

Chapter 3 — Affected Environment

This chapter describes the affected environment for the project alternatives. The affected environment is the portion of the existing environment that could be affected by the project. The information presented here focuses on issues identified through the scoping process and interdisciplinary analyses.

The affected environment varies for each issue. Both the nature of the issue and components of the proposed project and alternatives dictate this variation. The following sections concentrate on providing the specific environmental information necessary to assess the potential effects of the proposed action and alternatives.

General Physical Environment

The Fort Berthold Indian Reservation encompasses about 1,583 square miles in portions of six counties in west-central North Dakota. The counties are Dunn, McKenzie, McLean, Mercer, Mountrail, and Ward. Surface elevations range from about 1,835 feet above mean sea level (AMSL) along Lake Sakakawea to more than 2,600 feet AMSL in Dunn County.

The project area occurs at the confluence of two North Dakota ecoregions — the Missouri Coteau Slope and the Northwestern Glaciated Plains (Bryce et al. 1998). Physiographically, this area consists of nearly level till plains and rolling morainic hills and is also known as the glaciated Prairie Pothole Region (PPR). The PPR is a unique area of approximately 300,000 square miles in the United States and Canada that stretches northwest from northern Iowa through southwest Minnesota, eastern South Dakota, eastern and northern North Dakota, southwest Manitoba, and south Saskatchewan to southeast and east central Alberta and bordering areas of northern Montana (Kantrud et al. 1989).

The landscape of the PPR is largely the result of the scouring action of Pleistocene glaciation that created and maintained numerous shallow depressions (which are classified into various wetland classes). The numerous seasonal, semi-permanent and permanent wetlands (also known as potholes or sloughs) capture snowmelt and rainwater or are within reach of shallow subsurface waters (Samson et al. 1998). Historically, the PPR contained approximately 25 million wetlands, or an average of about 83 per square mile (Kantrud et al. 1989). Today, the PPR is a major producer of cereal grains and is the most important area in North America for the production of waterfowl.

Characteristic vegetation communities in the region include seasonal, semi-permanent and permanent wetlands, mixed-grass prairie including numerous range sites, wooded draws, intermittent seasonal drainages, and agricultural/seasonal crop fields.

Geologic Setting

Sedimentary units on the Fort Berthold Indian Reservation (Figure 3-1) include all rocks above the Cretaceous-age Pierre Shale, a marine shale that is as much as 2,300 feet thick (Cates and Macek-Rowland 1998). Correspondingly, in western North Dakota, the top of the Pierre Shale may be considered the base of the fresh-water-bearing units. Rocks overlying the Pierre Shale include, in ascending order, the Cretaceous-age Fox Hills Sandstone and Hell Creek Formation, the Tertiary-age Fort Union Formation and Golden Valley Formation, and the Quaternary-age deposits of glacial drift and alluvium (Cates and Macek-Rowland 1998).

The Fox Hills Sandstone and the Hell Creek Formation were deposited in a deltaic environment. The Fort Union Formation includes the Ludlow, Tongue River, and Sentinel Butte Members, which are continental units that were deposited in a generally westward-transgressing sea on an alluvial plain, and the Cannonball Member, which is a marine equivalent and interfingers with the Ludlow Member (Cates and Macek-Rowland 1998). The Golden Valley Formation was deposited as fluvial point-bar sediments and flood-plain deposits (Cates and Macek-Rowland 1998).

The Williston Basin, a structural feature centered west of the Reservation, affects the thickness of the bedrock units of Cretaceous age and older. The Tertiary-age units on the Reservation are relatively horizontal or have westward dips of less than 10 feet per mile, although some small structures have dips that exceed 150 feet per mile (Cates and Macek-Rowland 1998). Major structural features on the Reservation include the Nesson Anticline and the Antelope Anticline. Correlation of the linear features with subsurface data indicates that several faults occur on the Reservation.

During the Pleistocene, glaciers advanced across central Canada and extended southward over most of the Fort Berthold Indian Reservation. Rivers that flowed from the Rocky Mountains northeastward to Hudson Bay were diverted by the glaciers and forced to flow southward into the Mississippi River Basin. Glacially derived material covers about 50 percent of the Reservation, mostly north and east of Lake Sakakawea. Large rivers fed by melting glaciers generally deposited Pleistocene-age sands and gravels on the Reservation. The East Fork of Shell Creek, Shell Creek, White Shield, New Town, and Sanish buried valleys occur beneath a veneer of glacial till. Pleistocene-age glacial sediments and Holocene-age fluvial sediments that were deposited on the underlying, eroded Tongue River and Sentinel Butte Member sediments fill the buried valleys. Most of the sand and gravel deposits within the buried valleys are horizontally layered lenses that generally have limited lateral extent.

Geology at Project Site

GeoTrans (2005) completed five shallow wells (40 feet deep) and five deep wells (110 to 125 feet deep) in February 2005 within the proposed refinery site (Figure 3-2). Based on the geologic logs from the ten ground water monitoring wells, the till deposits across the proposed refinery site range from 107 to more than 125 feet in thickness. Till is a glacial deposit which is characterized as non-layered and unsorted (i.e., mixture of particle sizes from clays to boulders). The thickest till occurs along the western boundary of the site.

Figure 3-1 Descriptive Geology of the Fort Berthold Reservation

Figure 3-2 Distribution of Ground Water Wells on the Refinery Site

The till below the site is composed almost entirely of clay except for a 5- to 10-foot-thick sandy to sandy silt layer that occurs in each of the five deep wells at a depth of about 95 to 105 feet. In four of the five deep wells, the first lignite deposit in the Fort Union Formation was encountered at about 105 to 110 feet.

Stratigraphy

The project site lies within the Williston Basin, one of the largest structural troughs in North America. The term “Williston Basin” is arbitrarily applied to the Phanerozoic succession in Manitoba, Saskatchewan, the Dakotas, and eastern Montana. However, in a structural context it denotes the ellipsoidal depression centered in North Dakota, more or less below the -1,500 meter (m) contour on the Precambrian basement (Kent and Christopher 1996).

Glaciers deposited most of the rock and sediment exposed at the surface during the Pleistocene. Marine and non-marine sedimentary rocks underlie the glacial deposits. Crystalline rocks of Precambrian age underlie the sedimentary rocks. The rocks deposited in the Williston Basin during the Paleozoic Era and during Triassic and Jurassic time, generally consist of evaporates and carbonates interbedded with some clastic rocks (Cates and Macek-Rowland 1998). Deposition of clastic rocks predominated from the latter part of the Paleozoic. Throughout the Paleozoic, the Williston Basin was at times a cratonic basin or a shelf area that bordered a miogeosyncline farther west. At other times, the area was flooded by seas that followed a trough extending eastward from the miogeosyncline across the area of the central Montana uplift and the central Williston Basin. At times, the entire Williston Basin area was above sea level and subjected to subaerial erosion for relatively short intervals of time. Figure 3-3 presents a generalized stratigraphic column of near-surface rocks of the Fort Berthold Reservation.

Hydrogeology

The Reservation east and north of the Missouri River is underlain by significant glacial deposits comprised primarily of till with lesser amounts of sand and gravel deposits (buried valley deposits). These deposits are collectively referred to as the Coleharbor Group. In places the glacial deposits exceed 400 feet in thickness, but are generally less than 150 feet thick.

Five significant buried valley deposits have been mapped by Cates and Macek-Rowland (1998). These include: (1) East Fork Shell Creek, (2) Shell Creek, (3) White Shield, (4) Sanish, and (5) New Town. The buried valley deposits are composed of Pleistocene-age sands and gravels deposited by large, glacial-fed rivers. The deposits occur in eroded valleys eroded into the underlying Tongue River and Sentinel Butte members of the Fort Union Formation. The five major buried valley deposits within the Reservation are linear, range in width from less than a mile to 10 miles, and underlie from 8.5 to 48 square miles (Table 3-1).

System	Series	Geologic Unit		Lithology	Maximum Thickness (feet)	Aquifers Contained within Geologic Unit
Quaternary	Holocene	Oahe Formation		Silt, sand, and gravel.	60	
	Pleistocene	Coleharbor Group		Till, silt, sand, and gravel.	450	Buried-valley
Tertiary	Eocene	Golden Valley Formation		Sandstone, silt, clay, claystone, lignite, and carbonaceous shale.	120	Golden Valley
		Paleocene	Fort Union Formation	Sentinel Butte Member	Clay, claystone, shale, sandstone, siltstone, and lignite.	425
	Tongue River Member			Marine sandstone, clay, shale, and siltstone.	640	Tongue River
	Cannonball Member			Marine sandstone, clay, shale, and lignite.	550	
	Ludlow Member			Continental siltstone, sandstone, shale, clay, and lignite.		
Cretaceous	Hell Creek Formation		Siltstone, sandstone, shale, claystone, and lignite.	350	Fox Hills - Hell Creek	
	Fox Hills Sandstone		Sandstone, shale, and siltstone.	375		
	Pierre Shale		Shale.	2,300		

Figure 3-3 Generalized Geologic Column on Near-surface Rocks of the Fort Berthold Indian Reservation

Table 3–1 Major Buried Valley Aquifers — Fort Berthold Indian Reservation

Buried Valley Aquifer	Areal Extent (miles ²)	Width (miles)	Depth (feet)	Thickness (feet)	Estimated Volume of Ground Water Storage (acre-feet)
East Fork Shell Creek (Parshall)	12	1	Down to 100	Approx. 20	48,000
Shell Creek	10	0.75 to 2	Down to 100	Up to 100 (generally less)	38,000
White Shield	48	2 to 10	Down to 350	18 to 226 (average = 100)	920,000
New Town	18	1.7 to 4.7	Up to 300	10 to 100	170,000
Sanish	8.5	1	Up to 300	25 to 270	240,000

Source: Wireman 2005

The Fort Union Formation underlies the glacial deposit. Within the Reservation, the Fort Union Formation is represented primarily by the Tongue River and Sentinel Butte members. Both of these members are composed primarily of inter-bedded claystones, siltstones, shale, and lignite. The Tongue River Member underlies the entire Reservation and crops out southwest of New Town. The Sentinel Butte Member overlies the Tongue River Member and is the subcrop except in the valleys of Shell Creek and Deepwater Creek. The Fort Union Formation generally exceeds 1,000 feet in thickness, and the top of the formation is typically identified by the first significant lignite deposit encountered. The lignite deposits, where thick enough, function as aquifers and can yield water to domestic wells.

The Fox Hills Formation underlies the Fort Union Formation beneath the entire Reservation. The Fox Hills Formation is composed primarily of sandstone with lesser amounts of shale and siltstone. The Formation ranges from 100 to 350 feet thick. Within the Reservation, depths to the top of the Fox Hills range from about 1,100 to 2,000 feet.

Geologic Hazards

Potential geologic hazards include landslides, subsidence, and seismic activity related to known or suspected active faults. No known active faults with evidence of Quaternary movement are present in the project area (U.S. Geological Survey 2004f). No earthquakes of significant intensity have occurred in North Dakota during historical times (U.S. Geological Survey 2003).

Seismic hazard is commonly expressed in Peak Ground Acceleration (PGA) of percent gravity with 10 percent probability of exceedance in 50 years. The project area falls at 0 percent gravity, which indicates virtually zero potential for damages to structures from an earthquake activity (U.S. Geological Survey 2002).

Landslide potential in the project area is moderate (Federal Emergency Management Agency 2004). In general, landslide potential is greatest in areas where steep slopes occur, particularly where rock layers dip parallel to the slope, or where erosional undercut-

ting may occur. Slope gradients in the project area are gentle; however, the few steeper areas may be susceptible to slumping, sliding, and creeping.

Ground Water Resources

EPA does not have the statutory authority to regulate ground water quality. In addition, the MHA Nation has not promulgated Tribal standards for ground water, and does not have a ground water classification system or a ground water discharge permit system.

The project site is within the glaciated Missouri Plateau section of the Great Plains physiographic province. The Missouri Plateau is subdivided into two districts: the Coteau du Missouri and the Coteau Slope, of which, the project site is located within the Coteau Slope district. The Coteau Slope is an area of older ground moraine that is characterized by gently rolling topography dissected by stream valleys.

Several surficial-outwash and buried-valley fill aquifers store large quantities of ground water within the Coteau du Missouri and Coteau slope region (Harkness and Wald 2003). Ground water in the region is contained in aquifers in the glacial drift of Quaternary age, the Fort Union Formation (Sentinel Butte and Tongue River), Hell Creek Formation, and the Dakota Group of Cretaceous Age. These glacial deposits range from 0 to 800 feet in thickness and average about 165 feet thick (Clayton 1972). The following sections describe these bedrock and buried valley aquifers.

Within the Reservation, ground water occurs in the till deposits, the buried valley deposits, the Fort Union Formation and the Fox Hills Formation. All of these geologic units will yield enough ground water to a well to be considered an aquifer. The Fort Union aquifers (Tongue River and Sentinel Butte Members) and the till typically yield only enough water for domestic uses. The buried-valley deposits and the Fox Hills Formation are capable of yielding enough water for public water supply, irrigation, and industrial use. However, the chemistry of the ground water in all of these aquifers constrains the use to some extent.

As indicated on Table 3–1, the estimated volume of ground water stored in the five major buried–valley aquifers within the Reservation is approximately 1,414,000 acre-feet. Well yields from these aquifers are quite variable and depend on saturated thickness. These aquifers are capable of yielding more than 300 gallons per minute (gpm) where there is sufficient saturated thickness. However, yields of less than 100 gpm are far more common. The East Fork Shell Creek aquifer has been used by the Town of Parshall to obtain municipal supplies.

The MHA Nation’s Environmental Protection Office estimates that more than 700 wells have been installed on the Reservation. Of these, about 300 are less than 100 feet deep and currently in use.

Depth to water in the till that underlies the project site ranges from 10 to 15 feet (GeoTrans, Inc. 2005). The ground water in the till appears to flow towards the southwest. GeoTrans (2005) determined that the horizontal gradient for the May 2005 water levels is about 0.01 feet/foot. Based on this gradient and hydraulic conductivity values derived from slug tests, GeoTrans (2005) also estimated horizontal ground water flow velocity in the till to be between 0.4 to 2.4 feet/year.

At least four of the five deep wells encountered the top of the Sentinel Butte Member of the Fort Union Formation. GeoTrans used water levels in these wells to construct a potentiometric surface map for ground water in the Fort Union Formation beneath the project site. Based on this map, GeoTrans (2005) determined the direction of ground water flow in the Fort Union is towards the southeast. The calculated horizontal gradient on the potentiometric surface is 0.0009 feet/foot (GeoTrans, Inc. 2005). Based on this gradient and the hydraulic conductivity value obtained from a pump test using deep well PW-3, GeoTrans determined the horizontal ground water flow velocity in the Fort Union Formation is as high as 100 feet/year. It is important to note that the potentiometric surface map included in Cates and Macek-Rowland (1998) indicates a northeast-to-southwest flow direction for the Tongue River east of the Missouri River.

