3. AFFECTED ENVIRONMENT

3.1 CHAPTER OVERVIEW

This chapter describes the environmental setting as it relates to the Proposed Action and alternatives. The chapter has been prepared to address the required elements of an EIS in accordance with NEPA (40 CFR 1502.15) and the Minnesota Power Plant Siting Act, and it includes information on relevant environmental resource areas identified through the scoping process in the following sections:

3.2 Aesthetics

3.3 Air Quality and Climate

3.4 Geology and Soils

3.5 Water Resources

3.6 Floodplains

3.7 Wetlands

3.8 Biological Resources

3.9 Cultural Resources

3.10 Land Use

3.11 Socioeconomics

3.12 Environmental Justice

3.13 Community Services

3.14 Utility Systems

3.15 Traffic and Transportation

3.16 Materials and Waste Management

3.17 Safety and Health

3.18 Noise

The extent of information provided in each section of this chapter is commensurate with the baseline data necessary to support the impacts analysis presented in Chapter 4.

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3.2 AESTHETICS

This section describes the existing aesthetic attributes that may be affected by implementation of the Proposed Action. Aesthetic resources include scenic areas, such as public lands (e.g., national parks or forests), nature preserves, viewsheds, and other visual resources preserved and managed by the Federal, state, and local governments.

3.2.1 Background and Definitions

3.2.1.1 Aesthetic Definitions and Principles

Aesthetic resources addressed in this section consist of two aspects: viewsheds and scenic resources. Other aesthetic aspects, such as noise and visual haze (air quality), are addressed in other sections of this chapter. For this EIS, scenic resources are considered to be lands that are managed by Federal, state, and local governments for preservation purposes. These areas generally have inherent natural or manmade aesthetic properties that give a landscape its character and value as an environmental factor. Viewsheds are generally non-managed areas with aesthetic value. While the government does not typically protect viewshed locations, the community may still value these aesthetic qualities.

The framework for characterizing the existing conditions is derived from the Bureau of Land Management's (BLM) resource inventory system, which was designed to categorize and describe viewscapes for management and NEPA purposes (BLM, 1980). The resource inventory system is comprised of three elements, scenic quality, visual sensitivity, and visual distance:

- "Scenic quality" measures the visual appeal of the land area, and includes factors such as landform shape, vegetation, water, color, adjacent scenery, and additional cultural modifications. In essence, it describes the purity, or "pristineness," of a given viewscape;
- "Visual sensitivity" gauges the public's concern for the scenic quality. Wilderness areas with virgin forests are considered to have higher visual sensitivity than an industrial park. Publicly held lands, parks, and scenic routes would also be expected to have high visual sensitivity; and
- "Visual distance" describes the depth perspective of the view. Objects found in the foreground tend to be more predominant than ones in the distance. However, a deeper perspective provides depth and can add to the scenic quality. Therefore, elevation, tree height, and visual distance all contribute to a viewscape's visual distance.

The above criteria are used to qualitatively describe current aesthetics resources of the region. Public lands, industrial mining areas, lookout points, and lakes will be described here to provide context for the impacts analysis in Section 4.2.

3.2.1.2 Regional Setting

The Minnesotan north woods is a scenic area with rolling hills, many lakes of varying size, and large swaths of forests. The area is rural, with small towns, and a mixture of recreation cabins among permanent residences. Four-season outdoor activities are a main source of recreation and area income. Major activities in the area include fishing, water recreation, biking, operating all-terrain vehicles (ATVs) and snowmobiles, hiking, and skiing. There are numerous trails and unpaved roads within the area, which connect local villages to the deep woods. Forest views are extremely restricted during the growing seasons but extend further with the absence of leaves during the fall, winter, and early spring. Vegetation is thick and high, with an average tree height between 60 and 80 feet.

There are numerous industrial traces in the Mesabi Iron Range area, resulting from historic and active iron ore mining. An abandoned mine area consists of the mine pit and an adjacent tailings pile. Groundwater infiltrates the mining pits and generates manmade lakes and ponds. Separate mines may also be connected by water, generating long, linear lakes. Where the mine pit edge is above the water, the

slopes are very steep from the extensive local cuts. Adjacent to the mine pits are large waste rock piles from the mining activities. The tops of these tailings piles can extend up to 200 feet above the surrounding topography. They have steep slopes and sparse vegetation, and are very prominent in the landscape. Trees have begun to re-vegetate the top and slopes of some tailings piles; however, the shape and red rock are still visible from a distance. Figure 3.2-1 shows the Canisteo mine pit and a tailings pile near the West Range Site in late October 2005. The branch in the foreground is the top of a dead tree drowned by the increasing pit water height.

Figure 3.2-1. View of the Canisteo Mine Pit and Tailings Pile Looking North

3.2.2 Viewsheds

A viewshed is the land, water, and other environmental elements that are visible from a fixed vantage point. Since much of northern Minnesota is forested, most of the views are foreground to medium depth. Tall trees often adjoin roadways and population centers, restricting long-distance views. Breaks in the trees, from wetlands, lakes, or cleared areas generate the medium-range views in the area. The local topography is relatively flat, with a typical elevation variation of 200 feet. The best long-range views are from the summits of man-made tailings piles and on the ridges along the Messabe Mountain range. These areas have few trees and generally provide the height needed to see for many miles (Figure 3.2-2).

Figure 3.2-2. View from the Lind Mine Pit Tailings Pile Looking East

3.2.2.1 West Range Site and Corridors

West Range Site

The West Range Site is currently forested with shorter vegetation occurring in wetlands and along existing HVTL corridors that cross the property (Figure 3.2-3). Sections 3.10, Land Use; and 3.8, Biological Resources; describe the land use and local vegetation in more detail. The topography varies from 1,300 to 1,520 feet above sea level. There are several natural lakes that provide viewsheds within the vicinity of the West Range Site as shown in Figure 2.3-3 in Section 2.3.1.3, including Dunning Lake Holman Lake, Big Diamond Lake, and Little Diamond Lake. Many of the lakes in the area have water access through private cabins along the lakefront. The largest natural lakes in the West Range area are Trout Lake, Swan Lake, and Twin Lakes. Further discussion of the lakes is provided in Section 3.5, Water Resources.

Figure 3.2-3. View of West Range Site Looking North along HVTL (45L)

There are also numerous water-filled mine pits in the vicinity of the West Range Site. The CMP consists of a sequence of flooded mines extending from east to west. To the east, the Arcturus Mine, Hill Trumbull Mine and Hill-Annex Mine form the Gross-Marble Mine Pit (GMMP). When the pits were mined, large swaths of glacial overburden were removed, and the iron ore extracted. These cuts are still visible along the mine wall, with sheer drops of tens of feet occurring in places. Current access to the water occurs along old mining access roads and allows recreational boating to occur.

CR 7 extends north from US 169 around the west side of the West Range Site (Figure 3.2-4). This highway is screened on either side by trees and by wetlands to the west near US 169. From US 169, CR 7 extends north for approximately 25 miles and ends at Big Fork. Near Big Fork, CR 7 crosses portions of the George Washington State Forest. CR 7 is not a state or National Scenic Byway, and the designation "Scenic Highway" is considered to be a local reference.

West Range Corridors

HVTL corridors for the West Range Site are described in Section 2.3.1.5 and shown in Figure 2.3-4. Where possible, HVTLs would follow existing utility corridors. In general, the existing corridors are characterized by areas of cleared/maintained low-lying vegetation bordered by forested areas (Figure 3.2-3). Surrounding forests typically screen the existing utility corridors with the exception of where they intersect roads or terminate at mine pits (Figure 3.2-4).

Figure 3.2-4. View of CR 7 Near West Range Site Looking North

The proposed rail alignments would cross Diamond Lake Road (Figure 3.2-5) and a minor unpaved road at different locations as illustrated in Figure 2.3-2. These corridors are generally comprised of undeveloped, vegetated lands except at road crossings or along areas disturbed by prior mining activities. Residential receptors near the West Range Site and associated utility and rail corridors are shown in Figure 3.2-6 and Figure 3.2-7.

Figure 3.2-5. View of Diamond Lake Road Near Potential Rail Crossing

3.2.2.2 East Range Site and Corridors

East Range Site

The East Range Site is located in an area characterized by active mining operations and undeveloped forest (Figure 3.2-8). The immediate area around the East Range Site slopes to the southeast towards wetlands and the northern border of Colby Lake. Sections 3.10, Land Use; and 3.8, Biological Resources; describe the land use and local vegetation in more detail. Area elevations range from 1,450 to 1,500 feet above sea level. Mine tailings piles exist in two locations near the proposed site. The closest is approximately 300 feet west of the East Range Site. The other is approximately one mile northeast of CR 666. Minnesota Power's Syl Laskin Energy Center, a coal-fired power plant, is located approximately 2 miles south of the East Range Site. The Syl Laskin exhaust stack is currently visible to the Hoyt Lakes population.

Two lakes are located within the vicinity of the proposed East Range Site. Colby Lake and Whitewater Lake are located directly south of the East Range Site. Numerous four-season residences are located on the shores of the lakes. There are no residences immediately north of the East Range Site due to active mining operations by CE.

Elongated bedrock mountains are located to the north-northwest of the eastern portion of the Mesabi Iron Range (including the towns of Biwabik, Aurora, and Hoyt Lakes). Embarrass Mountain is located approximately 4 miles to the northwest of the East Range Site, rising 1,940 feet above sea level. There are several lookout towers and a commercial skiing resort located on these mountains. The Giants Ridge Ski Area (1,844 feet above sea level) is located directly west of Embarrass Mountain.

Figure 3.2-8. View of East Range Site from Tailings Pile Looking East

East Range Corridors

The Mesabi Iron Range stretches north of the HVTL corridors and has topographic heights extending 500 feet above the surrounding area. The Messabe Mountain near Gilbert reaches an elevation of 1,840 feet above mean sea level. Farther north, Pike Mountain and Lookout Mountain have summit elevations of approximately 1,930 and 1,860 feet above mean sea level, respectively. Lookout stations on the summits provide views of the surrounding area. Alternative rail alignments and access roads would enter the East Range Site from the south through an area of forested land. Residential receptors near the East Range Site and associated utility and rail corridors are shown in Figure 3.2-9 and Figure 3.2-10.

3.2.3 Scenic Resources

There are many types of public land in northern Minnesota. Federal lands include National Parks, Forests, and Indian Reservation Lands. The Minnesota Department of Natural Resources (MNDNR) manages 90 percent of the state-owned lands, which include state parks and forests, wildlife management areas, scientific and natural areas, and state recreation areas (Minnesota State Legislature, 2006). These areas are used for a variety of purposes, including silviculture, recreation, and scientific study. Figure 3.2-11 shows the State Parks and other public lands in northern Minnesota. Certain state forests, such as Bowstring and Blackduck, are part of national forests (e.g., Chippewa National Forest). Public lands around the West and East Range locations are discussed in respective sections below. The Mesabi Trail, owned by the St. Louis and Lake Counties Regional Railroad Authority, extends 130 miles from Grand Rapids east to Winton along US 169 and SR 135, offering a wooded path for hiking, biking, skating, skiing, snow-shoeing, and limited snow-mobiling.

3.2.3.1 West Range Site and Corridors

West of Grand Rapids, large portions of land are part of the Chippewa National Forest. The Chippewa National Forest also includes the Leech Lake Indian Reservation. The Hill Annex Mine State Park is located to the east of the West Range Site. This state park features the mining history of the area, demonstrates mining equipment and operations, and provides views of flooded mine pits and surrounding lands from the top of the tailings piles. The Forest History Center features the north woods foresting and silviculture history. The center includes a 100-foot fire tower and a living history museum. Other state parks and forests are located 20 to 30 miles away from the West Range Site and potential corridors. Locally, Holman Lake provides a public recreation and swimming area within 2 miles south of the site. Table 3.2-1 lists some of the public lands and reservations in relation to the West Range Site. Section 3.10 also describes the publicly owned lands in the area.

Table 3.2-1. Public Lands in the Vicinity of the West Range

Name	Approximate Distance from the Site (miles)[1]	Location in relation to the Site
Hill Annex Mine State Park	5	Southeast
Forest History Center	15	Southeast
Chippewa National Forest	Closest edge is 20 miles	West-Northwest
Leech Lake Reservation	20	West
Golden Anniversary Sate Forest	20	Southwest
School Craft State Park	22	Southwest
George Washington State Forest	27	Northwest
Scenic State Park	26	Northwest

Note: [1]These sites are located outside of the 2-mile region of influence.

3.2.3.2 East Range Site and Corridors

The East Range Site is located adjacent to an active iron ore mining operation. The Syl Laskin Energy Center is also located south of the proposed East Range Site. A public landing and picnic spot, known as Birch Cove, is located on the southern border of Colby Lake overlooking the Syl Laskin plant (Figure 3.2-12).

Figure 3.2-12. View of Syl Laskin Energy Center from Birch Cove Park Looking North

Portions of the Superior National Forest are adjacent to Hoyt Lakes and a portion extends in to the city limits, and extends further north, south, and east. As an extension of the Superior National Forest, the Superior National Forest Scenic Byway extends from Aurora, through Hoyt Lakes, and along State Route 16 to Silver Bay at Lake Superior's north shore. The scenic byway is considered to be a scenic, rural passage through pine forests and the Mesabi iron mining towns (Explore Minnesota, 2006). Aside from the Superior National Forest, two other state parks are located within 30 miles of the East Range Site, as shown in Table 3.2-2. Section 3.10 describes the publicly owned land surrounding the East Range Site and corridors.

Table 3.2-2. Public Lands in the Vicinity of the East Range

Name	Approximate Distance from the Site (miles)	Location in relation to the Site
Superior National Forest	<1	East
Bear Head Lake State Park	16	North
Soudan Underground Mine State Park	20	Northwest

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3.3 AIR QUALITY AND CLIMATE

This section describes the overall air quality within the region. Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. The emissions from the Mesaba Generating Station (combined Phase I and II), except for particulate matter – 10 microns (PM_{10}), would be independent of the site selected.

