5. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

5.1 COMPARATIVE IMPACTS OF ALTERNATIVES

5.1.1 Summary Comparison of Alternatives and Impacts

Table 2.4-1 (Chapter 2) compares the potential impacts for the No Action Alternative with the Proposed Action as located at the West and East Range Sites. The impacts for each environmental resource are based on the analyses found in Chapter 4.

5.1.2 Impacts of Commercial Operation

The demonstration of the Mesaba Energy Project for the CCPI Program would be considered successful if the results indicate that the continued operation of the gasifier would fully meet the fuel needs of the combined-cycle unit and would be economically and environmentally feasible (i.e., the project would achieve commercially competitive performance in terms of availability, thermal efficiency, emissions, and cost of electricity). However, if the fuel needs of the combined-cycle unit would need to be met or supplemented by using natural gas for continued commercial operation, then the demonstration of synthesis gas (syngas) production by coal gasification would be considered unsuccessful.

Following completion of the one-year demonstration in late 2012, three scenarios would be reasonably foreseeable: (1) a successful demonstration of the Mesaba Energy Project followed immediately by commercial operation of the facilities at approximately the same production level; (2) an unsuccessful demonstration followed by continued commercial operation of the combined cycle power-generating unit using the gasifier to the extent possible, while using natural gas to serve the balance of the combined-cycle unit's requirements not met by the gasifier; and (3) an unsuccessful demonstration followed by continued commercial operation of the combined-cycle unit using natural gas exclusively.

Under all three scenarios, the expected operating life of the facilities would be at least 20 years, including the one-year demonstration period. An extension beyond 20 years would be based on the continued economic feasibility of the facility. Under the first scenario (successful demonstration followed by commercial operation), the level of short-term impacts for environmental resource areas during commercial operation would not differ from those described in Section 4 because the proposed facilities would continue operating 24 hours per day with the same operating characteristics.

For long-term effects, the impacts would be identical to those discussed in Chapter 4, except for impacts that accumulate with time (i.e., solid waste disposal and CO_2 emissions). As described in Sections 2.2.3.3 and 2.2.3.4, solid wastes would be minimized through the removal of elemental sulfur from the IGCC syngas in relatively concentrated form resulting in a marketable product. The other principal solid waste from the syngas process would be an inert, glass-like slag that may be marketable for asphalt aggregate, landfill cover, or other applications depending on carbon content and gasification fuel source. Unmarketable sulfur and/or slag would be disposed of at an appropriate commercial landfill. Disposal of these wastes would increase the waste volume in the landfill, but would not change other potential impacts associated with the landfill. Solid wastes from the ZLD system in the form of a crystallized filter cake would be disposed of at a licensed hazardous waste landfill. The impacts of solid waste management are described in Section 4.16.

Emissions of CO_2 over the 20-year commercial life of the generating station would be approximately 214 million tons without mitigation. However, as described in Section 2.2.1.3, the plant would be designed to be adaptable for retrofit of carbon capture technology. Excelsior has presented a plan to remove up to 85 percent of the CO_2 in the syngas fuel, which would result in an overall CO_2 capture rate of 30 percent for the plant (Appendix A1). Furthermore, Excelsior is working in coordination with the Energy and Environmental Research Center, as part of the Plains CO_2 Reduction Partnership, to develop

CO_2 management options for the Mesaba Energy Project based on evaluations of sequestration opportunities associated with regional geologic formations and nearby terrestrial features.

Under the second scenario (an unsuccessful demonstration followed by commercial operation of the combined-cycle unit using the gasifier to the extent possible), the types of impacts resulting from the proposed facilities would be similar to those in the first scenario. However, the level of impacts would be reduced because less coal would be used and less elemental sulfur, slag, and carbon dioxide would be produced. Fewer trains would be needed to deliver coal to the Mesaba Generating Station than for the first scenario operating at full load. Disposal requirements and/or transportation off the site for commercial sale of elemental sulfur and slag would be reduced correspondingly. During periods when the gasifier would not be operating, cooling water demand for project facilities also would be reduced in comparison to the first scenario.

Under the third scenario (an unsuccessful demonstration followed by commercial operation of the combined-cycle unit using natural gas exclusively), the gasifier and associated equipment would no longer be required and most likely would be dismantled and removed from the site for reuse or salvage. Potential short-term impacts would result from fugitive dust and emissions by engines during dismantlement and off-site transport of unneeded equipment, from additional traffic associated with hauling the equipment off site, and from temporary socioeconomic impacts related to the additional workers needed to dismantle and remove the equipment. Also, the likely operational downtime that would occur for the generating station during the dismantling of the gasifer would result in reduced operational impacts.

5.1.2.1 Carbon Dioxide Capture and Geologic Storage

The Carbon Capture and Sequestration plan presented in Appendix A1 was prepared by Excelsior and submitted to the PUC to provide a starting point from which the State of Minnesota could consider meeting its obligations under future CO_2 regulations. Although this option is not feasible during the time frame of the project demonstration phase, Excelsior may install CO_2 capture technology and sequester the power plant's CO_2 in a deep underground geologic formation at some point during the commercial life of the project. The analysis presented here describes the potential environmental impacts associated with the scenarios and possible pipeline routes presented in Appendix A1, based on the best available information.

Excelsior has not established a specific, detailed design for carbon capture, transport or sequestration. Hence, this analysis is based primarily on publicly available information compiled by DOE that is considered most representative of the potential future design of these features appropriately scaled for the Mesaba Energy Project. It is expected that if CO_2 capture and storage were implemented at some time in the future, a more detailed analysis would be conducted, including detailed design and engineering, environmental and geotechnical studies, and permitting necessary to comply with appropriate laws and regulations.

For conceptual purposes, two possible CO_2 capture scenarios are examined in this section: Scenario 1, in which approximately 20-30 percent of the CO_2 is captured (depending on the feedstock used), and Scenario 2, in which approximately 85-90 percent of the CO_2 is captured. The captured CO_2 would be stored in an oil-bearing formation for enhanced oil recovery (EOR) or in a deep saline formation. These scenarios help present a valid range of impacts that could occur if CO_2 capture and sequestration were implemented during the power plant's commercial operation phase.

Geologic sequestration (or storage) is the injection and storage of CO_2 in a suitable subsurface formation with the capability to contain it permanently. The injection of gases underground is not a new concept and has been performed successfully for decades, including natural gas storage projects around the world and acid gas injection at EOR projects.

Geologic storage of anthropogenic (man-made) CO_2 as a greenhouse gas mitigation option was first proposed in the 1970s, but little research was done until the early 1990s. In a little over a decade, geologic storage of CO_2 has grown from a concept of limited interest to one that is quite widely regarded as a potentially important mitigation option. Technologies that have been developed for and applied by the oil and gas industry can be used for the injection of CO_2 in deep geologic formations. Well-drilling technology, injection technology, computer simulation of reservoir dynamics, and monitoring methods can potentially be adapted from existing applications to meet the needs of geologic storage (IPCC, 2005).

Types of geologic formations capable of storing CO_2 include oil and gas bearing formations, saline formations, basalts, deep coal seams, and oil- or gas-rich shales. Not all geologic formations are suitable for CO_2 storage; some are too shallow and others have low permeability (the ability of rock to transmit fluids through pore spaces) or poor confining characteristics. Formations suitable for CO_2 storage have specific characteristics such as thick accumulations of sediments or rock layers, extensive covers of low permeability sediments or rocks acting as seals (caprock), permeable layers saturated with saline water (saline formations), structural simplicity, and lack of transmissive faults (IPCC, 2005).

Impacts of CO_2 Capture

Table 5.1-1 lists the potential CO_2 capture rates and expected material requirements, wastes and water use associated with Scenarios 1 and 2. These estimates are based on information for representative carbon capture and storage systems that would most likely be included in the detailed design for the Mesaba Energy Project.

Under Scenario 1, approximately 20-30 percent of the CO_2 would be captured using amine scrubbing, in which a solution of amine and water contacts the syngas. Higher capture rates would be possible with Powder River Basin coal as a feedstock, while other feedstock blends would result in a lower capture rate. Under Scenario 2, a gas reheater and water-gas shift reactors would be placed upstream of the CO_2 amine scrubber, enabling approximately 85-90 percent of the CO_2 to be captured. Current turbine designs cannot accommodate the higher percentages of hydrogen in syngas produced by this process; however, the advancement of this technology is a primary objective of DOE’s FutureGen project, which is planned to begin operation in 2013.

The amine and CO_2 in the syngas undergo a chemical reaction forming a CO_2-rich amine that is soluble in water. This solution would then be pumped to a desorber where it is heated or de-pressured, which reverses the reaction and releases pure CO_2 gas. A portion of the recovered amine would be sent to a reclaimer where it would be heated to a higher temperature to distill and reclaim usable solvent that is recycled to the process. There would be some degradation of the amine solvent through irreversible side reactions with SO_2 and other syngas components, resulting in solvent loss.

Amine solutions, such as N-Methyldiethanolamine (MDEA), are stable and not particularly hazardous but require safe chemical handling (such as skin, eye and respiratory protection) and proper hazardous material storage procedures (DOW, 2004). Soda ash could be added to aid in the precipitation of higher boiling point waste material, which includes heat stable amine salts and other degradation products. The waste would be transferred to the plant’s wastewater tank for off-site disposal.

In addition to the reclaimer waste and spent carbon, the process would generate used filter elements from the solvent filters at the carbon bed (Chapel, Ernest, and Mariz, 1999). While waste quantities are estimated in Table 5.1-1 based on the best available information, the actual amount of waste generated would be function of the syngas composition and power plant operating conditions. Because Scenario 2 would result in nearly 3 times greater CO_2 capture than Scenario 1, it would require nearly 3 times the amount of solvent, soda ash, water, and energy. It would also generate nearly 3 times the amount of reclaimer waste and spent carbon filter material. The reclaimer waste would be disposed of by incineration and the spent carbon filter material would most likely be regenerated (recycled) by the vendor (Chapel, Ernest, and Mariz, 1999).

Table 5.1-1. Expected Characteristics of CO_2 Capture Scenarios

Parameter	Scenario 1	Scenario 2
Power Plant Rating (MW gross)	1,200	1,200
Total CO_2 generated (tons a year) without capture and sequestration	10,600,000	10,600,000
Capture rate (nominal)	30 percent	90 percent
CO_2 captured (pounds/hour)	726,000	2,178,000
CO_2 captured (tons/year)	3,180,000	9,540,000
CO_2 emitted (million tons/year) after capture and sequestration	7,420,000	1,060,000
Solvent, MEA		
Solvent recirculation rate (gallons per minute) [based on 2.18 gallons MEA/pound of CO_2 removed] [a]	26,400	79,100
Solvent make-up rate (gallons per minute) [based on 0.05 percent loss] [b]	13.2	39.6
Solvent delivery (gals/day) [based on losses]	19,000	57,000
Rail car deliveries of solvent (cars/week) [based on 30,000-gallon capacity tank cars] [c]	4	13
Soda Ash		
Soda ash consumed (pounds/hour) [based on 370 lbs/hr for 4,800 gpm solvent recirculation rate] [b]	2,000	6,000
Soda Ash requirement (tons/year)	8,900	27,000
Spent Carbon Filter		
Spent carbon (pounds/day) [based on 0.165 pounds per metric ton of CO_2] [d]	1,300	3,900
Spent carbon disposal/regeneration (tons/year)	240	720
Energy Use		
Energy penalty (% decrease in efficiency) [e, f]	1-3	8
Reduction in Capacity (MW)	33-100	267
Reclaimer Waste		
Reclaimer waste (cubic meters/day) [based on 0.003 cubic meters per metric ton of CO_2 captured] [d]	24	70
Reclaimer waste, cubic meters/year	8,700	26,000
Water Use		
Water (gallons per minute) [based on 180 gpm required for 2,800 MT per day CO_2 recovery]	<500	1,500
Process water (gallons/day)	731,600	2,195,000

Note: Quantities of materials, waste, water and energy are estimated based on the best available data; however, the actual amounts would be a function of the flue gas composition and power plant operating characteristics. Many of the estimates for the 30% capture scenario are conservative as they represent a third of the 90% case and do not account for the fact that the proposed 30% capture case would not require the water gas shift reactor.

[a] EPRI, 2000
[b] Chinn, et al., 2004.
[c] ARI, 2005
[d] Chapel, Ernest, and Mariz, 1999
[e] Ciferno, et al., 2007 (Energy penalty shown is based on Selexol. Use of amine would have a higher energy penalty)
[f] Southern California Edison, 2006

Impacts of CO_2 Compression and Transport

Background on CO_2 Compression and Pipelines

To deliver the captured CO_2 to the injection site, the gas would be compressed into a supercritical state (i.e., exhibiting properties of both a liquid and a gas) to make it more efficient to transport. CO_2 compression uses the same equipment as natural gas compression, with some modifications to suit the properties of CO_2. Once compressed, the CO_2 would be conveyed by pipeline to the sequestration site.

Approximately 3,000 miles (4,800 kilometers) of CO_2 pipelines exist in the United States. CO_2 pipelines are regulated as hazardous liquids pipelines. The U.S. Department of Transportation's CO_2 Pipeline and Hazardous Materials Safety Administration has responsibility for safe and secure movement of hazardous materials to industry and consumers by all transportation modes, including the Nation's pipelines. Ordinarily, Federal approval is not required for development of a new hazardous liquids pipeline unless it would cross Federal lands. Generally, state and local laws regulate construction of new hazardous liquids pipelines. However, under Federal and state regulations, pipeline operators are responsible for ensuring the safe operation of their pipelines. Operators must use qualified materials and sound construction practices; thoroughly inspect, test, maintain, and repair their pipelines; ensure their workers are trained and qualified; implement best management practices (BMPs) to prevent damage to pipelines; and develop adequate risk management and emergency response plans. A Computational Pipeline Monitoring System is required by Federal regulation (49 CFR Section 195.444) for leak detection in CO_2 pipelines. This type of leak detection system automatically alerts the operator when a leak occurs so that appropriate actions can be taken to minimize the release. The proposed routes to EOR sites cross international boundaries and would require bilateral coordination between the U.S. Department of Transportation and the Canadian National Energy Board.

Supercritical CO_2 - CO_2 usually behaves as a gas in air or as a solid in dry ice. If the temperature and pressure are both increased (above its supercritical temperature of 88ºF [31.1ºC] and 73 atmospheres [1,073 psi]), it can adopt properties midway between a gas and a liquid, such that it expands to fill its container like a gas, but has a density like that of a liquid.

Most pipelines for hazardous liquids are located or buried within existing rights-of-way (ROWs). A ROW consists of consecutive property easements acquired by, or granted to, the pipeline company. The ROW provides sufficient space to perform pipeline maintenance and inspections, as well as a clear zone where encroachments can be monitored and prevented. If an existing utility ROW is not available or suitable for the proposed CO_2 pipeline, new ROW would be obtained where necessary.

The diameter of the pipeline would depend on many factors, particularly the length of the pipeline and transport pressure. It is likely that the pipeline would be buried at least 3 feet (0.9 meter) below the surface except where it is necessary to come to the surface for valves and metering. A typical distance between metering stations is 5 miles (8 kilometers). These features may be aboveground or could be located below ground in concrete vaults. The pipeline would require protection from above ground loading at road crossings, either by increased wall thickness or by casing the pipe. In cold climates, transporting warm CO_2 could increase the ground temperature, which may affect ground frost and freeze in the winter. To avoid problems with icing at road crossings, the pipeline depth or pipe insulation thickness may be increased.

The use of existing ROWs is preferable, because developing ROWs for new CO_2 pipelines could cause changes in land use and ownership, including land clearing and soil disturbances, utility and road crossings, wetland and habitat disturbances, and potential surface leaks of CO_2.

Storage Option 1- Transport to Oil Fields for Enhanced Oil Recovery

As explained in Appendix A1, CO_2 has been proven to be very effective for oil recovery by both displacing and decreasing the viscosity of otherwise unrecoverable oil. This process provides an economic benefit that can offset all or some of the costs of CO_2 capture, transport and sequestration. For Option 1, pipelines could be constructed between the Mesaba Energy Project and a cluster of oil fields in north central North Dakota, the southwestern corner of Manitoba and the southeastern corner of Saskatchewan. For the main trunk pipeline connecting the power plant and the oil field, two route options were examined. These routes would follow existing ROWs to minimize potential impacts to environmental resources and land uses. While these routes are good candidates for such a pipeline, other potential corridors may exist and could be selected if CO_2 capture and storage were pursued. Both of the examined routes could service either the West Range or East Range sites (with slight differences). Routes 1 and 2 are presented in Figure 5-1.2-1. If CO_2 regulations are instated, a comprehensive network of CO_2 pipelines may develop to meet regional sequestration needs and link sources with potential sinks; The Mesaba Energy Project may be able to efficiently connect to that pipeline network.

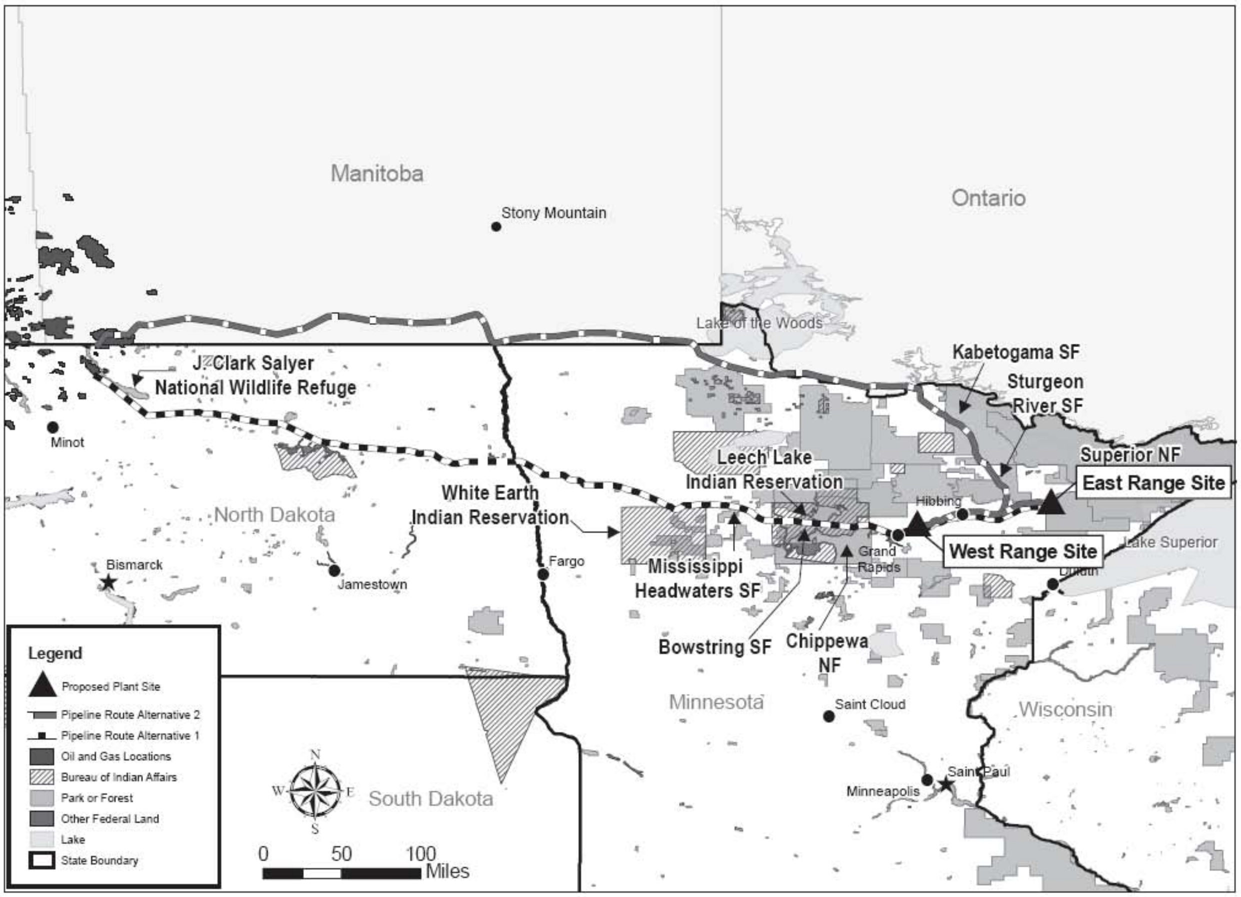

Figure 5-1.2-1. Potential Pipeline Routes from the Mesaba Energy Project to EOR Fields.

Route 1

Route 1 would originate at either the East Range Site or West Range site, following an existing ROW to the west. From the West Range site, the route would be about 400 miles long and from the East Range site, the route would be about 450 miles; depending on which capture scenario is employed the pipeline may be expanded to reach additional oil fields.

For either site, pipeline route 1 would travel through the Chippewa National Forest near Grand Rapids, as well as the Mississippi Headwaters and Bowstring State Forests within existing railroad ROW.

For the East Range Site, route 1 between Hibbing and the East Range Site would also pass through a portion of Superior National Forest within existing railroad ROW.

Route 1 for either power plant site would pass through two Indian reservations in Minnesota, including 3 areas that are part of the Leech Lake Indian Reservation and the northern portion of the White Earth Indian Reservation. If this route were chosen, the railroad ROW agreement would need to be examined for each reservation to determine if utility lines (like CO_2 pipelines) would be allowed under the current agreement. If not, Excelsior would seek to obtain a separate right-of-way agreement across each reservation in accordance with 25 CFR 169 (Bureau of Indian Affairs, Department of Interior, Part 169, Right of Way Over Indian Lands). If written consent is obtained from the tribe, a written application for a right-of-way would then be filed with the Secretary of Interior.

Route 1 would travel through 41 towns and communities, ranging from populations of less than 100 to 49,000. The largest towns along the route would be Hibbing (East Range only), Grand Rapids, Bemidji, Crookson, Grand Forks, and Devils Lake.

Route 2

Pipeline Route 2 would originate at either the East Range Site or West Range site, following existing railroad ROW ultimately to the north towards Canada, where it would then turn west toward the oil fields. From the West Range site, the route would be about 525 miles long and from the East Range site, the route would be about 500 miles; depending on which capture scenario is employed, the pipeline may be expanded to reach additional oil fields.

For either site, route 2 would also travel through the Superior National Forest north of Hibbing and the Sturgeon River and Kabetogama State Forests within existing railroad ROW. For the East Range site, route 2 between Hibbing and the East Range Site would also pass through a portion of Superior National Forest within existing railroad ROW. Route 2 would not pass through any Native American tribal lands.

Route 2 would travel through 18 towns and communities, ranging from populations of less than 100 to 17,000. The largest towns along the route would be Hibbing (East Range only), International Falls, Virginia, Eveleth, and Mountain Iron.

Storage Option 2 – Transport to Saline Formation

Deep saline formations are also good candidates for CO_2 storage if they have adequate seals or caprock above them to prevent upward migration. While there is currently no economic benefit of sequestration in saline formation when compared to EOR, saline formation generally have much greater capacities to store CO_2 than oil-bearing formations. If future CO_2 regulations generate value for reducing emissions, an economic benefit for saline storage could emerge.

Under this option, the pipeline route would most likely follow route 1 described above for the EOR option. However, the route would be approximately 200 miles shorter for each power plant site alternative, terminating somewhere between Grand Forks Air Force Base and the Town of Devils Lake in eastern North Dakota. There is also the potential for saline storage in the Mid-continent Rift formation in Minnesota, which could be reached with a <100 mile pipeline.

Impacts of Geologic Sequestration

Background

Injection of CO_2 in its supercritical state into a deep geologic formation would be achieved by pumping the CO_2 down an injection well. To increase the storage potential, CO_2 would be injected into very deep formations where it could maintain its dense supercritical state. The fate and transport of CO_2 in the formation would be influenced by the injection pressure, dissolution in the formation water, and upward migration due to CO_2's buoyancy.