Hydraulic Conductivity

Slug tests and baildown tests from wells on the project site showed that the hydraulic conductivity values in the water table wells ranged from 5×10^{-5} cm/sec to 3×10^{-6} cm/sec (GeoTrans, Inc. 2005). The values represent clay till in which all the water table wells are screened. The hydraulic conductivity values ranged from 2×10^{-2} cm/sec to 1×10^{-5} cm/sec. The higher hydraulic conductivity was from a well that was screened in a sand layer. Conversely, the other wells were screened in much finer grained material within the Fort Union Formation, resulting in lower hydraulic conductivities.

The average linear ground water flow velocity was calculated for each of the wells using the horizontal gradient and the average hydraulic conductivity for each well. The calculated ground water velocity ranges from 0.4 to 2.4 feet per year for the clay till. The calculated ground water velocity in the Fort Union Formation ranges from 0.2 to 100 feet per year, with the upper end of that range due to the sand lens. However, because of the limited lateral extent of the sand lens, the surrounding low permeability of the silts and clays will determine the overall ground water flow velocity in this formation. Based on water level elevations in the ten monitoring wells on the project site, a strong downward vertical gradient exists between the till and the Fort Union Formation.

Bedrock Aquifers

Bedrock aquifers include Fox Hills-Hell Creek, Tongue River, and Sentinel Butte. These three aquifers are estimated to store 93 million acre-feet under the Reservation boundary (Cates and Macek-Rowland 1998).

The hydraulic characteristics of the ground water aquifers have been investigated by pumping tests and slug tests in monitoring wells previously installed throughout the Reservation. Data from these pumping and slug tests provide estimates of hydraulic conductivity, transmissivity, and storativity.

Hydraulic conductivity and transmissivity are measures of the permeability of an aquifer. Storativity is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Fox Hills-Hell Creek

The Fox Hills-Hell Creek aquifer underlies the entire Reservation and ranges from 100 to 350 feet in thickness under the Reservation. The Fox Hills Sandstone consists mainly of

brown shale and massive, fossiliferous, and white marine sandstone (Armstrong 1971, Cates and Macek-Rowland 1998). Conversely, the Hell Creek Formation primarily consists of light-gray sands and clay of both fluvial and marine sediment origin (Armstrong 1971, Cates and Macek-Rowland 1998). Sandstone beds in the upper Fox Hills Sandstone and the lower Hell Creek Formation are apparently connected hydrologically (Armstrong 1971). Therefore, the water-producing interval within the two formations is considered a single aquifer.

This aquifer is composed mainly of very fine- to medium-grained sandstone interbedded with siltstone and shale (Armstrong 1971). The elevation of the base of the aquifer ranges from about 295 to 877 feet AMSL (Cates and Macek-Rowland 1998). Transmissivity of the aquifer ranges from about 180 to 260 feet squared per day (Cates and Macek-Rowland 1998). Based on an areal extent of 1,583 square miles, an average cumulative thickness of 200 feet, and an assumed porosity of 25 percent, the volume of water stored in the Fox Hills-Hell Creek aquifer is about 51 million acre-feet (Cates and Macek-Rowland 1998). The potentiometric surface of the Fox Hills-Hell Creek aquifer suggests general flow is from northwest to southeast (Cates and Macek-Rowland 1998).

Production from wells completed in the Fox Hills-Hell Creek varies with location. Wells within Mountrail County could yield production as low as 3 gpm (Armstrong 1971). In contrast, yields of 200 to 400 gpm have been reported in Dunn County (Klausing 1979 as cited in Cates and Macek-Rowland 1998).

Direct recharge of the aquifer occurs outside of the Reservation where the aquifer crops out in the extreme southwestern corner of North Dakota and in eastern Montana (Cates and Macek-Rowland 1998). Within the Reservation, recharge results from downward movement of ground water from overlying aquifers. Discharge occurs by lateral movement of water to adjacent areas, upward leakage to overlying aquifers, flowing wells, and well pumpage (Cates and Macek-Rowland 1998).

The Fox Hills and Hell Creek aquifers are being considered as water sources for the proposed project. According to Schmid (2004), very few deep wells have been drilled in this region of the Reservation. This is due in part to two primary reasons: the topographical relief of lands on the north side of Lake Sakakawea is not suited for irrigated agricultural crops and the small, rural populations that occur in this area of the Reservation make use of the abundant, shallow surficial glacial aquifers as local water supply sources. Therefore, the demand for irrigation water and local water supply is relatively low in this portion of the Reservation.

A search was conducted on the North Dakota State Water Commission (NDSWC) website database to determine if any wells have been completed in the Fox Hills-Hell Creek aquifer near the project area. The search revealed that only one well (152-093-26BCC *see* Table 3-2) was completed in the Fox Hills or Hell Creek aquifers within Mountrail County and no wells were identified in Ward County. According to Wanek (2004), NDSWC has not updated its database for wells in either Mountrail or Ward County. Therefore, an additional search of the Wald and Cates (1995) report and the U.S. Geological Survey (USGS) website database (U.S. Geological Survey 2004e) was conducted. The results of both searches suggest that 40 wells have been drilled into the Fox Hills-Hell Creek aquifer within Reservation lands (Table 3-2). Figure 3-4 shows their approximate location and proximity to the project site. A review of Figure 3-4 shows that well 153-088-33 is the closest proximity deep-water well (7.7 miles).

Table 3–2 Record of Wells and Test Holes Completed within Fox Hills and Hell Creek Aquifer on Reservation Lands

ID #	USGS ID	Depth drilled (feet)	Depth of well (feet)	Year of Construction.	Aquifer code ¹	Elevation of Land Surface
153-094-32CDBD	480132102475301	1,590	1,524	09-29-89	211FXHL	2,266
153-094-23CCC1	480311102442501	1,860	1,767	08-21-80	211HCFH	2,186
153-088-35	--	1,560	1,523	05-28-1997	211HCFH	--
151-096-36AAA ²	475141102535701	1,300	--	12-08-81	211FXHL	2,490
151-095-30ACA ³	475220102530001	1,500	1,460	06-15-83	211FXHL	2,316
151-095-30ABD ²	475226102530001	1,470	1,400	--	211FXHL	2,320
151-095-04DBD2	475529102502702	1,620	1,432	06-30-81	211FXHL	2,309
151-091-11BBC	475504102175601	1,340	1,340	04-15-85	211FXHL	1,880
151-090-29BBC	475227102140801	1,620	1,620	10-19-82	211FXHL	2,150
150-095-08BDBD	474942102520901	1,580	1,560	07-15-83	211FXHL	2,319
150-095-05BBA ²	475049102522102	1,460	--	--	211FXHL	2,380
149-095-09CDD	474400102504501	1,740	1,564	7-17-84	211FXHL	2,226
149-094-14BA	474349102403601	1,750	1,745	07-21-70	211HCFH	2,160
149-089-14CBB	474326102022501	1,370	1,370	05-02-85	211FXHL	1,920
148-095-22CCA	473711102463101	1,455	1,430	--	211FXHL	1,925
148-089-33CCA ²	473526102015201	1,390	1,390	10-22-86	211FXHL	1,940
148-087-33BBB	473607101464201	1,320	1,320	08-21-86	211FXHL	2,005
148-087-15DCD ³	473800101443701	1,160	1,160	09-09-82	211FXHL	1,910
147-095-26BBB1	473152102452301	--	1,850	1969	211FXHL	2,280
147-095-24AAC	473237102430801	--	1,580	1969	211FXHL	2,000
147-095-14AAA	473334102441501	1,430	1,430	1968	211FXHL	1,980
147-095-13CCC3	473246102440403	2,130	1,980	05-22-79	211FXHL	2,420
147-095-13CCC2	473250102440602	1,950	1,930	1971	211FXHL	2,420
147-095-13CCC1 ²	473250102440601	160	--	--	211FXHL	2,420
147-095-12CAD	473354102433701	1,420	1,410	1969	211FXHL	1,880
147-094-36BAD ²	473053102360001	1,460	1,450	05-27-89	211FXHL	2,000
147-094-35CBB ³	473034102452301	1,560	1,560	06-08-89	211FXHL	2,150
147-094-35CAA ²	473032102371501	1,610	1,610	10-09-74	211FXHL	2,270
147-094-34BAD	473054102383001	1,510	1,502	1968	211FXHL	1,980
147-094-33DB ²	473031102393201	--	1,660	1969	211FXHL	2,210
147-094-26BCB	473139102374201	1,510	1,500	1969	211FXHL	1,940
147-093-35CBC ³	473027102300303	1,420	1,320	10-14-89	211FXHL	1,860
147-093-34DBB	473028102304601	1,300	1,300	06-20-89	211FXHL	1,860
147-093-33DAC	473024102314001	1,400	1,390	05-19-89	211FXHL	2,220
147-091-35BDA ³	473045102141701	1,550	1,550	09-00-70	211FXHL	2,190
146-094-08DAD2	472840102402702	1,730	1,730	10-23-74	211FXHL	1,965
146-094-05DCC	472917102390001	--	1,500	1972	211FXHL	1,960
146-094-05CBD	472932102412401	1,410	1,410	1968	211FXHL	1,910
146-094-04BBC ²	472958102401801	--	1,600	1969	211FXHL	1,980
146-093-03CDD	472919102305301	1,525	1,525	07-15-72	211FXHL	2,160
146-092-15BBB	472820102234101	1,760	1,610	11-22-88	211FXHL	1,930

Notes:

1. Aquifer codes: 211FXHL Fox Hills; 211HCFH Hell Creek Formation

2. No data available

3. Only water quality or water level data available, but not both datasets.

Sources: Wald and Cates 1995, U.S. Geological Survey 2004e, North Dakota State Water Commission 2004

Tongue River

The Tongue River aquifer underlies the entire Reservation and crops out southwest of the New Town. The aquifer is composed mainly of claystones and siltstones and has widely distributed pockets of sandstone or lignite layers. Although claystone and siltstone are the dominant sediments in the Tongue River Member, lignite beds (which are a major source of ground water on the Reservation) are common and may be as thick as 15 feet (Cates and Macek-Rowland 1998). Hydraulic conductivity in the Tongue River aquifer underlying Dunn County ranges from 0.01 to 0.95 foot per day (Cates and Macek-Rowland 1998). Based on an areal extent of 1,583 square miles, an average cumulative thickness of 80 feet, and an assumed porosity of 30 percent, the volume of water stored in the Tongue River aquifer is about 24 million acre-feet of water (Cates and Macek-Rowland 1998).

Yields from water wells in the aquifer vary and depend on the zones in which the wells are completed. Yields range from 10 to 200 gpm (Klausing 1979 and Croft 1985 as cited in Cates and Macek-Rowland 1998). The potentiometric surface of the Tongue River aquifer suggests general flow is toward the Missouri River or Lake Sakakawea (Cates and Macek-Rowland 1998).

Based on the hydraulic heads of both the overlying Sentinel Butte aquifer and the underlying Fox Hills-Hell Creek aquifer, recharge occurs from leakage and recharge (Cates and Macek-Rowland 1998). Discharge from the Tongue River aquifer is by lateral movement of water to adjacent areas, base flow into streams, and well discharge (Cates and Macek-Rowland 1998).

Sentinel Butte

The Sentinel Butte aquifer underlies most of the Reservation. The aquifer is composed mainly of interbedded claystones, siltstones, shale, fractured lignite, and poorly consolidated sandstone (Cates and Macek-Rowland 1998). The sandstone beds (which occur at depths ranging from 10 to 400 feet) are composed mainly of fine sand interbedded in a matrix of clay and silt and range in thickness from a few feet to about 120 feet. The lignite beds are limited in lateral extent and yield only local water supplies (Cates and Macek-Rowland 1998). Transmissivity within a well completed in sandstone in the Sentinel Butte aquifer near Plaza is about 400 square feet per day (Armstrong 1971). Based on an areal extent of 914 square miles, an average cumulative thickness of 100 feet, and an assumed porosity of 30 percent, the volume of water stored in the aquifer is about 18 million acre-feet of water (Cates and Macek-Rowland 1998).

Yields from water wells in the aquifer vary and depend on the zones in which the wells are completed. Yields from wells completed in sandstones range from 1 to 100 gpm. In contrast, yields from wells completed in lignite beds are generally about 1 gpm (Armstrong 1971).

Recharge occurs primarily by infiltration of precipitation. Conversely, discharge is by lateral movement of water to adjacent areas, downward seepage into the Tongue River aquifer, seepage into streams and springs, and wells (Cates and Macek-Rowland 1998).

Buried-Valley Aquifers

The East Fork Shell Creek, Shell Creek, White Shield, New Town, and Sanish aquifers occur within buried valleys and store about 1,414,000 acre-feet of water within the Reservation (Cates and Macek-Rowland 1998). Five buried-valley aquifers occur in the general vicinity of the project site. They are the East Fork Shell Creek, Shell Creek, Ryder Ridge, Hiddenwood Lake, and Vang aquifers (Figure 3-5).

Yields from the above-mentioned aquifers are highly variable and water from these sources is typically very hard. The East Fork of Shell Creek aquifer was previously used by Parshall as their local water supply and yields from this aquifer may be as high 150 gpm, but typically will be less than 50 gpm (Bartlett and West Engineers, Inc. 2002). The area also has two deep aquifers, the Dakota aquifer and the Fox Hills-Hell Creek aquifer. Both are very deep aquifers, as the Dakota aquifer ranges from 3,505 feet to 5,210 feet and Fox Hills at 2,100 feet below the land surface (Bartlett and West Engineers, Inc. 2002). Yield from the Dakota is as high as 320 gpm and yield from the Fox Hills/Hell Creek is as much as 60 gpm (Bartlett and West Engineers, Inc. 2002).

A file search of well logs records near the project area was conducted in the NDSWC's offices. Based on a search of approximately 60 to 70 well logs, seven wells were identified that may have relevant baseline data useful for comparison analyses (Table 3-3).

Table 3-3 Summary of Wells Data Relevant to the Project Site

Well ID	Date Drilled	Well Depth (feet)	Static Water Level (feet)	Pumped Gallons per Minute	Pumped Water Level (feet)
152-87-10	01-1990	240	35	33	55
152-87-26	05-1988	296	30	5	65
152-87-27	10-1981	158	27	30	70
152-87-31	08-2001	189	--	6	80
152-88-04	04-1981	88	25	37	55
153-88-23	06-1982	160	31	80	100
153-88-35	05-1997	1,543	155	32	1,200

Source: Schmid 2004

Well numbers 152-87-10, 152-87-26, 152-87-27, 152-87-31, 152-88-04, and 152-88-23 have been completed in various sand lenses in the underlying glacial aquifers (Schmid 2004). These sand lenses vary in depth, recharge, and volume of water. Therefore, the exploration of these sand layers should be analyzed as sources of reliable water supply at the project site. Schmid (2004) estimated that three to four wells completed within these sand lenses should be able to produce 40+ gpm. Because the boundaries of the underlying aquifers and subsequent sand lenses are not extensively mapped, a modeling drawdown analysis was not conducted. However, a review of static water levels and associated draw down levels for the wells in Table 3-3 show that these shallow wells are capable of producing water quantities that may be required throughout the year.

