigan. As currently designed, a new nuclear power plant at the Belle River-St. Clair site has the potential to affect two of the previously identified resources. The proposed layout for the Belle River-St. Clair site is proximate to archaeological sites 20SC153 and 20SC71 and may result in disturbance or destruction during preconstruction and construction activities. Site 20SC153 was previously determined not eligible for listing in the NRHP by the Michigan SHPO in 1999 (Lillis-Warwick et al. 2009). Because this archaeological resource is not considered a historic property, a new nuclear power facility at the Belle River-St. Clair site would have no effect on this resource pursuant to 36 CFR Part 800. Site 20SC71 would have to be evaluated for NRHP eligibility to determine the effect of a new nuclear power facility at the Belle River-St. Clair site on this resource, pursuant to 36 CFR Part 800. The proposed layout for the Belle River-St. Clair site includes structures (buildings and cooling towers) and operational activities (condensation plumes) that would be new landscape elements in viewsheds from East China Fractional District No. 2 School and would result in indirect (visual) impacts on this architectural resource. This architectural resource would have to be evaluated for NRHP eligibility to determine the effect of a new nuclear power facility at the Belle River-St. Clair site on this resource pursuant to 36 CFR Part 800.

Consultation with the Michigan SHPO would be necessary to determine the need for cultural resources investigations (including archaeological and architectural surveys) to identify cultural resources within the portion of the APE in Michigan and prior to any onsite ground-disturbing activities, to determine whether any identified cultural resources are eligible for inclusion in the NRHP, to evaluate the potential impacts on cultural resources and historic properties, and to determine the effect of a new nuclear power facility at the Belle River-St. Clair site pursuant to Section 106 of the NHPA. As part of this consultation, Detroit Edison would be expected to put protective measures in place to protect discoveries in the event that cultural resources were found during building or operation of a new plant. If an unanticipated discovery was made during building activities, site personnel would have to notify the Michigan SHPO and consult with it in conducting an assessment of the discovery to determine whether additional work is needed.

The incremental impacts from installation and operation of offsite transmission lines would be minimal if there were no significant alterations (either physical alteration or visual intrusion) to the cultural environment. If these activities resulted in significant alterations to the cultural environment, then the impact could be greater. Construction and operation of the offsite transmission lines would be the responsibility of a transmission company. For impacts greater than small, mitigation might be developed by the transmission company in consultation with the appropriate Federal and State regulatory authorities. Only Federal undertakings would require a Section 106 review.

A portion of the visual impact APE extends east across the St. Clair River into St. Clair Township, which is in Lambton County, in Ontario, Canada. No previously identified Federal, provincial, or municipal heritage properties, historic sites, or other cultural resources were identified within the Ontario portion of the visual APE for the Belle River-St. Clair site (Parks Canada 2010a, b, c; Ontario Ministry of Culture 2008, 2009; The Architectural Conservancy of Ontario 2010; Ontario Heritage Trust 2010; The Corporation of the County of Lambton 2010). The NRC would consider the need to consult with Parks Canada, the Ontario Ministry of Culture, and local municipalities regarding indirect impacts on potential heritage properties, historic sites, or other cultural resources within the Ontario portion of the APE.

The portion of the APE in Michigan does not contain any Indian reservation land, and no Federally recognized Indian Tribes have indicated an interest in St. Clair County (BIA undated; NPS 2010c). However, consultation with Federally recognized Indian Tribes in the State of Michigan would be necessary in accordance with Section 106 of the NHPA. As part of this consultation, the NRC would consult with all 12 Federally recognized Indian Tribes that are located within the State of Michigan, as identified for the Fermi site (Michigan Department of Human Services 2001–2009). The portion of the APE in Ontario does not contain any First Nation Reserve land. However, prior to Euro-American settlement, the APE in both Michigan and Ontario may have been settled and/or used by groups now located within Canada.[(a)] In Canada, these groups are often called First Nations.[(b)] Two First Nation reserves are located outside, but in the general vicinity of, the portion of the APE in Ontario, Canada: Sarnia Reserve 45 and Walpole Island Reserve 46 (INAC 2010). Sarnia Reserve 45 is located approximately 15 mi north of the Belle River-St. Clair site, on the eastern side of the St. Clair River near Sarnia, Ontario. The Aamjiwnaang First Nation is associated with Sarnia Reserve 45. Walpole Island Reserve 46 is located approximately 15 mi south of the Belle River-St. Clair site, on the eastern side of the St. Clair River near Wallaceburg, Ontario. The Walpole Island First Nation is associated with Walpole Island Reserve 46. Additional First Nation reserves are located farther to the north and east in southern Ontario (see Table 9-18)

(a) The Canadian government recognizes the original inhabitants of North America as Aboriginal peoples. There are three formally recognized Aboriginal groups: Indians, Métis, and Inuits. Indians comprise three legally defined groups: Status Indians (people who are registered as Indians under the Indian Act of 1876, as amended [Indian Act], which specifies the requirements for determining who is an Indian for the purposes of the Indian Act); non-Status Indians (people who are Indians but are not registered as Indians under the Indian Act); and Treaty Indians (Status Indians who belong to a First Nation that signed a Treaty with the Crown). Métis comprise people of “mixed First Nation and European ancestry who identify themselves as Métis, as distinct from First Nations people, Inuit, or non-Aboriginal people.” Inuit comprise “Aboriginal people in Northern Canada, who live in Nunavut, Northwest Territories, Northern Quebec and Northern Labrador” (INAC 2009).