3.3.1 Sensitive Air Quality Receptors

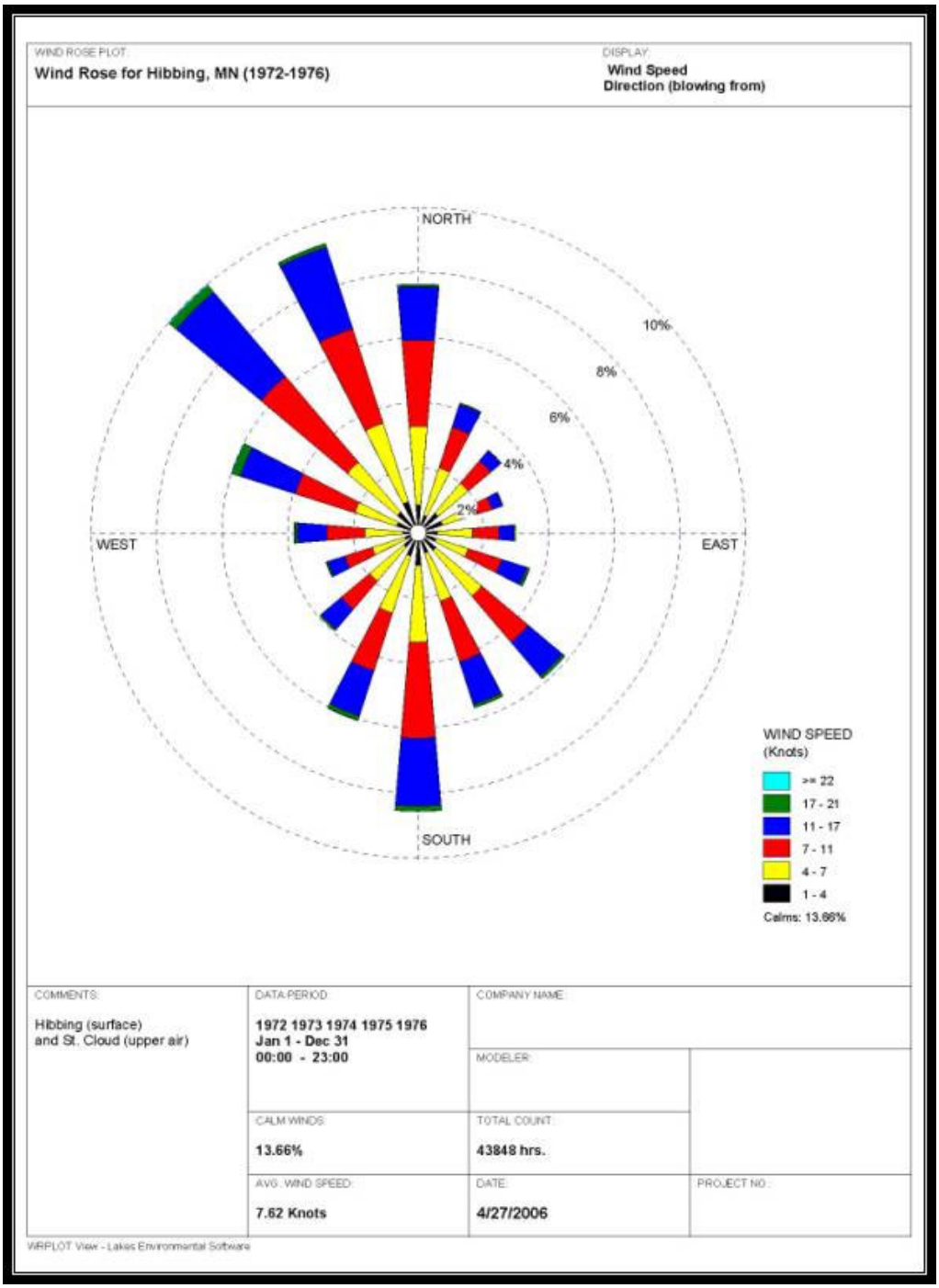
For the purposes of air quality analysis, any area to which the general public has access is considered a sensitive receptor, and includes residences, day care centers, educational and health facilities, places of worship, parks, and playgrounds. An Air Emission Risk Assessment (AERA) was conducted to assess whether air emissions from the Mesaba Energy Project could pose an unacceptable health risk to nearby residents (see Section 4.17).

The closest residence to the power plant footprint in the West Range Site is located 1.1 kilometers (0.7 miles) away. A farm is located approximately 1.7 kilometers (1.1 miles) west-southwest of the power plant footprint on the West Range Site. For the East Range Site, the nearest residences are located about one mile directly south of the Mesaba IGCC Power Plant Combustion Turbine Generator/Heat Recovery Steam Generator (CTG/HRSG) stack, in the City of Hoyt Lakes. There are no other significant receptors, such as schools, daycare centers, recreation centers, playgrounds, nursing homes or hospitals located within this distance. The primary emission point from either site will be the flare and CTG/HRSG stack. The closest residence to the flare and CTG/HRSG stack emission points on the East Range Site is located about 1.9 kilometers (1.2 miles) and 2.6 kilometers (1.4 miles) away, respectively.

3.3.2 Local and Regional Climate

Minnesota has a continental-type climate and is subject to frequent occurrences of continental polar air throughout the year, with occasional Arctic occurrence during the cold season. Occasional periods of prolonged heat occur during summer, particularly in the southern portion when warm air pushes northward from the Gulf of Mexico and the southwestern United States. Pacific Ocean air masses that move across the western United States produce comparatively mild and dry weather at all seasons (MCWG, 2006). Prevailing winds are from the northwest (approximately 10 percent of the observations) and the north-northwest (9 percent of the observations) at between 7 to 17 knots (8 to 20 miles per hour). Southerly winds occur in just over eight percent of the observations. Figure 3.3-1 provides a wind rose based on five years of hourly meteorological data (1972–1976) from Hibbing, Minnesota (surface) (MNDNR, 2006a). This wind rose is applicable to both the West Range and East Range sites.

Temperatures throughout the year are highly variable, with extremes ranging from 114°F to negative 60°F. Average temperatures range from 5.7°F in January to 67.4°F in July. From December through February, the maximum temperature is below 32°F for an average of 24 days per month. During the summer, the maximum temperature exceeds 90°F for an average of five to six days a year. Mean annual precipitation is 34 inches in southeast Minnesota and 19 inches in the northwest portion of the state. The number of days with precipitation per month varies from seven days in February to 13 days in June, with approximately two-thirds of the annual precipitation occurring between August and December.



Source: MNDNR, 2006a

Figure 3.3-1. Wind Rose Data at Hibbing, Minnesota

The area receives an average of approximately 56 inches of snow annually. Snow cover of one inch or more over Minnesota occurs on an average of about 110 days annually, ranging from 85 days in the south to 140 days in the north. Due to the abundance of small lakes in the region, fog is likely to form on and around the lakes during clear, calm conditions in the evening and early morning. Persistent fogging at either the West Range Site or the East Range Site is unlikely (MnDOT, 2006a).

3.3.3 Local and Regional Air Quality

The Clean Air Act (CAA) requires that the EPA establish National Ambient Air Quality Standards (NAAQS). Accordingly, EPA developed primary and secondary ambient air quality standards for six criteria pollutants. These pollutants are SO_2, CO, ozone (O_3), nitrogen dioxide (NO_2), lead (Pb), and inhalable particulates, which are also known as respirable particulate matter (PM). The PM_{10} standard covers particles with diameters of 10 micrometers or less and the $PM_{2.5}$ standard covers particulates with diameters of 2.5 micrometers or less. The NAAQS are expressed as concentrations of the criteria pollutants in the ambient air; that is, in the outdoor air to which the general public has access [40 CFR 50.1(e)]. Primary standards are set to protect the public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are set to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The Minnesota Pollution Control Agency (MPCA), which is responsible for monitoring air quality for each of the criteria pollutant and assessing compliance, has also promulgated rules governing ambient air quality in the State of Minnesota. These rules, codified in Minnesota Rules 7009.00800, further regulate concentrations of the criteria pollutants and include standards for H_2S and total suspended particulate matter (TSP). Table 3.3-1 lists the NAAQS and Minnesota Ambient Air Quality Standards (MAAQS).

Table 3.3-1. National and Minnesota Ambient Air Quality Standards

Pollutant	Averaging Period	Standard Value		Standard Type[1]	Notes
Carbon Monoxide	8-Hour	9 ppm	10 mg/m^3	Primary	Maximum concentration not to be exceeded more than once per year.
	1-Hour	35 ppm	40 mg/m^3	Primary	
	1-Hour [2]	30 ppm	35 mg/m^3	Primary and Secondary	
Nitrogen Dioxide	Annual Arithmetic Mean	0.05 ppm	100 µg/m^3	Primary and Secondary	Maximum annual arithmetic mean.
Ozone	8-Hour	0.08 ppm	235 µg/m^3	Primary and Secondary	Daily maximum 8-hour average.
Lead	Quarterly		1.5 µg/m^3	Primary and Secondary	Maximum arithmetic mean averaged over a calendar quarter.
Total Suspended Particulate (TSP) [2]	Annual Geometric Mean		75 µg/m^3	Primary	Maximum annual geometric mean.
			60 µg/m^3	Secondary	
	24-Hour		260 µg/m^3	Primary	Maximum concentration not to be exceeded more than once per year.
			150 µg/m^3	Secondary	
PM_{10}	Annual Arithmetic Mean [3]		50 µg/m^3	Primary and Secondary	Maximum annual arithmetic mean.
	24-Hour		150 µg/m^3	Primary and Secondary	Not to be exceeded more than once per year on average over 3 years.

Table 3.3-1. National and Minnesota Ambient Air Quality Standards

Pollutant	Averaging Period	Standard Value		Standard Type(1)	Notes
$PM_{2.5}$	Annual Arithmetic Mean		15 µg/m^3	Primary and Secondary	Not to exceed the 3-year average of the weighted annual mean concentrations.
	24-Hour		35 µg/m^3	Primary and Secondary	Not to exceed the 3-year average of the 98th percentile of 24-hour concentrations.
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	80 µg/m^3	Primary	Maximum annual arithmetic mean.
		0.02 ppm	60 µg/m^3	Secondary (2)	
	24-Hour	0.14 ppm	365 µg/m^3	Primary and Secondary	Maximum concentration not to be exceeded more than once per year.
	3-Hour	0.5 ppm	1,300 µg/m^3	Primary and Secondary (4)	
	3-Hour (5)	0.35 ppm	915 µg/m^3	Secondary	
	1-Hour (2)	0.5 ppm	1,300 µg/m^3	Primary	
Hydrogen Sulfide (2)	½-Hour	0.05 ppm	70 µg/m^3	Primary	½-Hour average not to be exceeded over 2 times per year.
	½-Hour	0.03 ppm	42 µg/m^3	Primary	½-Hour average not to be exceeded over 2 times in any 5 consecutive days.

(1) Primary standards set limits to protect human health; Secondary standards set limits to protect public welfare (i.e., decreased visibility; damage to animals, vegetation)
(2) Minnesota State Ambient Air Quality Standard only.
(3) Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual PM_{10} standard (effective December 17, 2006). However, it is still reflected in the State of Minnesota's regulations.
(4) Secondary standard for Air Quality Control Regions 128, 131, and 133
(5) For Air Quality Control Regions 127, 129, 130, and 132
Source: EPA, 2006a and MPCA, 2006a

3.3.3.1 Air Quality Management Plan

Attainment status for NAAQS is determined primarily by evaluating data from ambient air quality monitoring stations. The MCPA conducts ambient air quality monitoring throughout the state. Currently, there are no nonattainment areas in Minnesota. Attainment means air quality in the county meets the standards. An "unclassified" status means that no data exists that demonstrates non-compliance. The West Range Site and the East Range Site are located in Itasca and St. Louis counties, respectively. Monitoring results from the closest monitors to Itasca and St. Louis Counties are shown in Table 3.3-2. The two counties are in close proximity of each other and the monitoring sites are within the region of influence for both potential project sites.

The table includes the average ambient air concentrations over the past three years (2002-2005) for each pollutant and averaging period. Based on the monitored data, Itasca and St. Louis Counties are designated attainment or unclassified for each of the standards.

Table 3.3-2. Monitored Background Concentrations

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
Carbon Monoxide	8-Hour	1.6 ppm	9 ppm	Primary	314 West Superior Street, Duluth
	1-Hour	3.3 ppm	35 ppm 30 ppm(1)	Primary Primary and Secondary	314 West Superior Street, Duluth
Nitrogen Dioxide	Annual	0.004 ppm	0.05 ppm	Primary and Secondary	Carlton County
Ozone	8-Hour	0.066 ppm	0.08 ppm	Primary and Secondary	Voyageurs National Park
Lead	Quarterly	0.01 µg/m^3	1.5 µg/m^3	Primary and Secondary	Virginia City Hall
Total Suspended Particulate (TSP) (1)	Annual	16 µg/m^3	75 µg/m^3 60 µg/m^3	Primary Secondary	Virginia City Hall
	24-Hour	35.7 µg/m^3	260 µg/m^3 150 µg/m^3	Primary Secondary	Virginia City Hall
PM_{10} (2)	Annual	16 µg/m^3	50 µg/m^3	Primary and Secondary	Virginia City Hall
	24-Hour	35.7 µg/m^3	150 µg/m^3	Primary and Secondary	Virginia City Hall
$PM_{2.5}$	Annual	6.1 µg/m^3	15 µg/m^3	Primary and Secondary	Virginia City Hall
	24-Hour	19 µg/m^3	35 µg/m^3	Primary and Secondary	Virginia City Hall
Sulfur Dioxide	Annual	0.001 ppm	0.03 ppm 0.02 ppm (1)	Primary Secondary	Rosemount, MN
	24-Hour	0.005 ppm	0.14 ppm	Primary and Secondary	Rosemount, MN
	3-Hour	0.010 ppm	0.5 ppm 0.35 ppm	Primary and Secondary (3) Secondary (4)	Rosemount, MN
	1-Hour	0.019 ppm	0.5 ppm (1)	Primary	Rosemount, MN

(1) Minnesota State Ambient Air Quality Standard only.
(2) The EPA revoked the annual PM_{10} standard (effective December 17, 2006). However, it is still reflected in the State of Minnesota's regulations.
(3) Secondary standard for Air Quality Control Regions 128, 131, and 133
(4) For Air Quality Control Regions 127, 129, 130, and 132
Source: Excelsior, 2006b

3.3.3.2 Class I Areas

In addition to the NAAQS, national air quality standards exist for the Prevention of Significant Deterioration (PSD). The PSD requirements provide maximum allowable increases (expressed as increments) in concentrations of pollutants for areas that are already in compliance with the NAAQS. Allowable PSD increments currently exist for three pollutants, SO_2, NO_2, and PM_{10}. One set of allowable increments exists for Class II areas, which covers most of the United States and another set of more stringent allowable increments exists for Class I areas, which include many national parks and monuments, wilderness areas, and other areas as specified in 40 CFR 51.166(e). The allowable PSD increments are shown in Table 3.3-3.

Under the Clean Air Act, a **Class I area** is one in which only a small amount of new pollution is allowed. These areas include national parks, wilderness areas, monuments, and other areas of special national and cultural significance. **Class II areas** include all other clean air regions and allow moderate pollution increases.

Table 3.3-3. Allowable PSD Increments

Pollutant, averaging period	Allowable Increment (µg/m^3)	
	Class I Area	Class II Areas
SO_2, 3-Hour	25	512
SO_2, 24-Hour	5	91
SO_2, Annual	2	20
NO_X, Annual	2.5	25
PM_{10}, 24-Hour	8	30
PM_{10}, Annual	4	17

Source: 40 CFR 51.166(e), 2006

In addition to complying with the more stringent allowable PSD increments, proposed projects that are within 100 kilometers (62 miles) of Class I areas must evaluate impacts of the project on air quality related values (AQRVs) such as visibility, flora/fauna, water quality, soils, odor, and any other resources specified by the Federal Land Manager (FLM) (NPS, 2006). The closest Class I areas to the proposed Mesaba Energy Project sites include two areas administered by the USFS (the BWCAW and Rainbow Lakes Wilderness Area [RLW], located in northwestern Wisconsin); and two national parks (VNP and Isle Royale National Park [IRNP], located in Michigan). The distance from the proposed sites to the Class I areas are provided in Table 3.3-4.