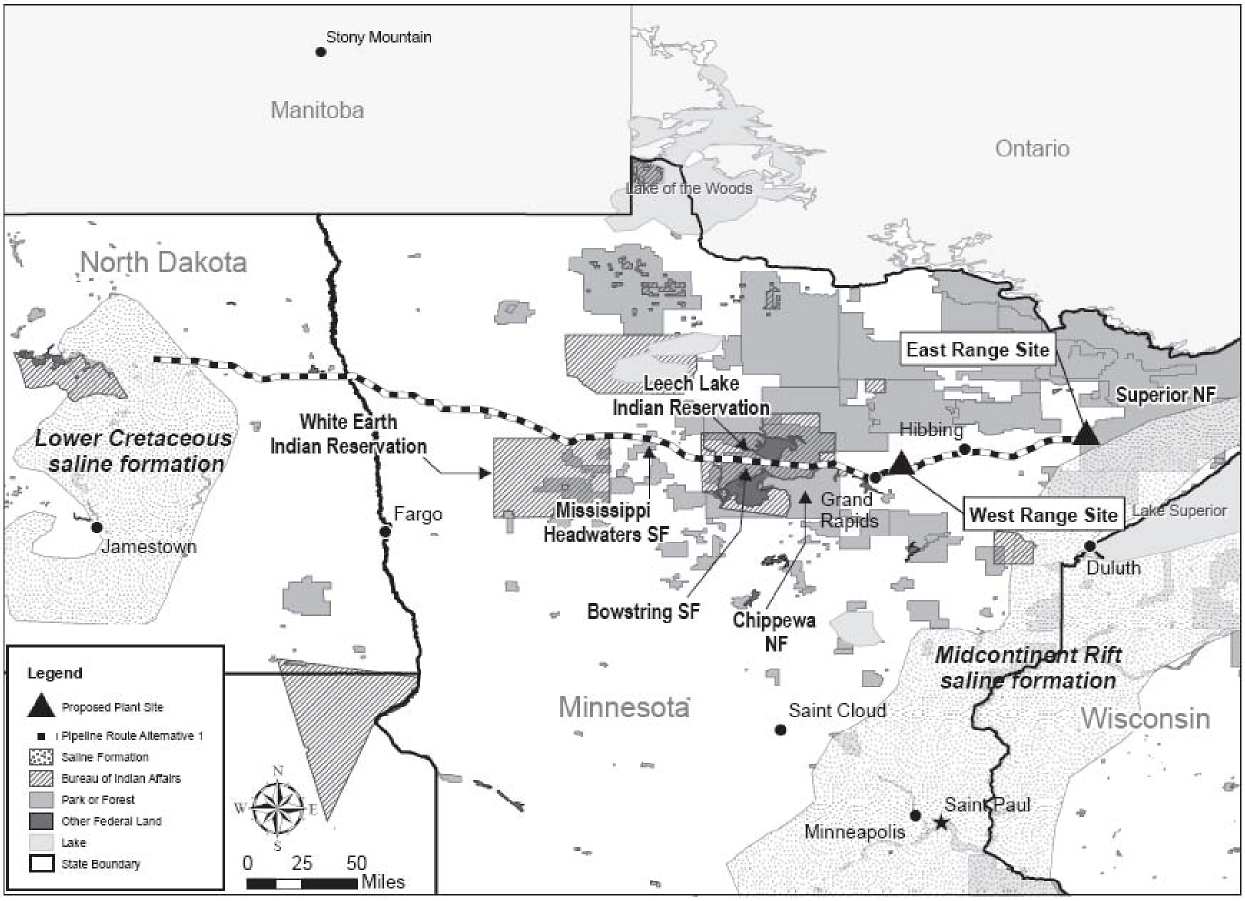

Figure 5-1.2-2. Potential Pipeline Route to the Lower Cretaceous Saline Formation.

When CO_2 is injected for EOR, it mixes with the oil and decreases the viscosity, enabling recovery of oil that was previously considered unrecoverable. During standard EOR practices, a small fraction of the CO_2 injected remains in underground storage, but most is recycled as the oil is produced. The CO_2 that remains in the structure is stored over the long term by the same trapping mechanisms observed in saline formations and described below. Although standard industry practices result in permanent underground storage of 33 percent of the CO_2 injected, employing advanced technologies could result in EOR with 60 percent of the CO_2 stored (Kuukstra, 2006).

When CO_2 is injected into a deep saline formation in a liquid or liquid-like supercritical dense phase, it is only somewhat miscible in water. Because supercritical CO_2 is much less viscous than water (by an order of magnitude or more), it would be more mobile and could migrate at a faster rate than the saline groundwater. In saline formations, the comparatively large density difference (30 to 50 percent) creates strong buoyancy forces that could drive CO_2 upwards.

To provide secure storage (e.g., structural trapping), a low permeability layer (caprock) would act as a barrier and cause the buoyant CO_2 to spread laterally, filling any stratigraphic or structural trap it encounters. As CO_2 migrates through the formation, it would slowly dissolve in the formation water. In systems with slowly flowing water, reservoir-scale numerical simulations show that, over tens of years, up to 30 percent of the injected CO_2 would dissolve in formation water. Larger basin-scale simulations suggest that, over centuries, the entire CO_2 plume would dissolve in formation water. Once CO_2 is dissolved in the formation water, it would no longer exist as a separate phase (thereby eliminating the buoyant forces that drive it upwards), and it would be expected to migrate along with the regional groundwater flow.

As migration through a formation occurs, some of the CO_2 would likely be retained in the pore space, commonly referred to as "residual CO_2 trapping." Residual trapping could immobilize large amounts of the CO_2. While this effect is formation-specific, researchers estimate that 15 to 25 percent of injected CO_2 could be trapped in pore spaces, although over time much of the trapped CO_2 dissolves in the formation water (referred to as "dissolution trapping"). The dissolved CO_2 would make the formation water more acidic, with pH dropping as low as 3.5, which would be expected to dissolve some mineral grains and mineral cements in the rock, accompanied by a rise in the pH of the formation water. At that point, some fraction of the CO_2 may be converted to stable carbonate minerals (mineral trapping), which is the most permanent form of geologic storage. Mineral trapping is believed to be comparatively slow, taking hundreds or thousands of years to occur (IPCC, 2005).

To ensure the safe storage of sequestered CO_2, a monitoring, mitigation and verification (MM&V) strategy would be implemented. The purposes of monitoring include assessing the integrity of plugged or abandoned wells in the region; calibrating and confirming performance assessment models; establishing baseline parameters for the storage site to ensure that CO_2-induced changes are recognized; detecting microseismicity associated with the storage project; measuring surface fluxes of CO_2; and designing and monitoring remediation activities.

Regulations Governing Underground Injection of CO_2

The underground injection of CO_2 is regulated under the U.S. Environmental Protection Agency's (EPA's) Underground Injection Control (UIC) Program. The UIC Program works with state and local governments to oversee underground injection of waste in an effort to prevent contamination of drinking water resources. All injection wells require authorization under general rules or specific permits.

The EPA groups underground injection into five classes for regulatory control purposes. Each class includes wells with similar functions, and construction and operating features so that technical requirements can be applied consistently to the class. Although the classification of UIC wells would be determined at the time of permitting, there is an overall standard of protection under the UIC Program that prohibits the movement of fluids into underground sources of drinking water. The citation below (from 40 CFR Part 144) provides the standard that all injection wells must be measured, including Class V (shallow and other) wells. This standard is currently in effect:

§ 144.12 Prohibition of movement of fluid into underground sources of drinking water.

(a) No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons. The applicant for a permit shall have the burden of showing that the requirements of this paragraph are met.

Furthermore, if any water quality monitoring of underground sources of drinking water indicates the movement of any contaminant into the water source, the state or EPA would require corrective action, operation, monitoring, or reporting as necessary to prevent such movement. The injection permit would be modified to reflect these additional requirements or the permit may be terminated. Appropriate enforcement action can be taken if a permit is violated.

In North Dakota, Class II UIC wells cover the injection of brines and other fluids associated with oil and gas production and are regulated by the North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division (North Dakota Department of Health, 2007). Class II is the most likely class of UIC well that would be used under the EOR option although EPA has recently promulgated UIC guidance allowing the use of Class V wells for CO_2 sequestration research initiatives.

In Canada, underground injection and groundwater protection are regulated at the provincial level, except where provincial or international boundaries are crossed. In this case, because the CO_2 would be piped from Minnesota, the Canadian Federal government would have jurisdiction. Both Saskatchewan and Manitoba have a provincial Environmental Assessment Act, under which CO_2 injection would be classified as a development requiring ministerial approval (PCOR, 2005).

Impacts of EOR Storage

The target formation for injection for EOR storage would be various hydrocarbon formations within the Williston Basin in eastern North Dakota, southeastern Saskatchewan, and southwestern Manitoba. Possible fields for CO_2 EOR development with CO_2 from the Mesaba Energy Project include the Nesson anticline, Saskatchewan, and Northwestern Flank. Oil production in the Williston basin is from Paleozoic-age rocks where oil is contained in stratigraphic traps.

The economic benefits and incentives for CO_2 EOR are described in Appendix A1. Preliminary estimates indicate that under either capture scenario, there are fields suitable to accept the CO_2 from the Mesaba Energy Plant for the planned 22-year operations cycle. The use of CO_2 from the Mesaba Energy Project at existing oil fields could extend the operating life of those fields, allowing for greater volumes of oil to be extracted. A small fraction of the CO_2 would mix with the recovered oil that would be removed in the processing stage. However, because of the economic value of the CO_2, it would probably be recovered and re-injected at the EOR site. Extending the life of nearly-depleted oil fields could create or prolong existing jobs at these fields and provide additional oil and gasoline for consumers. Impacts associated with using the CO_2 for EOR could potentially include, but would not be limited to:

- Constructing new CO_2 injection sites that require the permitting and drilling of new UIC wells
- land clearing and soil disturbance for installing wells, pumps, distribution piping, access roads, and utility lines
- sealing or mitigation of abandoned wells
- potential surface leaks of sequestered CO_2
- potential vertical or lateral migration of CO_2 in the subsurface that could cause changes in soil gas concentrations, cause chemical changes or mineralization, impact groundwater supplies, or mobilize heavy metals
- prolong oil recovery operations at the site
- providing the economic benefits of additional oil recovery

The amount of oil recovered would vary based on site-specific conditions. However, a nominal estimate would be three barrels of incremental oil produced per metric ton of CO_2 injected (EU DG JRC, 2005). Under the 30 percent capture scenario, up to 3.2 million tons (2.9 million metric tons) per year of CO_2 could be used for EOR. This could result in the additional recovery of up to 8.7 million barrels of oil per year. For the 90 percent capture scenario, up to 9.5 million tons (8.6 million metric tons) per year of CO_2 could aid the recovery of an additional 25.3 million barrels of oil per year.

Impacts of Saline Formation Sequestration

The target formations for storage in saline formations would be the Lower Cretaceous saline formation within the Williston Basin in eastern North Dakota or the Mid-continent Rift formation in Minnesota. The formations that make up the Lower Cretaceous portion of the northern Great Plains aquifer system are, in descending order, the Newcastle, Skull Creek, and Inyan Kara in North Dakota (Bluemle et al., 1986). Overlying the Lower Cretaceous aquifer system in North Dakota are impermeable rocks of the TK4 aquitard system. Marine shale is the primary lithology of the TK4. Other lithologies include sandstone, siltstone, and chalk; there are also numerous beds of bentonite throughout parts of the section. With respect to CO_2 sequestration, the thick shales and occasional bentonite formations of the TK4 would serve as competent seals in areas where it is present (PCOR, 2005). The Mid-continent Rift formation has not been characterized at this point, but preliminary studies indicate it warrants further study as a potential CO_2 storage reservoir.

Potential impacts of injection into a saline formation include induced seismic responses if proper injection pressures are maintained. State and Federal agencies regulate the injection pressures that can be utilized during the sequestration process, and monitoring of the formation pressure would help detect potential over-pressurization. Some saline formations are located in geologic traps that also serve as petroleum reservoirs. Therefore, prior to the sequestration of CO_2 in a saline formation, the surrounding area would be studied to determine if the sequestration would affect any oil and gas resources. As with the other geologic sequestration technologies, surface and underground mining in the area of the injected CO_2 could affect the integrity of the hydrogeologic features that cap and isolate the reservoir, thus may allow undesirable migration of the CO_2.

It is essential to protect the water supply aquifers that are stratigraphically above the injection zone. The addition of CO_2 to the saline water-bearing formation can decrease the water pH and alter the pH of the water causing the mobilization of trace elements (e.g., arsenic, selenium, lead). However, selecting sites with competent, extremely tight caprock above the injection zone and other favorable geologic features that restrict both vertical and lateral flow would isolate the sequestered CO_2 from any aquifer that could be used as a potable water supply source. Utilizing BMPs for design, construction, operation, and monitoring can control the subsurface leakage of formation fluids. Injection pressures would be carefully monitored and controlled to avoid hydrofracturing of the formation or caprock that could allow formation fluids to migrate to shallower aquifers. Impacts associated with the construction of the pipeline and injection wells would be the same as for storage via EOR.

Summary of Impacts of CO_2 Capture and Sequestration

Potential impacts of CO_2 capture and storage are provided in Table 5.1-2. Because the addition of CO_2capture and storage technologies at the Mesaba Energy Plant is not part of the Proposed Action, impacts are described in general terms. Additional site specific analysis would be needed should the commercial operations include CO_2 capture and storage.

Table 5.1-2. Summary of Impacts and Mitigation Measures for CO_2 Capture and Storage

Resource Area	Summary of Impacts	Possible Mitigation Measures
Aesthetics	Capture: • No additional impact on aesthetics would be anticipated with the addition of capture technologies. Storage: • If existing ROWs are not used, land clearing would result in potential moderate adverse impacts (long-term and localized) on aesthetic and scenic resources. Such impacts may range from negligible to moderate depending upon the characteristics of the proposed corridor. Pipeline route 1 would pass through 2 national forests, 1 wildlife refuge, and 2 state forests. Pipeline route 2 would pass through 1 national forest and 2 state forests.	Capture: • No mitigation measures warranted. Storage: • Final pipeline routes should use existing ROWs to the extent possible and avoid scenic resources.
Air Quality	Capture: • Beneficial impact from reduced CO_2 emissions would occur. • Criteria emission rates would increase proportionately to the reduced heat rate of the plant. Storage: • Equipment used to compress, transport and inject the CO_2 (which could be fossil-fueled) may emit additional air pollutants; overall impact would be negligible. • Possibility exists for leakage of CO_2 from storage site to the atmosphere. Risk of leakage is greatest during injection. Once injection ceases, wells would be properly sealed and abandoned to minimize this leakage pathway. Once within the formation, mineralization reactions would slowly decrease the risk of leakage. Impact is expected to be negligible, provided monitoring, mitigation and verification (MM&V) measures are followed.	Capture: • No mitigation measures warranted. Storage: • Determine the air impacts associated with operation of CO_2 compression and injection equipment as applicable. Consult state air permitting officials to determine if the project would meet emission standards as designed. • Mitigate possibility for leakage of CO_2 to the atmosphere through careful site selection, acquiring applicable permits, review of all wells or other surface conduits in the area, and employing appropriate MM&V technologies to measure releases of CO_2 from the surface above geologic formations. • Locate pipelines and injection areas away from populated areas.
Climate	Capture: • Beneficial impact from reduced CO_2 emissions would occur. Storage: • EOR or saline storage would not cause any unavoidable adverse impacts relevant to climate and meteorology.	• No mitigation measures warranted.
Geology	Capture: • Capture technologies would have no impact on geological resources. Storage: • No unavoidable adverse impacts would occur to geological resources, provided mitigation measures are followed. Reservoir space would be used to store the injected CO_2.	Capture: • No mitigation measures warranted. Storage: • Following appropriate regulatory requirements and maintaining appropriate injection pressures is critical to preserving the integrity of the storage reservoir. • Impacts to sub-surface microbial communities may be unavoidable.

Table 5.1-2. Summary of Impacts and Mitigation Measures for CO_2 Capture and Storage

Resource Area	Summary of Impacts	Possible Mitigation Measures
Soils	Capture: • Capture technologies would have no impact on soils Storage: • Temporary disturbances to soil would occur along proposed pipeline corridors. BMPs would minimize adverse impacts. Overall, impacts would be moderate but temporary.	Capture: • No mitigation measures warranted. Storage: • BMPs for pipeline corridors should be implemented to decrease soil erosion.
Groundwater	Capture: • Increased need for water for CO_2 capture represents a minor impact to regional groundwater resources. Storage: • No unavoidable adverse impacts would occur to groundwater resources. BMPs would be used to minimize impacts.	Capture: • No mitigation measures warranted. Storage: • Careful site selection and risk assessment prior to injection as well as following appropriate regulatory requirements would ensure protection of groundwater resources. The MM&V plan may include groundwater monitoring.
Surface Water	Capture: • Compression of CO_2 would result in condensate water with trace chemicals and increased salinity; no impacts are expected, provided appropriate permits are received and BMPs followed. Storage: • Water may be produced, or withdrawn, from the underground formation prior to injection at both EOR and saline storage sites; appropriate permits for disposal would be needed to avoid adverse impacts. Disposal to surface waters may not be possible and the waste water may be reinjected through a UIC-permitted saltwater disposal well. • Direct impacts of CO_2 on surface water are extremely unlikely.	Capture: • Appropriate permits for any pollutant discharge should be obtained (NPDES). Storage: • UIC or National Pollution Discharge Elimination System (NPDES) permits may be required for disposal of produced water.
Wetlands and Floodplains	Capture: • Capture technologies would have no impact on wetland and floodplain resources. Storage: • Construction of pipeline infrastructure could result in unavoidable temporary impacts to wetlands along the pipeline corridors. BMPs would minimize adverse impacts, and no long-term operational impacts are anticipated.	Capture: • No mitigation measures warranted. Storage: • Pipeline corridors could be located to avoid wetlands where possible. • Section 404 permits would be obtained for jurisdictional water-body and wetland alternations needed for pipeline construction. As a permit condition, mitigation of wetland impacts would be in the form of direct replacement or other approved U.S. Army Corps of Engineers (USACE) and state mitigation requirements.

Table 5.1-2. Summary of Impacts and Mitigation Measures for CO_2 Capture and Storage

Resource Area	Summary of Impacts	Possible Mitigation Measures
Biological Resources	Capture: • Capture technologies would have no impact on biological resources. Storage: • Temporary disturbances to additional aquatic and terrestrial habitats would occur along proposed pipeline corridors. • Surveys for endangered and threatened species before pipeline construction and injection would determine if they occur in the area. BMPs and coordination with state and Federal agencies would minimize adverse impacts. • Seismic imaging (a key MM&V technique) has potential temporary adverse impacts on wildlife and potential localized destruction or harm to plant populations.	Capture: • No mitigation measures warranted Storage: • Mitigation for Federal endangered species, if necessary, would be defined during consultation with the U.S. Fish and Wildlife Service and could include passive measures such as construction timing outside of critical breeding periods, or more aggressive measures such as complete avoidance of impacts. • Seismic survey plans should undergo environmental review before testing is authorized and conducted
Cultural Resources	Capture: • No additional cultural resource impact is anticipated beyond what is described elsewhere in this document. Storage: • Consultation with Native American tribes would be needed along either proposed pipeline route. Any potential of unavoidable adverse impacts would be resolved once consultation is complete. • Although there are no known areas of cultural significance, the potential exists for an adverse impact to cultural resources along the pipeline corridor and at proposed injection sites. Archaeological surveys would determine location of any cultural resources and the possible extent of impact.	Capture: • No mitigation measures warranted. Storage: • Required management and mitigation measures regarding traditional cultural properties are unknown until consultation with Native American tribes is complete. • Consultation with the State Historic Preservation Officer (SHPO) for any new unforeseen areas of construction or ground disturbance not included within the EIS would be completed before construction to determine the need for cultural resource investigations and any appropriate mitigation measures.
Land Use	Capture: • No additional impact, although the Mesaba Energy Project with capture may have a slightly larger construction footprint within the existing plant site. Storage: • Potential impact due to displacement of oil and gas wells, if saline storage option is chosen in an area with oil and gas resources. • Possible new ROW for pipeline construction.	Capture: • No mitigation measures warranted. Storage: • Displaced oil and gas wells could be relocated. • Existing ROWs would be used for pipeline placement to the extent possible.
Socio-economics and Environmental Justice	Capture: • Addition of capture technologies could increase electricity rates and have a long-term adverse impact. Storage: • Construction and operation of storage facilities generally would have negligible to minor adverse impacts on demographic and socioeconomic conditions; additional revenue from EOR would have potential beneficial impact on the local economy.	Capture: • Consider distributing potential increases in utility costs to support the proposed project to mitigate the potential for adverse and disproportionate impacts on low-income populations. Storage: • Mitigation measures would be implemented as required according to specific demographic conditions.

Table 5.1-2. Summary of Impacts and Mitigation Measures for CO_2 Capture and Storage

Resource Area	Summary of Impacts	Possible Mitigation Measures
Community Services	Capture/Storage: • No unavoidable adverse impacts would occur to community services. BMPs would be used to minimize impacts.	Capture/Storage: • No mitigation measures warranted.
Utility Systems	Capture: • Capture technologies would result in increased electricity needs, referred to as an energy penalty as described in Table 5.1-1; overall impact for capture and compression is estimated to be 2.6-8% of the power plant's output, depending on the capture scenario chosen. Storage: • Transport and re-compression of the CO_2 would result in increased electricity usage. Amount is minor compared to CO_2 separation and compression described under capture. Capture/Storage: • Impacts on water and wastewater infrastructure would be related to the size and distribution of potential facilities and/or region-specific issues affecting the ability to obtain a sustained supply of water or dispose of treated wastewater. Because volumes would be relatively small, the impacts are expected to be negligible or minor.	Capture: • No mitigation measures warranted. Storage: • No mitigation measures are warranted
Transportation and Traffic	Capture: • No additional impact on transportation and traffic would be anticipated. Storage: • Slightly increased traffic volumes near construction sites for compression facilities may be anticipated, but impact would be negligible.	Capture/Storage • Traffic controls would be implemented as required during construction across roadways.
Materials and Waste Management	Capture: • Some waste materials, including amine reclaimer sludge and spent carbon from the filter would be generated; with proper disposal impacts are negligible. Storage: • Anhydrous ammonia is needed for some compressors; following BMPs will mitigate any impacts. • Injection practices would generate waste from cutting and drilling, use of tracers, as well as fuel for equipment. Best management practices would mitigate any impacts.	Capture/Storage • All hazardous, solid, or industrial wastes should be disposed of according to Federal, state and local regulations. • Require implementation of a system to respond to spills of hazardous materials or waste including reporting the spill to the correct authority, providing appropriate means of cleaning up spills, and properly disposing of the resulting waste.

Table 5.1-2. Summary of Impacts and Mitigation Measures for CO_2 Capture and Storage

Resource Area	Summary of Impacts	Possible Mitigation Measures
Human Health, Safety, and Accidents	Capture: • Operation and maintenance of capture equipment is similar to other environmental control technologies; negligible impact is expected provided OSHA workplace standards are followed. Storage: • Remote potential exists for release of large quantities of CO_2; impact would be unlikely provided BMPs for site selection, risk assessment, and MM&V are followed. Some industry knowledge of CO_2-specific BMPs exist, and experience can be drawn from the natural gas industry as well as the EPA's UIC Program. Should a large-scale release occur, impact could be severe.	Capture/Storage: • Prepare a comprehensive safety program that addresses the construction and operations phases of the project. Ideally that plan would include a training plan, regular safety meetings, and an employee safety-awareness program. • Confer with the local emergency planning committee early in the planning process to establish a dialogue, explain the proposed facility, and learn how the emergency plan can be amended to address the new facilities. • Since the sudden release of a large quantity of CO_2 can have ground-level impacts on nearby flora, fauna, and humans, monitoring for leaks in and around pipelines and around injection points is an important consideration of any system design. Transmission piping and wells should be located to allow for adequate dispersion of CO_2 (away from populated areas) in the event of an accidental release. • Design an effective monitoring and alarm system to detect CO_2 leaks from pipelines, valves, and other equipment. • Prepare a Risk Management Plan (RMP) if any of the facilities would use chemicals in quantities sufficient for the facility to become subject to the risk management provisions of Section 112r of the CAA amendments.
Noise and Vibration	Capture: • Construction of the capture facility may result in unavoidable temporary elevated noise levels. BMPs would reduce impacts. Storage: • Construction of the pipeline and associated facilities would result in unavoidable temporary elevated noise impacts BMPs would reduce impacts.	Capture and storage: • Require the implementation of noise suppression equipment and BMPs to reduce noise to acceptable levels at property boundaries of adjacent communities.