(b) First Nations is a term that came into common usage in the 1970s to replace the word “Indian,” which some people found offensive. Although the term First Nation is widely used, no legal definition of it exists. Among its uses, the term “First Nations peoples” refers to the Indian peoples in Canada, both Status and non-Status. Some Indian peoples have also adopted the term “First Nation” to replace the word “band” in the name of their community (INAC 2009).

Table 9-18. First Nations and First Nation Reserves in Southwestern Ontario

First Nation	Reserve	Approximate Distance and Direction from the Belle River/ St. Clair Site	Approximate Distance and Direction from the Greenwood Site	Closest Town or City
Aamjiwnaang First Nation	Sarnia Reserve 45	15 mi north	15 mi southeast	Sarnia, Ontario
Walpole Island First Nation	Walpole Island Reserve 46	15 mi south	30 mi southeast	Wallaceburg, Ontario
Moravian of the Thames	Moravian Indian Reserve 47	30 mi southeast	50 mi southeast	Thamesville, Ontario
Chippewas of Kettle and Stony Point	Kettle Point Reserve 44	40 mi northeast	30 mi east	Forest, Ontario
Caldwell	None	55 mi southeast	65 mi southeast	Blenheim, Ontario
Chippewas of the Thames First Nation	Chippewas of Thames First Nation Reserve 42	50 mi east	70 mi east	Muncey, Ontario
Munsee-Delaware Nation	Munsee-Delaware Nation 1	50 mi east	70 mi east	Muncey, Ontario
Oneida Nation of the Thames	Oneida Indian Reserve 41	45 mi east	70 mi east	Southwold, Ontario

Source: INAC 2010

(INAC 2010). The review team would consider the need to consult with INAC and First Nations to determine any concerns regarding physical (direct) or visual (indirect) impacts on cultural resources within the APE.

The following cumulative impact analysis for historic and cultural resources includes building and operating a new nuclear power facility at the Belle River-St. Clair site. This analysis also considers other past, present, and reasonably foreseeable future actions that could affect historic and cultural resources, as identified in Table 9-9. The APE for the cumulative impact analysis for historic and cultural resources for the Belle River-St. Clair site consists of the alternative site area and any new transmission line corridors, and a 1-mi buffer area around the site and the corridors.

The Belle River-St. Clair site includes areas of agricultural land, some young forest, and previous development (e.g., power plants, aboveground transmission lines, pipelines, roads, and railroads). Agricultural activities such as plowing, disking, and harvesting (whether historic or modern [mid-nineteenth to mid-twentieth century]) and logging or clearing of original forests (prior to the reestablishment of the existing young forested areas) are likely to have resulted in minimal subsurface disturbance, suggesting that at least some areas at the Belle River-St. Clair

site, which are currently used for agricultural purposes or as woodland, may have sustained minimal prior ground disturbance. Other areas at the site are likely to have undergone significant prior disturbance during previous development. Past actions at the Belle River-St. Clair site that may have destroyed, disturbed, or otherwise affected onsite historic and cultural resources in the APE may have included construction and operation of the existing Belle River and St. Clair Power Plants, River Road, State Route 29, CSX rail lines, and an existing 345-kV transmission line.

Additional past actions onsite or in the general vicinity of the Belle River-St. Clair site, as identified in Table 9-9, may have also indirectly (visually) affected cultural resources within the visual APE. These past actions would have included construction and operation of the Greenfield Energy Center and the Lambton Generating Station, located approximately 1 mi east and northeast, across the St. Clair River, respectively. Additional past actions, such as construction and operation of the Marysville Power Plant, approximately 10 mi north on the St. Clair River, and recently completed or proposed projects, such as the Suncor Ethanol Production Project and the Suncor Ethanol Plant Phase II Project, more than 20 mi north of the Belle River-St. Clair site, in Ontario, Canada, would likely be too far to incur cumulative indirect (visual) impacts on historic or cultural resources within the APE at the Belle River-St. Clair site. Because a new nuclear power facility at the Belle River-St. Clair site would be located on property that already contains the existing Belle River and St. Clair power plants, it is likely that the proposed project would not result in new significant indirect (visual) impacts on cultural resources within the visual APE.