Shell Creek

The Shell Creek aquifer lies within a broad, deep buried valley northwest of Parshall (Figure 3-5). The Shell Creek aquifer is composed of sand and gravel lenses that are surrounded by less permeable till. Flow in the aquifer is down gradient towards the Missouri River, which generally corresponds to the topography of the drainage basin. The aquifer has an areal extent of about 10 square miles and ranges from $\frac{3}{4}$ to 2 miles in width (Armstrong 1971, Cates and Macek-Rowland 1998). Available data suggest that the aquifer's thickness is as much as 100 feet (Armstrong 1971). Assuming an areal extent of 10 square miles, an average cumulative thickness of 20 feet, and a porosity of 30 percent, the volume of water stored in the aquifer is about 38,000 acre-feet (Cates and Macek-Rowland 1998).

Although very few wells have been drilled in the aquifer, transmissivity at well 155-89-25ACB1 was evaluated using the Theis method. This testing suggests a transmissivity of about 90,000 gallons per day (gpd) per foot at the test well and about 138,000 gpd at a nearby observation well (Armstrong 1971). The storage coefficient was calculated at 0.0004. Based on these results, Armstrong (1971) concluded that pumping rates as high as 300 gpm probably could be maintained over an irrigation season.

Recharge to the aquifer is from direct precipitation, underflow through adjoining out-washes, and inflow from the adjacent Fort Union sediments (Armstrong 1971). Flow of ground water generally follows the topography of the drainage basin.

East Fork Shell Creek

The East Fork Shell Creek aquifer consists of glaciofluvial sediments deposited in buried valleys. The East Fork Shell Creek aquifer underlies East Fork of Shell Creek and has an areal extent of about 12 square miles and width of about one mile (Armstrong 1971). The aquifer is composed of sand and gravel lenses that vary in thickness, have unknown lateral extent, and are surrounded by less permeable till (Cates and Macek-Rowland 1998). The sand and gravel lenses occur at various depths down to 100 feet. The aquifer is underlain directly by the Tongue River Member, which was eroded into a rugged topography before or during glaciation.

According to Armstrong (1971), the specific capacity of well 152-090-25DBC2 in the East Fork Shell Creek aquifer is 11 gpm per drawdown, indicating a transmissivity of about 2,950 feet squared per day. Additionally, Schmid (1962) determined a similar transmissivity of 3,350 square feet per day and a storage coefficient of 0.0043 at well 152-090-25DBC1. Based on an areal extent of 12 square miles, an average cumulative thickness of 20 feet, and an assumed porosity of 30 percent, the volume of water stored in the East Fork Shell Creek aquifer is about 46,000 acre-feet (Cates and Macek-Rowland 1998).

Recharge is primarily from direct precipitation, seepage from stream flow in times of maximum runoff in the East Fork of Shell Creek, and from inflow from the Sentinel Butte Formation (Armstrong 1971). Flow of ground water generally follows the topography of the drainage basin.

Figure 3-4 Wells within the Fox Hills-Hell Creek Aquifer

Figure 3-5 Buried Valley Aquifers

Ryder Ridge

The Ryder Ridge aquifer extends from just west of Ryder, northwestward across T152N, R87W, and into Mountrail County approximately 9 miles (Figure 3-5). West of the Makoti, the aquifer apparently overlies the Hiddenwood Lake aquifer. The Ryder Ridge aquifer has a core of water-bearing sand and gravel that reaches a total thickness of 55 feet, and material ranges in size from fine sand to fine gravel (Pettyjohn and Hutchinson 1971).

The USGS monitored ground water levels in the aquifer at test well 151-086-05CBB (USGS 475540101431201) for a 1-year period of record (1966). The ground water level in the aquifer was observed at 27 feet below ground surface (U.S. Geological Survey 2004b). No wells were known to produce water from the Ryder Ridge aquifer (Pettyjohn and Hutchinson 1971).

Hiddenwood Lake

The Hiddenwood Lake aquifer is a valley-fill deposit that was cut into the bedrock at least 130 feet below the upland surface (Pettyjohn 1968). It extends from McLean County northward through Hiddenwood Lake to Makoti in southwestern Ward County (Figure 3-5). The aquifer material consists of fine to coarse sand and fine to medium gravel, which ranges between 9 to 45 feet in thickness, including a few thin layers of clay (Pettyjohn and Hutchinson 1971). This is overlain by at least 66 feet of glacial drift, predominantly lake deposits, in its southern end, and generally by more than 100 feet of glacial till in its northern end (Pettyjohn 1968).

The USGS monitored ground water levels in the aquifer at test well 152-087-28DAA (USGS 475729101483401) for a 30-year period of record (1965 to 1995). As shown on Figure 3-6, ground water levels in the aquifer have ranged from a low of 29 feet below ground surface to a high of 22 feet below ground surface (U.S. Geological Survey 2004a).

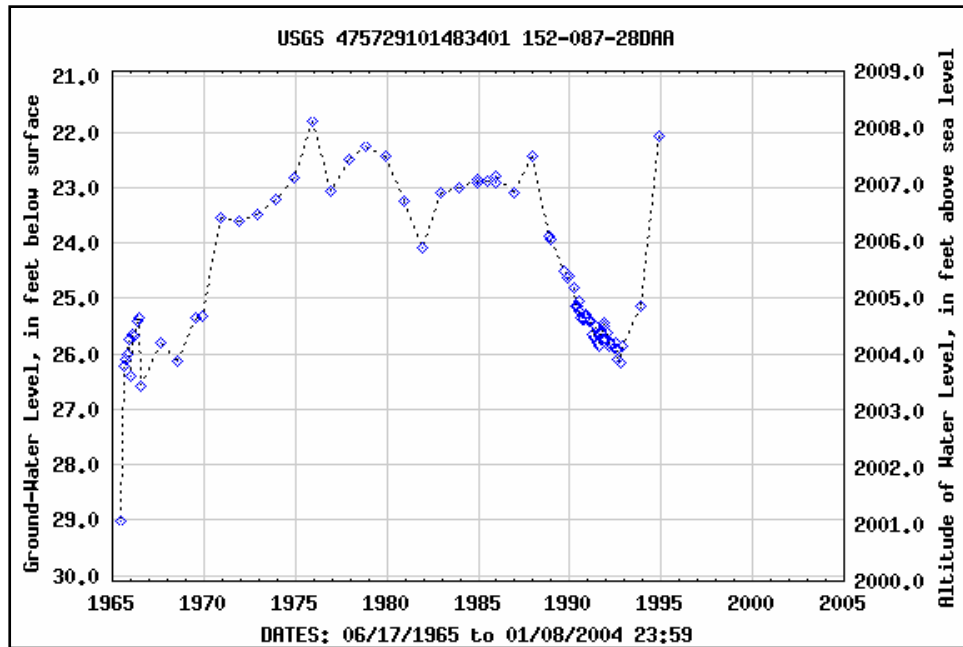


Figure 3-6 Ground Water Levels — Hiddenwood Lake Aquifer

Vang

The Vang aquifer extends southwestward from the west-central part of T153N, R85W through T153N, R86W and T152N, R87W, and into Mountrail County approximately 14 miles (Figure 3-5). The City of Makoti obtains its local water supply from two wells completed in this aquifer. The aquifer is a collapsed-outwash deposit that partly fills a glacial drainage way that averages about 1,000 feet in width to slightly more than 2 miles in length (Pettyjohn and Hutchinson 1971). The aquifer material ranges in size from fine sand to coarse gravel and ranges in thickness from 0 to 28 feet. The estimated average permeability of the entire deposit is approximately 1,500 gallons per day (Pettyjohn and Hutchinson 1971). In addition, the aquifer provides water to a few domestic and stock wells, and in several small areas, wells could produce an estimate of 150 gpm (Pettyjohn and Hutchinson 1971).

The USGS monitored ground water levels in the aquifer at test well 152-087-16AAA for a 28-year period of record (1966 to 1994). As observed in Figure 3-7, ground water levels in the aquifer have ranged from a low of 10.5 feet below ground surface to a high of 5.5 feet below ground surface (U.S. Geological Survey 2004c).

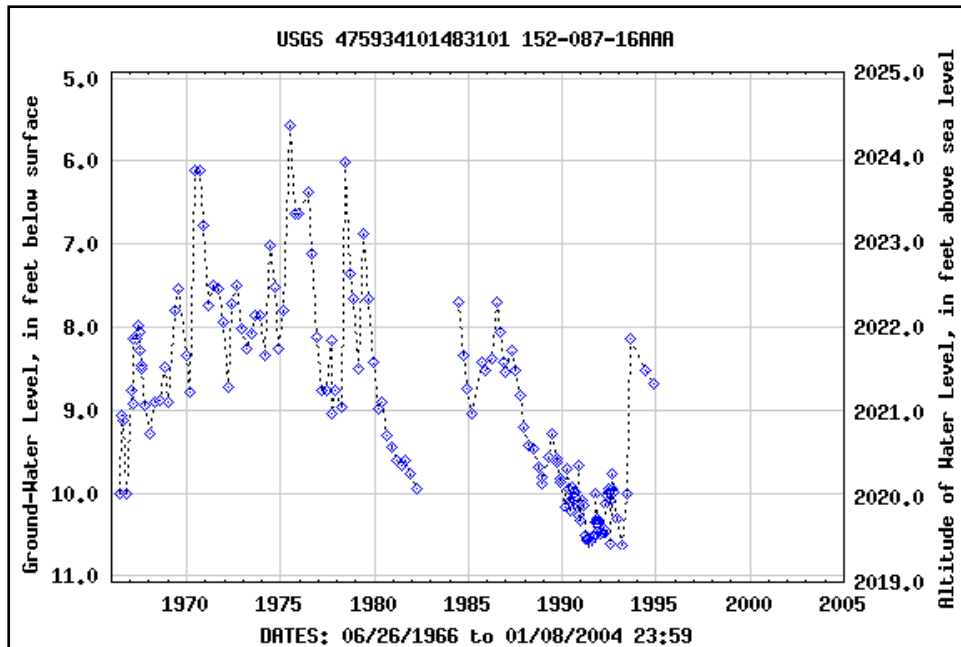


Figure 3-7 Ground Water Levels — Vang Aquifer

Ground Water Quality

The USGS conducted a study of water resources of the Reservation during May 1990 through November 1992 (Wald and Cates 1995). Water quality data were collected from 293 water samples from wells and springs, and additional trace element data were collected from 225 wells. In addition, Cates and Macek-Rowland (1998) prepared a water resources report of the Fort Berthold Indian Reservation. The 1998 report detailed distribution, quantity, and quality of water on the Reservation. Finally, GeoTrans and EPA completed water quality sampling events in 2005.

Bedrock Aquifers

Fox Hills Formation

Because the Fox Hills Formation is quite deep in this part of North Dakota, ground water that occurs in the aquifer has had a long residence time. This results in relatively high concentrations of TDS. TDS concentrations typically exceed 1,500 mg/L. With respect to the common cations in ground water, dissolved sodium concentrations commonly exceed 500 mg/L, and dissolved boron concentrations commonly exceed 1,000 µg/L. With respect to common anions, bicarbonate and alkalinity concentrations typically exceed 1,200 mg/L (as CaCO₃), chloride concentrations commonly exceed 100 mg/L, and locally sulfate concentrations exceed 500 mg/L. Ground water in the Fox Hills is a sodium-bicarbonate type of water.

The available water chemistry data for the Fox Hills formation in west-central North Dakota do not indicate any common exceedances of primary maximum contaminant levels (MCLs). Because of the high sodium concentrations, ground water in the Fox Hills For-

mation typically has a very high sodium adsorption ratio (SAR) with values typically exceeding 80. The combination of high salinity (total dissolved solids [TDS]) and high SAR indicates that ground water from the Fox Hills Formation is unsuitable for irrigation.

Because of the significant depth to the top of the aquifer, not many wells are constructed in this aquifer within the Reservation. However, the City of Plaza recently finished a deep well within the aquifer to use as a public water source. According to Rogers (2004), Plaza historically relied on shallow wells for its local water supply. In the early 1990s, one of the wells was abandoned and the remaining two active wells produced water with copper and lead levels above North Dakota Department of Health standards (Rogers 2004). Because of reliable water quality concerns, Plaza constructed a deep water well in 1997 to alleviate this problem. Well 153-088-35 (Well #4 for example) was completed to a depth of 1,560 feet in the Fox Hills-Hell Creek aquifer. The well produces approximately 40 gpm and is the primary water supply for the Plaza's 170 residents (Rogers 2004). Plaza does rely on the two shallow wells during peak use periods when make-up water is needed. Annual water usage by the town averages about 7 million gallons annually.

According to the Well Driller's Report, Well 153-088-35 was completed in a vacant lot within the city limit boundary (Greystone 2004). The well is a 6-inch-diameter casing extending from 2+ feet to 1,398 feet, and 3-inch-diameter casing from 1,366 to 1,523 feet. At the time of well completion, the static water level was 155 feet below the surface. Data from a well pump test show that pumping water at 32 gpm for 3 hours reduced the water level to 1,200 feet below land surface (Greystone 2004).

The North Dakota Department of Health, Division of Water Quality completed a wellhead protection area delineation for the Plaza well field in 2000 (Greystone 2004). In general, the wellhead protection area encompasses 212 acres. The local land use is a mixture of local residences and commercial business within the city limits. Agricultural crops surround the city on all sides. Plaza is also included within an active oil field.

The NDSWC's website database was queried for data on the quality of water in well 153-088-35; however, no data were available for this well. Plaza does conduct annual water tests to comply with the Safe Drinking Water Act (SDWA).

Fort Union Formation

The chemistry of the ground water in the two members of the Fort Union Formation is similar. Ground water in both members varies from a sodium-bicarbonate to a mixed calcium/magnesium/sodium-sulfate type. This reflects the dissolution of cations from the rocks that comprise the Fort Union. Total dissolved solids concentrations presented in Cates and Macek-Rowland (1998) range from 133 to 4,230 mg/L (135 wells) and commonly exceed the secondary MCL of 500 mg/L. Ground water from many wells in the Fort Union exceeds the secondary MCL for iron, manganese, and sulfate. The SAR for ground water in the Tongue River member is high. In combination with high salinity values, this indicates that the ground water in the Tongue River is unsuitable for irrigation. The SAR for ground water in the Sentinel Butte member is low. In combination with high salinity values, this indicates that ground water from the Sentinel Butte member is suitable for irrigating soils with high permeability.

It is likely that at least a few hundred domestic wells within the Reservation are withdrawing water from the Fort Union Formation. Well yields that are sufficient for domestic /stock use are common.

Tongue River

Cates and Macek-Rowland (1998) summarized water quality data collected from 52 wells within the Tongue River aquifer between 1952 and 1992. Background water quality in the aquifer is slightly basic with pH values ranging from 6.7 to 9.1, with a median of 8.2. Water in the aquifer varies from a sodium-bicarbonate type to a mixed calcium/magnesium/sodium-sulfate type. Concentrations of dissolved solids ranged from 817 to 4,660 mg/L and had a mean of 2,110 mg/L. In addition, these sampled values for dissolved solids range from slightly saline to moderately saline. Sampled fluoride levels ranged from 0.2 to 8.4 mg/L, and nitrate levels ranged 0.11 to 5.9 mg/L (Greystone 2004).