5.2 POTENTIAL CUMULATIVE IMPACTS

This section presents the results of the joint DOE and MDOC analysis of potential cumulative impacts of the Mesaba Energy Project combined with the potential impacts of other relevant on-going actions and reasonably foreseeable future activities in the vicinities of the West Range and East Range Sites. The CEQ regulations implementing NEPA require the consideration of cumulative impacts (40 CFR 1508.7) as part of the EIS process. Although the Mesaba Energy Project is subject to the Minnesota Power Plant Siting Act (Minnesota Rules Chapter 4400), which does not require the consideration of cumulative impacts comparable to those of the Minnesota Environmental Policy Act (MEPA) in Minnesota Rules Chapter 4410, MDOC has agreed to the consideration of cumulative impacts in this joint Federal/state EIS document based on public comments received.

5.2.1 Approach and Analytical Perspective

As described in Appendix D, DOE used the following approach and analytical perspective to perform this cumulative impacts analysis:

- DOE required the use of quantitative modeling specifically for this cumulative impacts analysis.
- Projects included in the cumulative impacts analysis are those that have the highest potential for causing identifiable cumulative impacts and considered potential Federal, state, and private activities.
- DOE considered a reasonably foreseeable action to be a future action for which there is a reasonable expectation that the action could occur, such as a proposed action under analysis by a regulatory agency, a project that has already started, or a future action that has obligated funding.

As outlined in the approach to cumulative impacts analysis (Appendix D), based on a consideration of the regions of influence for impacts on environmental resources from respective foreseeable actions, not all of the resource areas addressed in Chapter 3 and 4 of this EIS would be subject to cumulative impacts. For example, potential impacts on vegetation and archaeological resources generally would be limited to the locations of anticipated land disturbance, which are specific to the individual projects. Therefore, the needs for cumulative impacts analyses were specifically identified for air quality conditions (Section 5.2.2), air inhalation health risk (Section 5.2.3), water resources (Section 5.2.4), wetlands (Section 5.2.5), wildlife habitat (Section 5.2.6), and rail traffic (Section 5.2.7). The cumulative impacts analyses for these resources were developed based on specific methodologies and assumptions as described for each.

5.2.2 Air Quality

Air quality analyses were conducted to assess the cumulative impacts on Class I areas related to the Mesaba Energy Project (Phases I and II) in combination with existing and reasonably foreseeable future emission sources. The analyses addressed the BWCAW, VNP, and RLW. For each Class I area, model results were obtained to evaluate PSD increment consumption and compliance with ambient air quality standards, deposition of sulfur (S) and nitrogen (N) compounds, and visibility impacts. A visibility assessment was not conducted for RLW, since visibility is not considered a critical value for RLW. Additionally, the concentration of mercury in air at Class I area receptors from major existing and proposed sources in the area was estimated.

The major categories of potential cumulative impacts to air quality from the Mesaba Energy Project and other regional activities include construction- and operation-related emissions. Cumulative impacts from construction activities would be similar for the West Range Site and the East Range Site. Since cumulative impacts from operations would occur at either one site or the other, the impacts were derived and presented separately for the West Range Site and East Range Site.

5.2.2.1 Sources Identified for Cumulative Impact Analysis

Emissions data and source parameters for major sources in northern Minnesota were assembled for the cumulative impact analyses, and included on-going actions and proposed new sources as provided in Appendix D1. Data were provided by the MPCA, including information acquired from permit applications and regulatory submittals. The modeled sources can be classified into the following groups:

- Existing sources that have not experienced significant permit or emissions changes since the applicable PSD baseline dates for major sources. These sources do not affect PSD increment consumption, and were assumed to continue operation in the future at their current emission rates.
- Existing sources that have submitted applications or received permits or permit modifications after the applicable baseline dates. For these sources, emission changes (i.e., increases or decreases) since the baseline date were modeled for the cumulative PSD increment analyses. The sources were also included in the future cumulative modeling analyses at their current emitting conditions.
- Existing sources that are expected to reduce emissions in the future as a result of pollution control projects required for compliance with CAIR, BART, CAMR, or other regulations. The sources in this category are the Minnesota Power Boswell, Laskin, and Taconite Harbor generating stations. The planned emission reductions were taken into account for both PSD increment and future total impact modeling analyses.
- Proposed sources not yet in operation. These sources were modeled at their proposed permit limits for both PSD increment and future total impact analyses.

The emissions data for the sources provided by the MPCA for increment analysis were based on MPCA's records of pollutant-specific baseline dates for northern Minnesota. For visibility and deposition analysis, all existing and proposed sources for which data could be acquired were included. Minor sources, mobile sources, and mining sources that emit primarily particulate matter less than 10 micron (PM_{10}) were not included in the cumulative modeling. Nearly all such sources are at ground level and far from Class I areas, and would not likely cause significant air quality impacts in the Class I areas.

5.2.2.2 Impacts from Construction-Related Emissions

Emissions of concern from construction activities include fugitive dust, SO_2, NO_X, VOCs, and CO emissions. Emissions resulting from the combustion of fuel in machinery and equipment, including SO_2, NO_X, VOCs, and CO, would be minimal compared to those from operation of the Mesaba Energy Project. Activities such as construction, surface disturbance, and use of haul trucks in the area would cause the generation of fugitive dust. Control of fugitive dust is generally provided by water suppression or, in some cases, application of a chemical compound designed to minimize dust emissions. Construction of most of the projects and activities identified in this cumulative impacts analysis (See Appendix D1) would generate some level of fugitive dust; however, the plumes associated with fugitive dust generation would be localized to the area being disturbed and would be temporary. Therefore, these activities are not expected to have long-term and cumulative effects on air quality either locally or within the region.

5.2.2.3 Impacts from Operations-Related Emissions

The cumulative air quality modeling analyses includes operation activities associated with ongoing actions and proposed new sources. Table 5.2.2-1 shows a comparison of existing emissions from modeled sources and predicted future emissions. Since MP is expected to reduce their emissions in the future through the implementation of planned pollution control projects, the cumulative impact analysis indicates that future emissions of all pollutants are expected to be less than existing emission levels. This analysis includes the proposed additional emission related to the Mesaba Energy Project (Phase I and Phase II). It is also likely that further emission reductions would occur at the other sources as a result of future regulatory programs; however, such reductions could not be quantified and were therefore not considered in the analysis.

Table 5.2.2-1. Comparison of Present and Future Emissions[1, 2, 3]

Source	SO_2 (lbs/day)		NO_X (lbs/day)		PM_{10} (lbs/day)		Hg (lbs/day)	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Mesaba Energy Project (Phases I and II)	0	11,294	0	15,916	0	2,417	0	0.148
PolyMet	0	522	0	1,354	0	6,592	0	0.004
Mesabi Nugget	0	2,286	0	5,714	0	2,619	0	0.206
Minnesota Steel	0	3,442	0	9,962	0	18,035	0	0.222
Laurentian Energy (Hibbing)	25,785	25,992	8,160	8,985	1,537	1,697	0.040	0.040
Laurentian Energy (Virginia)	16,301	16,438	5,272	6,097	3,055	3,192	0.040	0.040
MP – Clay Boswell [4]								
#1,2,3	466,087	116,520	54,241	13,560	51,906	2,596	0.311	0.030
#4	40,458	40,458	49,056	49,056	12,261	12,261	0.534	0.053
MP – Laskin	64,763	64,763	15,840	6,335	19,010	19,010	0.055	0.055
MP – Tac Harbor	41,846	14,646			10,726	10,726	0.214	0.021
Potlatch – Grand Rapids	19	19	2,286	2,286	1,077	1,077		
Blandin Paper – Grand Rapids	14,295	14,295	2,876	2,876	1,291	1,291		
US Steel – MN Tac			56,477	56,477				
Hibbing Taconite	18,536	18,536			345	345		
MP – Hibbard	10,002	10,002						
Boise Cascade	8,635	8,635	8,895	8,895	1,615	1,615		
Potlatch – Cloquet	21,193	21,193						
Northshore Mining	49,881	49,881	38,921	38,921	3,988	3,988		
Potlatch – Cook			3,415	3,415	1,066	1,066		
Ispat Inland Mining			43,201	43,201	20,324	20,324		
United Taconite					19,734	19,734		
Keewatin Taconite					69,068	69,068		
Total (lbs/day)	**777,801**	**418,922**	**288,640**	**273,050**	**216,913**	**197,563**	**1.194**	**0.820**
Total (tpy)	**141,949**	**76,453**	**52,676**	**49,832**	**39,587**	**36,055**	**0.218**	**0.150**

[1] Although predictive modeling conducted for Mesaba Energy Project alone indicated that CO impacts are highest for the 8-hrs averaging time during startup (see Section 4.3.4.1), there are no PSD increments for CO and NAAQS compliance need only be demonstrated for 1-hr ambient CO standard.
[2]Where reasonable, emissions from multiple stacks or emission points at a single facility were combined for modeling. The total emissions were represented as occurring from one or several stacks with stack parameters typical of the majority of emissions.
[3] Emissions data for existing sources provided by MPCA based on permit application modeling in their files and were maximum short-term permit limits, with the exception of MP Clay Boswell Unit #4. If no modeling of specific pollutants had been required, no emissions data were provided.
4 The maximum (95[th] percentile) 3-hr and 24-hr emissions rates were used.
Source: Excelsior, 2006b

Modeling Approach

The potential for a significant cumulative impact to air quality was determined using the same criteria used to assess the impact of Mesaba Energy Project alone (see Section 4.3). All modeling utilized the CALPUFF model system, which is the EPA preferred method for simulation of long-range transport and dispersion. The CALPUFF modeling for the cumulative increment, visibility, and deposition modeling followed the MPCA protocol. Options and input variables in the models were generally selected per standard guidance from the EPA and FLMs. Meteorological data for the modeling represented calendar years 2002, 2003, and 2004. Receptors for modeling consisted of the high-resolution receptor grids provided by the National Park Service for each of the three Class I areas.

For visibility calculations "Method 6" of CALPOST, monthly average relative humidity values for each Class I area, and annual average natural background light extinction for each Class I area in accordance with EPA and MPCA guidance were applied. Mercury emissions were modeled only for sources for which emissions data were available; these sources were electric generating plants and proposed new sources. Since the speciation of mercury is not defined, it was not possible to calculate deposition directly with the CALPUFF model. Mercury was modeled as a non-reactive pollutant with no deposition. Model results for mercury therefore represent a conservative estimate of maximum mercury concentration in the ambient air for all mercury species combined. Separate model results were obtained for each Class I area, and for Mesaba West Range and East Range sites. Data are provided for the Mesaba Project alone, and for all sources combined. Appendix D1 presents a detailed modeling approach.

Class I Impacts and Increment Consumption

Cumulative PSD increment model results are shown in Table 5.2.2-2. The modeling results indicate that the cumulative increment consumption would be well below PSD Class I increment limits for all pollutants in the Class I areas. Additionally, the effect of overall regional SO_2 emission reductions from existing sources is shown as negative increment consumption for the annual SO_2 increment throughout each Class I areas.

Table 5.2.2-2. Maximum Predicted Concentrations for Cumulative Impact to Class I Areas from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

Class I Area	Pollutant	Averaging Time[1]	West Range Site (μg/m^3)	East Range Site (μg/m^3)	Class I PSD Increment (μg/m^3)
BWCAW	SO_2	3-hour	8.31	6.83	25.0
		24-hour	1.48	1.80	5.0
		annual	-0.150	-0.124	2.0
	NO_2	annual	0.699	0.732	2.5
	PM_{10}	24-hour	2.10	2.16	8.0
		annual	0.174	0.195	4.0
VNP	SO_2	3-hour	5.94	5.94	25.0
		24-hour	1.40	1.40	5.0
		annual	-0.123	-0.117	2.0
	NO_2	annual	0.341	0.347	2.5
	PM_{10}	24-hour	1.13	1.09	8.0
		annual	0.060	0.062	4.0

Table 5.2.2-2. Maximum Predicted Concentrations for Cumulative Impact to Class I Areas from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

Class I Area	Pollutant	Averaging Time[1]	West Range Site (µg/m^3)	East Range Site (µg/m^3)	Class I PSD Increment (µg/m^3)
RLW	SO_2	3-hour	2.93	2.69	25.0
		24-hour	0.79	0.71	5.0
		annual	-0.134	-0.131	2.0
	NO_2	annual	0.071	0.078	2.5
	PM_{10}	24-hour	0.65	0.71	8.0
		annual	0.007	0.009	4.0

[1] 3-hour and 24-hour average concentrations are "highest second-high" values; annual concentrations are highest values
Source: Excelsior, 2006b

Total Air Quality Impacts

Table 5.2.2-3 provides the results of total air quality impact modeling of emissions from Mesaba Energy Project, combined with all existing sources as well as foreseeable future sources in the region of the West Range Site and East Range Site. As shown, the predicted total SO_2, NO_2, and PM_{10} impacts are far below the applicable state and Federal ambient air quality standards. There are no substantive differences between West and East Range.

Table 5.2.2-3. Maximum Predicted Concentrations for Cumulative Impact to Air Quality from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

Class I Area	Pollutant	Averaging Time [(1)]	West Range Site (µg/m^3)	East Range Site (µg/m^3)	MAAQS/NAAQS (µg/m^3)
BWCAW	SO_2	3-hour	35.97	37.87	915 [(2)]
		24-hour	11.89	12.95	365
		annual	1.646	1.704	60
	NO_2	annual	1.646	1.680	100
	PM_{10}	24-hour	8.28	8.11	150
		annual	1.004	1.014	50
VNP	SO_2	3-hour	33.99	33.99	915 [(2)]
		24-hour	5.64	5.72	365
		annual	0.854	0.843	60
	NO_2	annual	0.753	0.758	100
	PM_{10}	24-hour	5.62	5.46	150
		annual	0.493	0.494	50
RLW	SO_2	3-hour	9.44	9.26	1300
		24-hour	4.72	4.60	365
		annual	0.732	0.733	80
	NO_2	annual	0.259	0.261	100
	PM_{10}	24-hour	2.92	3.27	150
		annual	0.275	0.278	50

[(1)] 3-hour and 24-hour average concentrations are "highest second-high" values; annual concentrations are highest values predicted for any receptor in the respective Class I area. Receptor grids in each Class I area were the standard grids provided by the National Park Services.
[(2)] The MAAQS values for Air Quality Control Regions 127, 129, 130, and 132
Source: Excelsior, 2006b

Class I Visibility/Regional Haze Analysis

The results of maximum visibility impacts are presented as the number of days per year in each Class I area on which visibility impact (the change of natural or pristine background visibility) exceeds 0.5 deciview (dv), and the 98th percentile (8th highest per year) deciview change. A threshold of 0.5 dv is considered the level at which visibility change is potentially perceptible to a viewer, and is considered the lowest level at which a source is considered to contribute to visibility degradation. Results for the cumulative visibility modeling are presented in Table 5.2.2-4.

Table 5.2.2-4. Results of Cumulative Visibility Impacts in Class I Areas from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

	2002	2003	2004	2002	2003	2004
	Num Values >.5 dv	Num Values >.5 dv	Num Values >.5 dv	8th Highest dv	8th Highest dv	8th Highest dv
East Range Site						
BWCAW	238	244	245	8.734	8.407	7.481
VNP	190	205	189	7.156	6.354	5.713
West Range Site						
BWCAW	231	242	244	8.600	8.420	7.635
VNP	189	206	191	6.959	6.340	5.740

Source: Excelsior, 2006b

The modeling results indicate that visibility impacts are significant for the BWCAW and VNP when all sources are combined; however, as the visibility calculations are considered conservative, the potential for impairment tends to be overstated. In other words, the model results indicate the greatest number and magnitude of potential impacts (i.e., maximum allowable pollutant emissions from all sources on every day of the year) rather than actual observable impacts. The calculations do not explicitly account for natural visibility degradation due to fog, clouds, or precipitation. Prior analyses (see Section 4.3) have shown that a large fraction of the days on which visibility impacts are predicted for northern Minnesota are days of very low temperature, fog, and/or precipitation on which natural visibility is severely limited. Therefore, adverse impacts to visibility would be expected to occur during the winter and would generally coincide with days when visibility would naturally be degraded.

Deposition of Nitrogen and Sulfur

Total annual S and N depositions to the ground surface were determined by summing contributions from all S and N species (gaseous and particulate) at each Class I receptor. Results of the analysis represent the highest annual deposition value for any receptor and any of the three years modeled, for each Class I area. Table 5.2.2-5 shows maximum total cumulative deposition from all sources. Model results show deposition rates exceeding the deposition analysis threshold of 0.01 kg/ha-yr established for USFS Class I areas (i.e., BWCAW and RLW). For National Park Service (NPS) Class I areas (i.e., VNP) no acceptable deposition values for impacts on soils or waters have been established.

Table 5.2.2-5. Maximum Annual S and N Deposition from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

Class I Area	West Range Site		East Range Site	
	S (kg/ha-yr)	N (kg/ha-yr)	S (kg/ha-yr)	N (kg/ha-yr)
BWCAW	1.146	0.501	1.194	0.508
VNP	0.628	0.267	0.622	0.267
RLW	0.453	0.124	0.453	0.128

Source: Excelsior, 2006b

The USFS has defined screening criteria for terrestrial and aquatic impacts of deposition (see Section 4.3) in the Green Line criteria. Predicted cumulative deposition impacts compared to the Green Line criteria are presented in Table 5.2.2-6. Though no similar thresholds are available for VNP, it is reasonable to assume that ranges of the same order as those for BWCAW and RLW would be reasonable to use for evaluating the potential for impacts. The analysis indicates that total S and N deposition, including background, would be within the acceptable Green Line ranges if the Mesaba project were sited at either the West Range Site or the East Range Site. It should be noted that the background values presented likely include the current impacts of some of the modeled sources considered in this analysis. Therefore the predicted future total deposition data in Table 5.2.2-6 may be conservative.

Table 5.2.2-6. Comparison of Projected S and N Deposition Rates to Green Line Criteria for Impacts to Terrestrial and Aquatic Ecosystems

Class I Area	Parameter	Background [1] (kg/ha-yr)	Maximum Cumulative Impact (kg/ha-yr)	Total (kg/ha-yr)	Green Line [2] Value (kg/ha-yr)
West Range Site					
BWCAW	Terrestrial				
	Total S Depo	2.85	1.146	4.00	5-7
	Total N Depo	4.75	0.501	5.25	5-8
	Aquatic				
	Total S Depo	2.85	1.146	4.00	7.5-8
	S + 20% N	3.80	1.246	5.05	9-10
RLW	Terrestrial				
	Total S Depo	2.98	.453	3.43	5-7
	Total N Depo	5.88	.124	6.00	5-8
	Aquatic				
	Total S Depo	2.98	.453	3.43	3.5-4.5
	S + 20% N	4.16	.479	4.64	4.5-5.5

Table 5.2.2-6. Comparison of Projected S and N Deposition Rates to Green Line Criteria for Impacts to Terrestrial and Aquatic Ecosystems

Class I Area	Parameter	Background [1] (kg/ha-yr)	Maximum Cumulative Impact (kg/ha-yr)	Total (kg/ha-yr)	Green Line [2] Value (kg/ha-yr)
East Range Site					
BWCAW	Terrestrial				
	Total S Depo	2.85	1.194	4.04	5-7
	Total N Depo	4.75	.508	5.26	5-8
	Aquatic				
	Total S Depo	2.85	1.194	4.04	7.5-8
	S + 20% N	3.80	1.296	5.10	9-10
RLW	Terrestrial				
	Total S Depo	2.98	.453	3.43	5-7
	Total N Depo	5.88	.128	6.01	5-8
	Aquatic				
	Total S Depo	2.98	.453	3.43	3.5-4.5
	S + 20% N	4.16	.479	4.64	4.5-5.5

[1] Background values from Mesabi Nugget Class I Air Modeling Report. Barr Engineering Company, May 2005.
[2] Green Line Values from Screening Procedure to Evaluate Effects of Air Pollution on Eastern Region Wilderness Cited as Class I Air Quality Areas. USFS. 13991.
Source: Excelsior, 2006b

Deposition of Mercury

Combined sources modeling results for mercury concentration are presented in Table 5.2.2-7. These concentrations represent the three-year average highest ambient mercury concentration at any point in each Class I area. There are no standards for ambient mercury levels in air to use as a basis for impact assessment; however, these predicted values, which estimate maximum levels of combined mercury forms, were considered in the air inhalation health risk assessment (Section 5.2.3).

Table 5.2.2-7. Average Mercury Concentration from Mesaba Energy Project combined with All Existing and Foreseeable Future Sources

Class I Area	West Range Site ($\mu g/m^3$)	East Range Site ($\mu g/m^3$)
BWCAW	6.118 E-6	7.042 E-6
VNP	2.825 E-6	2.919 E-6
RLW	1.492 E-6	1.595 E-6

5.2.2.4 Conclusion

Modeling results from the cumulative impact analysis indicate that the combined criteria pollutant emissions of Mesaba Energy Project and the all existing and foreseeable future sources would not pose a threat to Class I PSD increments or ambient air quality standards. Additionally, deposition of S and N from the combined sources would not cause adverse impacts to soil and vegetation in Class I areas.

The combined visibility impacts could potentially be significant; however, these impacts are considered to be conservative as they are based on the maximum allowable pollutant emissions occurring from all sources on every day of the year, which may not be realistic. The State of Minnesota is currently addressing visibility in BWCAW and VNP under the Regional Haze Rule, and would require BART emission reductions from many existing sources in the state. Potential actions at MP facilities at Boswell, Laskin, and Taconite Harbor, regarding these future control requirements, were considered in a separate analysis (Appendix D1). In the absence of controls, present emissions from the Minnesota Power facilities account for approximately 10 percent of current visibility impacts in BWCAW and VNP. The reduced visibility impacts resulting from MP controls exceed projected impacts of Mesaba Energy Project alone by 20 to 80 percent in the West Range Site and by approximately 50 percent in the East Range Site. Therefore, it is expected that MP reductions would potentially offset visibility impacts related to the Mesaba Energy Project. Additionally, it is expected that many other actions, both voluntary and in response to regulatory requirements, would be taken in the near future to reduce the potential for visibility degradation.

The net effects of the growth of the IGCC technology in the electric utility market would depend upon assumptions regarding the mix of technologies being displaced. For example, the displacement of conventional coal-fired power plants would result in lower emissions; whereas, displacement of natural gas-fired power plants would generally result in net increases in impacts. Although projections of net effects of commercialization of IGCC technology alone are not currently available, DOE has made projections of the market penetration of various technologies under various scenarios of fuel prices and regulations to estimate the benefits of the implementation of the fossil energy R&D program (DOE, 2007). This analysis considers the potential market penetration of fossil energy technologies, as well as nuclear and renewable energy technologies. Depending on the scenario considered, the implementation of the fossil energy R&D program would result in IGCC capturing from three percent to nine percent of the total market by 2025. Since fossil energy would still provide a substantial portion of the nation's electricity supply under all scenarios, the analysis shows that implementation of the fossil energy R&D program, which includes IGCC, would result in emission reductions of NO_X, SO_2, and CO_2 by the year 2025, relative to a scenario that does not involve fossil energy R&D and the subsequent advancement of IGCC technology.

Overall, the State of Minnesota oversees a comprehensive air quality permitting system to evaluate and approve only those projects that are allowable within quantitative air quality thresholds. The MPCA has jurisdiction over air quality programs in all counties in the state and has established and implemented air pollution control requirements, codified in Minnesota Rules, Chapters 7001 to 7023 and 7027. Projects that cannot demonstrate compliance with the applicable Federal and state regulations would not be permitted.