Based on reconnaissance-level information provided by Detroit Edison and identified by the review team and on the review team's independent evaluation of this information, the review team concludes that the cumulative impacts on historic and cultural resources from building and operating a new nuclear power facility at the Belle River-St. Clair site would be SMALL. A SMALL impact determination is based on available reconnaissance information, which indicates that no known historic properties would be affected (one previously identified cultural resource within the APE has been determined not to be NRHP eligible; the other two previously identified cultural resources within the APE have not been evaluated for NRHP eligibility) and that the five existing and operating power plants or generating facilities onsite or within 1 to 10 mi of the Belle River-St. Clair site are already landscape elements of the existing visual setting for the Belle River-St. Clair site. However, if a new nuclear power facility were to be developed at the Belle River-St. Clair site, then cultural resources investigations within the APE and for any proposed transmission lines may reveal important historic or cultural resources that could result in greater cumulative impacts.

9.3.3.8 Air Quality

Criteria Pollutants

For a plant with the same capacity as the proposed Fermi 3 plant, the emissions from building and operating a nuclear power plant at the Belle River-St. Clair site are assumed to be comparable to those from Fermi 3, as described in Chapters 4 and 5. The alternative site is located in St. Clair County, about 1 mi west of the United States–Canada border. St. Clair County is in the Metropolitan Detroit-Port Huron Intrastate Air Quality Control Region (AQCR) (40 CFR 81.37). Currently St. Clair County is designated as a nonattainment area for $PM_{2.5}$ NAAQS and as a maintenance area for 8-hr ozone NAAQS (EPA 2010b). In July 2011, the MDEQ submitted a request asking the EPA to redesignate Southeast Michigan as being in attainment with the $PM_{2.5}$ NAAQS (MDEQ 2011). In July 2012, the EPA issued a proposed rule designating southeastern Michigan as having attained both the 1997 annual $PM_{2.5}$ NAAQS and the 2006 24-hour $PM_{2.5}$ NAAQS, based on 2009–2011 ambient air monitoring data (77 FR 39659, dated July 5, 2012), but the final determination has yet to be made.

In Sections 4.7 and 5.7, the review team concludes that air quality impacts of building and operating a plant at Fermi 3, including those associated with transmission lines and cooling towers, would be SMALL, as long as appropriate measures are taken to mitigate dust during building activities. During operation, cooling towers would be the primary source of $PM_{2.5}$, which accounts for most of the total $PM_{2.5}$ emissions of 9.51 tons/yr at Fermi 3. However, these emissions would be relatively small and thus are not anticipated to elevate $PM_{2.5}$ concentrations in a designated nonattainment area. With dust mitigation, the impacts of building and operating a plant at the Belle River-St. Clair site would also be SMALL. Any new industrial projects would either be small or subject to permitting by the MDEQ. State permits are issued under regulations approved by the EPA and deemed sufficient to attain and maintain the NAAQS and comply with other Federal requirements under the CAA. Thus, the cumulative air quality impacts of building and operating a plant at the Belle River-St. Clair site would be SMALL.

Greenhouse Gases

The extent and nature of climate change is not sensitive to where GHGs are emitted, because the long atmospheric lifetimes of GHGs result in extensive transport and mixing of these gases. Since the emissions of a plant at the Belle River-St. Clair site would be comparable to those of a similar plant at the Fermi 3 site, the discussions of Sections 4.7 and 5.7 for Fermi 3 also apply to building and operating a similar plant at the Belle River-St. Clair site. Thus, the impacts of the plant's GHG emissions on climate change would be SMALL, but the cumulative impacts considering global emissions would be MODERATE. Building and operating a new nuclear unit at the Belle River site would not be a significant contributor to these impacts.

9.3.3.9 Nonradiological Health

The following impact analysis considers nonradiological health impacts from building activities and operations on the public and workers from a new nuclear facility at the Belle River-St. Clair alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect nonradiological health, including other Federal and non-Federal projects and those projects listed in Table 9-9 within the geographic area of interest. The building-related activities with the potential to affect the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the site. The operation-related activities with the potential to affect the health of members of the public and workers include exposure to etiological agents, noise, EMFs, and the transport of workers to and from the site.

Most of the nonradiological impacts of building and operation (e.g., noise, etiological agents, and occupational injuries) would be localized and would not have significant impact at offsite locations. However, activities such as vehicle emissions from transport of personnel to and from the site would encompass a larger area. Therefore, for nonradiological health impacts, the geographic area of interest for cumulative impacts analysis includes projects within a 50-mi radius of the Belle River-St. Clair site based on the influence of vehicle and other air emissions sources, because the site is in a nonattainment area (Section 9.3.3.8). For cumulative impacts associated with transmission lines, the geographical area of interest is the transmission line corridor. These geographical areas are expected to encompass areas where public and worker health could be influenced by the proposed project and associated transmission lines, in combination with any past, present, or reasonably foreseeable future actions.