Sentinel Butte

Cates and Macek-Rowland (1998) summarized water quality data collected from 83 wells within the Sentinel Butte aquifer between 1950 and 1992. Based on available data, background water quality in the aquifer is slightly basic with pH values ranging from 6.7 to 8.9, with a median of 7.7. Water in the aquifer varies from a sodium bicarbonate type to a mixed calcium/magnesium/sodium-sulfate type. Dissolved solids concentrations ranged from 133 to 4,230 mg/L, and a mean of 1,300 mg/L. The mean sampled values for dissolved solids occur in the slightly saline range (Greystone 2004).

Buried-Valley Aquifers

Though the buried-valley aquifers are the most productive (and most accessible) aquifers within the Reservation, their use is limited because, except for the White Shield aquifer, they are located along the northern border of the Reservation and close to Lake Sakakawea. Most people in this part of the Reservation receive water from a public water supply that obtains source water from Lake Sakakawea.

The sediments that comprise the buried-valley deposits are from the underlying formations. As a result, the chemistry of the ground water in these deposits is similar to that in the underlying Fort Union Formation. Cates and Macek-Rowland (1998) present chemistry data for 34 wells constructed in the five major buried-valley aquifers within the Reservation. Ground water in the East Fork Shell Creek aquifer, the Shell Creek aquifer, and the White Shield aquifer is a sodium-bicarbonate/sulfate type. Ground water in the New Town and Sanish aquifers is a mixed calcium/sodium/magnesium-bicarbonate/sulfate type. Concentrations of TDS range from 459 to 4,440 mg/L. Concentrations of iron, manganese, and sulfate often exceed the secondary MCL. The use of ground water from the buried-valley aquifers for irrigation is constrained by the high salinity. However, only ground water from the East Fork Shell Creek aquifer has a high SAR. Ground waters from the White Shield, New Town, and Sanish buried-valley aquifers have low SAR values. Ground water from all but the East Fork of Shell Creek aquifer can be used to irrigate soils with moderate to high permeability.

Shell Creek

Cates and Macek-Rowland (1998) summarized water quality data collected from four wells within the Shell Creek buried-valley aquifer between 1977 and 1990. Generally, water in the Shell Creek aquifer is a sodium bicarbonate sulfate type. Mean dissolved solids concentrations were 1,470 mg/L in water from the Shell Creek aquifer. Background water quality in the aquifer is slightly basic with pH values ranging from 7.3 to 8.4, with a median of 8.2. Dissolved solids concentrations ranged from 757 to

2,030 mg/L, and a mean of 1,470 mg/L (Greystone 2004). The mean sampled values for dissolved solids occur in the slightly saline range.

East Fork Shell Creek

Cates and Macek-Rowland (1998) summarized water quality data collected from five wells within the East Fork Shell Creek buried-valley aquifer between 1962 and 1990. Generally, water in the aquifer is a sodium sulfate bicarbonate type. Dissolved-solids concentrations ranged from 2,470 to 4,440 mg/L, with a mean of 3,220 mg/L. Dissolved iron concentrations ranged from less than 10 to 1,700 mg/L, with a mean of 880 mg/L and a median of 910 mg/L (Greystone 2004).

Ryder Ridge

The USGS monitored and performed water quality analyses for test well 151–086–05CBB (USGS 475540101431201) during the 1966 calendar year. Water sampled from this site indicated that it was a moderately hard sodium sulfate type. The water had a pH of 7.5 and a specific conductance of 1,640 $\mu\text{S}/\text{cm}$. In addition, the sulfate (672 mg/L) and salinity (288 mg/L) levels were relatively high (Greystone 2004). Based on the single data set of sampled parameters, water within this aquifer would be classified as poor to moderate quality.

Hiddenwood Lake

The USGS monitored and performed water quality analyses for test well 152–087–28DAA (USGS 475729101483401) in 1965, 1971, 1988, and 1992. Generally, water in the aquifer is a sodium sulfate bicarbonate type with high quantities of sulfate, iron, and dissolved solids. Dissolved-solids concentrations ranged from 4,740 to 4,960 mg/L. Dissolved iron concentrations ranged from 400 to 2,500 mg/L (Greystone 2004). Based on the sampled parameters, water within this aquifer is of very poor quality for any industrial use or as drinking water.

Vang

The USGS monitored and performed water quality analyses within the Vang aquifer from both test well 152–087–16AAA (USGS 475934101483101) during the 1966 calendar year and test well 152–087–18DDD (USGS 475847101510401) during the 1988 and 1992 calendar years. Generally, water in the aquifer is a hard calcium bicarbonate type. Dissolved-solids concentrations ranged from 2,470 to 4,440 mg/L. Dissolved iron concentrations ranged from 2,700 to 14,000 mg/L. Iron concentrations of this magnitude would most likely cause staining in clothes and plumbing fixtures (Greystone 2004).

Project Site — Ground Water Chemistry

The ten ground water monitoring wells installed in February 2005 have each been sampled. In February 2005, all ten wells were sampled and the samples analyzed for basic cations/anions, RCRA dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), seven polychlorinated biphenyls (PCBs), 19 common pesticides, and 78 volatile organic compound (VOCs) and polynuclear aromatics (PNAs). All ten wells were sampled again in May 2005, and the samples were analyzed only for the suite of VOCs and PNAs.

Chemistry data from the GeoTrans (2005) quarterly sampling events indicate the following:

- Ground water in the till deposits beneath the proposed refinery site is mainly a calcium-bicarbonate/calcium-sulfate type of water. Ground water in the underlying Fort Union Formation is mainly a sodium-bicarbonate/sodium bicarbonate type of water;
- All PCBs were at non-detectable levels in all samples;
- RCRA metal concentrations were below MCLs in all samples;
- Very low concentrations of some VOCs were detected in some samples; however, the duplicate samples were non-detectable;
- All samples were non-detectable for the 19 pesticides; and
- Total dissolved solids concentrations were high for all wells. Concentrations from samples collected from the five till wells (MW-1 to MW-5) ranged from 450 to 4,200 mg/L with a mean value of 2,280 mg/L. Concentrations for the Fort Union wells ranged from 2,500 to 4,500 mg/L with a mean value of 3,860 µg/L. Sodium concentrations for the ten wells ranged from 14 to 860 µg/L with a mean value of 355 mg/L. SAR values were not calculated from these data, but with the high sodium and TDS concentrations it is highly likely that SAR values are high and that most of the water beneath the proposed refinery site is not suitable for irrigation without treatment.

To supplement the chemistry database, EPA Region 8 sampled five of the ten wells for stable water isotopes in August 2005. Two samples were also collected from the pothole wetland on the western boundary of the refinery site and one sample from the perennial reach of the East Fork of Shell Creek about 15 miles northwest of the refinery site. Preliminary results are shown in

Delta ¹⁸O values in shallow ground waters are typically close to values for the weighted average of annual precipitation (Clark and Fritz 1997 as cited in Wireman 2005). Furthermore, the delta ¹⁸O values for precipitation are more depleted (more negative) with increasing latitude. The delta ¹⁸O values shown for ground water samples in Table 3-4 (MW-4, MW-3, MW-1, MW-2, P-5) are typical for precipitation in west-central North Dakota. These data suggest that the till is recharged by direct infiltration of precipitation.

A general summary of ground water in the till deposits and underlying Fort Union Formation beneath the proposed refinery site reveals that it is suitable for drinking water and stock watering but is not suitable for irrigation. Generally, the deep wells had higher TDS, total alkalinity, and sodium as compared to the shallow wells.

Table 3-4 Preliminary data for stable water isotopes obtained from analysis of samples collected in August 2005

Location	Delta ¹⁸ O	Deuterium
South inlet to wetland	-4.85	-41.5
North outlet from wetland	-5.16	-42.8
MW-4	-16.56	- 129.4
MW-3	-13.63	Cond. too high
MW-1	-15.05	-117.7
MW-2	-13.70	Cond. too high
P-5	-16.34	Cond. too high
East Fork Shell Creek	-10.66	Cond. too high
Source: Wireman 2005		

Surface Water Resources

The project site is located near the edges of the Coteau Slope and Coteau du Missouri. The Missouri Coteau is primarily east of the project site and is characterized as a rolling, hilly area that has numerous prairie potholes and lakes and generally lacks streams. The average 20-mile width of this area, which extends from east-central South Dakota northward into western Saskatchewan, is the continental divide between drainage into Hudson Bay and the Gulf of Mexico. Conversely, the Coteau Slope gradients westward from the Missouri Coteau and is characterized by several streams that are tributary to the Missouri River.

Drainage on the Coteau Slope is generally well developed, although there are a few local poorly drained areas and sub-basins. The four principal tributaries that drain the Coteau Slope in Mountrail and Ward Counties include the White Earth River, Little Knife River, Shell Creek, and East Fork of Shell Creek. These tributaries are generally incised and drain sub-basins and local topographical depressions that are interspersed within the glaciated topography. Surface flow in the region is generally southwesterly toward the Missouri River basin. Perennial, intermittent, and ephemeral streams generally originate in plains and open high hills at elevations ranging from 1,835 to 2,600 feet. Riverine wetlands associated with drainage basins in Mountrail and Ward Counties cover approximately 612 acres and 2,424 acres, respectively (Reynolds et al. 1996).

Surface water resources of the Reservation consist of many ephemeral streams and the Missouri River. Major streams near the project site include Shell Creek and the East Fork of Shell Creek (Figure 3-8). These streams are generally ephemeral, have extended periods without flow, and are tributary to the Missouri River (Lake Sakakawea). A large number of unnamed, ephemeral streams originating from deeply eroded, small drainage basins also flow into the Missouri River.

Lake Sakakawea is the largest surface-water body in the region and most prominent feature within the Reservation. Lake Sakakawea was formed in 1953 by impoundment (Garison Dam) of the Missouri River downstream of the Reservation. The lake averages between 2 and 3 miles in width and is 6 miles wide at its widest point. Its maximum depth is 180 feet at the face of the dam. At normal operating pool (1,850 feet AMSL), the lake covers 368,000 acres, has 1,300 miles of shoreline, and stores nearly 23 million acre-feet of water. Areas of complex glacial moraines bound the lake on the north and east, whereas outcrops of bedrock with scattered patches of glacial-remnant material typify the south and west. Rugged, deeply eroded badlands, formed when rivers eroded the glacial deposits and bedrock, occur in area south and west of the lake. The drainage area of the lake is about 181,400 square miles.

Applicable Regulatory Requirements — Clean Water Act

Section 402 NPDES Permitting Requirements

Section 402 of the Act creates the National Pollutant Discharge Elimination System (NPDES) regulatory program. Pursuant to Section 402, point sources discharging pollutants into “waters of the U.S.” must obtain NPDES permits from the appropriate govern-

mental body. EPA issues NPDES permits on the Fort Berthold Reservation since the MHA Nation has not applied for, and EPA has not approved the Tribes for “Treatment as a State” for purposes of Section 402. NPDES permits set limits on the amount of various pollutants that a source can discharge in a given time. The proposed project will require an NPDES permit for discharges of process water and storm water associated with facility operation. In addition, the proposed project may require a permit for discharges of stormwater associated with construction of the facility. The draft NPDES discharge permit is attached in Appendix C.

Section 404 Permitting Requirement for Discharges to Waters of the U.S.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Corps of Engineers, and in consultation with EPA, to issue permits where required for discharge of dredged or fill material into the “waters of the United States,” including certain wetlands, provided that the applicant demonstrates that the project design is the least environmentally damaging practicable alternative. The USACE will issue any such permits only after compliance with the USACE regulations (33 CFR 320 et seq.) and the CWA 404(b)(1) Guidelines (40 C.F.R. 230, et seq.). 33 CFR 331 sets forth the CWA Section 404 permit appeal process. The Corps of Engineers has determined the construction of the proposed project will require a permit for the discharge of dredged or fill material pursuant to CWA section 404 and its implementing regulations for discharges into certain wetlands.

Section 401 Certification Requirement

Section 401 of the Clean Water Act requires certification by the appropriate governmental body that any activity covered by a Federal license or permit, including, but not limited to the construction or operation of facilities which may result in any discharge into the navigable waters, will comply with the applicable provisions of Sections 301, 302, 303, 306 and 307 of the Act. This includes any Section 402 permits issued by EPA, or Section 404 permits issued by USACE.

EPA issues the Section 401 certification for discharges in Indian country where a Tribe has not received “Treatment as a State” status for Section 401 certification. EPA may grant, condition, or deny Section 401 certification for such federally permitted or licensed activities. The decision is based on determination from data submitted by an applicant (and any other available information) of whether the proposed activity will comply with the requirements of the applicable sections of the Act. EPA may thus deny certification because the applicant has not demonstrated that the project will comply with those requirements. Or EPA may place whatever limitations or conditions on the certification it determines are necessary to ensure compliance with those provisions.

For any permits issued for the proposed project, including Section 402 and Section 404 permits, 401 certification must be obtained from EPA.

Figure 3-8 Surface Water Resources on the Fort Berthold Indian Reservation

Water Quality Regulatory Requirements

Water quality standards are the foundation of the water-quality-based control program mandated by the Clean Water Act. Water Quality Standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. A water quality standard consists of four basic elements:

- (1) **designated uses** of the water body (e.g., recreation, water supply, aquatic life, agriculture),
- (2) **water quality criteria** to protect designated uses (numeric pollutant concentrations and narrative requirements),
- (3) an **antidegradation policy** to maintain and protect existing uses and high quality waters, and
- (4) **general policies** addressing implementation issues (e.g., low flows, variances, mixing zones)

The MHA Nation adopted Tribal water quality standards in 2000 to protect public health and welfare, and enhance the quality of water on the Reservation. Specifically, the MHA Nation adopted the *Water Quality Standards for the Three Affiliated Tribes — Fort Berthold Indian Reservation* for all surface waters within the exterior boundaries of the Reservation. It is also the intent of the MHA Nation that the adopted standards will be sufficient to protect any federally listed threatened or endangered species occurring on the Reservation. The Tribes' water quality standards specify Designated Uses to be achieved and protected for all Reservation surface waters. Those uses (including, but not limited to, aquatic life, recreation, agriculture, and public water supply) are assigned to individual waters within Reservation boundaries. Additionally, narrative Tribal water quality standards are applied to all Reservation surface water resources. Tribal standards for the protection of wetlands, and antidegradation policies are included in the adopted water quality standards and are intended to apply to all Reservation surface waters. Hence, the Tribal water quality standards are designed to protect the Tribes uses of their waters; specifically protect water quality for endangered species and wetlands; and contain antidegradation policies ensuring maintenance of existing water quality.

The proposed project discharge would drain to the East Fork of Shell Creek, flowing initially through the Fort Berthold Indian Reservation, then through the State of North Dakota, and subsequently back through the Reservation. A surface discharge would eventually reach the Missouri River via Lake Sakakawea. Hence, any such discharge should be consistent with both the MHA Nation and State of North Dakota surface water quality standards where the water crosses the boundary, without detriment to the water uses designated within each entity. EPA's CWA §304(a) criteria recommendations form the basis for the numeric criteria developed under both sets of water quality standards. Further, it is the stated intention of the MHA Nation and North Dakota to periodically update their water quality standards to remain current with any updates to the CWA §304(a) criteria recommendations published by EPA. Therefore, these criteria recommendations provide additional guidance for the protection of surface waters in the East Fork of Shell Creek. The specific water quality standards and criteria are shown in the Statement of Basis for the NPDES discharge permit attached in Appendix C.