Table 3.3-4. Distances to Class I Areas

Class I Area	Distance from West Range Site (kilometers (miles))	Distance from East Range Site (kilometers (miles))
BWCAW	100 (62)	40 (25)
VNP	120 (75)	90 (60)
RLW	190 (118)	170 (106)
IRNP	>300 (186)	>200 (124)

The West Range Site and East Range Site are similar regarding air quality; however the East Range Site is considerably closer to the Class I areas than the West Range Site.

3.3.3.3 Visibility and Regional Haze

In 1999, the EPA established the Regional Haze Program to improve visibility and air quality in national parks and wildlife areas. As part of this program, a network of monitors was set up by the Interagency Monitoring of Protected Visual Environments (IMPROVE) program to continuously record visibility and aerosol conditions for the protection of visibility in Class I areas. Specifically, these monitors record concentrations of ammonium sulfate, ammonium nitrate, coarse particulate matter, and variables to determine extinction coefficients and deciviews to measure visibility. The 1999 Regional Haze Program identifies certain older emission sources that have not been regulated under other provisions of the Clean Air Act. Those older sources that could contribute to visibility impairment in Class I areas may be required to install Best Available Retrofit Technology (BART).

Class I areas in northeastern Minnesota, that have monitors under the Regional Haze Program are located in the BWCAW near Ely and at VNP. Minnesota must submit to EPA a Regional Haze State Implementation Plan (SIP) by December 2007. The Regional Haze SIP must identify sources that cause or contribute to visibility impairment in these areas and must also include a demonstration of reasonable progress toward reaching the 2018 visibility goal for each of the state's Class I areas. Because the Mesaba Generating Station would be a new facility, it would not have to meet the BART requirement. However, to achieve reasonable progress toward the 2018 visibility goal, Minnesota may need to implement control measures on other sources (including new sources) in addition to BART and ensure that they do not hinder attainment of visibility goals. Any future control strategies on newer facilities, that the MPCA implements, would affect the Mesaba Generating Station. Currently, a new source of criteria and air toxics emissions is required to assess impacts to Class I areas visibility under the NEPA and PSD regulations. Section 4.3 addresses the impacts of the Mesaba Energy Project on Class I areas.

3.3.4 Pertinent Air Quality Regulations

Local, state, and Federal air quality regulations were reviewed to determine their applicability to the proposed Mesaba Energy Project. The CAA is the basis for Federal statutes and regulations that govern air pollution. Air quality regulations within the state of Minnesota are codified in the Minnesota Rules for the MPCA, Chapters 7001 to 7023 and 7027. The Minnesota Rules establish permit review procedures for all facilities that emit pollutants to the ambient air. New facilities are required to obtain an air quality permit before construction is initiated.

Federal and state regulations established as a result of the CAA and the Minnesota Rules that potentially apply to the Mesaba Energy Project and summarized in Table 3.3-5 include:

- Prevention of Significant Deterioration (PSD)
- New Source Performance Standards (NSPS)
- Minnesota Standards of Stationary Sources (MSSS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- Clean Air Interstate Rule (CAIR)
- Clean Air Mercury Rule (CAMR)
- Acid Rain Program
- Minnesota Acid Deposition Control
- Compliance Assurance Monitoring (CAM) Rule

- Minnesota Air Pollution Episodes Rules
- Regional Haze Rule and the Minnesota Regional Haze Program
- Chemical Accident Provisions
- General Conformity Rule

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
PSD	• 40 CFR 52.21 • Minn. R. 7007.3000.	The PSD is a pre-construction review and permit process for construction and operation of a new or modified major stationary source in attainment areas. A major source is a source for which the amount of any one regulated pollutant emitted equal to or greater than significance thresholds defined by the PSD rule. The required PSD review consists of the following elements: • A case-by-case best available control technology (BACT) demonstration, which takes into account energy, environmental, and economic impacts as well as technical feasibility. • An ambient air quality impact analysis to demonstrate that the allowable emissions from the proposed project will not cause or contribute to a violation of the applicable PSD increments and NAAQS. • An assessment of the direct and indirect effects of the proposed project on general growth, soil, vegetation, and visibility. Additionally, a source that might impact a Class 1 Federal area must undergo additional review. • An ambient air quality monitoring program for up to one year may be required if no other representative data are available and if the project impacts are greater than a monitoring de minimis level. • Public comment, including an opportunity for a public hearing. The Mesaba Energy Project is projected to have emissions above the PSD significance threshold for one or more of the regulated criteria air pollutants (see Section 4.3); therefore, PSD review is required under the regulations. An application for a Part 70/New Source Review Construction Authorization Permit for an air emission facility, which covers the Mesaba Generating Station sources, has been submitted to MPCA for review in accordance with the PSD regulations. The air permit application is filed for the West Range Site.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
NSPS	40 CFR Part 60	The Federal NSPS are technology-based standards applicable to new and modified stationary sources of regulated air emissions. Where the NAAQS emphasize on air quality in general, the NSPS focus on particular sources of pollutants. The NSPS program sets uniform emission limitations for approximately 70 industrial source categories or sub-categories of sources (e.g., fossil fuel-fired generators, grain elevators, steam generating units) that are designated by size as well as type of process. The standards that apply to the Mesaba Energy Project are as follows: • Subpart A – General Provisions, which provides for general notification, record keeping, and monitoring requirements. • Subpart Da – Standards of Performance for Electric Utility Steam Generating Units For Which Construction is Commenced After September 18, 1978, which applies to any electric utility combined cycle gas turbine that combusts more than 73 MW (250 MMBtu/hour) heat input of fossil fuel in the steam generator. • Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units, which covers the natural gas-fired auxiliary boiler because its heat input will be greater than 100 MMBtu/hr. • Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, which covers the Tank Vent Boiler because it is a steam-generating unit that is less than 100 MMBtu/hr, but greater than 10 MMBtu/hr. Since this unit will burn syngas, it is considered a coal-fired unit for the purposes of this regulation. • Subpart HHHH – Emission Guidelines and Compliance Times for Coal-Fired Electric Steam Generating Units: Subpart HHHH was included as part of the Clean Air Mercury Rule promulgated on March 15, 2005 (70 FR 28606). • Subpart Y – Standards of Performance for Coal Preparation Plants: Coal handling capacity at the IGCC power station will exceed 200 tons per day, and is therefore subject to this NSPS. These standards were considered as part of the BACT analysis.
MSSS	Minn. R. ch. 7011	The following Minnesota Standards of Performance are also applicable to the Mesaba Energy Project: • Control of Fugitive Particulate Matter (Minn. R. 7011.0150), which applies to bulk material handling operations including coal, petroleum coke, flux and other materials. The rule prohibits the release of “avoidable amounts” of particulate matter and facilities are required to take reasonable precautions to prevent the discharge of visible fugitive emissions beyond the property line. • Standards of Performance for Stationary Internal Combustion Engines (Minn. R. 7011.2300), which applies to the emergency fire water pumps and the emergency generators, limits visible emissions from these units to 20 percent opacity and limits SO_2 emissions to 0.5 lb/MMBTU heat input unless a higher limit has been established through modeling. • Standards of Performance for Post-1969 Industrial Process Equipment (Minn. R. 7011.0715), which applies to the Mesaba Generating Station’s coal, petroleum coke, and slag handling equipment that will generate particulate matter emissions. Since the Mesaba Generating Station is located outside of Minneapolis, St. Paul and Duluth, and is located more than one quarter mile from any residence or public roadway, the required control equipment efficiency standard to be applied is 85 percent. These standards were considered as part of the BACT analysis.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
NESHAP	40 CFR Parts 61 and 63	Non-criteria pollutants that can cause serious health and environmental hazards are termed hazardous air pollutants (HAPs) or air toxics. The 1970 CAA Amendments required EPA to promulgate national emissions standards for hazardous air pollutants to protect the public health and welfare with an ample margin of safety. Due to the difficulty in establishing health risks for HAPs, EPA identified and regulated only eight pollutants: asbestos, benzene, beryllium, inorganic arsenic, mercury, radionulides, and vinyl chloride. The 1990 CAA Amendments, section 112, changed the regulatory approach for controlling HAPs, basing it instead on available control technology. Subsequently, a list of 188 compounds to be controlled as HAPS was developed. The 1990 CAA Amendments define two types of NESHAP emissions standards: maximum achievable control technology (MACT) and generally available control technology (GACT). Unlike the health-based standards established under the initial NESHAPs, the MACT standards are technology-based emission limits that take into account available methodologies for controlling emissions of targeted HAPs from each source category. In general, a source is subject to a MACT standard if it is in a source category regulated under 40 CFR 63 and part of a facility that is defined as a major source for HAPs. A source is defined as a major source for HAPs if it emits a single HAP in excess of 10 tons (9.1 metric tons) per year or an aggregate emission rate of over 25 tons (22.7 metric tons) per year of any combination of regulated HAPs. GACTs are less stringent emission standards based on the use of more standard technologies and work practices. HAP emissions for the proposed Mesaba Energy Project would not exceed the associated major source thresholds (see Section 4.3); therefore, MACT standards do not apply to the proposed facility.
CAIR	Section 110 of the CAA Amendments	On March 10, 2005, EPA issued the CAIR, a rule that will achieve the largest reduction in air pollution of SO_2 and NO_X. The goal of the rule is to permanently cap emissions of SO_2 and NO_X from electric generating units (EGU) in the eastern United States so as to address $PM_{2.5}$ and ground-level O_3 transport. CAIR would achieve large reductions of SO_2 and/or NO_X emissions across 28 eastern states (including Minnesota) and the District of Columbia. When fully implemented, CAIR is expected to reduce SO_2 emissions in these states by over 70 percent and NO_X emissions by over 60 percent from 2003 levels. CAIR is expected to help sources in Minnesota reduce emissions of SO2 by 36 percent and NO_X by 59 percent, by 2015. The MPCA is currently considering changes to the Minnesota Air Rules to address the CAIR. In June 2006, the MPCA published an annotated draft of a new chapter in the state rules that would address issues related to CAIR. As an EGU in the Minnesota, the Mesaba Energy Project would be subjected to the CAIR once promulgated by the MPCA.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
CAMR	Section 111 of the CAA Amendments	In December 2000, EPA announced that it was "appropriate and necessary" to regulate and control emissions of mercury and other air toxics from coal- and oil-fired electric utilities under section 112 of the CAA Amendments (i.e., the MACT requirements). In January 2004, under the CAA, EPA was given the authority to regulate power plant mercury emissions by establishing performance standards or MACT, whichever the agency deems most appropriate. On March 15, 2005, EPA revised and reversed its December 2000 finding and issued the CAMR, which creates performance standards and establishes permanent, declining caps on mercury emissions from coal-fired power plants. The CAMR establishes "standards of performance" limiting mercury emissions from new and existing coal-fired power plants and creates a market-based cap-and-trade program. New coal-fired power plants ("new" means construction starting on or after January 30, 2004) will have to meet stringent new source performance standards in addition to being subject to the caps. As an electric utility steam-generating unit with more than 25 MWe output, the Mesaba Energy Project will be subject to the CAMR. In October 2005 (70 FR 62200), EPA agreed to reconsider certain aspects of its determination that regulation of electric utility steam generating units under section 112 of CAA was neither necessary nor appropriate, and removing coal- and oil-fired utility units from the list of source categories. However, EPA declined to issue a stay, and the CAMR remains in effect. The CAMR is a closely related action to the CAIR, which is discussed above. Together, the CAMR and the CAIR is expected to create a multi-pollutant strategy to reduce emissions throughout the United States.
Acid Rain Program	40 CFR Parts 72 through 78	The EPA established a program to control emissions that contribute to the formation of acid rain. The overall goal of the Acid Rain Program is to achieve significant environmental and public health benefits through reductions in emissions of SO_2 and NO_X, the primary causes of acid rain. The acid rain regulations are applicable to "affected units" as defined in the regulations. As a new utility unit, the Mesaba Generating Station is classified as an affected unit under 40 CFR 72.6(a)(3) because it utilizes fossil fuel-fired combustion to generate over 25 MW of electricity for sale and is therefore subject to the Acid Rain Program. The objectives of the program are achieved through a system of marketable allowances, which are used by utility units to cover their SO_2 emissions. One allowance means that an affected utility unit may emit up to one ton of SO_2 during a given year. Utilities cannot emit more tons of SO_2 than they hold in allowances. Allowances may be bought, sold, or traded, and any allowances that are not used in a given year may be banked and used in the future. Owners or operators of an affected unit are subject to the following Acid Rain Program requirements: • Acid Rain Permit Application, which must be submitted at least 24 months prior to the date of initial operation of the unit • SO_2 emission allowances, which are to be secured on an annual basis. • NO_X emission limitations. • Acid Rain Compliance Plan. • Continuous emissions monitoring requirements for NO_X, SO_2, CO_2, and opacity. Requirements under this program would be considered mitigation measures to reduce emissions from the IGCC power plant source.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
Minnesota Acid Deposition Control	Minn. R. 7021.0050	This regulation applies to existing electrical generating facilities that have a total capacity greater than 1,000 MW. As Mesaba Energy Project, Phase I and II, will be new generating facilities, they will not be subject to this rule. However, under the Acid Rain Program, Mesaba Energy Project will be required to annually purchase SO_2 allowances in an amount equal to the total IGCC power plant's annual SO_2 emissions. The CAIR will supersede the Acid Rain Program when it becomes effective. Pursuant to Minnesota regulations, the Mesaba Energy Project's compliance with the new CAIR also constitutes compliance with the Minnesota's acid deposition requirements. The IGCC power plant would also be subject to the Reasonable Available Control Technology (RACT) requirements of Minn. R. 7021.0050, Subpart 5 because the total indirect heating capacity of the CTGs, tank vent boilers, and auxiliary boilers exceed 5,000 MMBTU/hr. However, since emissions from these units are subject to BACT requirements, no additional limitations are necessary to meet RACT.
CAM Rule	40 CFR Part 64	The CAM Rule will apply to facilities that have emission units located at major sources subject to Title V air quality permitting and which use control devices to achieve compliance with emission limits. It requires that these facilities monitor the operation and maintenance of their control equipment to evaluate the performance of their control devices and report if they meet established emission standards. If these facilities find that their control equipment is not working properly, the CAM rule requires them to take action to correct any malfunctions and to report such instances to the appropriate enforcement agency (i.e., State and local environmental agencies). Although a major source, the Mesaba Generating Station would not be subject to the CAM Rule because it will not be equipped with add-on air pollution control devices. However, the Mesaba Generating Station would be subject to similar requirements specified under the Acid Rain Provisions and the applicable NSPS.
Minnesota Air Pollution Episodes Rule	Minn. R. 7009.1000 – 7009.1110	Since the Mesaba Generating Station will have allowable emissions of greater than 250 tons per year of any single regulated pollutant, the plant is subject to Minnesota's Air Pollution Episode rules. The rules require preparation of an emergency action plan to be implemented in the event that the Commissioner of the MPCA makes an air pollution episode declaration. Requirements under this rule would be considered mitigation measures to reduce emissions from the Mesaba Generating Station sources.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
Regional Haze Rule and the Minnesota Regional Haze Program	40 CFR Part 55, 51.300 – 51.309	In July 1999, EPA published the Regional Haze Rule to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas. Within its boundary, Minnesota has two Class I areas – the BWCAW and VNP. In addition, emissions from Minnesota may contribute to visibility impairment in other states' Class I areas, such as Michigan's IRNP and Seney Wilderness Area. By December 2007, Minnesota must submit to U.S. EPA a Regional Haze SIP that identifies sources that cause or contribute to visibility impairment in these areas. The Regional Haze SIP must also include a demonstration of reasonable progress toward reaching the 2018 visibility goal for each of the state's Class I areas. The Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the CAA. Those older sources that could contribute to visibility impairment in Class I areas may be required to install BART. Because the Mesaba Generating Station would be a new facility, it would not have to meet the BART requirement. However, under NEPA and PSD requirements a new source of criteria and air toxics emissions has to analyze its impacts to Class I areas. Section 4.3 addresses the impacts of the Mesaba Energy Project on Class I areas.
Chemical Accident Provisions	40 CFR Part 68 and Section 112(r) of the CAA Amendments	This regulation applies to stationary sources that will have more than a threshold quantity of the specific regulated toxic and flammable chemicals. It is intended to prevent accidental releases to the air and to mitigate the consequences of any such releases by focusing prevention measures on chemicals that pose the greatest risk to the public and the environment. Stationary sources covered by this regulation must develop and implement a risk management program that includes a hazard assessment, a prevention program, and an emergency response program. These elements are to be described in a risk management plan that must be submitted to EPA and state and local emergency planning authorities. The plan must also be made available to the public by the date that a regulated substance is first present in a process above a threshold quantity. The IGCC power plant is not expected to have any chemicals above the threshold amounts; however, more detailed calculations would be performed when the system design for the IGCC power plant is finalized. The Mesaba Energy Project is expected to comply with all applicable provisions of the regulation in a timely manner.