Building Impacts

Nonradiological health impacts on the construction workers from building a new nuclear unit at the Belle River-St. Clair site would be similar to those for building Fermi 3 at the Fermi site as evaluated in Section 4.8. These impacts include occupational injuries, noise, odor, vehicle exhaust, and dust. Applicable Federal, State, and local regulations on air quality and noise would be complied with during the plant construction phase. The Belle River-St. Clair site does not have any characteristics that would be expected to lead to fewer or more construction accidents than would be expected for the Fermi site. The site is in a predominantly rural area, and construction impacts on the surrounding populations, which are classified as medium- and low-population areas, would likely be minimal. Access routes to the site for construction workers would include State Route 29, which is already a high-volume road. Mitigation may be necessary to ease congestion, thereby improving traffic flow and reducing nonradiological health impacts (i.e., traffic accidents, injuries, and fatalities) during the building period.

Operational Impacts

Nonradiological health impacts on occupational health of workers and members of the public from operation of a new nuclear unit at the Belle River-St. Clair site would be similar to those evaluated in Section 5.8 for the Fermi site. Occupational health impacts on workers (e.g., falls, electric shock, or exposure to other hazards) at the Belle River-St. Clair site would likely be the same as those evaluated for workers at the new unit at the Fermi site. The average flow rate of St. Clair River is 188,000 ft^3/sec, which is large enough to support closed cycle NDCTs. Discharges to the river would be controlled by NPDES permits issued by MDEQ (Section 9.3.3.2). The growth of etiological agents would not be significantly encouraged at the Belle River-St. Clair site because of the large flow rate of the St. Clair River (i.e., >100,000 ft^3/sec; see p. 5.3.4-7 of NRC 2000). Noise and EMF exposure would be monitored and controlled in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations. Effects of EMFs on human health would be controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria. Nonradiological impacts of traffic during operations would be less than the impacts during building. Mitigation measures taken during building to improve traffic flow would also minimize impacts during operation of a new unit.

Cumulative Impacts

Past and present actions within the geographic area of interest that could contribute to cumulative nonradiological health impacts include the energy and mining projects in Table 9-9, as well as vehicle emissions and existing urbanization. Reasonably foreseeable future projects in the geographical area of interest that could contribute to cumulative nonradiological health impacts include construction of the proposed I-94 Black River Bridge Replacement in Port Huron and the two proposed energy projects, future transmission line development, and future urbanization.

The review team is also aware of the potential climate changes that could affect human health. A recent compilation of the state of the knowledge in this area (USGCRP 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature, increased likelihood of drought in summer, more heavy downpours, and an increase in precipitation, especially in the winter and spring, which may alter the presence of microorganisms and parasites. In view of the water source characteristics, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases.

Summary of Nonradiological Health Impacts at the Belle River-St. Clair Site

Based on the information provided by Detroit Edison and the review team's independent evaluation, the review team expects that the impacts on nonradiological health from building

and operation of a new nuclear unit at the Belle River-St. Clair site would be similar to the impacts evaluated for the Fermi site. Although there are past, present, and future activities in the geographical area of interest that could affect nonradiological health in ways similar to the building and operation of a new unit at the Belle River-St. Clair site, those impacts would be localized and managed through adherence to existing regulatory requirements. Similarly, impacts of a new nuclear unit operating at the Belle River-St. Clair site on public health would be expected to be minimal. The review team concludes, therefore, that the cumulative impacts of building and operation of a nuclear unit at Belle River-St. Clair on nonradiological health would be SMALL.

9.3.3.10 Radiological Health

The following impact analysis considers radiological impacts on the public and workers from building activities and operations for one nuclear unit at the Belle River-St. Clair alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and those projects listed in Table 9-9 within the geographic area of interest. The geographic area of interest is the area within a 50-mi radius of the Belle River-St. Clair site. As described in Section 9.3.3, the Belle River-St. Clair property contains two Detroit Edison-owned non-nuclear power plants. There are currently no nuclear facilities on the site or within a 50-mi radius. In addition, there are likely to be medical, industrial, and research facilities within 50 mi of the Belle River-St. Clair site that use radioactive materials.

The radiological impacts of building and operating the proposed ESBWR unit at the Belle River-St. Clair site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. These impacts are expected to be similar to those at the proposed Fermi site.

The NRC staff concludes that the dose from direct radiation and effluents from medical, industrial, and research facilities that use radioactive materials would be an insignificant contribution to the cumulative impact around the Belle River-St. Clair site. This conclusion is based on data from radiological environmental monitoring programs conducted around currently operating nuclear power plants. Based on the information provided by Detroit Edison and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the proposed ESBWR advanced reactor and other existing projects and actions in the geographic area of interest around the Belle River-St. Clair site would be SMALL.