Designated Uses — East Fork of Shell Creek

The East Fork of Shell Creek flows through both the Fort Berthold Indian Reservation and the State of North Dakota, and therefore designated uses under each must be considered. It is important to note that the designated uses may be specified as a goal for the waterbody segment whether the use is currently being attained or not. Designated uses for the portions of the East Fork of Shell Creek that are within the boundaries of the Fort Berthold Indian Reservation include: I – public water supply, primary IIA – contact recreation, IIB – secondary contact recreation, IIIA – coldwater aquatic life, IV – industrial water supply, V – agriculture, and VI – navigation.

For those areas of the East Fork of Shell Creek that are outside the Reservation, it is classified as a Class III surface water in North Dakota pursuant to 33–16–02.1–09 of the Standards of Quality for Waters of the State (North Dakota Century Code Chapters 61–28 and 23–33; specifically, sections 61–28–04 and 23–33–05, respectively). In general, Class III streams are characterized as having low average flows and, generally, prolonged periods of no flow. The streams are of limited seasonal value for recreation, fish, and aquatic biota. Finally, the quality of the water in this surface water class is typically suitable for agricultural uses such as livestock watering, industrial use, and in some circumstances irrigation.

It is important to note that the MHA Nation water quality standards have not been federally approved by EPA for Clean Water Act purposes. EPA has approved North Dakota water quality standards for all waters within the State of North Dakota, with the exception of those waters that are within Indian country, as defined in 18 U.S.C. Section 1151. Therefore, since EPA has not approved the Tribes' or the State's water quality standards for the Reservation, EPA would be directly implementing the Clean Water Act water quality standards program on the Fort Berthold Indian Reservation. In addition, unless the Tribes apply for and receive EPA approval to implement Clean Water Act Section 402, EPA will continue to implement the Clean Water Act NPDES permitting program on the Reservation.

Impaired Water Bodies

Section 303(d) of the federal Clean Water Act requires states and authorized tribes to periodically prepare a list of all surface waters for which beneficial uses of the water (for example, drinking, recreation, aquatic habitat, and industrial uses) are impaired by pollutants. Waters placed on the 303(d) list are prioritized for the preparation of Total Maximum Daily Loads (TMDLs), which identify the maximum amount of a pollutant that can be released into a water body so as not to impair uses of the water, and allocate that amount among various sources. Since EPA has approved North Dakota water quality standards only for waters within the State and not for those waters that are within Indian country, both the MHA Nation and the State's water quality standards would need to be consulted in fully evaluating the support of designated uses in the East Fork of Shell Creek. Any impairment evaluation conducted by the State of North Dakota is applicable only to those waters where the State water quality standards apply (i.e. not on any waters within the Fort Berthold Indian Reservation).

A review of the Section 303(d) TMDL Waters in the Missouri River Basin (North Dakota Department of Health [NDDH] 2003) reveals that both the East Fork of Shell Creek downstream to Lake Sakakawea (ND–10110101–072–S_00) and Unnamed Tributaries to the East Fork of Shell Creek (ND–10110101–073–S_00) were delisted in 2002. Rationale

for delisting was based on lack of sufficient credible data and/or information to make a use support determination (North Dakota Department of Health 2003). In addition, the previous claims of impairment for recreational activity were based on data that was older than 5 years (North Dakota Department of Health 2003).

Clean Water Act - Oil Pollution Act Regulatory Requirements

The Clean Water Act, as amended by the Oil Pollution Act, and its implementing regulations, require certain facilities that store and use oil to prepare and submit plans to ensure the facilities put in place containment and other countermeasures that should prevent oil spills that could reach navigable waters (Spill Prevention, Control and Countermeasure - SPCC Plans) and plans to respond to a worst case discharge of oil and to a substantial threat of such a discharge (Facility Response Plans – FRP). EPA regulations define who must prepare and submit SPCC plans and FRP plans and what must be included in the plan. See 40 CFR 112. The proposed project falls within the regulatory criteria of 40 CFR 112, therefore the facility must prepare both SPCC and FRP plans prior to operation.

Applicable Regulatory Requirements — Safe Drinking Water Act

EPA implements the Safe Drinking Water Act (SDWA) in Indian country if no other entity has been authorized to do so. All public water systems on the Fort Berthold Indian Reservation must comply with the National Primary Drinking Water Regulations (NPDWR) promulgated pursuant to the Safe Drinking Water Act (SDWA). The SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public water systems. The law was amended in 1986, and again in 1996 with further requirements to protect drinking water and its sources. The SDWA authorizes the EPA to set national health-based drinking water standards to protect against both naturally occurring and man-made contaminants. The NPDWR, based on these health-related criteria, protect public health by limiting the levels of contaminants allowed in drinking water.

Public Water Systems are those systems that have at least fifteen service connections or regularly serve an average of at least twenty-five individuals daily at least 60 days out of the year. 42 U.S.C. Section 300f(4). If the proposed facility meets the definition of a Public Water Supply System, EPA will regulate the facility pursuant to the SDWA. Regulated public water systems are classified into the following categories: non-community, non-transient non-community and transient non-community water systems.

A non-community water system means a public water system that is not a community water system. A non-community water system is either a “transient non-community water system” or a “non-transient non-community water system.” A non-transient non-community water system means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months of the year. A transient non-community water system means a non-community water system that does not regularly serve at least 25 of the same persons over six months of the year. Monitoring and reporting requirements differ based on the classification of a regulated water system, and whether the water system uses ground water or surface water.

Characteristics of Surface Drainage Systems

Primary drainages in proximity to the project site include Shell Creek, East Fork of Shell Creek, and Deepwater Creek drainages, which occur within the northern and eastern parts of the Reservation. These three streams are characterized by incised channels within glacial sediments, small stream slopes, and relatively low basin elevations. All three streams are tributary to the Missouri River/Lake Sakakawea.

The project site is in the East Fork of Shell Creek basin (Figure 3-9). The East Fork of Shell Creek is the nearest principal tributary to the project site and drains a watershed of 467 square miles, of which 125 square miles are within the Reservation (Cates and Macek-Rowland 1998). The East Fork of Shell Creek is characterized as a larger basin with flat stream slopes that typically has high flows characterized by rapidly rising flows and gradually receding flows (Macek-Rowland and Lent 1996). The upper portion of the creek is predominantly a Rosgen E channel type, and the upper stream gradient is about 2 percent, with wetted widths averaging around 6 feet (Confluence Consulting, Inc. 2001).

A Rosgen E channel is typically a meandering stream characterized by narrow channel width, low width-to-depth ratio, high entrenchment ratio, broad floodplain, high sinuosity, low slope gradient and cohesive stream banks retained in place by dense stands of woody shrubs and/or grass like vegetation.

The East Fork of Shell Creek is primarily regulated by periods of snowmelt, direct precipitation, surface runoff, and ground water discharge from seeps and springs. Surface runoff in the undrained or poorly drained basins within the watershed generally draws off into depressions or small individual basins commonly referred to as sloughs or prairie potholes. Many of these depressions represent small individual basins; however, some fill up, reach capacity, and overflow into well-developed basins interspersed throughout the region. Tributary streams that originate in the plains and open high hills generally are ephemeral, flowing primarily during spring runoff generally following winters with above average snowfall. USGS discharge data indicate that this stream is ephemeral and has many days of no flow during the 1991 through 2002 period of record (Harkness et al. 2003).

An unnamed tributary, which is characterized as a small, intermittent stream, flows north through the lowest topographical area within the western margin of Section 19 until its confluence with a large semi-permanent wetland. It is important to denote that a significant lineal length of the streambed within Section 19 has been channelized. The channel originates within a large semi-permanent wetland located in the southern ½ of the section. The tributary continues north (under Highway 23) for ¾ mile until its confluence with the East Fork of Shell Creek. Flow in the tributary is charged primarily by spring snowmelt runoff. Shallow-subsurface flow (water movement immediately beneath the land surface) would likely be towards the nearest surface depression, channel or swale. The ground water table at the site is estimated at 30 to 50 feet below the surface. As demonstrated by water level data from the Geotrans wells ground water in the till flows generally to the southwest.

Figure 3-9 East Fork of Shell Creek Drainage Basin

Stream Flow

Stream flow characteristics depend on the specific features unique to each drainage basin and sub-basin. These features typically include geology, topography, vegetative cover, size, climate, and land use. Major contributions to stream flows in the project site include direct precipitation and surface runoff, springs and seeps, and ground water discharge. Conversely, evaporation, evapotranspiration, and infiltration cause decreases in stream flow.

Statistics on stream flow have been compiled from USGS stream gauging stations at Parshall to provide a perspective of perennial stream flow within the project site. Specifically, the USGS monitors stream gage station 06332523¹ (established June 1991) on the East Fork of Shell Creek near Parshall, North Dakota prior to discharging into the Missouri River/Lake Sakakawea (Figure 3-8). There are no upstream dams within the watershed; therefore, subsequent discharges do not influence surface flows within the watershed.

The average annual runoff within the East Fork of Shell Creek watershed for the 11-year period of record (1991 to 2002) was 4,660 acre-feet (Harkness et al. 2003). Surface annual mean flows range from a low of 2.19 cubic feet per second (cfs) in 1992 to a high of 15.1 cfs in 1999. The annual mean for the period of record is 6.4 cfs (Harkness et al. 2003). Figure 3-10 clearly shows the variation in flows that occur in the East Fork of Shell Creek.

Peak stream flows also varied substantially over the period of record. The maximum recorded peak flow of 1,170 cfs was recorded on March 27, 1999 (Harkness et al. 2003). The lowest peak flow was 31 cfs, which occurred on May 12, 2000 (U.S. Geological Survey 2004d).

Monthly mean flow rates reported by USGS for the available periods of record are presented on Figure 3-11. The data clearly show that peak flows in the East Fork of Shell Creek basin are usually the result of spring runoff or intense spring or summer thunderstorms that occur over the basin. Most of the runoff occurs during March and April. Base or low flows occur during the winter months.

Surface Water Quality

The chemical composition of surface water changes continuously, as water quality in surface streams is commonly a function of stream flow. Alternatively, water quality in most surface drainages varies inversely with stream flow. Most changes in water quality are related to the amount of water and source of water flowing in a stream at a given time. The timing of precipitation events, adjacent land uses, geology, and elevation directly influence surface water quality.

¹ The East Fork of Shell Creek was converted to continuous record gaging station in June 1991. The new gaging site 06332524 was subsequently moved upstream to reflect a new site.

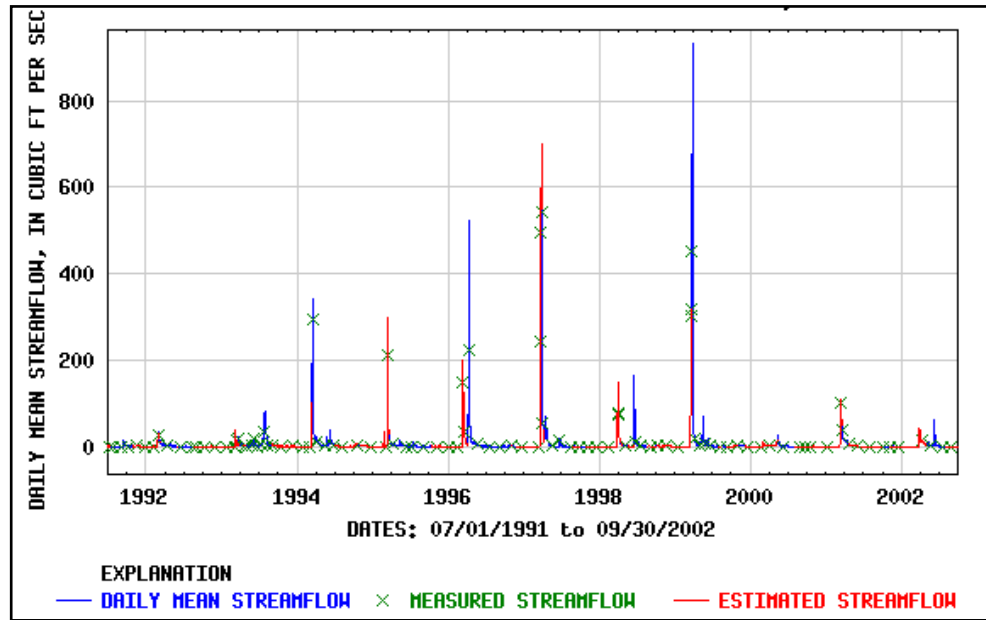


Figure 3-10 Hydrograph for Measured Daily Mean Stream Flow, Measured Stream Flow, and Estimated Stream Flow for the East Fork of Shell Creek

Stream flows resulting from snowmelt and spring precipitation events generally result in higher water quality. This is primarily because of the limited amount and time of contact with exposed soils and rocks; therefore, these waters generally have only small amounts of dissolved minerals. Conversely, stream flows occurring during the growing season typically have lower water quality. This may be due in part to the collection of solids and inert organic material from surface erosion and the collection of phosphorous and nitrogen from pesticide treated agricultural fields. Generally, most surface waters within the area are primarily sodium sulfate type waters (e.g., alkaline with moderate to high levels of hardness).

Figure 3-11 Monthly Stream Flows — East Fork Shell Creek, North Dakota

Ambient Water Quality — East Fork of Shell Creek

The USGS has periodically monitored water quality data within the East Fork of Shell Creek at stream gage station 06332523. In addition, Cates and Macek-Rowland (1998) sampled select locations within the watershed over a period of record from 1990 to 1991 and 1991 to 2002. Finally, Confluence Consulting (2001) conducted water quality sampling at three stream reaches within the East Fork of Shell Creek. Summaries for these selected water quality data are presented in Greystone 2004.

Based on available data, background surface water quality in the East Fork of Shell Creek is slightly basic with pH values ranging from 7.8 to 9.9. In addition, the stream exhibits moderate to high concentrations of total dissolved solids (206 to 3,040 mg/L). Dissolved oxygen levels are varied over the 11-year period of record, but it is important to note that most measurements are well above the water quality standard for dissolved oxygen of 5 mg/L. The water within the stream is characterized as a sodium sulfate bicarbonate type and the overall water quality of the stream system is inferior for most domestic uses.

A review of the values collected from water samples within the East Fork of Shell Creek show that most are usually found in the slightly saline range with some samples occurring in the moderately saline range.

Arsenic and lead concentrations were analyzed from several samples in the East Fork of Shell Creek. Concentrations of lead are generally low (0 to 1.94 $\mu\text{g/L}$) whereas arsenic concentrations (0 to 9 $\mu\text{g/L}$) have exceeded both the aquatic and human health maximum limit concentrations.

Field pH values collected over the 11-year sampling period of record have ranged from a low of 7.8 to a high of 9.9 (standard units). The median values fall within the maximum numeric criteria (7.0 to 9.0), and generally reflect moderate to good water quality.

Sulfate values collected and analyzed over the 11-year sampling period of record ranged from a low of 36 mg/L to a high of 1,540 mg/L.

Sample values for chloride analyzed over the 11-year sampling period of record have ranged from a low of 1.5 mg/L to a high of 52 mg/L. Therefore, no exceedances of chloride levels were collected within this period of record.