Table 3.3-5. Pertinent Air Quality Regulations

Regulation	Citation	Description
Clean Air Act General Conformity Rule	40 CFR Parts 6, 51 and 93,	An area that does not meet (or contributes to ambient air quality in a nearby area that does not meet) the primary or secondary NAAQS for a pollutant is referred to as a nonattainment area. The CAA requires states to submit to the EPA a SIP for attainment of the NAAQS. The 1977 and 1990 amendments to the CAA require comprehensive plan revisions for areas where one or more of the standards have yet to be attained. The 1990 Amendments to the CAA, Section 176(c)(1), required Federal actions to show conformance with the SIP. Federal actions are those projects that are funded by Federal agencies and include the review and approval of a proposed action through the NEPA process. Conformance with the SIP means conformity to the approved SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS, and achieving expeditious attainment of such standards. The need to demonstrate conformity is applicable only to areas that are not in compliance with the NAAQS or areas that were previously in nonattainment for one or more pollutants and are currently designated as maintenance areas. A Federal action will fall under the jurisdiction of either the General Conformity Rule or the Transportation Conformity Rule. The Transportation Conformity Rule covers highway and transit projects. The Mesaba Energy Project is a Federal action under the jurisdiction of the General Conformity Rule.

3.4 GEOLOGY AND SOILS

3.4.1 Geology

3.4.1.1 Regional Features

Physiography and Topography

The physiography surrounding the West and East Range Sites consists of rolling hills with forests, bogs, and lakes in glacial till over bedrock. The bedrock is a mixture of metamorphic and intrusive igneous rocks, and is considered to be among the oldest within the continent. Both the West Range and East Range Sites are located on the edge of the Giants Range physiographic area of Minnesota, within the Superior Upland of the Canadian Shield province (Wright, 1972). The Giants Range, also known as the Mesabi Iron Range, is a folded ridge of iron-rich rock that was exposed during erosion in the Mesozoic. The topography of the area has also been heavily modified by extensive glaciation events, the last of which occurred roughly 12,000 years ago. The regional physical relief varies from 600 feet above mean sea level (amsl) at Lake Superior to an elevation of 2,301 feet amsl at Eagle Mountain. The local landscape is also influenced by a number of 300- to 400-foot deep mine pits, large mine-pit tailing piles and basins, all associated with historical iron ore mining activity.

Climate

Minnesota has a continental climate and is frequently influenced by polar air masses. In Itasca and St. Louis counties, winters are very cold and summers are short and fairly warm. The short freeze-free time limits farmed crops to forage, small grains, and adapted vegetables. Snow covers the ground much of the time from late fall to early spring. The lowest recorded temperature in the area was in Embarrass (near the East Range Site) in 1996 at negative 63ºF. Early freezes, prior to snowfall, extend the frost depth to several feet. However, the frost depth recedes and seldom exceeds a few feet after the snow blanket is established. Frost depths, in the order of 6 feet or more, can occur in areas that are plowed or otherwise kept clear of snow.

Bedrock

The bedrock of northern Minnesota consists of primarily continental craton rocks overlain by metamorphosed sedimentary rocks that are intruded by igneous plutons and dikes. The predominant geological and physiological feature in the area is the Mesabi Iron Range, which is made of silica-rich chert and iron-rich hematite, magnetite and taconite over basal quartz sandstone. Table 3.4-1 describes the bedrock geology in the area in more detail

3.4.1.2 West Range Site and Corridors

The West Range Site is located primarily on granite of the Giants Range batholith, just north of the Mesabi Iron Range bedrock (see Figure 3.4-1). At the project site, the elevations are approximately 1,430 feet amsl to 1,470 feet amsl.

All of the West Range corridors would cross portions of the Biwabik formation, the Virginia formation, and the Giant's Range batholith (at approach to the West Range Site). Between the Biwabik formation and the batholith is the Pokegama Quartzite. The Biwabik formation consists of layers of chert with iron rich minerals (hematite, taconite, and magnetite) and carbonate rocks. South of the Biwabik formation is the Virginia Formation, which is composed of argillite and clay-rich siltstone. The northern edge of the Virginia formation is located approximately 1.5 miles south of the proposed Mesaba Generating Station site. Portions of the Virginia and Biwabik formation are covered by the Coleraine Formation, an irregular sandstone and conglomerate layer deposited during the Cretaceous (Table 3.4-1). The first appearances of the Coleraine Formation occur approximately 1 mile from the power plant site.

Table 3.4-1. Bedrock Geology at the West and East Range Sites

Age	Group	Formations	Description	Member Description[a]	Location[a]
Cretaceous	N/A	Coleraine Formation	Irregular conglomerate composed of iron-formation clasts, and hematite-cemented sandstone; contains marine fossils	N/A	WR
Upper Proterozoic	Duluth Complex	Ultramafic intrusions, Bald Eagle Lake Intrusion; South Kiwishi Intrusion; Partridge River intrusion; Anorthositic series	Troctolite-gabbro, intruded by titaniferous peridodite	Ultra mafic, oxide-rich intrusions medium grained and layered	ER
Proterozoic	Animike Group	Virginia Formation	Interbedded carbonaceous shale, mudstone siltstone	Argillaceous Siltstone/greywacke	WR/ER
		Biwabik Formation	Ferruginous chert	Granular chert, iron silicates, hematite and carbonate rocks	WR/ER
		Pokegama Quartzite	Sedimentary rock assemblages	Upper: quartz arenite Middle: shale/siltsonte Lower: laminated shale	WR
Archean Eon	Wawa subprovince of the Superior province	Giant's Range Batholith/Granite	Tonalite to granite rocks in metavolcanic + metasedimentary host rocks	Sedimentary strata overlying greenstone-granite and diabasic dikes	WR/ER
		Mud Lake Sequence	Volcanic and intrusive rocks overlain by sedimentary rocks	Greywacke, slate and Metagabboric rocks	ER

[a]N/A=Not Applicable, WR=West Range Site, ER=East Range Site
Source: Jirsa et al., 2005

All bedrock is covered by sand and gravel deposits left from the last glaciation. In some locations, organic soils have also developed on top of the glacial deposits. Table 3.4-2 describes the type of Quaternary sediments in more detail. The IGCC power plant would be located on glacial till of the Nashwauk Moraine Association. The corridors would cross portions of the Nashwauk and Sugar Hills Associations, glacial outwash, glacial lake sediment, glacial till, and peat (Hobbs and Goebel, 1982). Disturbed areas associated with mining activities are also located along the areas proposed for the corridors associated with the West Range Site.

Figure 3.4-2 shows the West Range IGCC power plant and its associated HVTL, pipeline, and transportation corridors in relation to the bedrock depth below ground surface. At the West Range Site, bedrock is closer to the surface near the proposed Mesaba Generating Station, increasing in depth further south. Bedrock is within 20 feet of the surface in three locations within the West Range Site. The bedrock is also within 20 feet of the surface in a location northeast of the Arcturus Mine. Southeast of the West Range Site is a bedrock valley that stretches northeast-southwest underneath Dunning Lake. The bottom of the bedrock valley reaches 200 feet below ground at its deepest. The rest of the bedrock immediately surrounding the IGCC power plant is within 50 feet of the ground surface.

South of Taconite and Bovey, the bedrock depth gradually increases to 250 feet below the surface. There is a subsurface ridge within 50 feet of the ground located 1 mile east of Taconite, between Holmes Lake and Twin Lakes (Meyer et al., 2004) (see Figure 3.4-2). In areas east of the West Range Site, the bedrock depth is within 50 feet of the surface.

Table 3.4-2. Quaternary Geology at the West and East Range Sites

Association	Deposit Type	Description	Location
Nashuwauk Moraine Association	Ground moraine (Glacial till)	Till is brown to grey, non-calcareous drift; clasts are predominantly igneous and metamorphic rocks of the Canadian Shield	1,2,3,4,5,7,8,9,10
			12,13,14
Vermillion Association	Ground moraine (Glacial till)	Till is extremely stony and sandy and contains only trace amounts of clay.	--
			12,13,14,17,18
Sugar Hills Association	End moraine (Glacial till)	Locally deposited reddish colored lake sediments.	2,3,4,5,6,7,8,9,10
			12,13,14
Culver Moraine Association	End Moraine (Glacial till)	Till is non-calcarous, clay-rich with sporatic clasts of shale. Deposits form rolling and hilly topography including numerous lakes and potholes.	--
			11,12,13,14,15,16,17, 18,19
N/A	Glacial outwash (Alluvium)	Alluvium is sorted sand and gravel deposits.	2,3,4,5,7,8,9,10
			13,14
N/A	Gravel glacial lake sediment	Soft to medium stiff, stratified clay and silt deposits. Occasional cobbles and boulders also occur within the deposit. Often has high water table.	2,3,4,5,6,8,9,10
			12,13,14,
N/A	Peat	Holocene-age, soft and highly compressible organic deposits, with a high water table	2,3,5,7,8,9,10
			12,13,14,
N/A	Mine tailings pile	Piles contain overburden soil and glacial deposits from iron mining operations, typically consisting of glacial till mixed with rock fragments and low grade ore.	3,4,6
			13,15
N/A	Mine pit	Areas where overburden and iron deposits have been removed. Depths approach 400 feet. Includes abandoned and active mine pits.	3,4,6
			13,15

Note:
1. West Range IGCC Power Plant site
2. West Range HVTL WRA-1, WRA-1A, and WRB-2A
3. West Range Gas Pipeline Alternative 1, 2, and 3 corridors
4. West Range Process Water Pipeline Segments
5. West Range Process Water Blowdown Pipeline 1
6. West Range Process Water Blowdown Pipeline 2
7. West Range Portable Water and Sewer Pipelines
8. West Range Rail Line Alternative 1A
9. West Range Rail Line Alternative 1B
10. West Range Access Roads
11. East Range IGCC Power Plant site
12. East Range HVTL 38L corridor
13. East Range HVTL 39L/37L corridor
14. East Range Gas Pipeline 1 corridor
15. East Range Process Water Pipelines: 9N-6, 9S-6, 6-S-2WX, K-2WX-Site, 2WX-2W, 2W-2E, 3-2E
16. East Range Potable Water and Sewer Pipelines
17. East Range Rail Line Alternative 1
18. East Range Rail Line Alternative 2
19. East Range Access Roads

N/A = Not Applicable (not organized by Association)

3.4.1.3 East Range Site and Corridors

The East Range Site would be located on vacant land north of Colby Lake and inside the city limits of Hoyt Lakes. The average elevation for the area is 1,500 feet amsl, with a north-south grade that gradually dips approximately 20 to 40 feet into shrub swamp wetland.

The bedrock underlying most of the proposed East Range Site and its associated corridors is the Virginia formation, which consists of interbedded argillite, argillaceous siltstone, and fine-grained feldspathic greywacke. This formation lies south of the Giants Range batholith and the Biwabik Iron Formation. The southeastern corner of the East Range Site is in the Partridge River Intrusion, part of the Duluth Complex, which consists of troctolite and locally grades to gabbro, with numerous inclusions of hornfels and anorthositic rocks (Figure 3.4-3, Table 3.4-1). Some areas proposed for the utility corridors are exclusively located in the Virginia Formation. The Biwabik Formation and the Mud Lake Sequence occur around Eveleth.

The bedrock depth is within 50 feet of the ground surface in the vicinity of the East Range Site, rail alignments, process water pipelines and access roads (Figure 3.4-4). Bedrock is exposed at the extreme southeast corner of the East Range Site and is 1 to 50 feet below the ground surface throughout most of the site. However, there are two areas where the depth to bedrock is 50 to 100 feet below the ground surface. Beneath the area of the proposed power plant footprint, the bedrock surface slopes downward from northwest to southeast. Along the proposed HVTL and natural gas corridors, the bedrock surface gradually slopes to the southwest. The bedrock is at its deepest southwest of Aurora, at over 200 feet below the ground surface. Near Eveleth, the bedrock depth gradually becomes shallower, until it is within 50 feet of the ground surface. There is no data for the area along the proposed HVTL corridors as they approach the Forbes Substation. In areas disturbed by mining activities, the bedrock depth is typically within 50 feet of the ground surface, but may vary locally from irregular fill.

The area proposed for the East Range Site and associated corridors occur on the Culver Moraine Association, an end moraine of the Des Moines lobe. The East Range Site would be located on glacial till of the Culver Moraine Association, layered deltaic sediments, and reworked till deposits as described in Table 3.4-1 and Table 3.4-2. The corridor locations would traverse glacial till, glacial lake sediments and peat. Glacial till of the Vermillion and Nashwauk moraines and mine tailing piles would also be crossed in some areas along the corridors. From a point 200 feet east of the plant site boundary to the east end of the rail corridor, the underlying soils are glacial till of the Vermillion Association of the Rainy Lobe.