5.2.3 Air Inhalation Health Risk

Cumulative impacts resulting from inhalation of air toxics emissions from the Mesaba Energy Project, nearby existing facilities, and other potential future emission sources listed in Section 3.2 were evaluated at both the East Range and West Range locations. Future emissions from the proposed Minnesota Steel Industries (MSI) plant, approximately 6 kilometers east of the West Range location, were included in this evaluation. Emission sources considered at the East Range location included the exiting Laskin Energy Center (2 kilometers southwest of the power plant footprint), the proposed Mesabi Nugget facility (5 kilometers northwest of the footprint) and the proposed PolyMet Mining (PolyMet) project (5 kilometers north of the footprint). It should be stressed that only the Laskin Energy Center (Laskin) is currently in operation; in fact, permits have not been issued for the MSI or PolyMet facilities to date.

Two proposed wood-fired boilers at the existing coal-fired power Laurentian Energy Generation Plants located near Virginia and Hibbing are also potential future emission sources. The Laurentian facility at Hibbing would be approximately 35 kilometers from the proposed West Range Site, and the Laurentian facility at Virginia would be approximately 40 kilometers from the proposed East Range Site. Because of the relatively large distances from these sites, the incremental risk resulting from inhalation of air toxics that the Laurentian facilities would contribute would not be significant and was therefore not considered in the analysis.

5.2.3.1 Approach

A step-wise approach was used to determine potential cumulative impacts to receptors from inhaled emissions generated by both phases of the Mesaba Energy Project and from other potential future emission sources.

The first, more conservative step determined the maximum cancer risk and non-cancer hazard index (HI) estimated for each facility. For the most part, this information was obtained from the most current AERA data submitted by each facility to the MPCA. For the Laskin facility, risk was estimated based on data obtained from the MPCA Annual Emission Inventory records. The maximum risks were evaluated for acute, sub-chronic, and chronic averaging periods (as available). As a worst-case scenario, it was assumed that the risks would be additive and that receptors would be exposed to inhaled pollutant concentrations that pose the maximum risks, without regard to the actual location of the risk determination.

The combined maximum cancer risks and maximum hazard indices from potential nearby facilities were compared to the thresholds of concern established by the Minnesota Department of Health (MDH). The threshold of concern for pollutants producing non-carcinogenic effects is 1 and the threshold of concern for pollutants producing carcinogenic effects is 1 in 100,000 or 1×10^{-5}. If the combined cancer risks and hazard indices were below the MDH threshold values, it was assumed that the cumulative worst-case risks are at acceptable levels and would not cause appreciable cumulative impacts.

If the combined risks or hazard indices were greater than the MDH threshold values, then the second, more refined, step in the process was conducted. Based on MPCA guidance, screening-level risk is assessed within a buffer zone of 3 kilometers for facilities with stack heights less than 100 meters and within a buffer zone of 10 kilometers for facilities with stack heights greater than 100 meters. In the second step, the calculated risks at receptor locations closest to the buffer zone portions common to each of the facilities (overlap areas) being assessed were added and compared to MDH threshold values. The facility buffer zones for the West Range Site can be seen on Figure 1 (Area A) and for the East Range Site on Figure 2 (Areas B and C) in Appendix D2.

Since several of the facilities are not currently in operation, a third step of evaluation was conducted on the East Range Site to evaluate the cumulative effects of the Mesaba Generating Station in combination with each of the Mesabi Nugget and PolyMet facilities separately. The purpose of this evaluation step was to evaluate the contribution of each facility in the event that either the Mesabi Nugget or PolyMet plants do not become operational.

5.2.3.2 West Range Site

The facilities considered for the West Range Site include the Mesaba Generating Station and MSI. The general area potentially impacted by both facilities can be seen on Figure 1 indicated by Area A (see Appendix D2). The combined acute hazard indices from both facilities resulted in a maximum acute cumulative hazard index of 1. A sub-chronic hazard index was not calculated for the MSI facility in the MSI Human Health Screening-Level Risk Assessment; therefore, a cumulative sub-chronic hazard index could not be evaluated.

The cumulative non-carcinogen and carcinogen results for the West Range Site are summarized in Table 1 in Appendix D2. The maximum sub-chronic contribution from the Mesaba Generating Station was 0.1, well below the threshold value of concern established by the MDH. The combined chronic hazard indices from both facilities result in a maximum cumulative hazard index of 0.2. The combined cancer risks from both facilities resulted in a maximum cumulative cancer risk of 9×10^{-7}. Since the combined maximum acute and chronic hazard indices and cancer risk did not exceed MDH threshold values for the Mesaba Generating Station and MSI facilities, a cumulative air inhalation risk would be within acceptable limits, and no further evaluation was required for the West Range Site.

5.2.3.3 East Range Site

Four facilities are in relatively close proximity near the proposed East Range Site. Three of those facilities, the Mesaba Generating Station, Mesabi Nugget, and PolyMet are close enough geographically to result in the overlap of all three buffer zones. To evaluate potential impact from these sources, it was assumed that emissions from all three facilities could potentially impact a receptor in the overlap area. Likewise, the buffer zones for the Mesaba Generating Station and Laskin facilities overlap. The Laskin buffer zone, however, does not overlap those of either Mesabi Nugget or PolyMet. The general area potentially impacted by the Mesaba Generating Station, Mesabi Nugget, and PolyMet can be seen on Figure 2 (Area B) in Appendix D2. The general area potentially impacted by the Mesaba Generating Station and Laskin is represented in Figure 2 as Area C.

The Mesaba Energy Project and Laskin Energy Center

Although the Laskin facility has been in operation for some time, an AERA was not available. Subsequently, the most recent air toxics data (2002) from the MPCA Annual Emissions Inventory database was used as a surrogate. Dispersion modeling of Laskin emissions was conducted using the Laskin emission source information and receptors having the maximum dispersion concentrations were identified. The 2002 annual pollutant emission rates and dispersion modeling factors were entered into the most recent version of the MPCA Risk Assessment Screening Spreadsheet (RASS) spreadsheet (dated August 29, 2006). Inhalation cancer risk and non-cancer hazard indices were then generated by RASS.

The results of the Step 1 evaluation of the Mesaba Generating Station and Laskin facilities are summarized in Table 2 of Appendix D2. The combined acute hazard indices from the proposed Mesaba Generating Station and Laskin facilities resulted in a maximum acute cumulative hazard index of 0.7. The combined sub-chronic hazard indices from the two facilities resulted in a maximum cumulative hazard index of 0.1. The combined chronic hazard indices from both facilities resulted in a maximum cumulative hazard index of 0.07. The combined cancer risks from both facilities resulted in a maximum cumulative cancer risk of 2×10^{-6}.

Based on the most current data and risk analyses performed for the Mesaba and Laskin facilities, maximum acute, sub-chronic and chronic hazard indices, and cancer risk would not exceed MDH threshold values, indicating that a cumulative air inhalation risk associated with these facilities would be within acceptable limits. Therefore, a Step 2 evaluation was not conducted for these two facilities.

The Mesaba Energy Project, Mesabi Nugget, and PolyMet

Because the buffer zones of the Mesaba Generating Station, Mesabi Nugget, and PolyMet facilities overlap, a combined evaluation of all three facilities was conducted. The results of the Step 1 evaluation of the Mesaba Generating Station, Mesabi Nugget, and PolyMet facilities are summarized in Table 3 of Appendix D2. The area potentially impacted by these facilities is shown on Figure 2 (Area B) of Appendix D2.

The combined acute hazard indices from all three facilities resulted in a maximum cumulative hazard index of 2. The combined sub-chronic hazard indices from the three facilities resulted in a maximum cumulative hazard index of 0.1. The combined chronic hazard indices from all three facilities resulted in a maximum cumulative hazard index of 2. The combined cancer risks from all three facilities resulted in a maximum cumulative cancer risk of 2×10^{-5}.

Based on the maximum risk values used under step one of the cumulative analysis, maximum acute and chronic hazard indices and cancer risk would exceed the MDH threshold values. Therefore, a Step 2 evaluation was considered necessary to further quantify the risks for these facilities. Since the maximum sub-chronic hazard index did not exceed MDH threshold values and this index was not carried forth into the Step 2 evaluation.

East Range Site – Step 2 Results

In Step 2 of the cumulative impacts approach, cancer risk and hazard indices were calculated for receptors in specific areas that would most likely be exposed to emissions from more than one facility (rather than maximum risk values used in Step 1). According to information in the PolyMet and Mesabi Nugget AERAs, air emission risk analyses for both of these facilities were calculated using the MPCA RASS. In this method, a maximum total air concentration from all sources was entered for each pollutant. The RASS spreadsheet does not include the geographical location of the entered concentrations. Geographical refinement of risk using RASS would require entering the concentrations of pollutants at specific receptor locations, rather than the maximum values. Based on the information available from the MPCA to date, refinement of the maximum hazard index and cancer risk could not be conducted for either the PolyMet facility or the Mesabi Nugget facility. Consequently, maximum hazard index/cancer risk values were used for these two facilities in all evaluation steps.

The AERA for the Mesaba Generating Station calculated health indices using the Q/CHI method (Q = emission rate; CHI = Critical Health Index) for acute and sub-chronic time periods. The Industrial Risk Assessment Program (IRAP) was used to calculate cancer risk and chronic hazard indices. IRAP incorporates algorithms in accordance with the U.S. EPA Human Health Risk Assessment Protocol (HHRAP). Both of these methods allow for the geographical examination of inhalation hazard index/cancer risk. Therefore, areas within or near the overlap of facility screening-level buffer zones for the Mesaba Generating Station were used to calculate the hazard index/cancer risk in Step 2. The results from the East Range Site evaluation are summarized in Table 4 of Appendix D2.

Based on the Step 2 analysis, the combined acute hazard indices from all three facilities result in a cumulative hazard index of 2. The combined chronic hazard indices from all three facilities result in a cumulative hazard index of 2. The combined cancer risks from all three facilities result in a cumulative cancer risk of 2×10^{-5}.

Based on the most current risk analyses, taking into account geographical location of risk only for the Mesaba Generating Station, acute and chronic hazard indices and cancer risk exceeded the MDH threshold values. The acute risk drivers in this scenario were the Mesabi Nugget facility (HI = 1) and PolyMet facility (HI = 0.7). The chronic non-cancer risk drivers were also the Mesabi Nugget facility (HI = 0.9) and PolyMet facility (HI = 1). The cancer risk driver was the PolyMet facility (1×10^{-5}). Since the inhalation risks posed by the risk drivers are at or near the MDH threshold values, additional risk from any facility would cause an exceedance of the threshold values based on the Step 2 analysis. However, it should be noted that the contribution of Mesaba Generating Station to inhalation risk is 10 percent or less in all three cases.

The cumulative risks associated with the Mesaba Energy Project are relatively small, particularly considering the fact that no geographical refinement of the risks could be applied for two of the three facilities. In addition, cumulative impacts from all three facilities occur in a very limited area (a small portion of Area B). Land use in this area is primarily mining. The conservative assumptions used to derive the maximum risks (i.e., those of a farmer or residential scenario) are not necessarily appropriate for a refined inhalation risk determination in this area (occupational scenario) and greatly overestimate cumulative impact.

East Range Site – Step 3 Results

Since the geographical buffer zone overlap of all three facilities on the East Range Site is so small and none of the facilities being evaluated are operational at this time, it was prudent to evaluate the cumulative effects from each separate facility combined with the Mesaba Generating Station. The results from Step 3 evaluation for the Mesaba Generating Station/Mesabi Nugget and Mesaba Generating Station/PolyMet are summarized respectively in Table 5 and Table 6 of Appendix D2.

The combined acute hazard indices from the Mesaba Generating Station and Mesabi Nugget facilities resulted in an acute cumulative hazard index of 1. The combined chronic hazard indices from both facilities resulted in a cumulative hazard index of 0.9. The combined cancer risks from both facilities resulted in a cumulative cancer risk of 7×10^{-6}. The projected contribution of the Mesaba Generating Station to the acute inhalation risk in this case would be 20 percent and 1 percent for both chronic non-cancer and cancer risk.

The combined acute hazard indices from the Mesaba Generating Station and PolyMet facilities resulted in a cumulative hazard index of 0.9. The combined chronic hazard indices from both facilities resulted in a cumulative hazard index of 1. The combined cancer risks from both facilities resulted in a cumulative cancer risk of 1×10^{-5}. The projected contribution of the Mesaba Generating Station to the acute inhalation risk would be 22 percent and 1 percent for both chronic non-cancer and cancer risk.

Taking into account geographical location of risk for the Mesaba Generating Station only, acute, sub-chronic, and chronic hazard indices and cancer risk would not exceed MDH threshold values for the Mesaba Generating Station combined with either the Mesabi Nugget or PolyMet facilities.

Conclusions

Cumulative impacts resulting from inhalation of air toxics, from reasonably foreseeable projects, in the vicinity of the Mesaba Generating Station for the West Range Site have been examined using conservative assumptions and were found to be at or below levels of concern set by the MDH. Results from the analysis of the East Range Site indicated that the hazard/cancer risk would exceed MDH standards in the area where the buffer zones of the Mesaba Generating Station, Mesabi Nugget, and PolyMet facilities overlap. However, this overlap occurs in a relatively small area on the Cliffs Erie property that is used primarily for mining, and the conservative assumptions used to derive the maximum risks (i.e., those of a farmer or residential scenario) overestimate cumulative hazard/cancer risk impact for this small area considering its non-residential land use. Areas outside the overlap of the buffer area associated with the Mesaba Generating Station, Mesabi Nugget, and PolyMet facilities were found to be at or below levels of concern set by the MDH.

Data Refinements

To the extent better data become available for the Mesaba Generating Station, Laskin Energy Center, Mesabi Nugget, PolyMet Mining, and MSI projects, subsequent revisions of this Air Toxics Inhalation Risk analysis would be revisited to determine whether the above conclusions are maintained. In general, risks associated with such emissions are found to decrease as the analysis of air toxic impacts become more refined.

5.2.4 Water Resources

The following section provides a discussion on the impacts of the Mesaba Energy Project, together with reasonably foreseeable future actions, within the watersheds of the two proposed power plant locations and the cumulative impacts on surface water resources in terms of water quantity and quality. This cumulative impacts analysis is based on the information contained in this EIS (see Sections 3.5 and 4.5), the material contained in Appendix D3 and USGS monitoring data.

5.2.4.1 West Range

The West Range Site lies within the Swan River watershed. The Swan River is designated as an impaired water by the MPCA. The causes of impairment are low oxygen and a fish consumption advisory due to mercury. In addition, the Trout, Swan, Upper Panasa, and Lower Panasa Lakes are also impaired due to fish consumption advisories for mercury. The primary source of the mercury in the water is atmospheric deposition. Roughly 70 percent of the atmospheric deposition of mercury is from man-made sources (such as energy, mining, and product disposal) and the remainder is from natural sources, such as volcanoes (MPCA, 2004b).

The only reasonably foreseeable future action in the watershed, besides the Mesaba Energy Project, is the MSI project, located near Nashwauk. Also, the Nashwauk and Coleraine-Bovey-Taconite WWTFs would receive additional wastewater influent from the MSI and Mesaba projects, respectively. In addition, the water currently pumped from the HAMP would be diverted from the Upper Panasa Lake for use at the Mesaba Generating Station.

Water Quantity

Limited water flow information exists for the Swan River. The USGS has operated two gauging stations on the Swan River; one just downstream of Swan Lake and the other just upstream of its confluence with the Mississippi River. The average flow of the Swan River downstream of Swan Lake is 64.8 cubic feet per second (29,000 gallons per minute) based on gauging data from 1965 to 1990. Prior to its confluence with the Mississippi River, the average reported flow is 188.6 cubic feet per second (85,000 gallons per minute) in the Swan River; however there is only one year of record (1954).

Currently the Hill-Annex Mine Park dewaters the mine pit into the Upper Panasa Lake. Due to financial reasons, the dewatering operations occur less than six months a year. Based on past water appropriations information, the park discharged 6.2 cubic feet per second (2,800 gallons per minute) averaged over a year, but has a permit to discharge up to 15.5 cubic feet per second (7,000 gallons per minute). This flow into the Upper Panasa Lake (and into the Swan River) is in addition to the flow measured downstream of Swan Lake.

The MSI project, located upstream of Swan Lake, plans to use mine pit water as their primary source of process water for their operations. The expected requirements are 9 cubic feet per second (4,063 gallons per minute); however, their permit application includes a request to appropriate water from the Swan River, if sufficient water is not available from the mine pit. Under the most extreme conditions, MSI could reduce the flow in the Swan River by about 9 cubic feet per second (14 percent), resulting in a flow from Swan Lake of roughly 55.9 cubic feet per second (25,000 gallons per minute). MSI would not discharge any process water, but reuse tailings leachate as well as use a ZLD to treat industrial wastewaters. The treated water from the ZLD would also be reused within the plant.

During Phase I of the proposed Mesaba Energy Project, some water would be diverted from the dewatering operations at the HAMP. Approximately 2.9 cubic feet per second (1,300 gallons per minute) of water would be pumped to the CMP and roughly 1.55 cubic feet per second (700 gallons per minute) would continue to be discharged to Upper Panasa Lake. In addition, the Mesaba Generating Station would discharge approximately 1.3 cubic feet per second (600 gallons per minute) to Holman Lake. The net effect from the Mesaba Generating Station would be a reduction of 3.4 cubic feet per second (1,500 gallons per minute) into the Swan River. The maximum cumulative reduction in average flow of the Swan River in the Mesaba Energy Project Phase I, assuming all MSI water is obtained from the Swan River, would be 12.4 cubic feet per second, or 19 percent.

Under Mesaba Phase II, no mine pit water would be discharged from the HAMP into the Upper Panasa Lake and the discharge to Holman Lake would be reduced to 0.9 cubic feet per second (400 gallons per minute). The total effect of Mesaba Phases I and II would be a net reduction of flow into the Swan River of 5.4 cubic feet per second (2,400 gallons per minute) downstream of Swan Lake. The maximum cumulative reduction in the average flow of the Swan River in consideration of the Phase I and Phase II, assuming all MSI water is obtained from the Swan River, would be 14.4 cubic feet per second, or 22 percent.

Both MSI and the Mesaba Generating Station would discharge domestic wastewaters to their respective WWTFs and both have sufficient capacity to accept the additional flows. The additional flows into and out of these WWTFs would have little net affect on the total water flow in the Swan River.

Water Quality

The primary pollutants of concern in the Swan River Watershed and associated with the Mesaba Energy Project are mercury and phosphorus. As the MSI project would not discharge any process or industrial wastewater, it is not being considered further in this analysis. The operations of the Mesaba Generating Station would not add any mercury or phosphorus to water discharges, but rather discharge phosphorus and mercury already present in the source waters (CMP and HAMP). Mesaba is also planning to limit mercury discharges (on a mass basis) to a level less than or equal to the mass of mercury discharged to the Swan River from HAMP dewatering activities, so there should be no net increase in mercury into the Swan River watershed from industrial wastewater discharges. The same holds true with phosphorus.

There would be a very small net increase in domestic wastewater discharges into the Swan River watershed from the Mesaba Generating Station and MSI operations via their connections to local WWTFs. However, these increased flows would not cause either WWTF to exceed their permit requirements for either flow or phosphorus loadings.

5.2.4.2 East Range

The East Range Site lies within the Partridge River watershed. The Partridge River is not designated as an impaired water by the MPCA, however, two of the local water bodes (Colby Lake and Whitewater Reservoir) are impaired due to fish consumption advisories for mercury. As with the West Range Site, the primary source of the mercury in the water is atmospheric deposition.

The foreseeable future actions in the watershed, besides the Mesaba Energy Project East Range Site, are the proposed PolyMet Mining project and the proposed Mesabi-Nugget plant (both north of Hoyt Lakes). The only other existing facility that would be affected by the Mesaba Generating Station and the proposed PolyMet or Mesabi-Nugget projects is the Hoyt Lakes WWTF. The Syl Laskin Energy Center is also located on Colby Lake.

Water Quantity

The USGS has operated several gauging stations on the Partridge River and two are used in this analysis: one just upstream of Colby Lake (Upper Partridge River) and the other several miles just downstream of Colby Lake (Lower Partridge River). The average flow at the Upper Partridge River station is 87.7 cubic feet per second (39,400 gallons per minute) based on data from 1979 to 1988. Downstream of Colby Lake, the average flow of the Lower Partridge River is 111.2 cubic feet per second (49,900 gallons per minute) based on data from 1943 to 1967.

There are a number of significant water appropriations in and near Colby Lake. The Syl Laskin Energy Center is permitted to pump 50,000 million gallons per year from Colby Lake for once-through cooling water. The average amount used, over the last 4 years, is 48,334 million gallons per year (92,000 gallons per minute). However, this water is returned to the lake with some evaporative losses. The City of Hoyt Lakes is also permitted to withdraw 160 million gallons per year (304 gallons per minute) for drinking water purposes, and has averaged about 125.4 million gallons per year (239 gallons per minute) over the past four years. A joint permit, issued to MP and Cliffs-Erie, LLC (CE), allows for withdrawing 6,307 million gallons per year (12,000 gallons per minute) to be used for mine processing, however, no water has been appropriated from Colby Lake under this permit since 2001. The City of Hoyt Lakes also is permitted to withdraw 4 million gallons per year (7.6 gallons per minute) from the Partridge River for watering a public golf course and has averaged 1.7 million gallons per year (3.2 gallons per minute) for the past four years.

In addition to the water appropriation permits for Colby Lake and the Partridge River, CE has a number of individual permits for dewatering mine pits (the same mine pits that are proposed for the source of process water for the Mesaba Generating Station East Range Site); however, no water has been withdrawn from these pits since 2001, as mining operations have ceased.

The PolyMet operation would appropriate process water from Colby Lake, at an estimated rate of 3,000 gallons per minute, using the existing water appropriation permit held jointly by MP and CE. The PolyMet operation would also require a water appropriation permit for mine pit dewatering, however, the amount of dewatering is not know at this point, but would likely be discharged to the Embarrass River (outside the Partridge River Watershed), unless used by the Mesaba Generating Station. The East Range Site is considering using a portion of the mine pit dewatering flow for process water requirements.

Mesabi-Nugget has been issued a permit to withdraw water at a rate of 5,000 gallons per minute from Mine Pit 1, located north of the proposed East Range Site. If necessary, the permit also allows the appropriation of up to 5,000 gallons per minute from Mine Pit 2WX, as a standby source.

The Mesaba Generating Station is proposing to withdraw water (see Table 4.5-11) from a series of mine pits that would be interconnected with piping and pumps to provide a majority of water necessary for operation. In addition, the Mesaba Generating Station would utilize 1,000 gallons per minute from the Mesabi-Nugget projects wastewater discharge, 4,000 gallons per minute from PolyMet's dewatering operation, and 2,900 gallons per minute from Colby Lake to provide high water demand supplies. Besides the withdrawal of water from Colby Lake, several of the mine pits that are proposed to be used by the Mesaba Generating Station currently discharge to local streams. The total amount that is estimated to be discharged by these mine pits is 935 gallons per minute (500 gallons per minute to the Upper Partridge River and 435 gallons per minute to the Lower Partridge River).

With the number of variables and appropriation needs not currently defined, it is difficult to determine the net affect on water quantity for Partridge River Watershed. The overall effect on water withdrawal within the watershed should be minimal, up to a maximum of 7,000 gallons per minute (or about 18 percent of the total water volume flowing into Colby Lake). If water levels in Colby Lake decrease significantly, MP is required to withdraw and transfer water from Whitewater Reservoir to Colby Lake in order to maintain adequate water levels, thus reducing the potential for cumulative impacts related to water withdrawals from Colby Lake and the Partridge River.

Water Quality

As the Mesaba Generating Station East Range Alternative would not discharge process or industrial wastewater, cumulative impacts from the project were not considered. There would be a small discharge of domestic (or sanitary) wastewater from the plant to the Hoyt Lakes WWTF, but this discharge is within the treatment capacity of the WWTF and should not result in significant pollutant loadings to the environment.