Physical, Chemical, and Biological Integrity of East Fork of Shell Creek

Confluence Consulting (2001) assessed the physical, chemical, and biological integrity of streams at 16 sites on six streams (including the East Fork of Shell Creek — see Figure 3-9) within the Reservation using the environmental monitoring and assessment program protocols developed by the EPA. The assessment involved three biological assemblages (fish, macroinvertebrates, and periphyton), analysis of select physicochemical parameters, and qualitative and quantitative assessments of stream morphology and riparian conditions. The analysis provided a means to estimate the extent of human influences on streams within the Reservation.

The following description of East Fork of Shell Creek aquatic resources was taken directly from the *Biological, Physical, and Chemical Integrity of Select Streams on the Fort Berthold Reservation, North Dakota* (Confluence Consulting, Inc. 2001).

Lower East Fork Shell Creek (2A)

Indicators of biological, chemical, and physical integrity suggest moderate impairment of beneficial uses at this site. Several physicochemical water quality parameters, including nutrients and specific conductance, were higher than ecoregion reference values. Nutrient loading could be from natural sources or agricultural activities in the basin. Furthermore, this site is below municipal lagoons for the town of Parshall, which may also contribute nutrients. Specific conductance at this level precludes use of this water for irrigation purposes.

Biological assemblages also provide indications of moderate impairment. Dominance by pollution-tolerant diatoms is further indication of nutrient enrichment. A ranking of 14 out of 16 stream reaches sampled for macroinvertebrates suggests significant impairment of invertebrate communities. Low richness values, low diversity, and high numbers of tolerant individuals contributed to this ranking. Likewise, the fish metrics indicated low diversity and a preponderance of pollution-tolerant species. The site also ranked 14th in terms of fish assemblage.

Habitat conditions were influenced largely by beaver activities and a road crossing. Beavers impounded the flow for much of the reach, and a large scour pool occurred under the bridge. The monotonous habitat was possibly related to the low diversity of fish.

In summary, biological communities and water quality samples at lower East Fork Shell Creek suggest moderate impairment of aquatic life, warm water fishery, and agricultural uses. Nutrient loading is implicated as a cause of impairment. More investigation is needed to assess the role of agricultural chemicals in shaping biological communities at this site.

Middle East Fork of Shell Creek

Conditions at Middle East Fork Shell Creek indicate minor to moderate impairment of physical, chemical, and biological integrity. Physicochemical parameters demonstrated elevated concentrations of nutrients and dissolved solids at this site. These relatively high values may be caused by either natural sources or human activities.

Measures of biological integrity varied with the assemblage. Diatom associations scored within the range of good biological integrity, with minor impairment caused by slightly elevated pollution and siltation indexes. The site ranked seventh out of 16 stream reaches in terms of macroinvertebrates. Macroinvertebrate communities demonstrated good richness and relatively high diversity, although the proportion of non-insect taxa was relatively high because of large numbers of snails and ostracods. The near lentic conditions in the lower half of this reach were probably responsible for the abundances of these taxa.

Several factors in this site's fish assemblage suggest moderate impairment. First, taxa richness was low, with only two species represented (fathead minnow and brook stickleback). In addition, the fish here displayed the highest level of observed abnormalities. Eye problems were the most prevalent, although tumors were also observed. These could be the result of several factors. Nutrient loading could increase primary productivity and

decomposition so that supersaturation of gases exerts pressure on eyes. Another potential cause of abnormalities is the presence of toxic chemicals. This site had the greatest degree of human influence of all sites, including excessive amounts of trash and a railroad crossing, both of which are potential sources of toxic chemicals. Nevertheless, diatoms did not demonstrate indications of toxicity through abnormal cells.

Land use at this site varied at a fence line near the midpoint. The downstream half was grazed by horses and had an unusually wide and shallow channel. Poor sediment transport capacity in this section resulted in a substrate dominated by deep mud and dense filamentous algae. The upper half was not grazed as intensively and retained riffle pool morphology and more diverse substrate composition.

In summary, this site warrants a determination of moderate impairment and partial support of warm-water fishery, aquatic life, agriculture, and aesthetics beneficial uses. Additional investigation is recommended to evaluate causes of fish abnormalities.

Upper East Fork of Shell Creek

This site presents a scenario of least impaired habitat conditions but fair to poor biological integrity based on periphyton, macroinvertebrate, and fish samples. There were numerous indications of high-quality habitat. For example, this site scored the highest of all sites on the rapid habitat assessment questionnaire. This site was characterized by a narrow, deep channel with some of the most diverse substrate composition of all sites evaluated. The channel was classified as a Rosgen E channel type. Cover features for fish included undercut banks and overhanging vegetation. The riparian area was dominated by herbaceous species, and grazing pressure was light. Impairment of biota in the presence of good habitat suggests that water quality is the primary factor limiting beneficial uses. As discussed below, agricultural chemicals are a possible source of impairment at this site.

In contrast to the other assemblages, algal associations demonstrated a few indications of excellent biological diversity. This was most apparent in the high diversity of diatoms and low proportion of the dominant species. Still, the pollution index was the highest of all sites sampled, suggesting nutrient loading from either natural sources or human activities.

Ranking of macroinvertebrate assemblages indicate this site is among the most impaired, with a ranking of 13th out of the 16 stream reaches sampled. The dominance by non-insect taxa despite diversity of substrate particles and substantial flow suggests toxic conditions. Pesticides in this heavily farmed basin are a potential source of impairment. Pesticides are usually specific to arthropods (including insects), and do not affect other invertebrates such as snails, worms, and amphipods.

Fish populations at this site rated relatively low in light of the high-scoring habitat conditions. Fish at this site consisted of low numbers of two species, fathead minnow and brook stickleback, resulting in a rank of ninth out of 16. While brook stickleback are considered moderately tolerant to pollution, they can withstand relatively high levels of dissolved solids. Their tolerance of agricultural chemicals is unknown.

Generally, the site demonstrates moderate to severe impairment of fish and macroinvertebrate communities, despite least impaired habitat conditions. Nutrient loading, herbi-

cides, and pesticides may be a factor in limiting these assemblages. Further investigation into sources of impairment is recommended.

In summary, East Fork Shell Creek demonstrated indications of slight to severe impairment. Several lines of evidence at the three sampling sites indicated nutrient loading from either human activities or natural sources. In addition, low proportions of insects suggest that pesticides may be affecting aquatic life at two sites. Further evidence of toxic chemicals included high proportions of tumors and other abnormalities on fish and low diversity of fish species.

Water Supply

Water supplies for domestic and municipal uses are obtained from both surface water and ground water sources. Lake Sakakawea is the source of Public Water Supply for Newton and Parshall. The Towns of Makoti and Plaza obtain public water supplies from buried valley aquifers and the Fox Hill Formation. Many residents of the MHA Nation obtain domestic water supplies from wells constructed in the surficial deposits, primarily till. More than 700 domestic wells occur within the Reservation. The water contained in the till typically has relatively high TDS and may exceed secondary MCLs, however the water quality does not preclude its use for drinking water. The till cannot yield sufficient quantities of water for a public water supply but does yield sufficient quantities for domestic water supply.

Immediate Surroundings of the Project Site

Six residences occur within 1 mile of the project site. All of these are isolated rural residences that are part of the agricultural operations surrounding the project site. Horace Pipe (2006) of the MHA Nation has gathered information about the sources of water for two of these residences. The following is a summary of the contacts.

- The farm residence just north of Highway 23 has a well that is 103 feet. This well is only used to water their horses. They haul water for drinking and all household activities (washing, cooking, and plumbing). The water has a lot of TDS and is brownish-red colored.
- The farm residence to the south of the refinery site has a well was completed August 8, 2001 at a depth of 189 feet. This residence also hauls water and the well water is used for cattle and horses.

Makoti

Makoti does not operate a water treatment plant. Residents within the town obtain water from two ground water wells completed in the Vang aquifer at depths of 22 and 41 feet below the surface (Wavra 2004, North Dakota Department of Health 2000). The two wells (152-086-18baa and 152-086-18abb) are located in Section 18, T152N, R86W, about 3 miles northeast of Makoti. According to the Safe Drinking Water Information System (U. S. Environmental Protection Agency 2004), approximately 145 residents are served water by these two wells. The two wells produce an annual average of 9.2 million gallons or about 28 acre-feet (North Dakota Department of Health 2000). Residential homes outside of the town boundary use either cisterns or domestic wells.

Plaza

Residents within the town of Plaza obtain water from three ground water wells: well #1, well #2, and well #4. Well #1 and well #2 are completed at depths of 88 and 91 feet below the ground surface. In 1997, well #4 was constructed within Section 35, T153N, R88W at a depth of 1,560 feet below the ground surface. Well#4 is finished in the Fox Hills-Hell Creek aquifer and yields about 45 gpm (Rogers 2004). Well#4 fills most of the local water needs; however, well #1 and well #2 are used when make-up water is needed during high usage periods. Plaza also has an inactive well (Wavra 2004).

Plaza operates a water treatment plant that utilizes greensand filtration process and potassium permanganate treatment to facilitate removal of iron and manganese. In addition, water is chlorinated prior to distribution. The City of Plaza treats about 7 million gallons per year (North Dakota Department of Health 2002). According to the Safe Drinking Water Information System (U. S. Environmental Protection Agency 2004), about 170 residents are served by these three wells. Homes outside of the town boundary use either cisterns or domestic wells.

Parshall

The town of Parshall is the community closest to the project site that is served by a public water system. Rural residents in the area use either domestic wells or cisterns. The Parshall water supply uses an intake at Parshall Bay on Lake Sakakawea. The water treatment plant has the capacity to produce approximately 575,000 gallons of water per day, although current average daily use is approximately 360,000 gallons or 63 percent of operational capacity (Bartlett and West Engineers, Inc. 2002).

Soils

Soils within the project area have developed on till plains and moraines in a climatic regime characterized by cold winters, warm summers, and low to moderate precipitation. The soils have developed in four kinds of parent material: glacial till, glacial lacustrine deposits, glacial outwash, and postglacial alluvium. Slopes range from nearly level to very steep with deeper soils found in the less steeply sloping areas. Approximately $\frac{2}{3}$ of the land use is cropland with the remaining $\frac{1}{3}$ used as rangeland within the two counties. Remnant native grassland is predominantly mixed-grass prairie that is used for grazing and wildlife habitat.

The following section lists the dominant soil series for all the associations in the project area, and the general characteristics of the soils are listed below for each series. A brief description of the general physical characteristics for wind erosion hazard, poor revegetation potential, and prime farmland and hydric soils also follows. This information was derived from both the *Soil Survey of Ward County, North Dakota* (Howey et al. 1974) and *Soil Survey of Mountrail County, North Dakota* (VanderBusch 1991).

Soil Mapping Units

The following section contains detailed descriptions of the soil mapping associations and series/units identified in the project area using the *Soil Survey of Ward County, North Dakota* (Howey et al. 1974) and *Soil Survey of Mountrail County, North Dakota*

(VanderBusch 1991). The Williams-Hamerly-Bowbells and Williams-Zahl associations are dominant throughout the project area, and subsequently include Williams, Parnell, Bowbells, Zahl, Hamerly, Manning, and Wabek soil series/units. Figure 3-12 shows the areal distribution of soil mapping units within the project site.

Williams – Hamerly – Bowbells Association

This association consists of level and nearly level soils on flats, rises, and in swales on till plains. A characteristic landscape would consist of rolling hills intermixed with depressions and knolls with slopes ranging between 0 and 3 percent. Williams series soils are typically located on the flats and rises, Hamerly on flats adjacent to the depressions, and Bowbells occurring in the swales and flats. Minor soil series occurring within this association typically consist of Tonka and Parnell, which are poorly and very poorly drained and most often occur in both shallow and deep depressions, respectively.

This association is well-suited for cultivated crops primarily small grains, but some areas are used for range and pasture. The Tonka and Parnell soils are primarily associated with palustrine wetlands, which are best suited for wetland habitats.

Figure 3-12 Soil Survey Map

(11 x 17 figure)

backside of 11 x 17 figure

Hamerly Series

The Hamerly series consists of deep, level and undulating, moderately well drained soils that formed in glacial till, and the corresponding range site is primarily categorized as silty. These soils are adjacent to intermittently ponded closed depressions. Permeability is moderately slow, and these soils typically have a seasonally perched water table that delays tillage. Shrink-swell potential is low to moderate.

Hamerly loam, 0 –5 percent slopes (Hf) – This soil is found in the areas around rims and low swales of potholes. The areas of deposits are small and irregularly shaped and typically include other series. Permeability is moderately slow (0.2 to 0.63 inches/hour), and surface runoff is slow to medium. The land capability for crop cultivation is moderately limited due to potential erosion from wind.

Tonka silt loam (3) – This deep, level, poorly drained soil is in shallow depressions on till plains, moraines, and lake plains. Permeability is slow (0.06 to 2.0 inches/hour), runoff is generally ponded, and the seasonal high water table is generally 0.5 foot above to 1 foot below the surface. The land capability for crop cultivation is moderately limited due to potential impacts from water.

Vallers loam, saline (4) – This soil is deep, level, poorly drained, moderately saline, highly calcareous and typically associated with drainage ways on till plains. Permeability is moderately slow (0.6 to 6.0 inches/hour), runoff is slow, and the seasonal high water table is usually within a depth of 1 foot. The land capability for crop cultivation is severely limited due to potential erosion from wind.

Hamerly – Tonka complex, 0 – 3 percent slopes (17) – These deep soils are located on till plains. The level and nearly level, somewhat poorly drained soil is typically found on flat areas surrounding depressions. Permeability is moderately slow (0.6 to 2.0 inches/hour), and runoff is slow. The land capability for crop cultivation is moderately limited due to potential erosion from wind.

Bowbell Series

The Bowbell series consists of deep, level and gently sloping, moderately well drained soils that formed in glacial till and local alluvium derived from till, and the corresponding range site is primarily categorized as silty. These soils are typically found on upland till plains and permeability is moderate to a depth of about 36 inches (and moderately slow below that depth). These soils receive additional moisture from snow accumulation and runoff from adjacent slopes. Shrink-swell potential is moderate.

Bowbells-Tonka loams, 0 – 2 percent slopes (BoB) – This complex consists of nearly level soils in shallow swales on till plains. Bowbells loam makes up about 75 to 90 percent of the complex with the remainder encompassing Tonka silt loam. Bowbells is better drained and is on the higher parts of the swales and concave depressions, while the Tonka soil is in the low depressions that are flooded by water from adjacent areas. Permeability is moderate to a depth of 18 inches: 0.63 to 2.0 inches/hour, and surface runoff is slow. The land capability for crop cultivation is moderately limited due to a slight potential erosion from wind.

Williams – Zahl Association

This association consists of undulating and gently rolling soils on side slopes, shoulder slopes, summits, low ridges, and knolls on till plains. A characteristic landscape within this association would typically be dotted with depressions, swales, and flats with slopes ranging between 3 and 9 percent. The Williams series occur on the side slopes and summits, contrasted by the Zahl series on the shoulder slopes, low ridges, and knolls. Minor soil series within this association typically consist of Bowbells series within the swales, Farnuf on the flats, Parnell and Tonka within the depressions, and Vebar on the side-slopes.