3.4.2 Mineral Resources and Mining

3.4.2.1 Regional Features

In the Mesabi Iron Range, iron ore is mined from the Biwabik formation from open pits. Mining operations remove the overburden (including the glacial deposits), any occurrences of the Coleraine Formation, and excess shale and quartzite in order to mine the iron-rich ore. Starting in 1945, many of the mining operations in the area were abandoned as the amount of high-quality ore declined. A typical abandoned mining area contains the pit and the tailings pile, as well as old access roads and a few pieces of old equipment. The area water table is close to the ground surface, and constant pumping was likely required to keep the pits dry when they were actively mined. However, once mining ceased, groundwater and other water inputs began filling the pits. Some abandoned mines in the region have reopened with the development of the taconite pellet process, which uses lower-grade ore. Other mineral resources commercially mined in northern Minnesota are crushed stone, sand and gravel for construction (USGS, 2004). Granite bedrock, as well as sand and gravel from glacial deposits are excavated by aggregate supply companies in Grand Rapids and Hibbing.

3.4.2.2 West Range Site and Corridors

The West Range Site has not been disturbed by mining activity. However, there are several abandoned mine pits to the southwest and southeast of the West Range site. The CMP is a flooded sequence of mines that stretches from Taconite to Coleraine. The GMMP connects the Arcturus Mine, the Hill Trumbull Mine, and the Hill-Annex Mine Pits during high water conditions. Surrounding these mine pits are mine tailing piles and basins, which are also located to the south, west and east of the West Range Site. Previous mining activity is presented in Figure 3.4-5. There are no mining activities occurring in the vicinity of the West Range Site.

3.4.2.3 East Range Site and Corridors

The proposed East Range site has not been disturbed by mining activity (Figure 3.4-6). There are two mine pits nearby that are located on CE property. One is located approximately 0.25 to 0.5 miles northwest of the proposed plant site and the other is north of the proposed plant site, across CR 666. Mine tailings piles also exist in two locations. One is on the west of the utility easement that forms the west edge of the proposed plant site, and the other is northeast of the proposed plant site, approximately 0.25 miles from CR 666.

Glacial deposits are also occasionally mined for aggregate rock in northern Minnesota; however, there are no rock quarries in the immediate vicinity of the East Range Site. The closest crushed rock supplier to the area is located in Hibbing.

3.4.3 Seismic Activity

3.4.3.1 Regional Features

The structural geology of the Mesabi Range is complicated; faults in the Animike Group (1,600 million years ago) record several tectonic events that occurred within the last 1 billion years. The dominant structural feature of the Mesabi Range consists of a gently dipping fold that strikes east-northeast and dips 5 to 15 degrees southeast (USDI, 1965). Fault traces within the Mesabi Iron Range vicinity tend to strike northwest to southeast. A steeply dipping northeast trending fault is located at the eastern end of the HAMP, but it appears to be inactive. The faults surrounding the Mesabi Iron Range are traces of older tectonic movement, rather than recent causes of seismic activity.

South of the West and East Range Sites is the Morris fault, a primary structural feature in central Minnesota. This fault is part of a larger mid-continent structure, the Great Lakes Tectonic Zone (GLTZ) that extends from central South Dakota to the north shore of Lake Huron in Ontario, Canada. The Morris fault has been interpreted as a late Archean suture that joined two continental blocks over 2 billion years ago. This suture fused a 2,600 to 3,600 million year old gneiss terrane to a 2,650 to 2,750 million year-old greenstone-granite terrane located to the northwest (Chandler, 1994). The Animike Basin extends northeasterly from the northeast end of the Morris fault and is separated by the Penokean fold and thrust belt in central Minnesota.

Some studies have attributed most of the seismic activity in Minnesota to the Great Lakes Seismic Zone, of which the Morris fault is the eastern anchor (Chandler and Morey, 1989). However, more recent geophysical studies in Minnesota have considerably improved the understanding of the GLTZ and adjacent structures. These recent studies have identified northwest-southeast trending substructures (subfaults) trending off of the GLTZ and the suggestion is that the earthquakes concentrated along the GLTZ are related to places where the northeast trending GLTZ is intersected by the northwest-southeast trending substructures (Chandler and Morey, 1989). The primary reason for this interpretation is that the epicenters for earthquakes in the vicinity of the GLTZ occur away from the immediate vicinity of the GLTZ along the northwest trending subfaults.

3.4.3.2 Earthquake History

The mechanism of seismicity in the central United States is poorly understood, but the prevalent model suggests that earthquakes occur by the modern stress field reactivating ancestral faults in Precambrian rocks (Chandler, 1994). Minnesota is considered to be one of the most seismically stable states in the United States; however, this does not mean that the area is earthquake free. Chandler (1994) reviewed historical documents and cited 19 earthquakes that have occurred in Minnesota since 1860. The largest earthquake in the last 50 years occurred near Morris, Minnesota, on July 9, 1975, and recorded a magnitude of 4.6 to 4.8 on the Richter scale. A similar magnitude quake (4.1) took place about 28 miles south of this location in Dumont on June 4, 1993. Both of these quakes occurred near the Morris fault within the GLTZ. However, there is no record of these quakes being felt in the vicinity of the West or East Range Sites. Other researchers have hypothesized that the 7.8 magnitude New Madrid quake of 1812 would have been felt throughout Minnesota, but due to a lack of population density no records exist for that quake in northern Minnesota (Mooney, 1979). A list of historical seismic activity within Minnesota for the last 100 years is presented in Table 3.4-3.

Table 3.4-3. Minnesota Earthquakes within the Last 100 Years

Epicenter (nearest town)	Month/Day/Year	Latitude	Longitude	Felt Area (km^2)	Maximum Intensity	Magnitude (Richter Scale)
Red Lake	2/6/1917	47.9	95.0	---	V	3.8
Staples	9/3/1917	46.34	94.63	48,000	VI-VII	4.3
Bowstring	12/23/1928	47.5	93.8	---	IV	3.8
Detroit Lakes	1/28/1939	46.9	96.0	8,000	IV	3.9-3
Alexandria	2/15/1950	46.1	95.2	3,000	V	3.6
Pipestone*	9/28/1964	44.0	96.4	---	---	3.4
Morris*	7/9/1975	45.50	96.10	82,000	VI	4.8-4.6
Milaca*	3/5/1979	45.85	93.75	---	---	1.0
Evergreen*	4/16/1979	46.78	95.55	---	---	3.1
Rush City*	5/14/1979	45.72	92.9	---	---	0.1
Nisswa*	7/26/1979	46.50	94.33	v. local	III	1.0
Cottage Grove	4/24/1981	44.84	92.93	v. local	III-IV	3.6
Walker	9/27/1982	47.10	97.6	v. local	II	2.0
Dumont*	6/4/1993	45.67	96.29	69,500	V-VI	4.1
Granite Falls*	2/9/1994	44.86	95.56	11,600	V	3.1

*Denotes earthquakes that were recorded instrumentally. All others and associated magnitudes based solely on intensity data from felt reports.
Source: Chandler, 1994

The closest earthquake epicenter to the Mesabi Iron Range is the 1928 Bowstring earthquake, whose epicenter is located approximately 25 miles to the northwest of the West Range Site. The magnitude of the Bowstring quake was estimated to be 3.8. Magnitude 3 earthquake shocks are barely perceptible by humans. Magnitude 5 shocks will be disturbing to nearby observers but will not do much damage. The Bowstring epicenter is located along one of the northwest trending fault lines emanating out from the iron range. However, the West Range and East Range Sites do not appear to be located on these fault lines.

3.4.4 Paleontological Resources

3.4.4.1 Regional Features

Fossils are found within sedimentary rocks of the appropriate age and type. The Mesabi Iron Range consists of mostly igneous and metamorphic rocks, which do not contain fossils. Only one of the sedimentary rock formations in the area is known to contain fossils. The Coleraine Formation is an irregular conglomerate composed largely of iron-formation clasts, hematite-cemented sandstone, and blue-green shale, and was formed within a marine environment. There are mostly invertebrate fossils in the form of shells preserved in the deposits; though fossilized shark's teeth, ocean snails, clams, and crocodile parts have been uncovered.

3.4.4.2 West Range Site and Corridors

The Coleraine Formation is found within isolated pockets between the Proterozoic and the glacial deposits in the area around the West Range Site. Because glacial deposits cover the majority of the area, the occurrences of the Coleraine Formation are restricted to areas with mining operations, where the overburden has been removed. The Coleraine Formation is primarily known from the walls of the HAMP, which is located in the Hill Annex Mine State Park. The state park also has tailings piles with waste rock excavated from the mining operations. It currently provides fossil-hunting tours to the public.

The West Range Site is located to the north of the assumed extent of the Coleraine Formation; however, the southern portion of the rail alignment and most of the HVTL lines would be located where the formation is hypothesized to be found. The true extent of the Coleraine formation is not known, particularly because it is not continuous.

3.4.4.3 East Range Site and Corridors

The Coleraine formation is not found in the vicinity of the East Range Site or its corridors.

3.4.5 Soils

3.4.5.1 Regional Features

Soil formation in northern Minnesota is dominated by erosion, glacial activity, and the type of parent material. The final retreat of the glaciers at the end of the Holocene left a thick layer of sediment carried from the north. Soil formation today in northern Minnesota occurs primarily on these glacial deposits and is modified by the large amount of glacial water trapped above the igneous bedrock. Wetlands are found in areas of low elevation and generate thick organic soils sequences. Upland areas tend to be well drained and can have a wide variety of clast size. Therefore, landscape position and parent material are some of the primary factors in the area soil formation.

The soil descriptions provided are categorized by their parent material because they are well correlated to the soil characteristics pertinent to the impact analysis. Further discussion of the West Range Site soil series and their attributes can be found in the Itasca County Soil Survey (USDA, 1987).

In some locations, soil surveys in northern Minnesota are still incomplete. The Soil Survey of Itasca County was completed in 1987, and the Natural Resources Conservation Service (NRCS) is currently preparing a soil survey for St. Louis County. Selected areas around Hoyt Lakes are depicted on preliminary maps, and limited soil descriptions are available. An earlier, rudimentary survey mapped soil landscape units around Hoyt Lakes in 1989. These data provide broad descriptions and lower resolutions than standard soil survey maps, and are only used as a baseline description. Since the soil survey information is in draft form, the East Range Site soil types are discussed qualitatively. The West Range and East Range Sites have a similar Quaternary history and topographic profiles, therefore, the soils could be considered similar.

3.4.5.2 West Range Site and Corridors

The West Range Site soils consist of nearly level to very steep, well-drained and somewhat poorly drained loamy and silty soils that formed in glacial till. Organic deposits also occur within the West Range Site, directly north and south of the footprint of the proposed IGCC power plant. Table 3.4-4 presents more detail about the soil series in the West Range Site and corridors. Where areas of wetness occur the soils are described as poorly drained till sediments and peat bogs. The HVTL corridors would cross recent organic deposits and soils formed from lacustrine deposits, glacial till, and glacial outwash. Given the length of the proposed HVTL corridors, there is not one predominant soil type. More information on the soil types is described in Table 3.4-4.

The organic soils have formed nearly level bogs, lake plains, and outwash plains. The depth of the peat extends to at least 6 feet, the maximum depth evaluated by the soil survey. There are numerous areas of compressible, highly organic soils with a groundwater table 3 feet or less below the surface. Shallow excavations in organic deposits are very unstable due to seeping water and cutbank cave-ins. Some organic materials are also found over sandy alluvial materials. These soils consist of 1 to 2 feet of peat underlain by loam, loamy sand, coarse sand, loamy coarse sand, sand, and silt loam. The depth to the seasonal high groundwater table ranges from 2 feet above to 3 feet below ground surface.

Lacustrine deposits are poorly drained and occur on flat and slightly concave slopes on glacial lake plains and outwash plains. They consist of silt loam, clay loam, loam, loamy very fine sand, and very fine sand. The water table is also very high in these soils, which severely impedes shallow excavations because of wetness and caving cutbanks. Glacial till soils are extremely variable, with their characteristics depending on the local topography and water table. The soils consist of silt loams to loamy fine sand, and are located on the tops of glacial moraines to flat glacial till plains. When digging in areas with a high water table, these soils are also unstable.

The majority of soils formed on glacial outwash deposits are well to excessively well-drained. These soils include loamy fine sand, fine sand, fine sandy loam, sandy loam, loamy sand, coarse sand, loamy coarse sand, sand, silt loam, and gravelly sand. The finer soils tend to be near the ground surface and become coarser with depth.

All of the natural gas pipeline alternatives would cross organic, glacial till, and glacial outwash deposits. Given the length of the proposed gas pipeline corridors, there is not one predominant soil type. Organic deposits and a high water table are primarily found along the southern corridor of the NNG Pipeline Alternatives 1 and 2, around Trout Lake, and approaching the town of Blackberry.The process water pipeline corridors would follow existing corridors that, when necessary, cross mine tailing deposits, also known as slickens. Slickens consist of mine tailings left over from the taconite concentration process. Process water pipeline segments 2 and 3 would cross glacial till with a water table deeper than 3 feet below ground surface. More information on these soil types is provided in Table 3.4-4. The Blowdown Pipeline Alternatives 1 and 2, and potable water and sewer pipelines all primarily cross well-drained glacial till.

The Rail Alignment Alternatives 1A and 1B both cross glacial till on their approach to the proposed IGCC power plant site. Alternative 1A would cross peat after branching from the CN rail line, and again within the West Range Site. The rail loop would be located on primarily poorly-drained organic and glacial till deposits. Alternative 1B would first cross mine tailing piles and slickens north of the Arcturus mine, then over a large area of peat and muck directly east of the power plant. The Alternative 1B rail loop would also be located on the organic soils adjacent to the Mesaba Generating Station.

The access roads 1 and 2 would primarily cross glacial till. Access Road 1 would cross a mine tailings pile and an old mine tailings basin directly north of US 169. The road would cross organic soils where it would join CR 7. Access Road 2 would cross more organic deposits when approaching the West Range Site.