9.3.3.11 Postulated Accidents

The following impact analysis considers radiological impacts from postulated accidents during operation of a nuclear unit at the Belle River-St. Clair alternative site. The analysis also

considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and those projects listed in Table 9-9 within the geographic area of interest. As described in Section 9.3.3, the Belle River-St. Clair site is an active power generation site; however, there are currently no nuclear facilities on the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Belle River-St. Clair site. Existing facilities potentially affecting radiological accident risk within this geographic area of interest are Fermi 2 and Davis-Besse, because the 50-mi radii for Fermi 2 and Davis-Besse overlap part of the 50-mi radius for the Belle River-St. Clair site. No other reactors have been proposed within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design-basis accidents (DBAs) at the proposed Fermi site would be minimal for an ESBWR. DBAs are addressed specifically to demonstrate that a reactor design is sufficiently robust to meet NRC safety criteria. The ESBWR design is independent of site conditions, and the meteorologies of the alternative and the proposed Fermi sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the site would be SMALL.

Because the meteorology, population distribution, and land use for the Belle River-St. Clair site are expected to be similar to the proposed Fermi site, risks from a severe accident for an ESBWR located at the Belle River-St. Clair site are expected to be similar to those analyzed for the proposed Fermi site. These risks for the proposed Fermi site are presented in Tables 5-34 and 5-35 of this EIS and are well below the mean and median values for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (i.e., Fermi 2 and Davis-Besse), the Commission has determined the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Because of the NRC's safety review criteria, it is expected that risks for any new reactors at any other locations within geographic area of interest for the Belle River-St. Clair site would be well below risks for current-generation reactors and would meet the Commission's safety goals. The severe accident risk due to any particular nuclear power plant becomes smaller as the distance from that plant increases. However, the combined risk at any location within 50 mi of the Belle River-St. Clair site would be bounded by the sum of risks for all these operating nuclear power plants and would still be low.

On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Belle River-St. Clair site would be SMALL.

9.3.4 Greenwood Site

This section presents the review team's evaluation of the potential environmental impacts of siting a nuclear reactor at the Greenwood Energy Center. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action, if it were implemented at the Greenwood site, and by other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment were other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action, if implemented at the Greenwood site. Other actions and projects considered in this cumulative analysis are described in Table 9-19. The location and vicinity of the Greenwood alternative site are shown in Figure 9-7.

Referred to by Detroit Edison in its site selection process as "Site F," the Detroit Edison-owned Greenwood Energy Center is approximately 3 mi west of Port Huron State Game Area in St. Clair County, Michigan. The site encompasses 1280 ac on Sections 21, 22, 27, and portions of Section 28 of Township 8 North, Range 14 East. The site is currently used by Detroit Edison to generate electricity through the operation of an 800-MW oil-fired unit and three gas combustion turbines. The closest human receptors are approximately 2 mi from the site in the town of Avoca.

Access to the site is provided by State Route 136, approximately 1 mi south of the site. A spur of the CSX rail line provides rail access. The power generated at the Greenwood Energy Center is delivered to the grid via a 345-kV transmission line entering the site from the south.

Outside the industrial footprint, land on the site is a mixture of cropland, wooded areas, and two large wetland areas. In addition to the wetlands on the site, the nearest sensitive environmental areas are wetlands to the south and southeast of the industrial areas of the site. Other sensitive areas include the Port Huron Game Area and the Black River, both approximately 3 mi east of the site. The Lake Huron shore contains recreational beaches, as does Lakeport State Park and Beach, both about 7 mi east of the site. State parks and wildlife areas also exist about 27 mi south near Anchor Bay in Lake St. Clair. Ecology on the site and in the immediate vicinity is a mixture of grassland, shrub, and woodland communities.

The nearest towns are Yale, with a population of 2000, and the city of Port Huron, located approximately 11 mi to the southeast, with a 2000 population of approximately 32,300. The population of St. Clair County is approximately 164,200 (2000 data).

Table 9-19. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Greenwood Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
Greenwood Energy Center	Oil-fired peaking unit and three natural gas combustion turbines with 1071 MW combined capacity	On Greenwood site	Operational
Fermi Unit 2	1098-MW nuclear power plant, including recently completed ISFSI and decommissioned Fermi 1 collocated on site	83 mi southwest of Greenwood site on Lake Erie	Operational
Marysville Power Plant	200-MW coal-fired plant	17 mi southeast of Greenwood site on St. Clair River	Operational
Suncor Ethanol Plant Phase II Project	Expansion of existing St. Clair Ethanol Plant to increase the supply of ethanol for blending with gasoline. The expansion will increase the plant's production capacity from 200 million L/yr to 400 million L/yr.	17 mi southeast of Greenwood site in St. Clair Township, Ontario, Canada	Recently completed
Suncor Ethanol Production Project	Ethanol production facility with production capacity of 200 million L/yr	17 mi southeast of Greenwood site in Sarnia, Ontario, Canada	Recently completed
Diesel Fuel and Hydrogen Pipelines	3.3 km of one 10-in. hydrogen pipeline and two 8-in. diesel fuel pipelines from the Shell Canada Refinery in Corunna to the Suncor Refinery in Sarnia	17 mi southeast of Greenwood site in Sarnia, Ontario, Canada	Recently completed
Belle River Power Plant	1664-MW coal-fired plant	24 mi south-southeast of Greenwood site	Operational
St. Clair Power Plant	1929-MW coal-fired plant	25 mi south-southeast of Greenwood site	Operational