5.2.5 Wetlands

This section provides an analysis of cumulative wetland impacts within the defined Study Areas, as described below, for the West and East Range Site alternatives for the proposed Mesaba Energy Project in conjunction with other reasonably foreseeable future actions. This section represents a summary of a more detailed analysis by consultants to the project proponent, which is provided in its entirety in Appendix D4.

The quantitative impact estimates from the analysis performed in this section are not completely consistent with results reported in Section 4.7 or Appendix D4 for two reasons: (1) This cumulative effects analysis was performed for defined study areas based on watersheds, as described below, therefore some of the associated project infrastructure, as described in Section 4.7, lies outside the study areas and is not included in this particular analysis. (2) This cumulative effects analysis includes potential impacts to wetlands that could occur in the interiors of potential rail line center loops; the analysis performed by the project proponent's consultants, which is included in Appendix D4, excluded these impacts. DOE determined that it would be most appropriate to include those potential impacts.

5.2.5.1 Study Areas

Because many of the primary functions performed by wetlands are closely related to the surrounding watershed, the study areas for the cumulative effects assessment was defined according to the limits of the affected subwatersheds for each alternative site.

West Range Site

The West Range Site is located within subwatersheds on the boundary between the Swan River and Prairie River watersheds. Therefore, the study area associated with the West Range site is defined as follows:

- That part of the Swan River watershed upstream of the point where Holman Lake discharges to the Swan River. The Holman Lake discharge point represents the point on the Swan River affected by discharge and drainage from the West Range Site; and
- That part of the Prairie River watershed upstream of Prairie Lake.

East Range Site

The East Range Site is located in a subwatershed of the Partridge River in St. Louis County, Minnesota. The study area of the East Range Site is defined as that portion of the Partridge River Watershed upstream of its confluence with the St. Louis River.

5.2.5.2 Methodology

This analysis includes the evaluation of the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions. The proposed project was evaluated along with reasonably foreseeable future actions within the study area to determine the potential for cumulative effects on wetland resources for each alternative site. Determinations of past, present, and future conditions were performed as follows:

- **Past Conditions** – The past condition of wetland resources in the project area is defined as the condition that existed at the time of the National Wetlands Inventory (NWI) (1980s). The existing NWI data were used to represent the wetland area that existed at the time aerial photography was flown.
- **Existing Conditions** – Wetland areas estimated for the existing conditions were developed by compiling the following data:
  1) The NWI was used to identify wetlands in most areas, particularly where additional detailed information was unavailable. However more accurate or more detailed data were used in place of NWI data where available, as described in items 2 and 3 below.
  2) Wetlands shown to be disturbed by mining and other development and industry were identified through interpretation of aerial photography. Where wetlands were shown to be filled or otherwise obliterated, they were removed from the "existing wetlands" data.
  3) A "composite" wetlands layer was developed by deleting all of the NWI wetlands from the areas where additional data and/or photo interpretation show that wetlands have been impacted.
- **Future Conditions** – Wetland areas estimated for future conditions were developed by defining reasonably foreseeable future projects. Table 5.2.5-1 provides a summary of the projects considered reasonably foreseeable in each of the study areas. The potential effects of each project

on existing wetland resources was estimated using the existing conditions wetland mapping described above and an assumed footprint of disturbance for each potential future project.

Table 5.2.5-1. Foreseeable Future Actions within the Defined Study Areas

West Range Site Study Area	East Range Site Study Area
Minnesota Steel Industries	PolyMet Mining NorthMet Project
Nashwauk Gas Pipeline	Mesabi Nugget
Itasca County Highway 7 Realignment	St. Louis County – new roadway from Hoyt Lakes to Babbitt
Itasca County Railroad	

5.2.5.3 Cumulative Effects Analysis Results

Tables 5.2.5-2 and 5.2.5-3 provide the results of the analysis for the West Range Site and the East Range Site respectively. The impacts of the Mesaba Generating Station are limited to areas inside of the defined Study Areas that would be permanently impacted by being filled. Temporary impacts or changes in wetland type are not included in the analysis. In instances where infrastructure alternatives (e.g., alternative rail alignments) would produce differing impact acreages the more conservative (larger) estimate was utilized.

Potential impacts to wetlands located within proposed rail line center loops for both sites were not included in the analysis in Appendix D4, because design specifications have not yet been finalized and permitting and mitigation specifics have not yet been made by applicable regulatory bodies. For the purposes of this section, the wetland acreages have been included for the rail loops based on the analysis in Section 4.7. These acreages are considered to represent the upper limits (worst case) of the wetland acreages that would be lost as a result of rail loop construction and operation.

Wetland impacts are considered to be losses of wetland areas primarily through the placement of construction fill. Impacts do not consider wetland mitigation scenarios, such as wetland restoration or creation, which would lessen impact totals. More detailed information on the study areas, past and existing conditions, foreseeable future actions, and impacts, including impacts by wetland type, is included in Appendix D4.

West Range Site

Table 5.2.5-2 describes the results of the cumulative wetland impacts analysis for the West Range Site within the defined study area that includes portions of the Swan River and Prairie River watersheds. Foreseeable future actions, including the Mesaba Generating Station with worst-case rail loop impact, are anticipated to result in 1,325 acres of wetland impacts, which would represent a loss of 1 percent of the total wetland acreage contained within the Study Area. The Mesaba Generating Station implemented at the West Range Site would impact approximately 122 acres of wetlands, including potential impacts to 65 acres within the center loop of the proposed rail line, which would represent a loss of approximately 0.1 percent of the total wetlands currently within the Study Area. Therefore, the Mesaba Generating Station would account for 9 percent of the total wetland loss anticipated for all of the foreseeable future actions combined.

Table 5.2.5-2. West Range Site Cumulative Wetland Impacts Analysis Results

	Wetlands in Study Area (acres)	Wetland Impacts (acres)	Percent Loss of Wetlands	
			From Past	From Existing
Past – Circa 1980	128,917			
Existing – Circa 2006	125,322		2.8%	
Future Actions				
Mesaba Energy Project Impacts[1]		122		0.10%
Minnesota Steel Impacts[2]		1,163		0.93%
Nashwauk Gas Pipeline Impacts		26		0.02%
Highway 7 Realignment Impacts		2		0.001%
Itasca County Railroad Impacts		12		0.01%
Total of Future Actions[3]		1,325		1.06%
Future – Circa 2026[4]	123,997			

[1] This impact acreage includes potential impacts to 65 acres of wetlands located inside of proposed rail line center loop.
[2] This impact acreage may be reduced to 945 depending upon the final site layout for the facility.
[3] This impact acreage may be reduced to 1,107 if the final site layout for the Minnesota Steel project impacts 945 acres.
[4] This acreage may increase to 124,215 if only 945 acres of wetlands are impacted as a result of future actions.
NOTE: See Section 5.2.5 for explanation of differences between this table and Appendix D4.

East Range Site

Table 5.2.5-3 describes the results of the cumulative wetland impacts analysis for the East Range Site within the defined study area that includes a portion of the Partridge River watershed. Foreseeable future actions, including the Mesaba Generating Station with worst-case rail loop impact, are anticipated to result in 1,339 acres of wetland impacts, which would represent a loss of 4 percent of the total wetland acreage contained within the Study Area. The Mesaba Generating Station implemented at the East Range Site would impact approximately 82 acres of wetlands, including potential impacts to 48 acres within the center loop of the proposed rail line, which would represent a loss of approximately 0.25 percent of the total wetlands currently within the Study Area. Therefore, the Mesaba Generating Station would account for about 6 percent of the total wetland loss anticipated for all of the foreseeable future actions combined.

Table 5.2.5-3. East Range Site Cumulative Wetland Impacts Analysis Results

	Wetlands in Study Area (acres)	Wetland Impacts (acres)	Percent Loss of Wetlands	
			From Past	From Existing
Past – Circa 1980	34,500			
Existing – Circa 2006	33,212		3.7%	
Future Actions				
Mesaba Energy Project Impacts[1]		82		0.25%
PolyMet Mining Corp.		1,257		3.78%
Mesabi Nugget[2]		unknown		0%
Roadway from Hoyt Lakes to Babbitt[3]		unknown		0%
Total of Future Actions		1,339		4.03%
Future – Circa 2026	31,873			

[1] This impact acreage includes potential impacts to 48 acres of wetlands located inside of proposed rail line center loop.
[2] Approximately 85 acres of wetlands have been identified within the boundaries of the Mesabi Nugget project; however it is currently unknown how much will actually be impacted by the project.
[3] At this time no specific footprint has been decided upon with respect to this potential roadway. Therefore, no impact acreage can be determined, however, due to the general planned location it is expected that construction would cause some wetland impacts.
NOTE: See Section 5.2.5 for explanation of differences between this table and Appendix D4.

5.2.6 Wildlife Habitat

This section provides an analysis of cumulative wildlife habitat impacts within the defined Study Areas, as described in Section 5.2.6.1, for the West and East Range Site alternatives for the proposed Mesaba Energy Project in conjunction with other reasonably foreseeable future actions. The analysis consists of two parts:

- The total amount of habitat, by habitat type, that would be impacted by the Mesaba Energy Project and the other foreseeable future actions as compared to the total amount of existing habitat within the Study Areas.
- The potential effects of the Mesaba Energy Project and the other foreseeable future actions to wildlife travel corridors across the Iron Range minerals formation within the Study Areas. These habitat travel corridors have been identified in a study by the MNDNR and documented in a report titled *Cumulative Effects Analysis on Wildlife Habitat Loss/Fragmentation and Wildlife Travel Corridor Obstruction/Landscape Barriers in the Mesabi Iron Range and Arrowhead Regions of Minnesota*. The MNDNR study examined the Iron Range minerals formation because this location represents a linear feature approximately 100 miles long that, due to substantial historic mining activities, has become a barrier for wildlife travel from the northwestern to southeastern portions of the Arrowhead Region in northern Minnesota. The study identified 13 existing travel corridors, of which three are located within the Study Area for the West Range Site and four are located within the Study Area for the East Range Site.

This cumulative impacts analysis for wildlife habitat was performed independently from the analysis provided by the project proponent's consultants as included in Appendix D5. Therefore, apparent discrepancies exist between data in this section and data in Appendix D5. After reviewing the results of the proponent's study, DOE elected to perform its own analysis for three reasons: (1) The approach taken in Appendix D5 is not consistent with the approach anticipated based on initial discussions with the project proponent's consultants. (2) The analysis in Appendix D5 of impacts to wildlife habitat included only single project-wide impact acreages. DOE determined that impacts should be described in terms of the amounts of each habitat type that would be affected. (3) The analysis of aerial habitat in Appendix D5 is very speculative and non-quantitative. DOE concluded that the analysis does not provide a meaningful description of impacts and, therefore, excluded it from the analysis presented in this section. DOE has, never-the-less, included the project proponent's analysis in Appendix D5 for appropriate consideration.

5.2.6.1 Study Areas

Since many of the primary wildlife habitat functions performed by vegetation communities are closely related to a surrounding watershed, the study areas for the cumulative effects assessment were defined according to the limits of the affected subwatersheds for each alternative site.

West Range Site

The West Range Site is located within subwatersheds on the boundary between the Swan River and Prairie River watersheds. Therefore, the study area associated with the West Range site is defined as follows:

- That part of the Swan River watershed upstream of the point where Holman Lake discharges to the Swan River. The Holman Lake discharge point represents the point on the Swan River affected by discharge and drainage from the West Range Site; and
- That part of the Prairie River watershed upstream of Prairie Lake.

East Range Site

The East Range Site is located in a subwatershed of the Partridge River. The study area of the East Range Site is defined as that portion of the Partridge River Watershed upstream of its confluence with the St. Louis River.

5.2.6.2 Methodology

This analysis to assess potential cumulative impacts to wildlife habitat included the evaluation of the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions. Determinations of past, present, and reasonably foreseeable future conditions were performed as follows:

- **Past Conditions** – The past condition of wildlife habitat was determined by utilizing MNDNR Gap Analysis Program (GAP) land cover data in GIS software to determine areas that are presently disturbed by mining and development. Those areas were then considered locations that were at some point in the past covered by natural features and provided habitat for wildlife. Those estimates were combined with the total amount of currently existing natural habitat to provide a total estimate of the amount of habitat that existed without human disturbance within each Study Area.

- **Existing Conditions** – The existing condition was defined as the areal extent of habitat types described in the MNDNR GAP land cover data, which were mapped with GIS, in each Study Area.

- **Future Conditions** – Wildlife habitat areas estimated for future conditions were developed by defining reasonably foreseeable projects that would be expected to be implemented in the future. Table 5.2.6-1 provides a summary of the projects considered reasonably foreseeable in each of the study areas.

Table 5.2.6-1. Reasonably Foreseeable Future Actions within the Defined Study Areas

West Range Site Study Area	East Range Site Study Area
Minnesota Steel Industries	PolyMet Mining NorthMet Project
Nashwauk Gas Pipeline	Mesabi Nugget
Itasca County Highway 7 Realignment	St. Louis County – new roadway from Hoyt Lakes to Babbitt
Itasca County Railroad	

Using the "Existing Conditions" GIS mapping described above and an assumed footprint of disturbance for each potential future action, potential habitat loss estimates were calculated for existing habitats. This provided data on the total area of each habitat type that would be impacted by the implementation of each action, which were then compared to total amounts currently existing in the Study Areas. For consideration of potential impacts to wildlife travel corridors, GIS data was used to spatially orient the MNDNR-defined wildlife travel corridors with the assumed footprints of disturbance for the potential future actions. Based on the relative locations of these features, the potential for impacts to the travel corridors was characterized based on best professional judgment. The analysis is focused on impacts to larger mammals as they are considered the most mobile terrestrial species.

5.2.6.3 Cumulative Effects Analysis Results

The impacts of the Mesaba Energy Project would be limited to areas inside the defined Study Areas that would be permanently impacted (e.g., wetlands filled, habitat conversion). In instances where infrastructure alternatives (e.g., alternative rail alignments) would produce differing impact acreages, the more conservative (larger) estimate was utilized. Wetland mitigation scenarios, such as wetland restoration or creation which would lessen impact totals, were not considered for the cumulative impact analysis. Impacts from reasonably foreseeable future actions, other than the Mesaba Energy Project, were based on assumed site boundaries; therefore, these impacts may be reduced as facilities layouts within the site boundaries are finalized. For purposes of this analysis it was conservatively assumed that the entire area within the site boundaries would be impacted by the actions.

West Range Site

Habitat Loss

Overall, the impacts of the combined foreseeable future actions, including the Mesaba Energy Project, on the Study Area for the West Range Site would include a loss of 0.3 percent of the total wildlife habitat as compared to existing conditions (Table 5.2.6-2). The habitat type that would experience the greatest amount of disturbance would be deciduous forest at 0.9 percent (Table 5.2.6-3). It is estimated that the existing conditions represent a loss of 7.9 percent in overall wildlife habitat in the Study Area as compared to past conditions (pre-human settlement) (Table 5.2.6-2).

Table 5.2.6-2. West Range Site Cumulative Wildlife Habitat Impacts Analysis Results

	Total Habitat in Study Area (acres)	Total Habitat Impacts (acres)	Percent Loss of Total Habitat		Proportion of Cumulative Impact
			From Past	From Existing	
Past	400,422				
Existing	368,865		7.9%		
Future Actions					
Mesaba Energy Project		759		0.2%	60%

Table 5.2.6-2. West Range Site Cumulative Wildlife Habitat Impacts Analysis Results

	Total Habitat in Study Area (acres)	Total Habitat Impacts (acres)	Percent Loss of Total Habitat		Proportion of Cumulative Impact
			From Past	From Existing	
Minnesota Steel		307		0.08%	24%
Nashwauk Gas Pipeline		78		0.02%	6.0%
Highway 7 Realignment		35		0.009	3.0%
Itasca County Railroad		87		0.02%	7.0%
Total of Future Actions		1,266		0.3%	100%
Future	367,599				

NOTE: See Section 5.2.6 for explanation of differences between this table and Appendix D5.

Table 5.2.6-3. Total Habitat Impacts for Existing Conditions and Proportion Lost Due to Reasonably Foreseeable Future Actions within West Range Site Study Area

Habitat Type	Existing Conditions (acres)	Impacts of Reasonably Foreseeable Future Actions (acres)	Percent Loss Resulting from Implementation of Reasonably Foreseeable Future Actions
Coniferous Forest	25,134	69	0.3%
Deciduous Forest	60,683	524	0.9%
Grassland	19,938	132	0.7%
Mixed Wood Forest	76,766	198	0.3%
Open Water	38,517	22	0.06%
Regeneration/Young Forest	55,241	99	0.002%
Shrubby Grassland	15,252	15	0.1%
Wetland (bog)	53,166	152	0.3%
Wetland (marsh and fen)	24,168	55	0.2%
Total	368,865	1,266	0.3%

Potential impacts of the Mesaba Energy Project are listed in Table 5.2.6-4. The Mesaba Energy Project at the West Range Site would potentially result in a loss of 759 acres of wildlife habitat, which represents a loss of 0.2 percent of the total habitat within the Study Area. The habitat types that would experience the greatest impacts would be deciduous forest and grassland, which would experience losses of 0.5 and 0.4 percent, respectively, of the existing acreage in the Study Area.

Table 5.2.6-4. Mesaba Energy Project Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	43	0.2%	62%
Deciduous Forest	301	0.5%	57%
Grassland	86	0.4%	65%
Mixed Wood Forest	121	0.2%	61%
Open Water	7.0	0.02%	32%
Regeneration/Young Forest	50	0.09%	50%
Shrubby Grassland	5.0	0.03%	33%
Wetland (bog)	120	0.2%	79%
Wetland (marsh and fen)	26	0.1%	47%
Total	759	0.2%	60%

Potential impacts of the Minnesota Steel Industries project are listed in Table 5.2.6-5. This project would potentially result in a loss of 307 acres of wildlife habitat, which represents a loss of 0.08 percent of the total habitat within the Study Area. The habitat types that would experience the greatest impacts would be deciduous forest and grassland, which would both experience losses of 0.2 percent as compared to existing conditions within the Study Area.

Table 5.2.6-5. Minnesota Steel Industries Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	16	0.06%	23%
Deciduous Forest	124	0.2%	24%
Grassland	40	0.2%	30%
Mixed Wood Forest	49	0.06%	25%
Regeneration/Young Forest	24	0.04%	24%
Shrubby Grassland	5.0	0.03%	33%
Open Water	8.0	0.02%	36%
Wetland (bog)	26	0.04%	17%
Wetland (marsh and fen)	15	0.06%	27%
Total	307	0.08%	24%

Potential impacts of the Nashwauk Gas Pipeline project are listed in Table 5.2.6-6. This project would potentially result in a loss of 78 acres of wildlife habitat, which represents a loss of 0.02 percent of the total habitat within the Study Area. Coniferous forest would experience the greatest impact with a loss of 0.03 percent of the total amount represented by the existing conditions.

Table 5.2.6-6. Nashwauk Gas Pipeline Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	8.0	0.03%	12%
Deciduous Forest	16	0.02%	3.0%
Grassland	4.0	0.02%	3.0%
Mixed Wood Forest	15	0.01%	8.0%
Regeneration/Young Forest	20	0.002%	20%
Shrubby Grassland	4.0	0.02%	27%
Wetland (bog)	6.0	0.01%	4.0%
Wetland (marsh and fen)	4.0	0.02%	7.0%
Open Water	1.0	0.003%	5.0%
Total	78	0.02%	6.0%

Potential impacts of the Itasca County Highway 7 Realignment are listed in Table 5.2.6-7. This project would result in a potential loss of 35 acres of wildlife habitat, which represents a loss of 0.009 percent of the total habitat within the Study Area. The habitat type that would experience the greatest impact would be deciduous forest, which would experience a loss of 0.03 percent as compared to existing conditions within the Study Area.

Table 5.2.6-7. Itasca County Highway 7 Realignment Wildlife Habitat Impact s

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	2.0	0.008%	3.0%
Deciduous Forest	23.0	0.03%	4.0%
Grassland	1.0	0.005%	1.0%
Mixed Wood Forest	4.0	0.005%	2.0%
Regeneration/Young Forest	3.0	0.005%	3.0%
Open Water	1.0	0.003%	5.0%
Wetland (marsh and fen)	1.0	0.004%	2.0%
Total	35	0.009%	3.0%

Potential impacts of the Itasca County Railroad project are listed in Table 5.2.6-8. This project would potentially result in a loss of 87 acres of wildlife habitat, which represents a loss of 0.02 percent of the total habitat within the Study Area. Deciduous forest would experience the greatest impact with a loss of 0.1 percent of the total amount represented by the existing conditions.

Table 5.2.6-8. Itasca County Railroad Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Deciduous Forest	60	0.1%	12%
Grassland	1.0	0.005%	1.0%
Mixed Wood Forest	9.0	0.01%	5.0%
Regeneration/Young Forest	2.0	0.004%	2.0%
Shrubby Grassland	1.0	0.007%	7.0%
Open Water	5.0	0.01%	23%
Wetland (marsh and fen)	9.0	0.04%	16%
Total	87	0.02%	7.0%

Development of the Mesaba Energy Project as well as the other foreseeable future actions would likely cause localized habitat fragmentation around areas of development. This fragmentation may cause direct mortality to wildlife species by restricting access to necessary resources for survival, such as food and water. Over time, fragmented areas may experience a decline in the number of species present, affecting species diversity. However, due to the fact that the Mesaba Energy Project and the other foreseeable future actions would be located in regions of Minnesota with large amounts of similar habitat surrounding them, fragmentation impacts would be expected to individuals only and not to a population of a particular species.

Wildlife Travel Corridors

There are three MNDNR-defined wildlife travel corridors located within the Study Area for the West Range Site – wildlife travel corridors #2, #3, and #4 (refer to Appendix D5, Figure 3). Wildlife travel corridor #2 could potentially be severely disrupted by the Mesaba Energy Project, Itasca CR 7 Realignment, Itasca County Railroad, and Nashwauk Gas Pipeline. The footprint of the Mesaba Generating Station would be located just north of the western boundary of this wildlife travel corridor. Development of the plant site would place a relatively large barrier to wildlife utilizing the wildlife travel corridor when entering or exiting to or from the northwest. The Itasca CR 7 Realignment would run along the northern and eastern boundary of wildlife travel corridor #2. The roadway would fragment existing habitat in the area, however, this would not be an impenetrable barrier for larger mammals to cross. It would be expected that the roadway would cause some direct mortality to species crossing the roadway that would be struck by vehicles. The Itasca County Railroad would run across the southeastern corner and the southern boundary of wildlife travel corridor #2. Similar to the effects of the Itasca CR 7 realignment, the railroad would fragment existing habitat in the area without creating an impenetrable barrier for larger mammals to cross. Direct mortality to species could result from being struck by moving locomotives. The Nashwauk Gas Pipeline would run northeast to southwest to the north of the eastern half of wildlife travel corridor #2 and would then turn and run north to south through the center of the wildlife travel corridor. Maintenance during the operation of the pipeline would most likely involve clearing of trees and shrubs in the right-of-way (ROW), which would result in a permanent habitat conversion within the right-of-way where forested areas would be converted to grasslands. This would fragment existing habitat, but would not cause an impenetrable barrier for larger mammals to cross.

Wildlife travel corridor #3 is located approximately two miles east of corridor #2. This corridor could be disrupted by the Itasca County Rail Alignment. The Itasca County Rail Alignment would run along the northern boundary of the wildlife travel corridor and would fragment existing habitat in the area without creating an impenetrable barrier for larger mammals to cross. The Nashwauk Gas Pipeline would run in an east to west direction approximately 0.75 miles north of wildlife travel corridor #3. The pipeline is far enough away from the corridor that no impacts would be expected to result.

Wildlife travel corridor #4 is located approximately two miles east of the proposed Minnesota Steel Industries site. No impacts from the Mesaba Energy Project or any of the other foreseeable future actions would be anticipated to occur to this corridor.

East Range Site

Habitat Loss

Overall, the impacts of the combined reasonably foreseeable future actions, including the Mesaba Energy Project, on the Study Area for the East Range Site would include a loss of 5.5 percent of total wildlife habitat as compared to existing conditions (Table 5.2.6-9). The habitat type that would experience the greatest amount of disturbance would be mixed wood forest at eight percent (Table 5.2.6-10). It is estimated that the existing conditions represent a loss of 12 percent in overall wildlife habitat in the Study Area as compared to past conditions (pre-human settlement) (Table 5.2.6-9).