Table 3.4-4. Soil Types along the West Range Site and Corridors

Parent Material	Drainage	Seasonal High Groundwater Table Depth	Potential for Re-vegetation	Location
Recent Organic Deposits	Poorly drained	2 ft below to 2 ft above ground surface	**Good**: wetland plants **Poor**: grasses, wild herbaceous plants, hardwood and coniferous trees	1,2,3,4,5,6,7,9
Recent Organic Deposits over Alluvium	Poorly drained	3 ft below to 2 ft above ground surface	**Good**: wetland plants **Poor**: grasses, wild herbaceous plants, hardwood and coniferous trees	1,2
Lacustrine Deposits	Poorly drained	1 to 3 ft below ground surface	**Good**: wild herbaceous plants, grasses and legumes, hardwood trees and coniferous plants **Fair to Good**: wetland plants **Fair**: grasses, legumes, hardwood trees and plants	2
Glacial Till	Variable; Very poorly drained to Well drained	Variable; 1 to greater than 6 feet below ground surface	Variable; slope and local drainage determines the potential for re-vegetation **Good**: grasses, legumes, wild herbaceous plants, hardwood trees **Fair to Good**: coniferous plants and wetland plants	1,2,3,4,5,6,7,8, 9,10
Glacial Outwash	Well to excessively drained; some locations are poorly drained	Greater than 6 ft below ground surface	**Good**: grasses and legumes, wild herbaceous plants, hard wood trees, and coniferous plants **Fair**: wild herbaceous plants **Poor**: wetland plants	2,3
Mine Pits and Tailings Piles	Tailings piles are well drained. Flooding of mine pits varies by location	Varies by location	**Poor**: grasses, legumes, wild herbaceous plants, hardwood tress, coniferous and wetland plants	4,9,10

Notes:
1. West Range IGCC Power Plant site
2. West Range HVTL WRA-1, WRA-1A, and WRB-2A
3. West Range Gas Pipeline Alternative 1, 2, and 3 corridors
4. West Range Process Water Pipelines
5. West Range Process Water Blowdown Pipeline 1
6. West Range Process Water Blowdown Pipeline 2
7. West Range Portable Water and Sewer Pipelines
8. West Range Rail Line Alternative 1A
9. West Range Rail Line Alternative 1B
10. West Range Access Roads

3.4.5.3 East Range Site and Corridors

Since the St. Louis County Soil Survey is not yet available publicly, soils at the East Range Site were assumed to be similar to the West Range Site due to their locations in similar climatic conditions and the similar parent materials. The depth to the water table at the East Range Site is not known.

A previous soil landscape study performed for the area was used to provide a limited characterization of the locations of organic deposits (Land Management Information Center, 1996). The East Range Site would be located on glacial till deposits. Initial studies of the soil indicate that the area has well-drained, sandy, light colored soil, which is consistent with the glacial parent materials. The HVTL 38L alternative route would traverse glacial till, glacial lake sediments and peat. The water table would be high around the peat deposits. Glacial lake deposits contain soft to medium stiff, stratified clay and silt deposits, and

tend to have a high groundwater table. Occasional cobbles and boulders are also encountered within the deposits. The HVTL 39L/37L alternative route would cross slickens from mine tailings piles around Eveleth, in addition to the glacial till, glacial lake sediments and peat. Mine tailings piles contain overburden soil from iron mining operations, which typically consists of glacial till. They also contain fragments of rock and low-grade iron ore. The ore is typically 3 to 10 inches in diameter, but can range in size from pebbles to large boulders. The tops of the tailings piles are typically flat and the side slopes are steep. Some piles are as much as 200 feet high. The Natural Gas Pipeline corridor would cross soils similar to those along the HVTL corridors.

The process water pipeline corridors would exist on CE property, and would cross soils disturbed from mining operations. The spoil from mining operations includes glacial till and fragments of rock or iron ore, and becomes incorporated into the preexisting soil column. A portion of all of the process water pipelines would cross mine deposits, and segments 6-S-2WX, K-2WX, 2WX-Site, and 2WX-2W would also cross glacial till.

The soils underlying Rail Line Alternatives 1A and 1B, the potable water and sewer pipelines, and the access road corridors would consist of glacial till. These soils are discussed in further detail above and in the West Range section (Section 3.4.5.2).

3.4.6 Prime Farmland

3.4.6.1 Regional Features

The Federal Farmland Protection Policy Act (Public Law 97 98; 7 U.S.C. 4201 et seq.) and the Minnesota Agricultural Land Preservation and Conservation Policy Act (M.S. 17.80-17.84) have been enacted in an effort to document the potential impacts to agricultural land through the NEPA process and to preserve land with the potential to consistently produce food and raw materials. The supply of high quality farmlands is limited; therefore, the U.S. Department of Agriculture (USDA) encourages the preservation of soils classified as "Prime Farmland," "Prime Farmland, if Drained," or "Farmland of Statewide Importance." The NRCS Handbook, part 622.06 (USDA, 2006) defines prime farmland as:

> *Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for other uses. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.*

Minnesota Rule 4400.3450, Subpart 4 ("Prime Farmland Exclusion") provides that

> *No large electric power generating plant site may be permitted where the developed portion of the plant site, excluding water storage reservoirs and cooling ponds, includes more than 0.5 acres of prime farmland per megawatt of net generating capacity, or where makeup water storage reservoirs or cooling pond facilities include more than 0.5 acres of prime farmland per megawatt of net generating capacity, unless there is no feasible and prudent alternative.*

The provision does not apply to areas located within home rule charter or statutory cities, areas located within two miles of home rule charter or statutory cities of the first, second, and third class, or areas designated for orderly annexation under Minnesota Statutes § 414.0325 (Excelsior, 2006a).

Prime farmland or farmland of statewide importance may occur in a variety of parent materials, geomorphic locations and climates. In northern Minnesota, soils formed on lacustrine or glacial till parent materials are generally considered prime farmland. Soils that also contain surface water may also be considered "Prime Farmland, if Drained." Some soils are not considered prime farmland but may have properties that are recognized by the state as suitable for production of food, feed, fiber, or forage. The Minnesota state soil surveys identify soils that are considered prime farmland or farmland of statewide importance.

3.4.6.2 West Range Site and Corridors

Fourteen soil series found along the proposed West Range Site and utility corridors are classified as either "Prime Farmland," "Prime Farmland, if Drained," or "Farmland of Statewide Importance." These soils are primarily silt loams located on shallow slopes and are generally well drained.

The West Range Site footprint is primarily located on soils identified either as "Prime Farmland Soils," or "Prime Farmland, if Drained." For the West Range Site, soils that are within the site ownership boundary or within the utility corridor rights–of-way and have been designated as prime or statewide important farmland are shown on Figure 3.4-7. Some soils have a seasonally high water table, but qualify as prime farmland where they have been drained. There currently is no active farming in this area.

Prime and statewide important soils are ubiquitous in the area surrounding the West Range Site (Figure 3.4-7). All of the HVTL, pipeline, and transportation corridors would cross over sections of soils classified as "Prime Farmland," "Prime Farmland, if Drained," and "Farmland of Statewide Importance." Some corridors would cross land that has previously been disturbed from mining activities. The process water pipelines Segments 1, 2, and 3 would cross fewer farmland soils as they approach the mine pits. Rail Alignment Alternative 1B would also cross fewer prime and statewide important soils around the mine tailing piles to the east of the power plant.

Facilities associated with the West Range Site that lie outside the City limits of Taconite and Marble (Taconite and Marble abut one another at the eastern-most boundary of Taconite and both are statutory cities) are limited to the LMP pumping station, Segment 1 of the Process Water Supply Pipeline, and the outfall at its point of termination of the Segment 1 pipeline (Excelsior, 2006a).

3.4.6.3 East Range Site and Corridors

The St. Louis County soil survey is currently being prepared, therefore, only preliminary soils data exists for parts of the county. However, the soils surrounding the East Range Site have been qualitatively analyzed from preliminary maps. Based on available mapping, two soil series are classified as "Farmland of Statewide Importance" soils within the vicinity of the East Range Site. No soils in the southern portion of St. Louis County are associated with the Prime Farmland classification. Since the soil survey data from St. Louis County are preliminary, the maps used in this analysis, as well as soil series classifications, are subject to change. In locations where the corridors cross tailing piles or disturbed mining areas, the presence of prime and statewide important soils is highly unlikely.

The area surrounding the East Range Site is an industrial region with several mining operations. Therefore, there is little farming activity surrounding the East Range site and no current farming practices are being conducted on the proposed project site.

The generating station footprint and many of the station's associated facilities are located entirely within the City limits of Hoyt Lakes, a statutory city. The Process Water Supply Pipeline Segment 7 is located within the City of Aurora, also a statutory city. Facilities associated with the East Range Site that lie outside the City limits of Hoyt Lakes or Aurora are Segment 6 and Segment 8 of the Process Water Supply Pipeline (Excelsior, 2006a).

3.4.7 Suitable Formations for Geologic Sequestration of Carbon Dioxide

Excelsior is currently working with the University of North Dakota Energy and Environmental Research Center to assess CO_2 management options as part of the Plains CO_2 Reduction (PCOR) Partnership (see Section 2.2.1.3). The Phase I and Phase II Mesaba Generating Station would be designed as carbon capture adaptable, in the event that the CO_2 can be either commercially used under economically advantageous conditions, or sequestered in response to a nationally implemented climate change program that includes regulatory constraints on greenhouse gas emissions. It is anticipated that approximately one third of the carbon in the PRB feedstock could be captured with existing technology, with a subsequent reduction in capacity and plant efficiency.

Carbon is currently being sequestered in capped sandstone or limestone aquifers, frequently around areas with oil or gas production. Some of the closest areas for potential carbon sequestration around the Proposed Action would be in the oil fields or coal seams in the Williston Basin in northwestern North Dakota (approximately 400 miles from the proposed West Range Mesaba Generating Station). There is also potential for sequestration in saline formations within the Mississippian-Madison Saline Aquifer System in western North Dakota and northwest South Dakota, and also within the Lower Cretaceous Saline Aquifer System in central North Dakota and South Dakota (approximately 260 miles from the West Range Mesaba Generating Station). Additional information on these potential sinks and their estimated storage capacities is available in a December 2005 PCOR publication titled "Geologic Sequestration Potential of the PCOR Partnership Region" at http://www.netl.doe.gov/technologies/carbon_seq/partnerships/phase1/pdfs/MDJ-Geologic Sequestration Potential.pdf.

Excelsior prepared a "Plan for Carbon Capture and Sequestration" in October 2006 that explored the economic factors associated with selecting geologic sequestration options and locations. The most promising options would deliver the CO_2 by pipeline for enhanced oil recovery operations in the Williston Basin. The plan also evaluated injection into the Lower Cretaceous Saline Formation in eastern North Dakota. Although existing CO_2 pipelines would be utilized wherever feasible, new CO_2 pipeline would need to be constructed to transport CO_2 to the sequestration sites. Excelsior would continue to work with the PCOR Regional Partnership to explore possibilities for sequestering the CO_2 from the Mesaba Energy Project, such as collaborating on a potential Phase III demonstration project proposal under NETL's Carbon Sequestration Program.

Excelsior recently discussed potential carbon sinks in the Upper Midwest with Julio Friedmann, the Associate Program Leader of the Carbon Management Program at Lawrence Livermore National Laboratory and Harvey Thorleifson, Director of the Minnesota Geological Survey. Based on those discussions, Excelsior concluded that prospects do exist in Minnesota for geologic formations that may be appropriate for sequestration. At present, the geological understanding of these formations is limited and further study is necessary to determine their suitability for carbon sequestration.

A formation in eastern Minnesota called the Midcontinent Rift holds the potential to be suitable for carbon sequestration and comes within 100 miles of both proposed plant sites. It contains significant formations of sedimentary rock that may have adequate porosity for carbon sequestration. At this time, it is not certain whether such formations exist at a suitable depth and with a sufficient degree of geological seal for carbon sequestration to be feasible.

The geological formations and reservoirs that PCOR and other regional initiatives identify as carbon sequestration sinks (and quantify capacity thereof) have been relatively well characterized geologically as part of previous oil and gas exploration activities. Such characterization is expensive and therefore is generally (but not strictly) obtainable because of the economic opportunities that accompany fossil fuel exploration. Because of the lack of oil and gas exploration in the area, the Midcontinent Rift in Minnesota has not been characterized to the degree of other identified and confirmed sinks. Excelsior is exploring ways to facilitate this research. However, until this occurs, the potential to sequester carbon in Minnesota is uncertain.

3.5 WATER RESOURCES

Ready access to an abundant supply for water is an important consideration in siting power plants, as water is necessary for steam generation, cooling, and process water. The following sections describe the water resources (surface and groundwater) in the vicinity of the Mesaba Energy Project alternatives and the associated utility and transportation corridors.

3.5.1 West Range Site and Corridors

The following sections identify the prominent surface water features and describe the major drainage areas and watersheds associated with the West Range.

3.5.1.1 Surface Water Sources

The West Range Site lies in the northern region of the Upper Mississippi River Basin (UMRB) Watershed. Major surface water bodies in the vicinity of the Mesaba Generating Station are listed in Table 3.5-1. The major drainage areas throughout the Mesaba Generating Station and associated utility and transportation corridors are shown in Figure 3.5-1.

There are three primary watersheds within the vicinity of the West Range Site. The Prairie River watershed encompasses the northern portion of the project site. The southern portion of the Power Station lies in a sub-watershed that drains into the CMP. The CMP watershed does not have a surface hydrologic connection to the other watersheds since the CMP does not have a surface water outlet. The Swan River watershed is south of the CMP sub-watershed. Both the Prairie River and the Swan River drain to the Mississippi River.

There are a number of water features (natural lakes, water-filled mine pits, and rivers/streams) located in the area surrounding the proposed generating station. The primary natural lakes in the area include: Dunning Lake, adjacent to the east edge proposed generating station property; Big Diamond Lake, to the southeast of the proposed plant; and Holman Lake, to the south. As most of the taconite mining in the area has ceased, many of the pits created by these operations have filled in with water, some to the point that they have connected with adjacent pits. Specifically, these pits include the CMP, the HAMP Complex, and the LMP. A map of the locations of these water features near the proposed power station is provided in Figure 3.5-2. As the abandoned mine pits are being considered as sources of raw water for the power station, the current capacity of each is presented in Table 3.5-2.

Table 3.5-1. Surface Water Bodies

Surface Water	Watershed	FEMA[1] Designated Floodplain	Public Water[2]	Special Water[3]	MPCA Designated Impaired Water[4]	Target TMDL Study[5]	Source of Impairment
Big Diamond Lake	Swan River		X				
Canisteo Mine Pit (CMP)	**NA**						
Dunning Lake	Prairie River		X				
Greenway Mine Pit	Prairie River						
Hill-Annex Mine Pit (HAMP)	**Swan River**						
Holman Lake (Hill Lake)	**Swan River**		**X**				
Lind Mine Pit (LMP)	**Prairie River**						
Little Diamond Lake	Swan River		X				
Lower Panasa Lake	Swan River		X		X	NO	Mercury FCA[6]
Mississippi River		X	X	X	X	NO	Turbidity, Low oxygen Mercury FCA[6]
Oxhide Creek	Swan River		X				
Oxhide Lake	Swan River		X		X	NO	Mercury FCA[6]
Prairie River	**Mississippi River**	**X**	**X**				
Snowball Creek	Swan River		X				
Swan River	Mississippi River	X	X		X	NO	Fecal coliform Low oxygen Mercury FCA[6]
Trout Creek	Swan River		X				
Trout Lake	Swan River		X	X	X	NO	Mercury FCA[6]
Twin Lakes	Swan River		X				
Upper Panasa Lake	Swan River		X		X	NO	Mercury FCA[6]
West Hill Mine Pit	Prairie River						

[1] Federal Emergency Management Agency (FEMA)
[2] MNDNR Designated Public Water
[3] MPCA Designated Special Water
[4] MPCA Designated Impaired Water, 2006 EPA Draft 303(d) list of impaired waters. No data does not necessarily mean that the water body is not impaired. It may be that the water body has either not been sampled or there are not enough data to make an impairment determination.
[5] Total Maximum Daily Load
[6] Fish Consumption Advisory
Surface Waters shown in bold are being considered for either a process water source or receiving waters for discharges.
Source: Excelsior, 2006a

Table 3.5-2. Capacity of West Range Mine Pits (November 2005)

Water Source	Water Surface Elevation (feet)	Surface Area (acres)	Estimated Volume (acre-feet)
CMP	1,309	1,400	150,000
HAMP Complex			
Hill-Annex Mine Pit	1,249	216	20,600
Arcturus Mine Pit	1,269	105	4,490
Gross/Marble Mine Pit	1,249	141	11,100
LMP	1,265	82	8,310

Source: Excelsior, 2006a

In addition, there are a number of existing operations that use some of these water features as source water. Table 3.5-3 presents a summary of existing MNDNR water appropriation permits in the vicinity of the West Range Site.