Table 9-19. (contd)

Project Name	Summary of Project	Location	Status
Greenfield Energy Centre LP	1005-MW natural-gas-fired combined cycle electricity-generating facility	25 mi south-southeast of Greenwood site in Ontario, Canada	Operational
Lambton Generating Station	1920-MW coal-fired power plant	24 mi south-southeast of Greenwood site in Ontario, Canada	Operational
St. Clair Liquid Petroleum Gas Terminal	Liquid petroleum gas terminal	23 mi southeast of Greenwood site located near confluence of Pine and St. Clair Rivers	Operational
Dawn Gateway Pipeline	Operation of 30-km, 610-mm international natural gas transmission pipeline system (construction of 17-km new pipeline)	24 mi south-southeast of Greenwood site	Proposed
Mining Projects			
Clicks Sand and Gravel and RGE Aggregates, Inc.	Construction sand and gravel mine	5.8 mi south of Greenwood site	Operational
Mid Michigan Materials, Inc., Shipley Pit	Construction sand and gravel mine	5.4 mi northeast of Greenwood site	Operational
Cross Sand and Gravel Inc.	Construction sand and gravel mine	11 mi southwest of Greenwood site	Operational
Transportation Projects			
I-94 Black River Bridge replacement in Port Huron	First phase of the Blue Water Bridge plaza expansion, a project to modernize and improve capacity at the nation's second-busiest U.S.–Canadian truck border crossing	17 mi southeast of Greenwood site in Port Huron	Proposed; schedule undetermined
Parks and Recreation Facilities			
Fort Gratiot State Park	Planned infrastructure improvements for 30-ac State Park	11 mi southeast of Greenwood site on Lake Huron	Ongoing infrastructure improvements.

Table 9-19. (contd)

Project Name	Summary of Project	Location	Status
St. Clair County Trail System	Proposed upgrades and extensions of an existing offroad and onroad bike route network	Throughout St. Clair County	Proposed construction through 2024
Other Actions/Projects			
Dunn Paper Company	Paper mill discharging to St. Clair River	16 mi southeast of Greenwood site	Operational
E. B. Eddy Paper, Inc.	Paper mill discharging to St. Clair and Black Rivers	15 mi southeast of Greenwood site	Operational
Indian Trail North Mobile Home Park Wastewater Sewage Lagoon	Wastewater sewage lagoon located on Lake Huron	10 mi southeast of Greenwood site on Lake Huron	Operational
Sarnia Combined Sanitary/Storm Sewer Separation	The combined sewer separation project proposed will halt the combined sewer overflow to the St. Clair River.	16 mi southeast of Greenwood site in Sarnia, Ontario, Canada	Recently completed
Sarnia Wastewater System Improvements	Trunk sanitary sewer expected to reduce the number of combined sewer overflows to the St. Clair River	16 mi southeast of Greenwood site in Sarnia, Ontario, Canada	Recently completed
Dry Hydrant Installation, North Slip, Sarnia Harbor	Construction, installation, and maintenance of a dry hydrant and protection bollards along the North Slip embankment in Sarnia Harbor	16 mi southeast of Greenwood site in Sarnia, Ontario, Canada	Recently completed
Marysville Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair River	18 mi southeast of Greenwood site on St. Clair River	Operational
City of St. Clair Wastewater Treatment Plant	Wastewater treatment plant that discharges to St. Clair River	23 mi southeast of Greenwood site on St. Clair River	Operational
Detroit Water and Sewerage District Lake Huron Water Treatment Plant	Water treatment plant	11 mi east of Greenwood site on Lake Huron	Operational
Cargill Salt	Manufactures salt as food additive.	23 mi southeast of Greenwood site	Operational

Table 9-19. (contd)

Project Name	Summary of Project	Location	Status
Courtright Sewage Treatment Plant Upgrades	Upgrade and expansion of the Sewage Treatment Plant	22 mi southeast of Greenwood site on St. Clair River in Ontario, Canada	Recently completed
Metal Fabrication Company	Metal fabrication for automobile industry	14 mi east of Greenwood site on Lake Huron	
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; construction of water and/or wastewater treatment and distribution facilities and associated pipelines, as described in local land use planning documents. No specific data found concerning development/expansion of the towns within 20 mi of site.	Throughout region	Construction would occur in the future, as described in State and local land use planning documents
Global Climate Change/ Natural Environmental Stressors	Short- or long-term changes in precipitation or temperature	Throughout region	Impacts would occur in the future

Source: Modified from NRC 2010a, b, c

9.3.4.1 Land Use

The following impact analysis includes impacts on land use from building activities and operations at the Greenwood site and within the geographic area of interest, which is the 15-mi region surrounding the site. The analysis also considers past, present, and reasonably foreseeable future actions that affect land use, including other Federal and non-Federal projects and those projects listed in Table 9-19 within the geographic area of interest.