Williams Series

The Williams series consists of deep, level to strongly sloping, well drained soils that formed in loamy glacial till on glacial plains, and the corresponding range site is primarily categorized as silty. Permeability is moderate to a depth of about 30 inches and is moderately slow below that depth. Shrink-swell potential is low to moderate for the series, and the engineering index classification is A-6(12) and A-6(13) for the Bt and Bk horizons, respectively.

Williams loam, gently undulating, 2 to 4 percent slopes (W1B) – This soil is in areas characterized by low knolls, ridges, and smooth slopes. Permeability is moderate (0.2 to 0.63 inches/hour), and runoff is slow to moderate. The land capability for crop cultivation is moderately limited due to a slight potential erosion from wind.

Williams loam, undulating, 4 to 6 percent slopes (W1C) – This soil is on irregular knolls, ridges, and side slopes around potholes, swales and valley sides. Slopes are generally short, permeability is moderate (0.2 to 0.63 inches/hour), and runoff is medium. The land capability for crop cultivation is moderately limited due to a slight potential erosion from wind.

Williams – Zahl loams, 3 – 6 percent slopes (23B) – This soil is deep, undulating, well drained and primarily located on till plains. The Williams soil is typically on the side slopes and summits, while the Zahl soil generally occurs on the knolls, ridges, and shoulder slopes. Permeability is moderately slow (0.2 to 2.0 inches/hour), and runoff is medium. The land capability for crop cultivation is moderately to very severely limited due to a slight potential erosion from wind.

Williams – Zahl loams, 6 to 9 percent slopes (24C) – These deep soils are generally associated with gently rolling, and well drained areas of the till plains. The Williams soils are typically found on the side slopes and summits, while the Zahl soils are most commonly associated with the shoulder slopes and knolls. Permeability is moderately slow (0.2 to 2.0 inches/hour), and runoff is rapid. The land capability for crop cultivation is severely to very severely limited due to a slight potential erosion from wind.

Zahl – Williams loams, 9 to 25 percent slopes (24E) – These deep, rolling and hilly, and well-drained soils are primarily located on moraines. The Zahl soils are most commonly found on the shoulder slopes and summits, while the Williams soils are typically associated with the slopes and summits. Permeability is moderately slow (0.6 to 2.0 inches/hour), and runoff is very rapid. The land is unsuited for crop cultivation.

Zahl Series

The Zahl series consists of deep, rolling to steep, well-drained soils that formed in loamy glacial till, and the corresponding range site are primarily categorized as silty or thin silty. These soils are typically found on glacial moraines and slope breaks. Shrink-swell potential is moderate, and the engineering index classification is A-6(11) and A-7-6(13) for the Bk1 and C horizons, respectively.

Zahl-Max loams, rolling 6 to 9 percent slopes (ZmC) – This complex is found on hilltops and slope breaks. Zahl loam makes up 50 to 75 percent of the complex, and Max loam makes up the remaining 25 to 50 percent. In general, the Zahl soil is located on hilltops and crests of side slopes, while the Max soil is on the smoother and lower parts of the side slopes. Permeability is moderate (0.63 to 2.0 inches/hour) to a depth of about 15 inches and moderately slow below that depth, and runoff is rapid. The land capability for crop cultivation is severely limited due to a slight potential erosion from wind.

Manning Series

The Manning series consists of level to rolling, well drained soils that formed in moderately coarse textured material that is underlain by sand and gravel, primarily at a depth of 12 to 24 inches. Permeability is moderately rapid to a depth of about 24 inches and is very rapid below that depth. The corresponding range site is primarily categorized as sandy and/or shallow to gravel. Shrink-swell potential is low, and the engineering index classification is A-2-4(0) and A-2-4(0) for the Bw2 and C1 horizons, respectively.

Manning sandy loam, 1 to 6 percent slopes (49B) – This is a deep, nearly level, gently sloping, and excessively drained soil typically located on flats and rises on outwash plains and terraces. Permeability is moderately rapid (2.0 to 6.3 inches/hour) in the upper part of the Manning soil and very rapid in the lower part (>20.0 inches/hour). Runoff is slow and the sand and gravel layer typically restricts the depth to which plant roots can penetrate. The land capability for crop cultivation is moderately limited due to potential erosion from wind.

Parnell Series

The Parnell Series consists of deep, level, poorly drained soils that formed in fine-textured formed in glacial alluvium, and the corresponding range site is primarily categorized as wetland. Shrink-swell potential is high, and the engineering index classification for the 3 to 16-inch horizon is A-7-5(19), 16 to 30-inch horizon is A-7-5(20), and 36 – 60-inch horizon is A-7-6(20).

Parnell silty clay loam, 0 to 1 percent slopes (Pa) – This soil is in basins and depressions and is usually inundated by water (for example, ponded) until mid-summer or later. It may sometimes be ponded all year after a series of wet seasons, but after a series of dry years, it may pond only for a few days following heavy rains. Permeability is slow (0.06 to 2.0 inches/hour), and runoff is slow. The land capability for crop cultivation is moderately limited due to potential impacts from water.

Wabek Series

The Wabex series consists of level to hilly, excessively drained soils that formed in sand and gravel outwash material, and the corresponding range site is primarily categorized as very shallow. These soils are primarily associated with outwash plains. Permeability is

very rapid below the surface layer. Shrink-swell potential is low, and the engineering index classification is A-1-b(0) for the C horizon.

Wabek loam, 1 to 35 percent slopes (54E) – This is a deep, nearly level to steep, excessively drained soil that is primarily located on flats, knolls, and ridges on outwash plains and terraces. Permeability is very rapid (2.0 to >20 inches/hour) and runoff is rapid. As with the Manning soil, the sand and gravel layer typically restricts the depth to which plant roots can penetrate. The land capability for crop cultivation is severely limited due to steep slope and stony soil. This also limits construction potential.

Poor Revegetation Potential

Soils are grouped according to their limitations for field crops, the risk of damage if used for agriculture, and response to management. Capability classes are divided into eight groups (Roman Numerals I through VIII), with Class I soils having few limitations and Class VIII soils having multiple limitations that prevent commercial crop production. Therefore, Class VII and Class VIII soils are determined to have poor revegetation potential. Soils with poor revegetation potential were identified using the land capability classification given in the County soil surveys. Table 3–5 details soils with poor revegetation potential in the project area.

Table 3–5 Soil Series with Poor Revegetation Potential

Series/Unit	Slope	Class
Wabek loam	1 to 35 percent	Class VII
Zahl – Williams	9 to 25 percent	Class VIIe

Vegetation

Five cover types were identified in the project area: palustrine emergent wetlands, riverine wetlands, mixed-grass prairie, agricultural lands, and developed land. These broad categories often represent several vegetation community types that are generally defined by both species composition and relative abundance. The acres of occurrence and relative distribution of vegetation types within the project area are presented on Table 3–6. The vegetative community types described below generally correlate with wildlife habitat types.

Table 3–6 Summary of Cover Types Identified for the Project Site

Classification	Areal Extent (acres)
Wetlands	34
Agricultural Land	373
Mixed-grass Prairie	48
Developed	5
Total	460

Wetlands

Executive Order 11990 - Protection of Wetlands (May 24, 1977) directs each federal agency to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: (1) acquiring, managing, and disposing of federal land and facilities; (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et al. 1979). In general, wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods during the year, including during the growing season. Saturation with water largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetlands soils.

Wetlands and their associated habitats are grouped into classifications that provide several functions and values unique to each wetland complex. Wetlands perform many important hydrologic functions, such as floodwater storage, maintaining stream flows, slowing and storing floodwaters, stabilizing stream banks, nutrient removal and uptake, and groundwater recharge.

A number of wetland classification systems have been developed, but the Cowardin et al. (1979) classification method is the most widely recognized system. Using the Cowardin et al. 1979, system of wetland classification, one type of wetlands was identified on the project site — palustrine. The following sections describe these wetlands.

Palustrine Wetlands

Palustrine wetlands are non-tidal and tidal-freshwater wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or non-persistent emergent, erect, rooted herbaceous plants (persistent- and non-persistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also included in this category are intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.

Palustrine wetlands can be further divided based on the dominant plant life form or the physiography and composition of the substrate (e.g., aquatic bed, emergent, forested, scrub-shrub, unconsolidated bottom, or unconsolidated shore) and the seasonal water regime (e.g., intermittently exposed, semi-permanently flooded, seasonally flooded, saturated, or temporarily flooded) (Cowardin et al. 1979).

Palustrine wetlands within the project area occur in a variety of forms, sizes, depths, and type/classification. The wetlands can range from a few feet across and only inches deep, to basins 500 acres in size with depths of more than 10 feet. Most of the plants within the small to medium sized seasonal wetlands contain facultative wetland species (FACW) interspersed with a few obligate (OBL) species in the deeper portions of the basin.

In the higher elevation margins (typically unfarmed) of the basins, facultative (FAC) and to a lesser degree, facultative upland (FACU) plant species are the dominant constituents within the plant community. These species typically include smooth brome (*Bromus inermis*), kochia (*Kochia scoparia*), Russian thistle (*Salsola kali*), meadow foxtail (*Alopecurus pratensis*), quackgrass (*Elymus canadensis*), Kentucky bluegrass (*Poa pratensis*), and goldenrod (*Solidago missouriensis*). Conversely, in the saturated portions of the basin, characteristic FACW and OBL vegetation primarily consists of reed canarygrass (*Phalaris arundinacea*), curly dock (*Rumex crispus*), needle spike rush (*Eleocharis acicularis*), Baltic rush (*Juncus balticus*), American sloughgrass (*Beckmannia syzigachne*), smartweed (*Polygonum persicaria*), beggarticks (*Bidens frondosa*), bluejoint reedgrass (*Calamagrostis canadensis*), and woolly sedge (*Carex lanuginosa*).

Wetlands within this region possess unique environmental and biotic characteristics that add to the overall regional diversity and production of the aquatic invertebrates and the vertebrate wildlife that depend upon them as a food source. The PPR is a unique area that is of critical importance to migratory birds in North America. Wetlands within the region also support countless recreational opportunities such as hunting, fishing, trapping, bird watching, and photography. They also provide valuable livestock water and produce an abundance of forage.

Hydrology for wetlands follows a yearly cycle, beginning with the spring snow melt runoff draining into the depressional basins and ponding (depth of inundation is highly dependent on the amount of snow cover). Through the summer months, wetlands may receive direct precipitation and subsequent runoff from their surrounding watershed(s), while simultaneously exporting water through evapotranspiration and losing surface water through seepage. By late summer, the wetlands are generally drawn down or dry and enter the fall and winter months in a condition that prepares them to repeat the cycle the following spring.

Plant communities within prairie wetlands are dynamic and continually changing as a result of short- and long-term fluctuations in water levels, salinity, and anthropogenic disturbance (Kantrud et al. 1989). In general, marsh sediments and seed banks are exposed during drought periods. During this dry marsh phase, seeds of many mud flat annual and emergent plant species germinate on exposed mudflats, with annual species usually forming the dominant component (Davis and Brinson 1980). When water returns, the annuals are lost but the emergent macrophytes survive and expand by vegetative propagation (e.g., regenerating marsh). Depth and duration of the flooding period, combined with the tolerances of the individual species will determine how wetland communities develop over time. The resulting vegetation communities established within most area seasonal and semi-permanent wetlands consists of a mixture of tall grasses and forbs intermixed with a combination of emergent macrophytes.

Types, Distribution, and Areal Extent of Wetlands on the Project Site

According to the FWS — Habitat and Population Evaluation Team (HAPET) (which reclassified and processed original National Wetland Inventory data into basin class coverages that include temporary, seasonal, semi-permanent, lake and riverine, total wetland acreages by basin classes), both Mountrail and Ward Counties have 140,005 and 191,833 acres of wetlands, respectively (Reynolds et al. 1996).

The numerous topographical depressions and basins that capture snowmelt and rainwater or are within reach of subsurface waters generally support palustrine emergent wetlands (freshwater marshes, wet meadows, prairie potholes, and sloughs). In Mountrail County, temporary and seasonal basin classes (which correspond to palustrine wetlands) cover approximately 40,120 acres, or about 28 percent of the total wetland acreage, while in Ward County, they cover approximately 103,128 acres, or about 54 percent of the total wetland acreage (Reynolds et al. 1996). Extensive tracts of palustrine wetlands exist throughout the two counties in isolated depressions within mixed-grass prairies and agricultural fields; in lowlands adjacent to drainages, rivers, and lakes; and adjacent to springs or seeps. In the region, riverine wetlands occur in much less frequency than palustrine wetlands. In Mountrail and Ward Counties, riverine wetlands cover approximately 612 acres and 2,424 acres, respectively (Reynolds et al. 1996).

Sixteen wetlands were delineated within Sections 19 and 20 of the project site. Wetlands occupy a total of 33.6 acres within the project study area (Figure 3-13). Table 3-7 provides an acreage summary.

As detailed in Table 3-7, seasonal, temporarily flooded wetlands (PEMA and PEMC) were the most dominant wetland types delineated on the project site. Most of these wetlands are characterized as depressional basins that are generally less than 1.5 acre in size. One large, seasonal, persistent wetland (PEMF#2) was identified within the northwest corner of the Project Site within Section 19.

Project Site – PEMF #2 Wetland

Wetland PEMF#2 will be directly affected by the proposed project. This prairie pothole wetland is located in the northwest corner of the site and is associated with the lowest elevation contour within the NW¼ of Section 19. The source of water to this feature is primarily from spring runoff of snowmelt and precipitation from the adjacent local watershed. Additional water is supplied by a north to south drainage channel that empties into the southern boundary of the wetland. The watershed for wetland PEMF #2 is approximately 400 acres. This wetland is approximately 11.7 acres in size and was classified as a palustrine emergent semi-permanently flooded. This wetland was generally characterized by a predominance of emergent and obligate wetland vegetation on the outer margins and contains areas of open water (during spring and wet years) within the center portion of this basin. Additionally, this delineated wetland drains into a culvert constructed under Highway 23 that is tributary to the East Fork of Shell Creek. A distinct band of mixed-grass prairie immediately bordered the basin associated within this wetland.

The USACE has determined that wetland PEMF#2 is subject to CWA jurisdiction. Wetland PEMF#2 includes the pond wetland and the connected swale. The other wetlands (Figure 3-13) are isolated and not determined to be jurisdictional wetlands.

PEMF #2 Wetland Hydrology

During mid-August 2005 (when the isotope samples were collected), there was no discharge from the wetland (Wireman 2005). Isotope samples were collected from the up-gradient end (south) and the down-gradient end (north) of the wetland. The delta ¹⁸O values shown for the two wetland locations are much more enriched in ¹⁸O (-4.85 and -5.16) than the ground water in the till and underlying Fort Union Formation (Wireman 2005). This enrichment is caused by extensive evaporation of water in the wetland. These values are also a strong indication that the wetland does not receive ground water discharge (Wireman 2005).

Mixed-Grass Prairie

The mixed-grass prairie ecoregion occupies the northern limits of the boreal forests of Manitoba, Saskatchewan and Alberta, south to north-central Nebraska, and was historically one of the largest ecosystems in North America, originally covering about 69 million hectares or 171 million acres (Samson et al. 1998). Within both Ward and Mountrail Counties, most of the remaining mixed-grass prairie is used for rangeland². A substantial amount of the remnant mixed-grass prairie occurs on hills or very steep slopes, well drained or excessively drained soils, and moderately well drained to poorly drained alkali soils. These lands subsequent soils are generally unsuited or, at best, poorly suited for producing cultivated agricultural crops.