Table 3.5-3. Existing Water Appropriation Permits for Surface Waters Near The West Range Site

Permitee	Resource	Permitted		Reported Pumping (Million Gallons)				
		GPM	MG/Y	2000	2001	2002	2003	2004
Jackson, Allen	Mississippi River	250	13	ND	ND	2.2	ND	ND
Schwartz Redi Mix Inc.	West Hill-Annex Pit	900	39	ND	ND	ND	ND	21.6
MNDNR	Hill-Annex Tailing Basin	4,500	500	ND	ND	ND	ND	70.3
MNDNR	Hill-Annex Mine	7,000	3,416	ND	ND	621.1	1,550.3	1,374
U of MN	Prairie River	500	7	ND	ND	ND	ND	ND
U of MN	Prairie River	1,000	60	6.7	17	18.1	25.6	20.1
U of MN	Prairie River	1,000	60	7.8	ND	0.4	23.4	26.5
Blandin Paper Co.	Mississippi River	30,000	7,000	7,985	7,041	6,350	6,429	6,088
Jackson, Allen	Mississippi River	265	4	2.8	ND	ND	2.5	ND
Swan Lake Country Club	Oxhide Creek	540	10	4.6	8.5	9.2	8.4	5.8
City of Coleraine	Trout Lake	400	41	37	19.7	19.7	12.1	11.9

ND – No Data
Source: Excelsior, 2006a

The following sections provide more detail about the primary water bodies that are being considered as raw water sources or receiving waters for discharges from the West Range Mesaba Generating Station.

Canisteo Mine Pit Complex

The CMP Complex is made up of a number of abandoned mine pits. The CMP is situated northeast of the city of Grand Rapids and immediately north of the cities of Coleraine, Bovey, and Taconite. The entire mine pit complex is approximately 4.5 miles long and 0.5 miles wide and has a drainage area of

approximately 4,536 acres. The pit complex has a maximum depth of approximately 300 feet and a surface area of almost 1,400 acres. The water surface elevation in the mine pit on November 1, 2005 was 1,308.75 feet mean sea level (msl), which corresponds to a surface area of 1,393 acres and a water volume of 149,500 acre-feet.

The CMP Complex currently does not have a surface outlet. Water enters the complex through surface water runoff and groundwater inflow. Outflow consists only of groundwater seepage and evaporation. The amount of surface and ground water that currently enters the mine pit is greater than the amount of water lost by seepage and evaporation, which results in a net inflow of water. The water surface elevation has continued to rise since pumping of the CMP ceased in September 1985.

The CMP Complex has been modeled with the WATBUD model, which is a water balance model developed by the MNDNR, used to evaluate and predict water inflows and outflows for surface water bodies. The MNDNR has also monitored the water surface elevation in the mine pit and monitoring wells since 1989, and used these data to calibrate the WATBUD model and develop stage-storage relationships for the pit.

Using the stage-storage data from 1989 to 1995, the CMP had a net average inflow of 3,164 gallons per minute. From 1995 to present, recharge rates range from 810 gallons per minute to 4,190 gallons per minute, with an average of 2,580 gallons per minute. The stage-storage data has also indicated that the net inflow decreases as the level of the water in the pit reaches 1,300 feet msl, which is the elevation of the bedrock surrounding the pit. Results of the most recent (2005) modeling effort indicate that the CMP Complex will overflow within the next 4.5 to 8.5 years.

The U.S. Geological Survey (USGS) also conducted a study of the groundwater flow between the CMP and the surrounding aquifers (Jones, 2002). This study modeled the groundwater flows over varying CMP water level elevations (from 1,300 to 1,324 feet msl) and estimated the net inflow of groundwater into the CMP ranged from 628 gallons per minute at the 1,300 feet msl to 40 gallons per minute at the 1,324 feet msl. The 1,324 feet msl is the level at which the CMP will begin to overflow.

Jones (2002) found that some groundwater outflow from the CMP did occur at the 1,300 feet msl. The outflow occurred in the area between the CMP and Trout Lake (which is also the location of the two groundwater wells used by the City of Coleraine as their source from drinking water. The modeling also indicated that the net outflow drops to zero at CMP water levels at or below 1,292 feet msl.

Hill-Annex Mine Pit Complex

The HAMP Complex consists of the Arcturus, Gross-Marble, Hill-Trumbull, and Hill-Annex Mine Pits. These mine pits are located immediately north of the cities of Marble and Calumet, and cover an area of over three miles from east to west. The Arcturus, Gross-Marble, and Hill-Trumbull/Hill-Annex Mine Pits were separated by large volumes of waste material (tailings and overburden) deposited during the mining operations. Following the cessation of mining, the water levels in the pits began to rise, and the GMMP became connected to the Hill-Trumbull/Hill-Annex when the water surface elevation reached approximately 1,215 feet msl. The water surface elevation in the Arcturus is higher than that of the other pits, and has not developed a permanent surface connection to other pits; however water currently overflows out of the Arcturus into the GMMP. The stage in the GMMP and Hill-Trumbull/Hill-Annex pits were measured at 1,246.70 feet and Arcturus was measured at 1,268.51 feet on November 1, 2005 (Excelsior, 2006b).

Until 1979, mining operations kept the HAMP Complex completely dewatered. After that time, dewatering continued at several of the mine pits, while other pits began to fill with water after dewatering ceased. By 1981, all mining operations had ceased (Barr, 1987) and all the mine pits started filling with surface and groundwater. In 1988, the HAMP was established as a state park that offered tours of the mine pit features and facilities. The park, which is managed by the MNDNR, Division of Parks and Recreation, does operate a dewatering pump in order to keep the water level below some of the unique

features of the mine, but due to limited funding, the dewatering operations cannot be operated more than 5.5 months a year. As a result, the water level has risen above some of the mine features and facilities.

The current water level in the park allows the MNDNR to give boat tours of the pit during the summer months. There are mine features and several historic structures below the current water surface elevation that are viewed during these tours. According to the MNDNR's Draft Management Plan for the park, it is preferred to dewater the mine pit to an elevation between 100 and 150 feet below the current water surface elevation to expose historic structures and improve the interpretive quality of the site, as well as protect the historic structures on the pit rim. However, the dewatering of the pit to this level is currently cost prohibitive under the State Park's annual budget.

Inflows into the HAMP Complex include seasonal precipitation, surface and ground water components. Discharges from the system include evaporation, seepage (ground water outflow), and dewatering. The water levels in the HAMP Complex fluctuate as a result of the seasonal variations in evaporation, runoff, and dewatering. The dewatering operations at the HAMP by the MNDNR occur from the end of May until October, and the pumping averages 6,200 gpm while in operation.

Pumping records for the HAMP have been kept since 1973, and MNDNR staff continue to report dewatering volumes on a monthly basis, however stage data were not collected on a regular basis. Using the pumping records from 1973 to1979, when the HAMP was in operation, the estimated recharge rate was determined to range from 3,230 to 4,030 gallons per minute. Since these recharge rates are based on keeping the pit empty, they are likely the maximum rates and should decrease as the water level in the pit rises.

For the Arcturus Mine Pit (AMP), given that the pit was completely dewatered on January 1, 1979, and was completely full by 1999, an average recharge rate of 2,150 gallons per minute was calculated.

Prairie River

The Prairie River lies within the UMRB watershed and drains into the Mississippi River southeast of Grand Rapids and La Prairie. According to USGS data, the Prairie River watershed has an approximate drainage area of 360 square miles at the gauging station. The USGS also maintains a gauging station (gauge number 05212700) on the Prairie River, several miles upstream of its confluence with the Mississippi River. Prairie Lake lies on the Prairie River between the gauging station and the Mississippi River. Lake levels are controlled at an existing hydroelectric dam, located approximately 5 miles upstream of its confluence with the Mississippi River.

Flow data have also been collected at the gauging station from 1967 to 1983 and 2001 to present. Average monthly flow rates range from 50 to 200 cubic feet per second from August through March and range from 200 to 600 cubic feet per second range during the months of April, May, June, and July.

The Prairie River is being considered as a source of raw water for the West Range Power Station, and therefore, the raw water intake would be subject to the CWA rule 316(b) criteria regarding Cooling Water Intake Structures (CWIS). The rule specifies that, for CWIS on fresh water rivers, the maximum amount of water that can be taken is "5 percent of the mean annual flow or 25 percent of the 7Q10[1], whichever is the lesser."

The mean annual flow in the Prairie River is 319 cubic feet per second, and five percent of that flow is equal to 16 cubic feet per second. The 7Q10 in the Prairie River was determined to be 22 cubic feet per second, and 25 percent of that flow is equal to 5.5 cubic feet per second. Since 25 percent of the 7Q10 is the smaller amount, the maximum amount of water that can be appropriated from the Prairie River at one time is 5.5 cubic feet per second (2,468 gallons per minute). Only these data collected by MP at the

[1] The 7Q10 is the seven day low flow average with a 10-year recurrence interval.

Prairie Lake Dam from 1998 to 2004 were used in the determination of the mean annual flow and the 7Q10, since there was not a full year of record for 1997 and 2005.

Trout Lake

Trout Lake does not currently receive any surface water discharges from the CMP. Since the CMP water surface continues to rise, surface outlets for the CMP to Trout Lake have been evaluated by the MNDNR and Barr Engineering, and Trout Lake has been evaluated as a potential receiving water. The available studies (Excelsior, 2006b; Barr, 2004) identify a number of potentially negative and positive outcomes as a result of the CMP Complex discharging to Trout Lake.

Upper Panasa Lake

Upper Panasa Lake currently receives water from the HAMP Complex dewatering operations. The amount of water that is discharged ultimately to Upper Panasa Lake from the HAMP Complex is shown in Table 3.5-3. The impacts on Upper Panasa Lake resulting from the discharge water from the HAMP have not been studied.

Greenway Mine Pit

There are very little data on the Greenway Mine Pit (GMP). The pit has filled with water and has an outlet pipe that discharges to the Prairie River. Short Elliot Hendrickson, Inc. (SEH) personnel measured the pipe size, flow depth, and flow velocity at the pipe outlet (Excelsior, 2006b) and determined the outflow from the Greenway Mine Pit was approximately 1 cubic foot per second (450 gallons per minute) at the time of the field investigations.

West Hill Mine Pit

There are very little data on the West Hill Pit. The pit has filled with water and has an outlet pipe that discharges to the LMP. SEH personnel (November 2, 2005) measured the pipe size, flow depth, and flow velocity at the pipe outlet and determined the outflow from the West Hill Mine Pit was approximately 3.5 cubic feet per second (1,570 gallons per minute) at that the time of the field investigations.

Lind Mine Pit

There are very little data on the LMP. The pit has filled with water and has an outlet pipe that discharges to the Prairie River. SEH personnel (November 2, 2005) measured the pipe size, flow depth, and flow velocity at the pipe outlet and determined the outflow from the LMP was approximately 4 cubic feet per second (1,800 gallons per minute) at that time. A majority of the outflow comes from the West Hill Mine Pit (3.5 gallons per minute).

Holman Lake

Holman Lake is not being considered as a source for process water, but is being considered as a potential receiving water for cooling tower blowdown discharges. Holman Lake currently receives outflow from Little Diamond Lake, as well as surface water runoff. The lake previously received the dewatering discharge from the Canisteo Mine when the mine was operational. At that time, the water level in the lake was controlled by a concrete spillway. Currently, the water level is effected by a beaver dam built just upstream of the spillway. The lake is listed on MNDNR's Public Waters Inventory, but it is not currently designated for a particular water use classification, however there is a public swimming area on the eastern side of the lake. Some limited water quality information is available for Holman Lake.

3.5.1.2 Water Quality and Uses

The water needs of the Mesaba Generating Station at the West Range Site would be met by appropriating water out of the following nearby abandoned mine pits: the CMP, HAMP Complex, and the LMP. The Prairie River would also serve as a source of water supply and would be integrated into the mine pit water plan. The current water quality of each water source is summarized in Table 3.5-4. In

general, the current concentration of each constituent is based on the median concentration of available qualified water quality analyses.

Table 3.5-4. Current Water Quality for West Range Water Bodies

Constituent	Units	Water Quality Data				
		CMP	HAMP Complex	LMP	Prairie River	Holman Lake
Hardness	mg/L	308	229	n/a	n/a	n/a
Alkalinity	mg/L	180	163	178	76	186
Calcium	mg/L	55.3	59.1	73.2	50	50.2
Magnesium	mg/L	40.8	20.5	n/a	22	n/a
Iron	mg/L	<0.05	<0.05	n/a	n/a	0.75
Manganese	mg/L	<0.02	<0.02	n/a	n/a	0.04
Chloride	mg/L	5.15	5.2	4.9	1.3	8.4
Sulfate	mg/L	105	54.7	n/a	<5	10.1
TDS	mg/L	337	252	402	n/a	236
pH	mg/L	8.4	8.3	7.7	7.4	7.9
Aluminum	µg/L	<25	<25	n/a	91	n/a
Barium	µg/L	28.6	29.3	n/a	n/a	n/a
Cadmium	µg/L	<10	<10	n/a	n/a	n/a
Chromium (6+)	µg/L	<5	<5	n/a	n/a	n/a
Copper	µg/L	<10	<10	n/a	n/a	n/a
Fluoride	mg/L	n/a	n/a	n/a	n/a	n/a
Mercury	ng/L	0.9	0.9	0.8	0.59	<4.0
Nickel	µg/L	<5	<5	n/a	n/a	n/a
Selenium	µg/L	<2	<2	n/a	n/a	n/a
Sodium	mg/L	6.7	6.2	5.0	2.5	7.4
Specific Conductivity	umhos/cm	476	418	n/a	171	n/a
Zinc (3)	µg/L	<10	<10	n/a	n/a	n/a
BOD	mg/L	<2	<2	n/a	n/a	n/a
COD	mg/L	<2	<2	n/a	n/a	n/a
TOC	mg/L	1.9	1.8	n/a	n/a	n/a
TSS	mg/L	2	<1	n/a	n/a	n/a
Ammonia (as N)	mg/L	<0.1	<0.1	0.1	0.018	<0.1
Phosphorus	mg/L	<0.1	<0.1	0.01	0.029	0.01

n/a – no data available (not analyzed)
Source: Excelsior, 2006b

The natural surface water bodies within the project area are used for recreational purposes such as fishing, boating, and swimming. The CMP and the Greenway Mine Pit also host recreational uses, while the West Hill Mine Pit and the LMP do not have any known recreational uses.