The site is owned by Detroit Edison; most of the site is zoned industrial and hosts the existing Greenwood Energy Center power plants (Detroit Edison 2011a). The proposed location for the new facility includes approximately 60 ac of permanent use and 200 to 300 ac of temporary use, located in the southern part of the existing 1280-ac site (Detroit Edison 2009b). There are a number of buildings onsite associated with the power plants. There are no residential areas on the site, although there are a few residences more than 2 mi from the site (Detroit Edison 2011a). Site topography is flat with very little variation and is primarily agricultural land,

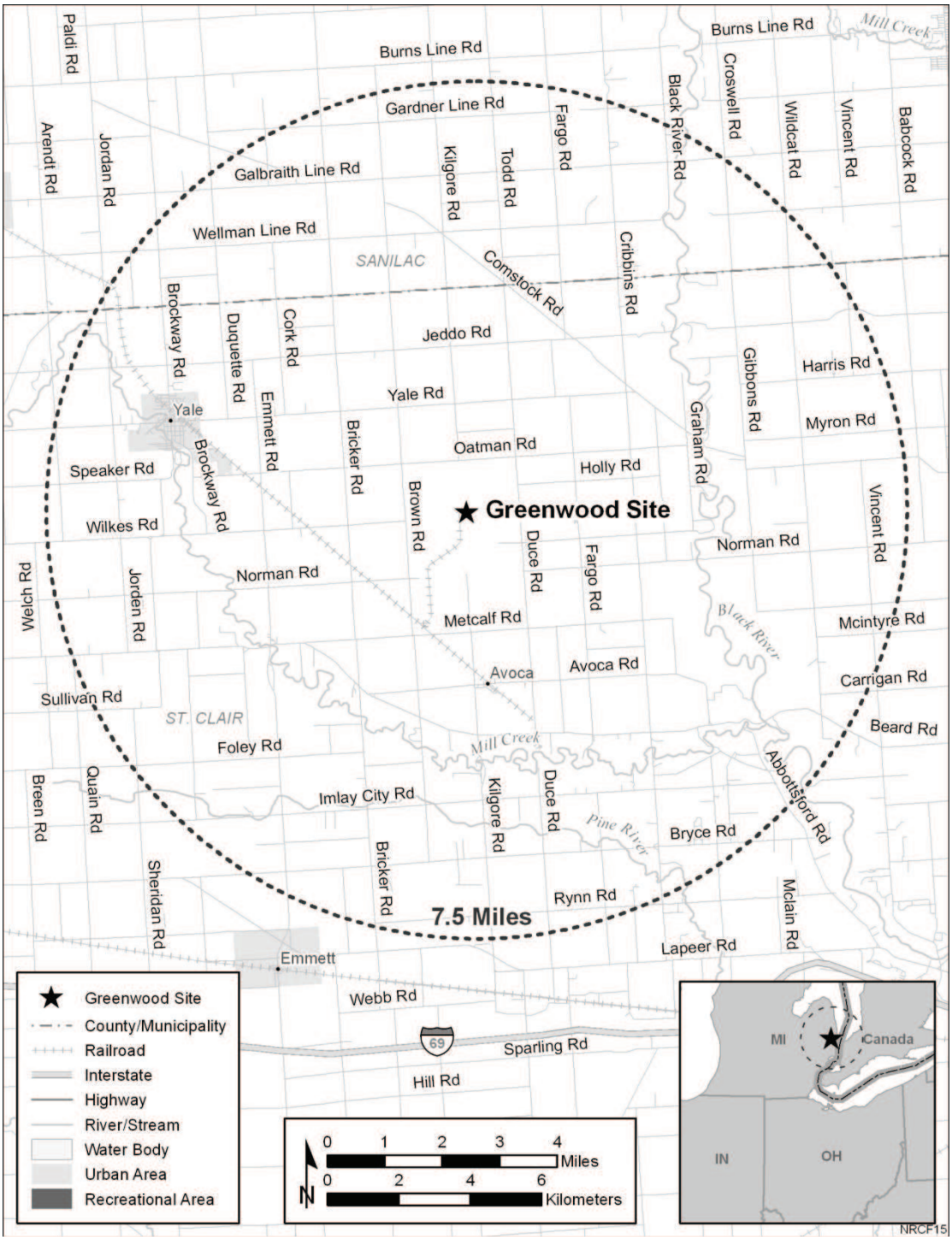

Figure 9-7. The Greenwood Alternative Site and Vicinity

with some young mixed deciduous woodland (Detroit Edison 2011a). Seven wetland areas have been identified on the site (see Section 9.3.4.3). Although the Federal Emergency Management Agency (FEMA) has not mapped the site for flood hazard, it is likely that the site is outside the Black River floodplain (Detroit Edison 2011a). If the facilities associated with this alternative would extend into the Coastal Zone defined by the State of Michigan under the Coastal Zone Management Act, Detroit Edison would have to obtain a coastal zone consistency determination from the MDEQ.