Table 5.2.6-9. East Range Site Cumulative Wildlife Habitat Impacts Analysis Results

	Total Habitat in Study Area (acres)	Total Habitat Impacts (acres)	Percent Loss of Total Habitat		Proportion of Cumulative Impact
			From Past	From Existing	
Past	103,644				
Existing	91,598		12%		
Future Actions					
Mesaba Energy Project		462		0.5%	9.0%
PolyMet Mining NorthMet Project		3,064		3.3%	61%
Mesabi Nugget		1,480		1.6%	30%
Total of Future Actions		5,006		5.5%	100%
Future	86,592				

NOTE: See Section 5.2.6 for explanation of differences between this table and Appendix D5.

Table 5.2.6-10. Total Habitat for Existing Conditions and Proportion Lost Due to Reasonably Foreseeable Future Actions within East Range Study Area

Habitat Type	Existing Conditions	Impacts of Reasonably Foreseeable Future Actions (acres)	Percent Loss Resulting from Implementation of Foreseeable Future Actions
Coniferous Forest	4,978	141	2.8%
Deciduous Forest	7,513	509	6.8%
Grassland	894	8	0.9%
Mixed Wood Forest	33,943	2,617	7.7%

Table 5.2.6-10. Total Habitat for Existing Conditions and Proportion Lost Due to Reasonably Foreseeable Future Actions within East Range Study Area

Habitat Type	Existing Conditions	Impacts of Reasonably Foreseeable Future Actions (acres)	Percent Loss Resulting from Implementation of Foreseeable Future Actions
Open Water	6,225	239	3.8%
Regeneration/Young Forest	8,954	302	3.4%
Shrubby Grassland	5,606	180	3.2%
Wetland (bog)	20,938	1,006	4.8%
Wetland (marsh and fen)	2,547	4	0.2%
Total	91,598	5,006	5.5%

Potential impacts of the Mesaba Energy Project are listed in Table 5.2.6-11. The Mesaba Energy Project would potentially result in a loss of 462 acres of wildlife habitat, which represents a loss of 0.5 percent of the total habitat within the Study Area. The habitat types that would experience the greatest impacts would be shrubby grassland, grassland, and mixed wood forest, which would experience losses of one percent, 0.9 percent, and 0.8 percent, respectively, of the existing acreage in the Study Area.

Table 5.2.6-11. Mesaba Energy Project Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	8.0	0.2%	6.0%
Deciduous Forest	49	0.7%	10%
Grassland	8.0	0.9%	100%
Mixed Wood Forest	270	0.8%	10%
Regeneration/Young Forest	54	0.6%	18%
Shrubby Grassland	54	1.0%	30%
Wetland (bog)	5.0	0.02%	<1.0%
Wetland (marsh and fen)	1.0	0.03%	25%
Open Water	13	0.2%	5.0%
Total	462	0.5%	9.0%

Potential impacts of the PolyMet Mining NorthMet Project are listed in Table 5.2.6-12. This project would potentially result in a loss of 3,061 acres of wildlife habitat, which represents a loss of 3.3 percent of the total habitat within the Study Area. The habitat types that would experience the greatest impacts would be mixed wood forest and bog wetlands, which would experience losses of 4.9 percent and 4.8 percent, respectively, as compared to existing conditions within the Study Area.

Table 5.2.6-12. PolyMet Mining NorthMet Project Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Coniferous Forest	133	2.7%	94%
Open Water	1.0	0.01%	1.0%
Mixed Wood Forest	1,678	4.9%	64%
Regeneration/Young Forest	248	2.8%	82%
Shrubby Grassland	3.0	0.05%	2.0%
Wetland (bog)	998	4.8%	99%
Wetland (marsh and fen)	3.0	0.1%	75%
Total	3,064	3.3%	61%

Potential impacts of the Mesabi Nugget project are listed in Table 5.2.6-13. This project would result in a potential loss of 1,480 acres of wildlife habitat, which represents a loss of 1.6 percent of the total habitat within the Study Area. Deciduous forest would experience the greatest impact with a loss of 6.1 percent of the total amount represented by the existing conditions.

Table 5.2.6-13. Mesabi Nugget Wildlife Habitat Impacts

Habitat Type	Habitat Impact (acres)	Percent Loss as Compared to Total Habitat within Study Area for Existing Conditions	Proportion of Cumulative Impact
Deciduous Forest	460	6.1%	90%
Mixed Wood Forest	669	2.0%	26%
Open Water	225	3.6%	94%
Shrubby Grassland	123	2.2%	68%
Wetland (bog)	3.0	0.01%	<1.0%
Total	1,480	1.6%	30%

There is currently no information available for a footprint for the anticipated St. Louis County roadway from Hoyt Lakes to Babbitt; therefore, no quantitative information could be included in this analysis. However, due to the general planned location of the roadway, it is assumed that construction of it would result in wildlife habitat impacts. Design of the potential alignment is expected to begin in 2007.

It is generally assumed that development of the Mesaba Energy Project, as well as the other foreseeable future actions, would cause some localized habitat fragmentation around areas of development. This fragmentation may cause some direct mortality to wildlife species resulting from those individuals being restricted from obtaining necessary resources for survival, such as food and water. Over time, fragmented areas may become less populous of species causing overall habitat quality to decline. However, due to the fact that the Mesaba Energy Project and the other foreseeable future actions are located in regions of Minnesota with large amounts of similar habitat surrounding them, fragmentation impacts are expected to result at the level of the individual and not to a population-wide level.

Wildlife Travel Corridors

There are four MNDNR-defined wildlife travel corridors located entirely or partially within the Study Area – wildlife travel corridors #9, #10, #11, and #12 (refer to Appendix D5, Figure 4). Wildlife travel corridor #10 could be substantially affected by the Mesabi Nugget project to the point that the corridor could be rendered unusable by wildlife. The assumed footprint for the project shows the entire northern boundary of the corridor being impacted, which would completely remove this area from being a viable wildlife movement corridor. However, the final site layout for the project with locations of facilities and ground disturbances would have to be analyzed to confirm or deny this assumption.

Wildlife travel corridor #11 could possibly be affected by the PolyMet Mining NorthMet Project. The PolyMet project would be located approximately one mile northwest of the corridor and it appears that the project could remove a large area of habitat that would affect the ability of wildlife to cross through into habitats to the north and south. However, the final site layout for the project with locations of facilities and ground disturbances would be necessary to determine if it would affect corridor #11.

Wildlife travel corridors #9 and #12 are both located on the boundary of the Study Area and would not be impacted by the Mesaba Energy Project or any of the foreseeable future projects.

The Study Area and the locations of the Mesaba Energy Project and the other reasonably foreseeable future actions have been historically used for mining activities. Both Mesabi Nugget and the PolyMet Mining NorthMet Project would be located on lands that have been degraded by previous mining activities. Therefore, the majority of the areas that would be impacted by the proposed projects have historically been disturbed.

5.2.7 Rail Traffic

As discussed in Section 3.15, the BNSF and CN rail lines are well established in the Arrowhead Region and experience infrequent to moderately frequent rail traffic on a daily basis. Any additional rail traffic would have the potential to cause increased noise and vibration levels along the rail lines and increased traffic congestion, delays, and safety hazards at public grade rail crossings. Due to current rail traffic along the existing rail lines, cumulative rail impacts would primarily result from the increase in the number, size, and frequency of trains proposed to result from the Mesaba Energy Project and other reasonably foreseeable projects. The cumulative impacts analysis from increased rail use is focused on the potential routes provided by the railways that would serve the Mesaba Generating Station. More specifically, the region of influence for the West Range Site includes the BNSF line from Grand Rapids to Hibbing. For the East Range Site, the region of influence includes the CN line from Iron Junction to Hoyt Lakes (see Appendix D6).

As discussed in Chapter 2, a small segment of rail between Gunn and the proposed West Range Site is currently inoperable due to rising water levels in the CMP. From the 1990's to 2001, this track was experiencing approximately four trains per day and even higher levels during the 1970s. As of October 2006, the Itasca County Regional Rail Authority (ICRRA) has been soliciting interest for a shortline railroad operator to provide switching service along this line. The County is currently under contract with a consultant to design and permit the track, and operation is anticipated to begin April of 2009, which would provide a direct eastbound route from Grand Rapids to the West Range Site. Service along this route would most likely return back to similar operating conditions when the track was serviceable during the 1990s and local train service would likely resume between Grand Rapids and Superior, Wisconsin. Currently, an estimated six trains daily pass through Grand Rapids in either direction (Excelsior, 2006c).

Once this segment returns to its prior operating condition, Minnesota Steel would satisfy their transport requirements through the base local train trips that would otherwise occur under these conditions. As a result, additional train trips are not expected to be generated by Minnesota Steel, and cumulative impacts related to rail traffic would be substantially similar to those described in Section 4.15 for the West Range Site.

5.2.7.1 Emergency Response

Potential congestion and delays at rail crossings may be a mere nuisance to everyday motorists; however, these delays may mean significant reductions in response time for emergency vehicles, which could result in increased loss of life or property damage. Since emergencies and train crossings are random events, predicting the likelihood of a passing train delaying an emergency vehicle and the length of delay becomes a complicated matter. In responding to an emergency, an emergency vehicle may encounter one of the following scenarios at a grade crossing:

- Not encounter a train and pass without delay through the crossing;
- Arrive at a crossing just as the train arrives and be required to wait the full train pass-by event or detour to the nearest unblocked or nearest grade-separated crossing;
- Arrive during the train crossing. Under this circumstance, the emergency vehicle could utilize the oncoming traffic lane to approach the crossing, avoiding any vehicle queue; or
- Arrive near the end of a train pass-by event and be required to make its way through traffic that has built up during the event.

The amount of time a crossing is blocked is based on the length of the train and the speed of travel. The faster a train is moving and/or the shorter the train length, the less time the crossing would be blocked. To analyze the cumulative impacts that additional train traffic would impose on emergency response vehicles at grade crossings, the time each crossing would be blocked per train crossing event was determined by assuming a length of train and the speed at which it was traveling. The estimated delay time also includes the time for the train to pass along with time for active warning devices to be deployed and restored after a train had passed (an additional 20 seconds). Since trains in the region typically travel at speeds ranging between 12 and 50 miles per hour, a traveling speed of 25 miles per hour was used for calculations concerning potential vehicle delay from non-project-related trains; for projected-related trains, a speed of 10 miles per hour was used as a conservative estimate based on the rail noise analysis in Section 4.18. Therefore, the blocked crossing time per train passing event for trains resulting from the project was estimated to be approximately 8 minutes for a 115-car train (approximately 7,000 feet) and 9 minutes for a 135-car train (approximately 8,000 feet). For other trains not related to the project, delays would be 3.2 minutes for a 115-car train and 3.6 minutes for a135-car train. The numbers of trains passing through any grade crossing within the regions of influence for the West Range Site and East Range Site are based on estimates provided in Appendix D6, which count each round trip on a rail line as 2 trains per day passing a given crossing. The potential delay times associated with current and reasonably foreseeable projects at both sites are listed in Table 5.2.7-1. These delays are considered conservative estimates and would be shorter at crossings farther away from the plant site, where project-related trains would travel at speeds greater than 10 miles per hour.

The delay time per unit train (i.e., delay time per train crossing event) shown in Table 5.2.7-1 represents the maximum delay time that an emergency vehicle would experience if it arrived at the beginning of a train crossing event. Since details of future train operations for the reasonably foreseeable projects are speculative at this time, conservative estimates on the number of cars per unit train were used to determine more conservative delay times. Discussions on how these delay times would impact each potential project site are provided below.

Table 5.2.7-1. Grade Rail Crossing Delay Times

	Number of cars per unit train	Delay time per unit train	Number of trains crossing per day	Total delay time per day
West Range Site				
Base train traffic	135 cars	3.6 minutes	6 trains (either direction)	21.6 minutes
Minnesota Steel, Inc.	90 cars	-	(included in base traffic)	-
Mesaba Generation Station	135 cars	9 minutes	4 trains (2 round trips*)	36 minutes
			Total	57.6 minutes
East Range Site				
Base train traffic	135 cars	3.6 minutes	12 trains (either direction)	43.2 minutes
Mesabi Nugget	115 cars	3.2 minutes	2 trains (1 round trip)	6.4 minutes
PolyMet	135 cars	3.6 minutes	2 trains (1 round trip)	7.2 minutes
Mesaba Generation Station	135 cars	9 minutes	4 trains (2 round trips*)	36 minutes
			Total	92.8 minutes

Source: Excelsior, 2006c
Note: *Maximum for Phases I and II assuming 5 deliveries every 4 days (Excelsior, 2006b)

West Range Site

As shown in Table 5.2.7-1, trains in the West Range Site vicinity could result in a total of 57.6 minutes of delay at the grade crossings each day, which represents a 4 percent probability that an emergency vehicle would be delayed at a grade intersection on any given day. As previously mentioned, Minnesota Steel, Inc. would be the only other reasonably foreseeable project within the region of influence and their transport needs would be accommodated with rail cars in the expected base traffic level. Therefore, from a cumulative standpoint, the time delay estimate for the West Range Site would most likely be equivalent to the estimate predicted in Section 4.13.3.2. However, to account for the unlikely event that the inoperable rail line between Gunn and Taconite could not be renovated, potential impacts to grade crossing delays resulting from Minnesota Steel's activities have been included for comparison. Under these circumstances, trains traveling eastbound from Grand Rapids would be required to detour south and loop back north to access the Taconite area.

West of the West Range Site, the BNSF rail line between Grand Rapids and Taconite comprises a total of 17 grade rail crossings, including eight in Grand Rapids, one in Coleraine, and two in Taconite. This rail line also includes grade-separated crossings at US 169 and US 2 on the northeastern outskirts of Grand Rapids and one at CR 7 near the project site. East of the West Range Site, the BNSF line between Hibbing and Taconite there are eight grade rail crossings and five grade-separated crossings (see Appendix D6).

The BNSF portion west of the site bisects the city of Grand Rapids. The Grand Itasca Clinic and Hospital is located on the south side of the railroad tracks and because of the rural nature of the region, limited road access to many areas could impede the movement of emergency vehicles. A number of emergency providers, including hospitals and the Itasca County Sheriff's Department were contacted to determine whether or not there were formal procedures to follow in the event of train passes. All had indicated that there were no specific procedures that were followed. The only grade rail crossings that could create a potential delay for emergency vehicles are in Grand Rapids and in Taconite because there are no grade-separated rail crossings within the city limits. Therefore, emergency vehicles stop and wait for trains to pass or take an indirect route around the train if possible. The only city that has one grade rail railroad crossing and no other means of crossing the railroad is Taconite (Clark, 2006). According to the Deputy Sheriff of the Itasca Sheriff's Department, all other communities between Grand Rapids and Nashwauk, have a bridge crossing and, therefore, do not typically have delay problems at grade crossings.

East Range Site

Rail lines serving the East Range Site have grade crossings at eight locations between Hoyt Lakes and Clinton Township south of Iron Junction, including one crossing in Aurora, one near McKinley, and three near Iron Junction (see Appendix D6). As shown in Table 5.2.7-1, trains in the East Range Site vicinity could result in a total of 92.8 minutes of delay at the grade crossings each day, which represents a 6.4 percent probability that an emergency vehicle would be delayed at a grade intersection on any given day.

Since most of the city limits of the communities near the East Range Site are located wholly on either the north or south sides of the rail line, there would be limited potential for delays at rail compared to the West Range Site. The only grade rail road crossing of concern to emergency response vehicles would be in Aurora – the grade crossing on Main Street is the only one in town. At this location, emergency vehicles would have no other choice, but to wait for the train to pass. All of the other grade rail crossings within the region of influence currently are not a concern, because most of the areas have access to at least one grade-separated crossing within a reasonable distance for re-routing, if necessary.

5.2.7.2 Public Safety at Grade Rail Crossings

The potential increase in risk of accidents at grade crossings is a public safety concern. The Proposed Action would not create new grade crossings; however, the increase in rail usage could increase the likelihood of a rail crossing accident along the existing rail corridors. The rail corridors within the regions of influence at the West Range and East Range Sites already experience daily rail traffic. Therefore, cumulative rail impacts on hazards at-grade crossings would primarily result from the increase in the frequency as a result of the Mesaba Energy Project and other reasonably foreseeable projects.

The most recent five years of accident history that was available at each grade crossing within the regions of influence were examined. In general, because there is relatively little traffic in the regions of influence, there were very few incidents at grade crossings reported in all of Itasca and St Louis Counties. Only two accidents occurred at grade crossings between Grand Rapids and Hibbing – one occurred in Grand Rapids at 3rd Avenue, NE, which employs passive warning signs (crossbuck signs), and the other incident occurred in Keewatin at 1st Street, which employs active signaling (flashing lights and sound). No incidents were reported in the region of influence for the East Range Site. Rail data for the past five years indicate that there are no planned or recommended improvements to existing safety guards at the grade crossings. Due to the low frequency of accidents at the grade crossings, it is assumed that the level of protection is adequate for the current level of traffic. It is expected that any additional increase in safety hazards would remain low as the incremental addition of trains (see Table 5.2.7-1) is small.

5.2.7.3 Noise and Vibration

Noise and vibration generated by the rail operations have the potential to impact sensitive noise receptors near the rail corridors. Noise sources from rail operations include diesel locomotive engine and exhaust noise, wheel/rail interaction noise (collectively referred to as wayside noise) and horn noise. Wayside noise affects all locations along the rail corridor. Horn noise is an additional noise source at and in the vicinity of grade crossings where trains are required by law to sound a horn for safety.

Since the new rail alignments for the Mesaba Energy Project would be in the proximity of the proposed plant and away from population centers, the cumulative impact discussion on noise and vibration is mainly concerned with the existing rail corridors. Hence, the sounds associated with rail traffic are already part of the existing environment within the regions of influence. The number of sensitive noise receptors and magnitude of noise and vibration levels that would be experienced by the receptors as analyzed in Section 4.18 would generally remain the same as only one train pass-by would occur at any given time. Therefore, cumulative noise and vibration impacts at the West Range and East Range Sites are expected to be substantially similar under the Proposed Action discussed in Section 4.18.

The frequency at which these impacts occur would increase as the frequency of train traffic would increase. However, as these are on established rail lines, it is expected that the incremental addition of train events would not cause significantly different impacts of the noise and vibration levels. This increase in occurrence of vibration events would present an inconvenience or annoyance to individuals experiencing it, but they would not be expected to cause any structural damage or significant reduction in individuals' quality of life. The most significant increase in noise levels would result from the increased occurrence of train horns at public grade crossing. Since these soundings are required by law to enhance safety of grade crossings the number of instances related to horn sounds would be equal to the number of additional grade crossing. This noise impact is considered a minor tradeoff when considered in the context of the safety benefits. Past FRA studies have indicated that banning whistles had averaged approximately 80 percent more collisions than comparable crossing where whistles were sounded (FRA, 1999).

5.3 MITIGATION OF IMPACTS

5.3.1 Mitigation Measures

For all environmental resources, the mitigation of potential adverse impacts from project activities would be achieved through the implementation of BMPs generally required by permitting processes and other Federal, state, or municipal regulations and ordinances. Table 5.3-1 outlines specific mitigation measures, including those required under Federal, state, or local regulations and permitting requirements that Excelsior would implement for each resource area.

Table 5.3-1. Mitigation Measures for the Mesaba Energy Project

Environmental Resources	Mitigation Measures[1, 2]
Aesthetics	**Construction:** • Prior to the commencement of construction, Excelsior would develop a SWPPP, which would outline the erosion BMPs that would be used to minimize landscape scarring. • Use of dust suppression BMPs. **Operation:** • Prior to operation, Excelsior would submit a request to the FAA for a determination of no hazard to avaiation from the emission stacks and HVTL towers. If applicable, obstruction lighting would be installed. • A comprehensive light plan would be generated using input from the Taconite and Hoyt Lakes City councils.
Air Quality and Climate	**Construction:** During construction, Excelsior would implement the following standard practice with regard to minimizing impacts to ambient air quality: • Use of dust abatement techniques such as wetting soils, covering storage piles with tarps, enclosing storage piles, and limiting operations during windy periods on unpaved, unvegetated surfaces to reduce airborne dust. • Surfacing of unpaved access roads with stone whenever appropriate. • Covering construction materials and stockpiled soils to reduce fugitive dust. • Minimizing disruption to disturbed areas. • Watering land prior to disturbance (excavation, grading, backfilling, or compacting). • Revegetating disturbed areas as soon as possible after disturbance. • Moistening soil before loading into dump trucks. • Covering dump trucks before traveling on public roads. • Minimizing the use of diesel or gasoline generators for operating construction equipment. **Operation:** The following process modification and improved work practices would be implemented to mitigate emissions: • To reduce NO_x: Use of diluent injection in the CTGs; use of clean syngas or natural gas in the TVBs; incorporating good flare design; flaring only treated syngas; implementing good combustion practices (GCP) in the TVBs; limiting the hours of operation of the fire pumps and emergency generators; and using low-sulfur diesel in the fire pumps and emergency generators. • To reduce CO and VOCs: Implementing GCP in the CTGs and TVBs; use of clean syngas or natural gas in the TVBs; incorporating good flare design; flaring only treated syngas; limiting the hours of operation of the fire pumps and emergency generators; and using low-sulfur diesel in the fire pumps and emergency generators.

Table 5.3-1. Mitigation Measures for the Mesaba Energy Project (continued)

Environmental Resources	Mitigation Measures[1, 2]
	• To reduce SO_2: Use of clean syngas in the CTGs; use of clean syngas or natural gas in the TVBs; implementing GCP in the TVBs; incorporating good flare design; flaring only treated syngas; limiting the hours of operation of the fire pumps and emergency generators; and using low-sulfur diesel in the fire pumps and emergency generators. • To reduce H_2SO_4: Use of clean syngas in the CTGs. • To reduce PM: Implementing GCP in the CTGs and TVBs; incorporating high efficiency drift eliminators in the cooling towers; use of clean syngas or natural gas in the TVBs; incorporating good flare design; flaring only treated syngas; limiting the hours of operation of the fire pumps and emergency generators; and use of low-sulfur diesel in the fire pumps and emergency generators. BACT has not yet been determined by the MPCA and the need for additional mitigation would be addressed by MPCA, in consultation with FLMs, through the PSD permitting process. DOE may consider additional mitigation as a condition of the Record of Decision. See also Section 5.3.2.2.
Geology and Soils	**Construction:** • Prior to the commencement of construction, Excelsior would develop and implement a SWPPP, which addresses erosion prevention measures, sediment control measures, permanent stormwater management, dewatering, environmental inspection and maintenance, and final stabilization. The SWPP would be submitted to the MPCA for approval prior to the initiation of any construction activities. • As part of the SWPPP, Excelsior would implement erosion BMPs, such as stockpiling and covering topsoil, installing wind and silt fences, and reseeding disturbed areas. **Operation:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction). • Prior to commencement of operation, Excelsior would develop and implement a SPCC Plan covering all facility operations as required by MPCA under the Clean Water Act.
Water Resources	**Construction:** • Prior to the commencement of construction, Excelsior would develop and implement an MPCA-approved SWPPP for construction activities (see Geology and Soils - Construction). The SWPPP would address both the plant site and construction along utility corridors. • Implement BMPs within the SWPPP for construction activities for dust suppression and sedimentation control measures (see Air Quality and Climate – Construction). • Prior to construction of the utility infrastructure, Excelsior would apply for MNDNR Public Waters Work Permit for all stream and water crossing, and implement all requirement BMPs or mitigative measures to protect these water resources. **Operation:** • Prior to the operation of the power plant, Excelsior would submit an NPDES permit application to MPCA for the discharges of cooling water blowdown. Once the operation commenced, the plan would be subject to meeting discharge limits on all pollutant parameters and complying with all other permit conditions. • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP for industrial activities and implement the required BMPs, inspections, and training requirements. • Prior to commencement of operation, Excelsior would develop and implement a SPCC Plan to mitigate potential impacts due to the release of petroleum products (see Geology and Soils – Operation). • For the West Range Site, Excelsior would develop a water management plan that would minimize potential impacts on water resources and control the withdrawals of water for use in the power plant.