3.5.1.3 Groundwater

Groundwater Quality and Quantity

The primary aquifer at the site is shallow Quaternary drift comprised of water-bearing sand and gravel deposits. Regionally, these aquifers occur beneath till and in ice contact features on the flanks of end moraines. End moraines are the ridge-like accumulation of till deposits marking a standstill position of a past or present glacier. Buried bedrock valleys in the region create variable thicknesses of Quaternary deposits. North of Taconite, Minnesota, Quaternary deposits range from approximately 10 to 40 feet thick, whereas, in the vicinity of the cities of Coleraine and Bovey (east of the site), Quaternary deposits are approximately 130 feet thick (USDI, 1965). Based on the results of geotechnical borings at the West Range Site, the unconsolidated deposits at the proposed facility consist of varying amounts of till and coarse alluvium, approximately 10 to 35 feet thick combined.

The West Range Site is located at a potentiometric high and groundwater recharge area for the shallow aquifer is due to the presence of the Giants Range Batholith (Excelsior, 2006b). A groundwater divide (where the groundwater flow direction is north and south with surface water features primarily influencing the direction of shallow flow) is present in the vicinity of the West Range Site. On the site itself, where the facility will be located, the groundwater flow direction of the shallow aquifer appears to be north and northwestward based on groundwater elevation data collected from the on-site groundwater monitoring wells. Ultimately, groundwater in the shallow aquifer at the site discharges to tributaries and surface water bodies that, subsequently, discharge into the Prairie River.

Immediately south of the West Range Site, a bedrock aquifer exists underlying the Quaternary deposits (Excelsior, 2006b). Bedrock in the area (Giants Range Batholith, Pokegama Quartzite, Biwabik Formation, and Virginia Formation) has very little primary porosity. However, secondary porosity in the form of fractures and leached zones has developed within Biwabik Formation allowing it to act as an aquifer (Excelsior, 2006b). Regional groundwater flow within the Biwabik Formation is south from the Giants Range Batholith toward the Swan River—a regional groundwater discharge feature. The groundwater flow direction of this bedrock aquifer specifically on the West Range site is interpreted to be south and southwest toward the CMP.

Mining activities in the area have influenced the natural groundwater system in the area (Excelsior, 2006b). Fractures and leached zones within the Biwabik Formation appear greatest near the mine pit complexes. The mine pits have been excavated below the water table and groundwater head of the Quaternary and bedrock aquifers. Local groundwater flow is influenced by the mine pits, directing flow towards the mine pit complexes (USDI 1965, Excelsior, 2006b). Since the cessation of mining activities, water levels in the mine pits have been increasing due to discharge of groundwater into the mined excavations.

Transmissivities and hydraulic conductivities of various shallow sand and gravel aquifers in the region have been estimated (Excelsior, 2006b). In studying the hydrogeology of the CMP area, the MNDNR and USGS installed 18 monitoring wells in the Quaternary drift aquifer(s) and performed pumping tests and hydraulic conductivity slug tests.

Average calculated transmissivities for sand and gravel aquifers ranged from 98 to 300 square feet per day. Average calculated hydraulic conductivities for the sand and gravel aquifers ranged from 2.2 to 68 feet per day (Excelsior, 2006b). Hydraulic conductivities for the four wells on the site ranged from 0.5 to 32.5 feet per day. Locally, well yields typically range from 300 to 500 gallons per minute for wells completed in the Quaternary drift deposits (Excelsior, 2006b), with yields up to 1,000 gallons per minute. The Biwabik Formation is a good source of groundwater for domestic use, and a fair source of supply for municipal and industrial use (Excelsior, 2006b). While the local aquifers have sufficient capacity to serve local municipal and residential groundwater users, these aquifers do not appear to have sufficient capacity to provide enough groundwater for the process water needs of the Mesaba Generating Station (over

15,000 gallons per minute peak requirements). Thus, a large number of wells would be required to pump enough water to meet the stations process water needs.

Although groundwater quantities and local aquifer capacities are limited (as far as being a source of process water supplies), it is feasible that one or more wells could be utilized for providing a potable water supply for the generating station. Indeed, several local public water supply wells are drilled into and utilize the Biwabik Formation.

Typically groundwater quality in the region has moderate dissolved solids content, is moderately siliceous, is very hard, and contains high levels of iron and manganese frequently above the maximum recommended limits of 0.3 milligrams per liter for iron and 0.05 milligrams per liter for manganese (USDI 1965, Excelsior, 2006b). Sand, ice-contact sand and gravel, and buried outwash aquifers have adequate yield (5 gallons per minute or more) and suitable quality for domestic use (total dissolved solids less than 1000 milligrams per liter) (Excelsior, 2006b). Of these, only buried outwash aquifers have suitable yield (900 gallons per minute or more) and quality (total dissolved solids less than 500 milligrams per liter, iron content less than 0.3 milligrams per liter, and hardness less than 180 milligrams per liter) for municipal or industrial use (Excelsior, 2006b).

Groundwater Depth and Recharge Sources

The potentiometric surface of the shallow Quaternary aquifer at the area is approximately 1350 to 1,400 feet msl (Excelsior, 2006b), approximately 10 to 60 feet below ground surface (bgs). Static groundwater elevations of the shallow aquifer(s) have been recorded by the Minnesota Department of Natural Resources in a series of monitoring wells in the area of the CMP, and from the time period between January 2001 and April 2005, the groundwater elevations ranged from 1280 to 1382 feet msl.

Groundwater flow is influenced by mine pits in the area (USDI, 1965); a potentiometric gradient exists between the surface water in mine pit lakes and groundwater in surrounding areas directing flow towards the mine pit complexes (Excelsior, 2006b). During periods of mine operation, dewatering in the mine pits reduced the amount of lateral flow (north to south) through bedrock and Quaternary deposits, and decreased potential vertical recharge to the bedrock aquifer south of the mine pits (Excelsior, 2006b).

Municipal wells for the cities of Bovey, Calumet, Coleraine, Marble, and Taconite are located south of the local mine pits (CMP and HAMP Complex). Table 3.5-5 summarizes the static water elevations and historic pumping in these wells.

Table 3.5-5. Pumping Groundwater Elevations City Municipal Wells

Date		Water Elevation	Pumping Rate	Duration
		ft msl	gpm	hours
	Marble 1			
1926	During mining operations	1150	300	-
1955		1164	350	-
1977		1105	248	2
1994	After mining operations ceased	1177	400	-
1999		1189	385	-
2000		1195	420	-
2001		1200	390	-
2002		1232	270	-
2003		1203	350	-

Table 3.5-5. Pumping Groundwater Elevations City Municipal Wells

Date		Water Elevation	Pumping Rate	Duration
		ft msl	gpm	hours
	Marble 2			
1955	During mining operations	1199	385	14
1965		1198	340	-
1977		1103	300	25
1989	After mining operations ceased	1236	270	-
1994		1193	300	-
1999		1196	330	-
2000		1201	360	-
2001		1203	310	-
2002		1207	-	-
2003		1221	220	-
	Bovey 1			
1953	During mining operations	1256	650	10
	Coleraine 1			
1918	During mining operations	1258	500	
	Coleraine 3			
1976	During mining operations	1243	1012	5
	Taconite 1			
1991	After mining operations ceased	1112	218	12

Average annual recharge to groundwater is approximately 5.7 to 7.6 inches (Excelsior, 2006b). Groundwater recharge to the shallow sand and gravel aquifer(s) is derived from precipitation infiltration and interconnections with surface water bodies (including mine pits that have filled with water). Groundwater recharge to the underlying Biwabik Formation bedrock aquifer is largely by vertical infiltration through the Quaternary deposits where the formation is not overlain by other bedrock (USDI, 1965). Lateral groundwater recharge occurs as groundwater travels south from the Giants Range Batholith.

Usage and Availability

Other than the four groundwater monitoring wells recently constructed, no wells are currently located on the property. However, numerous wells are located on surrounding properties. There are 23 domestic wells, 11 monitoring wells, three "other use" wells, and two public supply non-community transient wells in the area. The domestic supply wells are concentrated along CR 7, US 169, and north of Big Diamond Lake. These domestic wells utilize the Quaternary sand and or gravel aquifers.

Wells are also located adjacent to the CMP and the HAMP Complex. The wells adjacent to the mine pits are used for:

- Community Supply (10)
- Dewatering (1)
- Domestic (19)
- Industrial (2)

- Monitoring (38)
- Municipal (2)
- Public Supply (2)
- Other (7)

Public water supply wells for the cities of Bovey, Calumet, Coleraine, Marble, and Taconite are constructed in Quaternary and Biwabik Formation aquifers. Wells for the cities of Bovey and Coleraine are completed in the same unit of ice stratified Quaternary drift (USDI, 1965). The wells receive limited amounts of recharge through infiltration and receive some recharge from Trout Lake (USDI, 1965). According to the County Well Index and DNR State Water Use Database System of Water Appropriations Permits, the City of Bovey has one municipal well (Unique No. 228834). This well has a 16-inch diameter casing completed in sand and gravel Quaternary deposits. The static water elevation was 1,268 feet msl at the time of installation (1953). This groundwater level was recorded when the CMP was dewatered for mining activities. The City of Bovey is permitted to pump the well at a rate of 35.0 million gallons per year. The reported volume of groundwater pumped from this well in 2004 was 29.6 million gallons per year.

The City of Coleraine has two wells (Coleraine 1 and 3: Unique Nos. 241430 and 110457, respectively). Coleraine 1 is completed at a depth of 75 feet within undivided Quaternary drift. Coleraine 1 had a static water level of 1,283 feet msl at the time of well installation (1918). Coleraine 3 is 100 feet deep. It is completed within sand, gravel, and boulder Quaternary deposits. Coleraine 3 had a static water level of 1267 feet msl at the time of well installation (1976). The City of Coleraine is permitted to pump 80 million gallons per year from both wells. The reported pumped volume in 2004 was 52.2 million gallons per year for Calumet 1; there was no reported pumping in 2004 for Coleraine 3.

The cities of Marble, Calumet, and Taconite each have two public water supply wells. These six wells draw water from the Biwabik Formation bedrock aquifer. Marble 1 (Unique No. 228842) is 300 feet deep. The static water level was 1224 feet msl at the time of well installation (1926). Marble 2 (Unique No. 228846) had a static water level was 1258 feet msl at the time of installation (1955). The city of Marble is permitted to pump 49.0 million gallons per year from both of the wells. The reported volume of groundwater pumped for both wells in 2004 was 12.8 million gallons per year.

Calumet 2 (Unique No. 228839) was completed at a depth of 155 feet in the Virginia and Biwabik formations. The static water elevation was 1178 feet msl at the time of installation (1943). Calumet 3 (Unique No. 228838) is 203 feet deep. It is completed in the Virginia and Biwabik formations. The City of Calumet is permitted to pump 22.0 million gallons per year from both wells. The reported volume of groundwater pumped in 2004 was 5.8 million gallons per year for Calumet 2 and 6.2 million gallons per year for Calumet 3.

The City of Taconite Well 1 (Unique No. 241489) is 384 feet deep and is completed in the Biwabik Formation bedrock aquifer. The approximate static groundwater elevation in the well at the time it was constructed (1936) was 1,273 feet msl. Taconite No. 2 (Unique No. 495997) is 394 feet deep and also utilizes the Biwabik Formation aquifer. Its static water elevation was 1290 feet msl at the time of installation (1991). The City of Taconite is permitted to pump 20 million gallons per year (total) from both wells. The reported volume of groundwater pumped in 2004 was 7.9 million gallons per year for Taconite 1 and 7.3 million gallons per year for Taconite 2.

The cities of Bovey, Calumet, Coleraine, Marble, and Taconite rely on groundwater resources for public water supplies. Each city has public water supply wells open to either the shallow sand and gravel aquifer (the cities of Bovey and Coleraine) or the Biwabik Formation bedrock aquifer (cities of Calumet, Coleraine, Marble, and Taconite). Due to the close proximity of these local public water supply wells to

surface water bodies, a hydrologic connection may exist between the groundwater captured by the wells and local surface waters and mine pits. Due to the relatively high tritium concentrations detected by the Minnesota Department of Health (MDH) in the groundwater pumped from some of these public water supply wells, the source water aquifers (Quaternary sand and gravel deposits and the Biwabik Formation) appear to recharge quickly (i.e., 50 years or less) and are therefore more sensitive to land surface activities and more vulnerable to potential contamination.

Permits

No groundwater use or withdrawal permits currently exist for the Mesaba Energy Project. As previously mentioned in Section 2.5.2.3, MNDNR Water Appropriation Permits for groundwater withdrawal/use have been issued to local municipalities for public water supply systems (the cities of Bovey, Calumet, Coleraine, Marble, and Taconite). Regionally, groundwater appropriation permits have also been issued to mining companies for dewatering and farms for agricultural purposes and irrigation.

Four well permits were obtained from the MDH for constructing the four groundwater monitoring wells installed on the West Range Site in July 2005. These permits will be reissued annually by the MDH to the facility as long as the wells are still necessary and utilized.

Should groundwater be used for a potable water supply for the facility, a well permit from the MDH will be required. If the amount of groundwater pumped from a well for potable water supplies exceeds 10,000 gallons per day or 1 million gallons per year, a Water Appropriation Permit will be required from the MNDNR.

During construction of Phase I and Phase II, dewatering may be necessary that will temporarily lower the shallow water table aquifer in small localized areas. If the dewatering is expected to exceed 10,000 gallons per day or 1 million gallons per year, a Water Appropriation Permit will be attained from the MNDNR.

Any necessary discharges from the facility will be properly managed in accordance with the NPDES permits issued for plant, and applicable state and local regulations to prevent degradation of source water aquifers used for public water supplies.

3.5.2 East Range Site and Corridors

The following sections identify the prominent surface water features, and describe the major drainage areas and watersheds, land uses, soil classifications, and abandoned mine pits associated with the West Range.

3.5.2.1 Surface Water Sources

Major watersheds throughout the project area are shown in Figure 3.5-3. The drainage area boundaries shown on Figure 3.5-3 were delineated from the USGS maps of the area. This map, and therefore the drainage area boundaries, does not represent the altered hydrology in this area that has taken place due to mining activities in recent years. The East Range Site lies within the northwest region of the Lake Superior Watershed. The major surface water bodies in the vicinity of the project site are shown in Figure 3.5-4 and listed in Table 3.5-6.