If a new nuclear power plant were constructed on the Greenwood site, about 360 ac of the 1280-ac tract would be disturbed, and some of the agricultural land (possibly including some prime farmland) and woodland areas on the tract would be disturbed. Drainage connections between the site and the Black River 3 mi east could also be disturbed. To supply cooling water, Detroit Edison would have to build a 10-mi water pipeline from Lake Huron, and although the amount of land required for a pipeline corridor is not known, some offsite land would be affected. The pipeline would likely disturb agricultural land, forest land, and wetlands and cross several railroad tracks and local roads. No new offsite roadway would likely be needed during construction or operation of the proposed facility (Detroit Edison 2011a).

The recreational areas nearest to the site are the Port Huron State Game Area and the Black River, about 3 mi east of the site. Lake Huron, as well as Lakeport State Park and Beach, are approximately 7 mi east. Several parks and beaches are located along the coast of Lake Huron. A number of State game areas are about 25 mi to the west of the site and a group of State parks and wildlife areas about 27 mi south of the site, near Anchor Bay in Lake St. Clair (Detroit Edison 2011a). Those recreational resources closest to the site may be affected by development and operation of a plant at the Greenwood site, including increased user demand associated with the projected increase in population with the in-migrating workforce and their families, an impaired recreational experience associated with the views of the proposed 600-ft cooling tower and condensate plume, or access delays associated with increased traffic from the construction and operations workforce on local roadways.

Although an existing 345-kV transmission line serves the site, it may need to be upgraded to serve a new nuclear facility (Detroit Edison 2011a). Upgrading the line might require expanding the corridor width and hence clearing forests and possibly interfering with some agricultural activities. Land uses along the transmission line corridor are generally similar to those on undeveloped portions of the site and lands adjoining the site, with a mixture of cropland, wooded areas, and some wetlands. Because of the short distances to the transmission interconnections, the review team concludes that the land use impacts of building and operating transmission lines for a new nuclear plant at the Greenwood site would be minor.

For cumulative land use analysis, the geographic area of interest is the 15-mi region surrounding the Greenwood site. This geographic area of interest includes the primary

communities (Greenwood Township and Avoca Township) that would be affected by the proposed project if it were located at the Greenwood site.

A number of projects identified in Table 9-19 are likely to affect land use in the geographic area of interest around the Greenwood site. Upgrades and new construction of facilities at Fort Gratiot County Park on the lakeshore and the St. Clair County bike trail system are all proposed for locations within 10 mi of the proposed site, and all would require slight changes in land use around the Greenwood Energy Center. Other projects identified in Table 9-19 have contributed to or would contribute to some decreases in open lands, wetlands, and forested areas and generally result in increased urbanization and industrialization. However, several existing parks, reserves, and managed areas have been established to help preserve open lands, wetlands, and forested areas. Continued operation of existing facilities at the site is not likely to produce additional land use impacts. The review team concludes that the cumulative land use impacts of building and operating a new nuclear generating unit and associated transmission lines at the Greenwood site would be minimal, because the projects within the geographic area of interest identified in Table 9-19 would be consistent with applicable land use plans, undeveloped land at the existing energy center is readily available, and the distance to transmission interconnections are relatively short.

As described for the Fermi site in Section 7.1, climate change could increase precipitation and flooding around the Greenwood site, while increased lake evaporation and reduced lake ice accumulation could reduce lake levels, thus changing land use through an increase in low-lying lakeshore areas (USGCRP 2009). Forest growth may increase as a result of more carbon dioxide in the atmosphere, while existing parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by the same factors (USGCRP 2009). In addition, climate change could reduce crop yields and livestock productivity (USGCRP 2009), which might change portions of agricultural land uses in the geographical area of interest.

Based on the information provided by Detroit Edison and the review team's independent evaluation, the review team concludes that the cumulative land use impacts associated with siting a reactor at the Greenwood site would be SMALL and mitigation would not be warranted.

9.3.4.2 Water Use and Quality

Surface water features in the vicinity of the Greenwood Energy Center site include small creeks and ditches and an onsite cooling pond system for the existing power plants. Because the surface water resources near the site are poor, water for a reactor at the Greenwood site would most likely be obtained from Lake Huron, which is approximately 10 mi to the east. The site's existing power plants are supplied with lake water via a 10-mi-long pipeline system that has excess capacity of 40 MGD (Detroit Edison 2011a). However, the proposed Fermi 3's makeup water requirement is 34,000 gpm, or 49 MGD (Detroit Edison 2011a). It is unclear from this