Table 5.3-1. Mitigation Measures for the Mesaba Energy Project (continued)

Environmental Resources	Mitigation Measures[1, 2]
	• Excelsior would routinely monitor the quality of receiving waters (CMP and Holman Lake) to ensure pollutant levels (primarily mercury, phosphorus, and total dissolved solids) did not exceed water quality standards. Excelsior would take the necessary steps if concentrations of these parameters increase to levels near the water quality standards. This requirement may be incorporated into Excelsior's NPDES permit for cooling water discharges. See also Section 5.3.2.1.
Floodplains	**Construction:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction). • Should the Mesaba Energy Project be modified in such a manner as to impact a FEMA defined flood hazard boundary at the selected site, it may become necessary to submit the proposed plans to FEMA for incorporation into the community's FIRM panel. All affected communities and applicable local agencies, Mn/DOT and MNDNR, would have to be contacted by the Excelsior during the design phases of the project in order to ensure all flood control requirements are met. **Operation:** • For the West Range Site, Excelsior would develop a water management plan that would minimize potential impacts on water resources and would include pumping details on the CMP, which would prevent flooding potential currently associated with this mine pit.
Wetlands	**Construction:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction) that would minimize potential impacts on wetlands. • Mitigation of wetland impacts would be in the form of direct replacement or through the purchase of credits through an approved wetland bank under USACE and BWSR requirements and guidance. A Combined Wetland Permit Application would be submitted to applicable Federal, State, and local regulatory entities and would include any design details on wetland replacement sites, wetland banks, and/or sources of wetland credits for the project. Mitigation requirements would be determined during the wetland-permitting phase of the project following the NEPA process and before the commencement of construction activities. See also Section 4.7.7 and Appendix F2. **Operation:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction) that would minimize potential impacts on wetlands. • Prior to commencement of operation, Excelsior would develop and implement a SPCC Plan (see Geology and Soils – Operation). • For the West Range Site, Excelsior would develop a water management plan that would minimize potential impacts on wetlands.

Table 5.3-1. Mitigation Measures for the Mesaba Energy Project (continued)

Environmental Resources	Mitigation Measures[1, 2]
Biological Resources	**Construction:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction) that would minimize potential impacts on Biological Resources. • Implementing BMPs for dust suppression and sedimentation control measures (see Air Quality and Climate – Construction). • Impacts to biota in surface waters would be mitigated through the requirements of the NPDES permit and other environmental permits/approvals. • Complying with the provisions of the Federal MBTA, which would include limiting timber and land clearing activities, in particular within woodland and forest habitats, to periods outside of the songbird-nesting season. • A USFWS biological opinion is being completed for the Canada lynx and gray wolf. Mitigation for these Federally protected species, if necessary, may include passive measures, such as construction timing outside of critical breeding periods, to more aggressive measures, such as complete avoidance of impacts. The DOE Record of Decision would then be conditional upon implementing specific mitigation requirements in the biological opinion. • For state-listed species protected by the Minnesota Endangered Species Statute, species or sensitive habitats listed in the MNDNR NHIS database that may be potentially affected would require coordination with the MNDNR Division of Ecological Services. Mitigation of impacts to state-listed species can incorporate a wide variety of options ranging from passive measures, such as construction timing outside of critical breeding periods, permanent protection of known habitats elsewhere that contain the resource to be affected, or more aggressive measures including complete avoidance of impact. **Operation:** • Prior to the commencement of operation, Excelsior would develop and implement an MPCA-approved SWPPP (see Geology and Soils - Construction). • Prior to commencement of operation, Excelsior would develop and implement a SPCC Plan (see Geology and Soils – Operation). • For the West Range Site, Excelsior would develop a water management plan that would minimize potential impacts on biological resources. • Implementation of wetland mitigation requirements would minimize potential impacts on aquatic and wetland habitats (see Wetlands – Construction).
Cultural Resources	**Construction:** • In accordance with Section 106 of the National Historic Preservation Act, surveys and cultural resource assessments have been provided to MN SHPO and other appropriate agencies for review and comment. A Phase I archaeological survey of locations with high and medium potential will be conducted at the West Range site in the summer of 2007, consistent with the recommendations of the SHPO. • With regard to the roads, rail lines, HVTL and utility corridors related to either site, archaeological surveys would only be conducted for the site to be permitted by the PUC. And then, only those corridors that are permitted by the PUC would be surveyed. Surveys would necessarily be completed after the DOE Record of Decision. However, DOE intends to enter into an agreement with SHPO and other appropriate parties that will ensure the following: cultural resources are identified through a Phase I archaeological survey; architectural history resources within the APE are identified; eligibility of any resources for listing on the NRHP is determined; a determination of effects on such resources is made; a comprehensive Historic Property Treatment Plan is developed; and a plan for unanticipated discovery of cultural resources during construction is implemented. The DOE Record of Decision would then be conditional upon implementing the provisions of the agreement.

Table 5.3-1. Mitigation Measures for the Mesaba Energy Project (continued)

Environmental Resources	Mitigation Measures[1, 2]
Traffic and Transportation	**Construction:** • To prevent unnecessary traffic congestion and increased road hazards, Excelsior would coordinate with local authorities and implement transportation measures, especially during the movement of oversized loads, construction equipment and materials. • Where traffic disruptions would be necessary, Excelsior would coordinate with local authorities and implement detour plans, warning signs, and traffic diversion equipment to improve traffic flow and road safety. **Operation:** • West Range Site – If the new CR 7 could not be built, Excelsior would implement road improvements at the intersection of CR 7 and US 169 to minimize traffic congestion and road hazards currently associated with this intersection. Improvements include adding turning and acceleration lanes.
Safety and Health	**Construction/Operation:** • Comply with OSHA requirements and DOE safety-related directives as they apply to the project during construction and operation activities.
Noise	**Construction:** • Excelsior would implement a noise mitigation plan, which includes the contact of affected receptors during steam blowing and major construction events. • Steam piping would be equipped with silencers that would reduce noise levels during steam blows by 20 dBA to 30 dBA at each receptor location. **Operation:** • Once Phase I begins commercial operations, Excelsior would perform a noise survey to ensure that such operations are in compliance with applicable noise standards. Assuming that construction of Phase II would be concomitant with Phase I operations, Excelsior would perform a noise survey to confirm that the combination of activities (i.e., simultaneous Phase I operation and Phase II construction) would comply with MPCA requirements. • To ensure that noise levels would be below MPCA noise thresholds, Excelsior would conduct an acoustical analysis of the final design and evaluate and select the best suite of noise reduction alternatives to be incorporated as part of the plant design basis. Acceptable ambient noise levels for the proposed land use would be specified in contractor bids to ensure that appropriate noise attenuation features are included in the final facility design and layout specifications.

[1]Mitigation measures listed are applicable to both the West and East Range Sites unless specifically noted.
[2]List of Acronyms: APE – area of potential effect; BACT – best available control technology; BMPs – best management practices; BWSR – Board of Water and Soil Resources (Minnesota); CMP – Canisteo Mine Pit; CO – carbon monoxide; CTG – combustion turbine generator; DOE – Department of Energy; FEMA – Federal Emergency Management Agency; FIRM – Flood Insurance Rate Map; GCP – good combustion practice; H_2SO_4 – sulfuric acid; HVTL – high voltage transmission line; MBTA – Migratory Bird Treaty Act; MNDNR – Minnesota Department of Natural Resources; Mn/DOT – Minnesota Department of Transportation; MPCA – Minnesota Pollution Control Agency; MN SHPO – Minnesota State Historic Preservation Office; NHIS – National Heritage Information System; NO_x – nitrogen oxides; OSHA – Occupational Safety and Health Administration; PM – particulate matter; PUC – Public Utilities Commission; SO_2 – sulfur dioxide; SPCC – Spill Prevention, Control and Countermeasure; SWPPP – Stormwater Pollution Prevention Plan; TVB – tank vent boiler; USACE – U.S. Army Corps of Engineers; USFWS – U.S. Fish and Wildlife Service; VOC – volatile organic compound.

5.3.2 Additional Mitigation Options

If not otherwise required by Federal, state or local ordinances, there are mitigation options for cooling water discharge at the West Range Site that could reduce impacts to water resources. In addition, there are options for mitigation of visibility impacts to Class I areas that may or may not be included in the final air permit for the project. These mitigation options are discussed and assessed in the following sections.

5.3.2.1 Cooling Water Discharge Options at West Range Site

As described in Section 2.3.1.3, the project proponent's plan ("base case") for the West Range Site is to discharge most of the cooling tower blowdown (CTB) back to the Canisteo Mine Pit (CMP), with limited discharges to Holman Lake. Because the CMP is the source of process water for the plant, the water quality of the CMP would gradually decrease as certain constituents (TDS, hardness, and mercury) increase in concentration. While the plant would be operated to ensure that mercury concentrations would not exceed water quality standards within the CMP, other parameters (TDS, hardness, specific conductivity) could increase to levels above standards. The decreased water quality in the CMP would cause an increase in operational costs for the plant as a result of added treatment costs and chemical usage to improve the process water quality. At present water levels in the CMP, there is a net inflow of groundwater. Once water levels in the CMP are lowered for power plant operations, the flow into the mine pit would likely increase as the water level in the pit decreases).

The following mitigation alternatives, developed by the project proponent (see Appendix H) and summarized in Table 5.3-2 below, are presented to reduce or eliminate CTB discharges to the CMP:

- Mitigation Alternative 1 – Discharge all CTB effluent to Holman Lake; no discharge to the CMP during normal operation conditions;
- Mitigation Alternative 2 – Similar to the base case in regard to the CMP discharges, but discharge a portion or all of the effluent directly Swan River (rather than Holman Lake); and
- Mitigation Alternative 3 – Use ZLD to treat all CTB and recycle the treated CTB back to plant for process water use.

Table 5.3-2. Summary of CTB Mitigation Alternatives

Parameters	Base Case		Mit. Alt. 1		Mit. Alt. 2a		Mit. Alt. 2b		Mit. Alt. 3	
Phase	1	2	1	2	1	2	1	2	1	2
Cycles of Concentration	5	3	5	5	5	3	5	5	≥10	≥10
Discharge to CMP (gpm)	300	2,675	0	0	300	2,675	0	0	0	0
Discharge to Holman Lake (gpm)	600	825	900	1,800	0	0	0	0	0	0
Discharge to Swan River (gpm)	0	0	0	0	600	825	900	1,800	0	0
Cooling Water Requirements from the CMP (gpm)	4,400	10,300	4,400	8,800	4,400	10,300	4,400	8,800	3,500	7,000
Net Water Required (gpm)	4,100	7,625	4,400	8,800	4,100	7,625	4,400	8,800	3,500	7,000
Air Emissions (PM) from Drift(tons/year)	20	39	18	35	20	39	18	35	39	78

In addition to these three mitigation alternatives, CTB discharge directly to either the Mississippi or Prairie Rivers was also considered, but neither of these options offered an advantage over the mitigation alternatives. Discharge to either river would increase the capital costs for constructing the additional length of discharge pipelines and would also likely increase operational costs, as the discharge may require pumping. Both rivers are also impaired for the same pollutants (mercury and dissolved oxygen) as the Swan River. The flow in the Mississippi and Prairie Rivers offer more assimilative capacity than the Swan River, but no other advantages, so these are not considered further.

The environmental impacts of each of these mitigation alternatives are discussed below.

Mitigation Alternative 1 – Discharge all CTB Effluent to Holman Lake

Mitigation Alternative 1 provides an upper limit to the potential effluent volume discharged to Holman Lake compared to the base case presented in Section 4.5. Mitigation Alternative 1 would discharge 900 gpm during Phase I and 1,800 gpm during Phase II, and would not include a discharge to the CMP during either phase under normal operating conditions.

Under this alternative, the generating station would operate at 5 COCs during Phase II and, therefore, would require less water for cooling purposes with a resultant decrease in discharge volume. Operating the power station at 5 COCs would result in an increase in pollutant concentrations as more water would be evaporated during cooling. However, this increase would be partially offset by cleaner process water, because no discharges to the CMP (the source of process waster) would occur, and the process water chemistry would remain relatively constant throughout the operating period (subject only to the mixing of the different water sources).

Mitigation Alternative 1 was reviewed to determine the resources that would be affected by this alternative. Because the construction of the process water and discharge pipelines, as well as all the other supporting power generation and transmission infrastructure is the same as the base case, it was determined that the resources that would be affected would be water resources, wetlands, biological resources, and air quality.

Water Resources

Mitigation Alternative 1 would affect water resources in terms of process water withdrawals and the discharges of CTB to Holman Lake. The impacts to these resources are presented in the following sections.

Process Water Supply Systems

The effects on water resources from modifications to the water management plan under Mitigation Alternative 1 include: a decreased requirement for process water that results from operating the power station at 5 COCs rather than 3 COCs during Phase II; the elimination of discharges (during normal operations) to the CMP, reducing the available water supply in the CMP; and improved water quality of the process water and the CMP due to the elimination of discharges to the CMP from the plant that would contain TDS and mercury. As in the base case, the source water is the origin of mercury and phosphorus, rather than the generating station (although the pollutants become concentrated due to evaporation of water in the cooling towers).

Table 5.3-3 compares the process water requirements between the base case and Mitigation Alternative 1. The data shows that sufficient water should be available from the proposed water sources for both phases under Mitigation Alternative 1 under normal operating conditions.

During peak operating conditions, the process water requirements for Phase II could reach 13,000 gpm under Mitigation Alternative 1, which would appear to exceed the assumed sustainable flow (8,800 gpm). However, the peak requirements are of short duration and the water recharge rates in the mine pits are expected to increase as the water levels in the mine pits decrease. In addition, the power station could operate the pumping stations at the mine pits to transfer water (roughly 300 gpm), during normal operating conditions, into storage (CMP or HAMP) for use during peak demands. Under extreme drought conditions, Excelsior could take all or a portion of the discharge going to Holman Lake and route it back to the CMP as an additional water supply. Therefore, there appears to be sufficient water supply capacities to handle both normal and peak operating conditions for this proposed alternative.

Table 5.3-3. Water Source Supply Capacities.

Water Source	Estimated Range of Flow (gpm)	Assumed Sustainable Flow for Water Balance Modeling (gpm)	
		Base Case	Mitigation Alternative 1
Canisteo Mine Pit	810-4,190	2,800	2,800
HAMP Complex	1,590-4,030[a]	2,000[b]	2,000[b]
Lind Mine Pit	1,600-2,000	1,800[c]	1,800[c]
Prairie River	0-2,470[d]	2,470[d]	2,470[d]
Discharge from Mesaba Generating Station	350-3,500	Varies[e]	0
Total	4,350-16,190	>9,100[f] >11,700[g]	9,100
Phase I Requirements		4,400	4,400
Phase II Requirements		10,300	8,800

[a] Maximum flow occurs at minimum operating elevation.
[b] At an operating elevation of 1,230 feet msl.
[c] Estimates of flow are based on one summer flow measurement at the LMP outlet and one summer and one winter measurement taken at the West Hill Mine Pit outlet.
[d] Maximum available flow assumed to be 25% of the 7Q10 flow of the Prairie River.
[e] Water returned to the CMP is expected to be 350 gpm during Phase I operations and 2,650-3,500 gpm during Phase II (Alternative 1) operations.
[f] Total does not include any of the water discharged back to the CMP from the Mesaba Generating Station
[g] Total includes the minimum quantity of water expected to be discharged back to the CMP during the operation of Mesaba I and II of 2650 gpm, rounded to two significant figures.
Source: Table 4.5-2 and Appendix H

Mitigation Alternative 1 also offers an advantage over the base case in that the source water quality would remain relatively constant over the life of the power station. Table 3.5-4 (Section 3.5) presents the water quality of the different mine pits considered to supply process water for the West Range Site.

Process Water Discharges and Water Quality Standards

As presented in Appendix H, Mitigation Alternative 1 would route all the process water discharges (except those handled by the ZLD) to Holman Lake. The overall effects of this alternative (as compared to the base case) would be:

- An increased flow into Holman Lake (over the current flow of 1,215 gpm) during Phases I and II of 74 to 148 percent, respectively. The base case would result in an increased flow of 50 to 68 percent during Phases I and II.

- Reduced pollutant concentrations/chemical constituents in the discharge to Holman Lake, since the raw water stream from CMP would have a higher quality under this alternative than under the base case.
- A net increase in the pollutant/constituent loadings as a result of the increased flow (even with decreased concentrations). As with the base case, the origin of most of these pollutants (such as mercury and phosphorus) is the source water and not the discharge by the generating station.

Each of these effects is discussed below.

Increased Flow to Holman Lake

Holman Lake is a natural lake that has experienced both natural and man-made fluctuations in water levels and flow over the past several decades. During the operation of the Canisteo Mine, water from dewatering operations was discharged into the lake. Although the volume of water from these dewatering operations is not known, it is believed that the flow volume exceeded the amount planned under Phase II of Mitigation Alternative 1. When the lake was receiving the mine dewatering discharge, the lake level was controlled by a constructed spillway. This spillway no longer functions as a result of recurring beaver dams upstream of the spillway. The water level in the lake is now affected by the partial dismantling of the beaver dam when the water level reaches a height that inundates an adjacent railroad trestle (generally once per year). The water flow that results from this action lowers the water level in the lake approximately 1 to 2 feet over a period of several days, and the flow exiting the lake during this action exceeds the increased flow that would result from Mitigation Alternative 1.

The increased flow through Holman Lake under Mitigation Alternative 1 should help reduce periods of stagnation cited in Section 4.5. Downstream of Holman Lake, the outflow from the lake joins with the Swan River (28,000 gpm average flow, as measured at the discharge from Swan Lake). Based on the average flow for both the Swan River and Holman Lake, the net increase in flow of Mitigation Alternative 1 (during Phase II) would be 6 percent (1,800 gpm divided by 28,000 gpm and 1,215 gpm).

Reduction in Pollutant Concentrations/Chemical Constituents

By operating the generating station at 5 COCs and not using any of the CTB as part of the source for process water, the overall concentrations of pollutants/constituents in the CTB would be reduced (from that of the base case) and would not increase over time as they would under the base case. Table 5.3-4 presents the Phase II concentrations of process effluent after 30 years of operation that would be discharged to Holman Lake.

The chemical constituents that exceed water quality standards are shown in bold. The two constituents that are pollutants of concern for the Swan River are mercury and phosphorus, and the concentrations of both are below water quality standards. The constituents that exceed water quality standards have standards based on either drinking water or irrigation, neither of which would apply to Holman Lake; however, this determination would be made during the NPDES permitting process. The estimated concentrations of chemical constituents should not affect the recreational activities (swimming and boating) that currently occur on the lake.

The in-lake concentrations of these constituents (after mixing with the lake water) would be reduced up to 40 percent and would be below applicable water quality standards after mixing with the Swan River. For example, the full mixed concentration for mercury in Holman Lake would be approximately 2.8 ng/L and, after mixing with the Swan River, about 1.3 ng/L.

Overall, there is a slight beneficial effect for Mitigation Alternative 1 over the base case as a result of the overall decrease in pollutant concentrations/chemical constituents.

Table 5.3-4. Expected IGCC Power Station Discharges for the Base Case and Mitigation Alternative 1 and Applicable State Numerical Water Quality Standards

Constituent	Units	WQ Standard (chronic)	WQ Standard (acute/max)	Class	Anticipated Effluent Water Quality – Phase II (3 COCs) Base Case	Anticipated Effluent Water Quality – Phase II (5 COCs) Mitigation Alternative 1
Hardness	mg/L	250	-	3B	**2,052**	**1,540**
Alkalinity	mg/L		n/a		--	--
Bicarbonate	mg/L	305	-	4A	**1,200**	**869**
Calcium	mg/L		n/a		--	--
Magnesium	mg/L		n/a		--	--
Iron	mg/L		n/a		--	--
Manganese	mg/L		n/a		--	--
Chloride	mg/L	230 (T)	860 (T)	2B	38	26
Sulfate	mg/L		250/10	1B/4A	**590**	**487**
TDS	mg/L		500/700[5]	1B/4A	**2,070**	**1,685**
pH	mg/L		6 - 9	2B	6 - 9	6 – 9
Aluminum	µg/L	125 (T)	1072 (T)	2B	74	50
Arsenic	µg/L	53 (H)	360 (T)	2B	--	--
Barium	µg/L		n/a		--	--
Cadmium	µg/L	2[1] (T)	73[1] (T)	2B	Note 3	Note 3
Chromium (6+)	µg/L	11 (T)	16 (T)	2B	Note 3	Note 3
Copper	µg/L	15[1] (T)	34[1](T)	2B	Note 3	Note 3
Fluoride	mg/L		n/a		--	--
Mercury	ng/L	6.9 (H)	2400 (T)	2B	6.6	4.5
Nickel	µg/L	283[1](T)	2549[1] (T)	2B	37	25
Selenium	µg/L	5 (T)	20 (T)	2B	Note 3	Note 3
Sodium	mg/L		n/a		--	--
Specific Conductivity	umhos/cm	1,000	-	4A	**3,269**[4]	**2,400**[4]
Zinc	µg/L	191[1](T)	211[1](T)	2B	Note 3	Note 3
Phosphorus	mg/L		1[2]		0.05	0.02

[1] indicates a hardness based standard. It is assumed hardness in the receiving water is >200 mg/L based on available data.
[2] phosphorus standard is an effluent limit and not a water quality standard.
[3] results below detection limit.
[4] Values depicted reflect assumed values in the groundwater and LMP.
[5] WQ Standard of 700 mg/L is for total dissolved salts
WQ Standard- based on T-Toxicity Standard or H – Human Health Standard
Class denotes the appropriate MN water use classification for which the WQ standard is based upon. Note the TDS and sulfate standards would not apply to water in the CMP or Holman Lake, but would be applicable to any water used as a drinking or irrigation water source.
Source: Excelsior, 2006a and Appendix H

Increase in Net Pollutant Loadings

One of the main premises of the base case is that the overall loading of mercury and phosphorus would be less than or equal to the loading currently permitted from the dewatering operations at Hill Annex Mine Park. Under Mitigation Alternative 1, the discharge loading of mercury and phosphorus into Holman Lake would be roughly three times higher than the base case. However, the source of the mercury and phosphorus would be the existing levels in the process water sources. Some of the loading is strictly the re-introduction of mercury/phosphorus from one point to another (e.g., the mercury contained in the water removed from the Prairie River or Lind Mine Pit, which flows into the Prairie River, would be discharged to Holman Lake/Swan River and then back into the Prairie River). The remaining portion of the loading comes from the CMP, which currently does not discharge, but would if current water levels continue to rise.

As presented in Appendix H, Excelsior has explored effluent trading options with local permitted discharges. These trading options would involve funding the construction, operation and maintenance of new treatment systems at these permitted facilities to remove phosphorus or mercury to offset the increase in loadings of these pollutants from the Mesaba discharge. The potential for trading options would depend to some degree on the level of offsets required by MPCA during the NPDES permitting process.

Wetland Resources

The potential wetland impacts resulting from the proposed Mitigation Alternative 1 would be the same as those described in Section 4.7.3, West Range Process Water Blowdown Pipeline. The types of wetland functions potentially impaired by Mitigation Alternative 1 include the loss of wildlife habitat, sediment stabilization, flood flow attenuation from direct wetland impacts and the potential gain of fisheries and wildlife habitat resulting from possible secondary wetland impacts. The major difference between the base case and Mitigation Alternative 1 is that Mitigation Alternative 1 would discharge a larger volume of effluent during different operational stages of Phase I and Phase II of the IGCC power station. The increase in CTB discharged to Holman Lake by the base case would vary between 600 to 825 gpm, whereas the discharge by Mitigation Alternative 1 would vary between 900 gpm to 1,800 gpm (Phases I and II respectively).

The current volume of water discharged by Holman Lake without considering volumetric inputs from Phase I or Phase II is estimated at 1,215 gpm. By comparison, the average discharge from the lake associated with Mitigation Alternative 1 would be approximately 2,115 gpm (Phase I) and the potential maximum discharge would be 3,015 gpm (Phase II). Therefore, an increased volume of CTB entering Holman Lake would have varying levels of impacts to terrestrial and aquatic habitats, including wetlands. Changes in surface water elevations along the littoral fringe of Holman Lake could expand the size and shape of aquatic plant community based on the plants' tolerance to inundation and saturation, thereby potentially increasing fisheries wildlife habitat.

Additionally, the wetland biochemistry process could provide an opportunity to fixate or transform pollutants such as phosphorous and similar pollutants into a less mobile form, and thereby possibly improving water quality. An increase in the volume of water could have the potential to affect emergent wetlands located near Swan River. These wetlands could be subject to increased surface water elevations resulting in a slight change in wetland-dependant wildlife habitat. However, the change in habitat could be considered minor when compared to the volume of flow provided by Swan River.

Holman Lake currently experiences an annual drawdown in surface water elevation in order to keep concrete footers associated with railroad trestles near the head waters of the lake above water. Keeping water below the concrete footers functions in maintaining the structural integrity to the railroad trestles. Because Holman Lake would be receiving an increased volume of effluent, the culvert outlet and embankment may have to be structurally modified to support an increase in volume; however this would likely be required under either discharge alternative. Consequently, the aquatic resources bordering the culvert could be temporarily affected by direct and indirect impacts, such as vegetation removal or earth disturbance. Potential adverse impacts to surface water resources, including wetlands, would be avoided and minimized to the extent practicable, and implementation would be in accordance with mitigation required by the USACE during the wetland permitting phase of the project.

Biological Resources

Mitigation Alternative 1 would use the same effluent pipeline between the power plant and Holman Lake as described in Section 4.8.4, Process Water Blowdown Pipeline 1 (Mesaba IGCC Power Plant Footprint to Holman Lake) (West Range Site). Therefore, the alternative would have no additional construction impacts.

Aquatic Communities

Mitigation Alternative 1 may cause some temporary adverse impacts to aquatic fauna. Adverse impacts to aquatic communities could occur because of the increased flow into Holman Lake, which might result in the additional exporting of fish to Swan River. Impacts to the aquatic fauna would be considered minimal because the export of fish from Holman Lake to the Swan River has been occurring for a number of years, and these fish could use wetlands in or near the Swan River for food and shelter. Drawdown of Holman Lake has occurred on a yearly basis in the past; therefore, fish export has been occurring but may be more continuous under Mitigation Alternative 1.

Protected Species

There are no known occurrences of state-listed protected or otherwise rare plant species within 1 mile of the Process Water Blowdown Pipeline 1; however, investigations for protected species may be required to determine whether species of concern could be affected by the alternative.

Air Quality

For Mitigation Alternative 1, there would be a decrease in TDS concentrations within the process water compared to the base case. The result would be a decrease in worst-case emissions of particulate matter due to cooling tower drift from 39 tons per year to 35 tons per year.

Mitigation Alternative 2a – Base Case with Swan River Discharge

This mitigation alternative is similar to the base case but would relocate the outfall currently proposed for Holman Lake to the Swan River. Mitigation Alternative 2a would reduce the potential for localized impacts associated with discharge into a relatively small lake, and would expand the options for water quality trading mentioned in the discussion of Mitigation Alternative 1. The blowdown pipeline alignment would follow the proposed HVTL and natural gas pipeline corridor from the West Range Site, south approximately 4.5 miles, to where the corridor would cross the Swan River. This crossing is less than half a mile upstream from the confluence of Holman Lake's discharge and the Swan River (see Figure 2.1-2). While the currently proposed pipeline from the plant to Holman Lake could be eliminated, it may be necessary to maintain the proposed tie-in linking the CMP to Holman Lake in order to manage water levels in the CMP. In addition, this alternative could be combined with Mitigation Alternative 1, which would result in having all the CTB effluent being discharged to the Swan River (with no discharge to the CMP).

Mitigation Alternative 2a was reviewed to determine the resources that would be affected by this alternative. It was determined that the resources that would be affected would be water resources and wetlands, as described below.

Water Resources

Mitigation Alternative 2a would affect water resources in terms of process water withdrawals and the discharges of CTB to the Swan River. The impacts to these resources are presented in the following sections.

Process Water Supply Systems

The impacts to water resources from the water withdrawals associated with Mitigation Alternative 2 would be the same as discussed in Section 4.5 for the base case.

Process Water Discharges and Water Quality Standards

Under this alternative, process water discharges to the CMP would be the same as presented in Section 4.5, which indicate a gradual increase in pollutant levels within the CMP and some would eventually reach or exceed water quality standards. Mercury concentrations, however, would not exceed current water quality standards. The impacts to the Swan River would also be similar to the base case, as the mass loading to the watershed for chemicals of concern, such as phosphorus and mercury, would not change under this alternative. However, there would be no direct impacts in Holman Lake (either adverse or beneficial).

Under Mitigation Alternative 2a, impacts to the water quality in the Swan River would be similar to those presented for the base case during average flow conditions, as the discharge would mix with roughly the same overall volume of water (because the discharge would be just upstream of the confluence of Holman Lake). Once completely mixed with the Swan River under average flow conditions (roughly 28,000 gpm), the pollutant concentrations from the CTB discharges would be reduced approximately 33-fold. Based on the expected discharge concentrations shown in Table 5.3-4 for the base case, all parameters would be within water quality standards after complete mixing with the Swan River. However, no water quality monitoring data is available for the Swan River, so the additive effect of this discharge can not be determined.

There would be impacts to the Swan River under low flow conditions. Because the 7Q10 flow of the Swan River is low, 800 gpm (USGS, 2007), the river could consist primarily of CTB during low flow conditions. While the CTB discharge would augment the stream flow during such periods, the TDS and hardness concentrations would be relatively high and exceed standards. As with the base case, a variance for TDS and hardness would be required.

The discharge to Swan River instead of Homan Lake should reduce the possibility of impacts related to the formation of methyl mercury in Holman Lake. While the possibility of methyl mercury formation would not be completely eliminated, some factors that are suggested to be involved with its formation would be diminished. There would generally be less contact with adjacent wetlands under this alternative, and sulfate would be more fully diluted under normal flow conditions. While some localized impacts to the Swan River near the point of discharge are possible, they are of lesser concern in a flowing river than in a lake.

Thermal Impacts

Mitigation Alternative 2a would have minimal thermal impacts on the Swan River during normal flow conditions, as the blowdown discharge would be approximately 3 percent of the river flow. However, during low flows periods, the flow in the river (just downstream of the discharge point) would be predominantly CTB discharge. As in the discussion of water quality impacts for the base case (Section 4.5), there would likely be a need for a variance for the temperature of the discharge. During worst-case conditions, blowdown water would leave the plant at approximately 86°F during peak summer temperatures (Excelsior Energy, 2006a), which just meets absolute state water quality standards, but would exceed the relative limit of 3°F above ambient water temperatures (Minnesota Rules 7050.0220 subparagraph 5). Due to the low 7Q10 value for the Swan River, even with a mixing zone, it is unlikely that this standard could be met without a variance or without the use of cooling ponds.

Wetlands

This alternative would increase the total miles of blowdown pipeline by approximately two miles as compared to the base case. However, the additional pipeline would be along corridors used for the HVTL lines and natural gas pipeline, reducing any impacts associated with a new discharge pipeline corridor. A 150-foot right-of-way (ROW) is proposed where HVTL and natural gas pipelines share a corridor. The corridor may be able to accommodate the blowdown pipeline as proposed, or slight additional widening may be necessary. Therefore, while such widening may cause additional wetland and land use impacts, the impacts would be very small, and would be minimized by staying within established infrastructure corridors to the maximum extent possible and especially within wetlands.

Mitigation Alternative 2b – Mitigation Alternative 1 with Swan River Discharge

This alternative is a combination of Mitigation Alternatives 1 and 2a, where the CTB discharge would be directed to the Swan River rather than Holman Lake, and no CTB discharge would occur into the CMP under normal operating conditions. The impacts from construction of this alternative are the same as presented for Mitigation Alternative 2a; however, the impacts from operation are similar to Mitigation Alternative 1. The water management plan and expected discharge concentration in the CBT discharge would be the same as presented for Mitigation Alternative 1. The impacts from this alternative, not previously discussed for either Mitigation Alternative 1 or 2a, are presented below.

Process Water Discharges and Water Quality Standards

Under this alternative, impacts to the water quality in the Swan River would be similar to those presented for the Mitigation Alternative 2a during average flow conditions, but the volume of CTB discharge would increase up to 1,800 gpm, which would result in less attenuation of the discharge once mixed with the Swan River. However, once completely mixed with the Swan River, the pollutant concentrations from the CTB discharges would be reduced approximately 15-fold. Based on the expected discharge concentrations shown in Table 5.3-4 for the Mitigation Alternative 1, all parameters would be below water quality standards after complete mixing with the Swan River. However, no water quality monitoring data is available for the Swan River, so the additive effect of this discharge can not be determined.

There would be impacts to the Swan River under low flow conditions, as discussed for Mitigation Alternative 2a. While the CTB discharge would augment the stream flow during such periods, the TDS and hardness concentrations would be relatively high and exceed standards. A variance for TDS and hardness would be required.

Thermal Impacts

Mitigation Alternative 2b would have minimal thermal impacts on the Swan River during normal flow conditions, as the blowdown discharge flow would be approximately 6 percent of the river flow. However, during low flows periods, the flow in the river (just downstream of the discharge point) would be predominantly CTB discharge. For this alternative, a request for a variance for the temperature of the discharge may be necessary, as discussed for Mitigation Alternative 2a.

Mitigation Alternative 3 – ZLD Treatment

Mitigation Alternative 3 would employ ZLD treatment to eliminate all process-related effluent discharges from the plant. A ZLD system on the West Range Site would be implemented as described for the East Range Site in Section 4.5.4. This alternative would eliminate all CTB blowdown discharges and associated pipelines from the facility and would reduce the facility's overall water appropriation needs. The use of ZLD treatment for all the process wastewaters would result in a significant increase in capital and O&M costs, a reduction in plant efficiency and output, an increase in solid waste, and an increase particulate matter emissions from cooling tower drift.

Mitigation Alternative 3 was reviewed to determine the resources that would be affected. It was determined that the resources affected would be water resources, solid waste disposal, air quality, and plant capacity and efficiency. This alternative would also reduce the loss of wetlands (up to 17 acres) and reduce impacts to land use, as no CTB discharge pipeline would be constructed.

Water Resources

Process Water Supply Systems

Compared to the base case, the maximum water appropriation needs for two Mesaba phases under this alternative would decrease from 10,300 gpm to 7,000 gpm (Excelsior Energy, 2006a). However, the base case includes the CTB discharge from the plant to the CMP of up to 3,500 gpm, which would be eliminated under Mitigation Alternative 3. Overall, the water needs are slightly less than the base case and Mitigation Alternative 1.

Process Water Discharges and Water Quality Standards

By employing ZLD treatment of all process waters, there would be no impacts to water quality from the operation of the plant under this alternative.

Solid Waste Disposal

Mitigation Alternative 3 would increase the amount of non-hazardous salts that must be transported from the site for disposal at a landfill. For the East Range Site, the Mesaba Generating Plant could produce up to 24,000 tons/year of solid waste by employing ZLD treatment, based on the source water quality that has up to 1,800 mg/L of TDS (Excelsior Energy, 2006b). Because the source water quality on the West Range Site has a lower concentration of TDS (340 mg/L), the maximum non-hazardous waste (salt) production from the ZLD system would be less than 5,000 tons/year at full operation (Phase II). Discussions between Excelsior and the manager of the St. Louis County Solid Waste Department in Virginia, MN (the closest industrial non-hazardous waste facility) determined that the facility can accommodate the waste generated by the ZLD system.

Air Quality

Under this alternative, the cycles of concentration at which cooling towers operate would likely be increased (to 10 or more) and, therefore, there would be an increase of particular matter emissions due to cooling tower drift. At 10 COCs, the particulate emissions due to drift would increase from 39 tons/year to 78 tons/year, resulting in total facility wide particulate emissions of 532 tons/year (instead of 493 tons/yr with the base case). The visibility and air quality impacts from an additional 39 tons/year would be negligible.

Pipeline Alignment Impacts

Under this alternative, construction of blowdown pipelines from the plant would not be necessary. Impacts to wetlands may be reduced by up to 17 acres, and land use impacts would be reduced as well.

Plant Capacity and Efficiency

Operation of the ZLD system would consume electricity, adding to the parasitic load within the facility, which has two closely connected effects. First, it would reduce the net output capacity of the plant. Second, it would reduce the efficiency of the plant proportionately to this reduction in capacity. On the East Range Site, plant capacity could be reduced by up to 2 MW (approximately 0.3%), and the corresponding heat rate increase would be 31 Btu/kWh. As mentioned above, the source water quality at the West Range Site is superior, which is likely to reduce the parasitic load of ZLD treatment versus the East Range Site. Therefore, a 2 MW reduction in plant capacity and 31 Btu/kWh increase in heat rate are likely to overestimate this effect for the West Range Site. However, to the degree that efficiency is reduced, air emissions, on a per megawatt hour basis, would increase (by a maximum of about 0.3%).

5.3.2.2 Mitigation Options for Visibility Impacts to Class I Areas

As part of the Prevention of Significant Deterioration ("PSD") permitting process, Excelsior is currently negotiating with state and Federal regulators to achieve a set of operating conditions that will satisfy all applicable regulatory requirements (including those governing impacts on air quality and air quality-related values like visibility). Because of their inherently high-efficiency and low-polluting technology, IGCC power plants are able to meet more stringent emission standards than conventional power plant technologies (EPA, 2006e). The best available control technology (BACT) analysis for the two phases of the Mesaba Energy Project emphasizes the inherently lower polluting nature of IGCC processes and improvements in the design basis of E-Gas™ technology resulting from years of experience at the Wabash River Coal Gasification Repowering Project. However, if the current design basis for the Project is deemed by regulators to produce modeled visibility impacts above acceptable thresholds, additional mitigation may be required.

The purpose of this section is to identify options available for mitigating the modeled visibility impacts of the Mesaba Generating Station to Class I areas discussed in Section 4.3. The essence of any option implemented along a continuum of choices would be to reduce emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), two important precursors of fine particulate matter that produce modeled visibility impacts. Changing the current design basis of Phase I and Phase II of the Mesaba Energy Project to reflect pre and post-combustion SO_2 and NO_X controls characterizing Lowest Achievable Emission Rate (LAER) technology (*see* 40 CFR 51.165(a)(1)(xiii) to distinguish LAER from Best Available Control Technology, or BACT) represents one extreme of this continuum. Offsetting the Project's SO_2 and NO_x emissions through the purchase of emission allowances or other reduction credits from other facilities, which would not require changes to the Project's existing design basis represents the other extreme. Regardless of the outcome of Excelsior's negotiations with state and Federal regulators over the Project's modeled visibility impacts and any steps required to mitigate them, DOE can require additional mitigation as a condition of the Record of Decision for this EIS.

Enhancement of Existing Design Basis

The current design basis for Phase I and Phase II of the Mesaba Energy Project Generating Station employs a chemical solvent (i.e., methyl diethanolamine or MDEA) to reduce levels of hydrogen sulfide in syngas (which when combusted produces emissions of SO_2) and nitrogen dilution to reduce NO_X formation during syngas combustion. Although Excelsior maintains that the current design basis for the Mesaba Generating Station, involving IGCC technology, represents BACT for SO_2 and NO_x emissions as defined in 40 CFR 52.21(b)(12), Excelsior could be required to enhance its current design basis to produce further SO_2 and NO_X emission reductions to reduce modeled visibility impacts.

For SO_2 emissions, a potential design enhancement would involve increasing the capture efficiency of the acid gas removal system (i.e., the MDEA system) by altering equipment or by changing the solvent used. The MDEA system enhancement could involve adding refrigeration to the MDEA chemical solvent system or increasing the take-off height in the MDEA tower to allow for further contact between MDEA and the sour syngas. This approach would enhance capture of H_2S and ultimately reduce SO_2 emissions from the plant. Alternatively, emissions of SO_2 could be reduced by changing the MDEA chemical solvent to the more-efficient physical solvent, Selexol (a step in the continuum toward LAER technology).

Although these options could reduce SO_2 emissions and mitigate modeled visibility impacts in Class I areas, their implementation would adversely impact the power plant's performance. Such impacts would include: reducing the plant's thermal efficiency and output capacity (thereby increasing emissions of CO_2 and criteria pollutants on a pound-per-megawatt-hour basis); introducing additional complexity into system operations (e.g., the addition of programmable logic controls allowing automated variation of MDEA column take-off point and the resizing of equipment to handle increased gas flow through the Claus unit), increasing production of elemental sulfur to be managed; and increasing capital and operating costs as an overall result. Excelsior is addressing the overall assessment of these impacts as part of its BACT analysis under PSD permitting rules (Excelsior, 2006d).

For NO_x emissions, a potential design enhancement could involve installing post-combustion selective catalytic reduction (SCR) technology controls. In this case, ammonia would be injected into the flue gas at appropriate points within the HRSG and react with NO_x to produce nitrogen and water (such reaction being catalyzed by proprietary materials). SCR has been used extensively to control NO_x emissions from pulverized coal units as well as natural gas-fired combustion turbines. However, the use of SCR on higher sulfur coals can result in increased levels of sulfur trioxide (SO_3) (DOE, 2002). For IGCC, there are significant concerns related to the interaction of ammonia and sulfur species, and the addition of SCR can require deeper sulfur removal than otherwise necessary to comply with sulfur emission restrictions. Further, the use of SCR results in stack releases of ammonia via ammonia slip, which can present significant performance issues in the HRSG and decrease the availability of the power plant. Additionally, ammonia releases could contribute to small particle formation that could contribute to modeled visibility impacts.

Emission Offsets

Emissions of SO_2 and NO_x from Phases I and II of the Mesaba Generating Station can be offset through allowance purchases or controls placed on previously uncontrolled or poorly controlled air emission sources. The Mesaba Energy Project represents a unique circumstance in Minnesota in that it is the only coal-fueled power plant that it is required under the Clean Air Interstate Rule (CAIR) to purchase SO_2 allowances equivalent to 100 percent of its SO_2 emissions. Such allowances can be purchased selectively from sources having modeled visibility impacts on Class I areas, so as to represent an effective means of reducing such impacts from Project operations. To the extent that the Project's provision of SO_2 allowances required by the CAIR are determined to be insufficient to reduce modeled visibility impacts to acceptable levels, Excelsior could purchase additional SO_2 and NO_x allowances. Excelsior also has the option to upgrade existing air emission sources of SO_2 and NO_x to the extent that such improvements are cost-effective relative to addition of controls beyond BACT and to the extent that such controls would reduce modeled visibility impacts.

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5.4 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

The Proposed Action would commit either the West Range Site or East Range Site as the location for an IGCC electricity generating station for the foreseeable future. Site preparation would include the filling of low-lying areas and grading to provide a developable site plan, which would impact wetlands, vegetation, and wildlife habitat as described in Sections 4.7 and 4.8. Although arguably these resources could be reclaimed at some point in the future, it is unlikely that they would be restored to their original conditions and functionality. Therefore, these commitments are considered irreversible.

> A resource commitment is **irreversible** when primary or secondary impacts from its use limit future use options and **irretrievable** when its use or consumption is neither renewable nor recoverable for use by future generations.

The implementation of the Proposed Action would potentially result in the irretrievable commitment of building materials for construction of the Mesaba Energy Project, although many of the building materials can be reused or recycled at a future date. Operation of the proposed facility would require the irretrievable commitment of coal and/or petroleum coke, natural gas (used during startup and as a backup fuel), and small quantities of process chemicals, paints, degreasers, and lubricants as described in Sections 2.2.2 and 4.16. None of these resources is in short supply relative to the size and location of the proposed facilities. Process water and potable water used by the facility would be returned to the environment by evaporation, treatment, and discharge by publicly owned treatment works (potable water use), and discharge to surface waters (process water at West Range Site).

The construction and operation of the proposed facilities would require the commitment of human resources that would not be available for other activities during the period of their commitment, but this commitment would not be irreversible. Finally, the implementation of the Proposed Action would require the commitment of financial resources by Excelsior, its investors and lenders, and DOE for the construction, demonstration, and operation of the Mesaba Energy Project. However, these commitments are consistent with the purpose of and need for the Proposed Action as described in Chapter 1.

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5.5 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The Proposed Action would support the DOE objective of demonstrating and promoting innovative coal power technologies that can provide the United States with clean, reliable, and affordable energy using abundant domestic sources of coal. The long-term benefit of the proposed project would be to demonstrate advanced power generation systems using IGCC technology at a sufficiently large scale to allow industries and utilities to assess the technology's potential for commercial application. The ability to show prospective domestic and overseas customers an operating facility rather than a conceptual design or engineering prototype would provide a persuasive inducement for them to purchase this advanced coal power technology. Successful demonstration would enhance prospects of exporting the technology to other nations and may provide the single most important advantage that the United States could obtain in the global competition for new markets.

The proposed project would minimize SO_2, NO_x, mercury, and particulate emissions. The project is expected to remove almost 99 percent of the SO_2 produced in the IGCC process. The removal of nearly all of the fuel-bound nitrogen from the synthesis gas prior to combustion in the gas turbine would result in appreciably lower NO_x emissions compared to conventional coal-fired power plants. More than 90 percent of the mercury would be removed from the fuel as received, and particulate emissions from the preliminary turbine stack are expected to be near zero. Also, emissions of CO_2 are expected to be 15 to 20 percent less than would be produced at conventional coal-fired power plants, and the facility would be designed to be adaptable for retrofit of carbon capture technology.

The Proposed Action would also support the objectives of the Mesaba Energy Project proponent to provide a source of electric power for the State of Minnesota and the national electric grid, as well as provide economic revitalization for the Taconite Tax Relief Area and Arrowhead Region of Minnesota. Local officials, business leaders, and many residents consider the potential environmental impacts that would occur during construction and operation of the IGCC generating station to be acceptable tradeoffs for the long-term productivity of Iron Range communities. Project aspects that would enhance long-term productivity in the region include:

- The generation of 1,212 MWe to help alleviate the need within Minnesota for 3,000 to 6,000 MWe of new baseload power generation over the next 15 years (Section 1.4.1.1).
- The direct, indirect, and induced creation of 400 to 3,600 jobs annually in the Arrowhead Region during the six years of construction for the Mesaba Energy Project Phases I and II (Section 4.11.2.1).
- The direct, indirect, and induced contribution of $3.1 billion of total economic output in the Arrowhead Region during the six-year construction period for Phases I and II (Section 4.11.2.1).
- The direct, indirect, and induced creation of more than 400 jobs annually in the Arrowhead Region during full operation of Phases I and II beginning in 2015 (Section 4.11.2.2).
- The direct, indirect, and induced contribution of $1.1 billion of total economic output in the Arrowhead Region annually during full operation of Phases I and II (Section 4.11.2.2).
- The stabilization of water levels in the Canisteo Mine Pit, where increasing water depth has required the closure of a rail line along an embankment on the rim of the pit north of the City of Coleraine to prevent potential flooding from embankment failure.

Short-term uses of the environment would pertain to the activities and associated impacts during construction that have been described throughout Chapter 4 and include such effects as:

- Aesthetic impacts from construction affecting nearby residents as described in Section 4.2, including the effects on viewsheds from land-clearing activities and the exposure to emissions of fugitive dust and noise during construction.
- Impacts on air quality as described in Section 4.3, including fugitive dust emissions during construction.
- Erosion and sedimentation impacts on surface waters during construction as described in Sections 4.4 and 4.5, which generally would be mitigated through the use of required control measures.
- Loss of wetlands, vegetation, and wildlife habitat caused by land-clearing activities as described in Sections 4.7 and 4.8.
- Traffic impacts during construction attributable to temporary diversions and the movement of heavy equipment as described in Section 4.15.
- Increased noise from construction activities affecting nearby residents as described in Section 4.18.