Table 3–7 Summary of Jurisdictional Wetlands and Waters of the U.S. Inventoried on the Project Site

Location/Identifier ^{1,2}	Areal Extent (acres)
Section 19	
PEMC #1	2.5
PEMF #2	11.7
PEM/ABF #3	1.4
PEMC #4	0.7
Section 20	
PEMA #1	0.6
PEMA #2	0.8
PEMA #3	0.3
PEMC #4	0.7
PEMC #5	3.1
PEMC #6	6.0
PEMA #7	1.7
PEMA #8	0.4
PEMA #9	0.3
PEMA #10	1.1
PEMA #11	1.1
PEMA #12	1.0
Total	33.6

Notes:

1. Wetland classifications followed the Cowardin et al (1979) Classification System.
2. PEMA = Palustrine-Emergent-Temporarily Flooded, PEMC = Palustrine-Emergent-Seasonally Flooded, PEMF = Palustrine-Emergent-Semi-permanently flooded, and PEM/ABF = Palustrine-Emergent-Aquatic-Bed-Semi-permanently flooded.

² Rangeland is defined as a kind of land on which the historic climax vegetation was predominantly grasses, grass-like plants, forbs, or shrubs and is a primary source of forage for domestic livestock and for wildlife (Butler et al. 1997).

Figure 3-13 Wetland Delineation Map

Mixed-grass prairie landscapes are further divided into ecological range sites for the purposes of inventory, evaluation, and management. An ecological range site, as defined for rangeland, is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation (Butler et al. 1997). Ecological range sites have characteristic soils that have developed over time throughout the soil development process. Also, an ecological range site has a characteristic hydrology, particularly infiltration and runoff that has developed over time. The development of the hydrology is influenced by development of the soil and plant community. Therefore, the ecological range site descriptions contain information about soils, physical features, climatic features, associated hydrologic features, plant communities possible on the site, plant community dynamics, annual production estimates and distribution of production throughout the year, associated animal communities, associated and similar sites, and interpretations for management (Butler et al. 1997).

Ecological range sites are distinctive types of rangeland identifiable by a characteristic plant community that changes with the growing season (for example, cool season and warm season). An ecological range site is recognized and described based on the characteristics that differentiate it from other sites in its ability to produce and support a characteristic plant community. Ecological range sites are based on soil data compiled in soil surveys. Soil surveys for both Ward and Mountrail Counties classify the following ecological range sites as occurring within the region: clayey, claypan, limy sub-irrigated, overflow, saline lowland, sandy, shallow, silty, thin claypan, thin upland, very shallow, and wet meadow.

Agricultural Land

Agricultural land may be defined broadly as land used primarily for production of cultivated crops. However, pasture and other cultivated land may be infrequently included in this classification.

In 1997, Ward County had 1,172 farms. The average size farm had 1,030 acres, with a median size of 700 acres (National Agricultural Statistics Service 1997). In 1997, 829 farms harvested 11,144,094 bushels of wheat for grain on 512,545 planted acres (National Agricultural Statistics Service 1997). The average wheat for grain production is equal to about 21.7 bushels per acre. Durum wheat accounted for the second highest harvested crop. In 1997, 665 farms planted 332,340 acres that produced 7,337,044 bushels (National Agricultural Statistics Service 1997). This translates into 22.1 bushels per acre. The average market value of agricultural products sold per farm in 1997 within Ward County amounted to \$70,742 (National Agricultural Statistics Service 1997). This value is well below the statewide average per farm of \$124,424.

According to the 2002 agricultural statistics for Ward County, each acre planted in barley yields an average of 59.1 bushels. An estimated 400 acres of the project site are planted with malt barley, which would have a potential yield of 23,600 bushels (North Dakota Agricultural Statistics Service 2002). As of January 16, 2003, the average price for malt-barley grown in North Dakota was \$2.10 per bushel. At this price, barley grown on the project site would sell for an estimated \$49,500.

Developed Land

Developed land is composed of areas of intensive use with much of the land covered by constructed structures (for example, houses, outbuildings, and retail buildings). Included in this category are towns and cities; transportation infrastructure right-of-way including roads and railways; communication facilities; and areas such as those occupied by agricultural, industrial and commercial complexes; and industrial infrastructure that may, in some instances, be isolated from the urban areas.

Existing Disturbance

The agricultural value of the two “ecoregions” has tremendously affected prairie grasslands and wetlands, and the resulting landscape has been substantially altered since settlement in the late 1800s. Economic incentives to convert natural landscapes to agriculture have been intensive and resulted in the loss of significant amounts of mixed grass prairie grassland and wetland habitats. Wetland drainage (both surface and tile) to enhance agricultural production has been the primary factor resulting in the loss of wetlands in this region (Euliss et al. 1999).

Substantial areas of vegetation have been altered from their natural condition by past and current human activities. The primary surface disturbing activities for native vegetation communities are agriculture, intensive grazing, haying, oil and gas development, sand and gravel mining, road and railroad construction, and rural and urban development. Prior to the land use conversion, this extent of the northern prairie was predominantly mixed-grass prairie, which consisted of a mixture of cool and warm season mid-grasses (and, to a lesser extent, short and tall grasses), broad-leaved annual and perennial forbs, intermixed with numerous legumes.

Wildlife

Common Wildlife

The vegetative communities described above serve as reproduction, nesting, cover, shelter, and foraging/feeding habitats for a variety of wildlife species. Wildlife within this area is closely associated with the remnant mixed-grass prairie and wetlands including areas of open water. Agricultural land is the most common habitat type, while wetlands and mixed grass prairie make up a small percentage of the total land within the project area. However, the grasslands and wetlands are the most biologically diverse areas and support a greater density of northern prairie species.

Mammals

A number of terrestrial mammalian species may occur in the project area. Because of the conversion to agricultural lands from prairie grassland, pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphania*) and other prairie-adapted species primarily occur as transients. Mammals adapted to agricultural habitats, such as the white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon rotor*), and other small mammals are likely to occur in

the project area. These mammals typically use agricultural lands for forage and use wetlands and shelterbelts for shelter.

Muskrat (*Ondatra zibethicus*), raccoon (*Procyon rotor*), and mink (*Mustela vison*) proliferate within wetlands, and beaver (*Castor canadensis*) may occur along watercourses. Grasslands and agricultural fields are anticipated to have varying densities of western harvest mouse (*Reithrodontomys megalotis*), meadow vole (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), western jumping mouse (*Zapus princeps*), and long-tailed weasel (*Mustela frenata*). Badger (*Taxidea taxus*) and striped skunk (*Mephitis mephitis*) are also expected to occur throughout the area.

Avifauna (Birds)

Three hundred and sixty-five species of birds occur or potentially occur in the various habitats present in North Dakota (Faanes and Stewart 1982). Of the 365 bird species, 207 species are known to nest or have nested in the State, 95 occur primarily as migrants, 28 are accidental and 21 are occasional species that have been observed in North Dakota (Faanes and Stewart 1982). Birds occurring throughout the project area include raptors, waterfowl, wading birds, shorebirds, gallinaceous birds, and migrants.

Passerine

The open and sparsely vegetated agricultural fields of the project area do not typically support diverse species of birds because most passerines are usually associated with the remnant tracts of mixed-grass prairie grasslands and the structurally taller and denser riparian and woodland habitats. In general, bird diversity increases in the project area during the spring and fall when neotropical migrants pass through the general area in route to summer breeding or wintering grounds.

The occurrence of the various species of passerine birds inhabiting the area corresponds to the habitat types present. In agricultural areas, narrow strips of weedy habitats frequently border cropland and hayland fields and tracts of grazed prairie. These usually occur along fencerows, section lines, roadsides, and railroad rights-of-way. Vegetation in these situations is often composed of native prairie grasses and forbs in combination with many coarse, introduced weeds including species of grass and forbs that are characteristic of sites with disturbed soils. Occasional native trees or shrubs are also present.

Common passerine species that may occur within the agricultural fields include western meadowlark (*Sturnella neglecta*), American goldfinch (*Carduelis tristis*), western kingbird (*Tyrannus verticalis*), eastern kingbird (*Tyrannus tyrannus*), and horned lark (*Eremophila alpestris*). Common grassland species may include bobolink (*Dolichonyx oryzivorus*), savannah sparrow (*Passerculus sandwichensis*), clay-colored sparrow (*Spizella pallida*), grasshopper sparrow (*Ammodramus savannarum*), chestnut-collared longspur (*Calcarius ornatus*), and lark bunting (*Calamospiza melanocorys*). Riparian and woodland passerine species may include mourning dove (*Zenaidura macroura*), lazuli bunting (*Passerina amoena*), common grackle (*Quiscalus quiscula*), song sparrow (*Melospiza melodia*), least flycatcher (*Empidonax minimus*), house wren (*Troglodytes aedon*), gray catbird (*Dumetella carolinensis*), red-eyed vireo (*Vireo olivaceus*), and yellow warbler (*Dendroica petechia*). Passerine birds associated with the various types of wetland vegetation may include red-winged blackbird (*Agelaius phoeniceus*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*).

Gallinaceous Birds

Gallinaceous birds are upland birds that are ground-dwelling, usually quite secretive, and often found in small flocks. These birds are commonly hunted as game birds. Gallinaceous birds that occur throughout the project area include the ring-necked pheasant (*Phasianus colchicus*), gray partridge (*Perdix perdix*), and sharp-tailed grouse (*Tympanuchus phasianellus*).

Raptors

Species typically associated with grasslands and agricultural fields include the northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), and American kestrel (*Falco sparverius*). The great-horned owl (*Bubo virginianus*) is also a common resident of the region. One of the most common raptors in the area, the northern harrier, is a ground-nesting species.

Waterfowl and Shorebirds

Wetlands habitats in North Dakota include natural ponds and lakes, man-made ponds, reservoirs, natural fluviatile wetlands, and road ditches and drainage channels that support a breeding avifauna as rich and varied as the wetlands themselves. Most of these wetland-associated birds are short-distance migrants, wintering primarily north of the United States-Mexico border (Stewart 1975). Also, many wetlands in the region are important fall staging and rest areas during the migrations. The shallow, open wetlands associated with cultivated fields are used as forage sources by spring and fall migrant waterfowl (Kantrud 1990).

Wetlands are critical to this area, and they support a very rich and varied breeding avifauna. Almost 40 percent of the species on the North Dakota bird list use wetlands (Faanes and Stewart 1982). In addition, of the 223 species with known or inferred breeding status in North Dakota, 57 (26 percent) are marsh or aquatic birds other than waterfowl (Faanes and Stewart 1982). Finally, Stewart (1975) identified 63 breeding bird species as wetland associates in North Dakota alone.

The gadwall (*Anas strepera*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and blue-winged teal (*Anas discors*) are the most commonly observed species of waterfowl. The American bittern (*Botaurus lentiginosus*), great blue heron (*Ardea herodias*), and lesser yellowlegs (*Tringa flavipes*) are the most common wading birds expected to occur in the project area. The upland sandpiper (*Bartramia longicauda*), Wilson's phalarope (*Phalaropus tricolor*), willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), black tern (*Chlidonias niger*), and killdeer (*Charadrius vociferus*) are common shorebirds.

Amphibians and Reptiles

North Dakota does not support a diverse array of reptiles and amphibians. The semi-arid climate provides only marginal conditions for amphibian breeding and hibernation, whereas the low winter temperatures and the short growing season appear to be primary limiting factors for reptiles. According to Hoberg and Gause (1992), the herpetofauna of North Dakota includes 25 species (11 amphibians and 14 reptiles). Of these, only the tiger salamander (*Ambystoma tigrinum*), American toad (*Bufo americanus*), Great Plains toad (*B. cognatus*), Dakota toad (*B. hemiophrys*), Rocky Mountain toad (*B. woodhousei*), chorus frog (*Pseudacris nigrita*), leopard frog (*Rena pipiens*), wood frog (*R. sylvatica*), painted turtle (*Chrysemys picta*), plains garter snake (*Thamnophis radix*), and red-sided

garter snake (*T. sirtalis*) use prairie basin wetlands. The only species intimately associated with wetlands are the tiger salamander, leopard frog, and chorus frog.

Fish

According to Kantrud et al. (1989), fathead minnows (*Pimephales promelas*) and brook sticklebacks (*Culaea inconstans*) are the only two native fishes that can tolerate shallow water depths (less than 5 feet), low concentrations of dissolved oxygen, and occasionally high concentrations of sulfates and bicarbonates found in these wetlands. They also noted that most wetlands in the region lie in closed drainage basins, thereby limiting dispersal of fish.

Invertebrates

According to Cvancara (1983), the aquatic mollusks of North Dakota consist of 44 species, of which 13 are mussels, nine are pill clams, and 22 are snails. Characteristic groups of wetland invertebrates can be associated with four major habitat types. These groups include benthic invertebrates that live in mud or in association with the mud-water interface, pelagic invertebrates that occupy the water column, macrophyte associated invertebrates that live in or on vascular plants in association with periphyton communities, and neustonic invertebrates that live on the surface film.

Special-Status Species

Several species that occur or potentially occur within the project area are classified as federally threatened or endangered because of their recognized rarity or vulnerability to various causes of habitat loss or population decline. These species receive specific protection defined in the Endangered Species Act of 1973, as amended. Other species have been designated as candidate or sensitive on the basis of adopted policies and expertise of state resource agencies or organizations with acknowledged expertise. Table 3–8 summarizes the known occurrence or potential occurrence of each species within Ward and Mountrail Counties.

Whooping Crane

Historically, the primary breeding range of whooping cranes extended from Alberta to Manitoba south to Illinois. Whooping cranes are believed to have wintered along the Atlantic coast, the southern U.S., and down into central Mexico (U.S. Fish and Wildlife Service 2004). Whooping cranes were extirpated from north-central U.S. by the 1890s and from Saskatchewan by 1929.

Currently, the Aransas-Wood Buffalo flock remains the only self-sustaining wild population and migratory group. The breeding pairs nest almost exclusively within the borders of Wood Buffalo National Park in Northwest Territories, Canada. The wintering grounds are found within and near the Aransas National Wildlife Refuge in Texas.

The 2,400-mile migration route between the Wood Buffalo National Park and Aransas National Wildlife Refuge generally cuts across northeastern Alberta and southwestern Saskatchewan, through northeastern Montana, the western half of North Dakota, central South Dakota, Nebraska and Oklahoma and east-central Texas. The primary migration route through Nebraska is a narrow swath approximately 140 miles wide. Migration may take 2 to 6 weeks. During the fall 2003 migration, seven observations of whooping cranes

in North Dakota were confirmed (Stehn 2004b). During the spring 2004 migration, nine observations of whooping cranes in North Dakota were confirmed (Stehn 2004a).

Table 3–8 Federal Threatened, Endangered, and Candidate Species Occur or Potentially Occur in the Project Area

Species	Federal Listing Status	Habitat	Critical Habitat
Interior least tern (<i>Sterna antillarum</i>)	May 28, 1985; Endangered (50 FR 21784–21792)	Nests along midstream sandbars of the Missouri and Yellowstone Rivers.	None designated.
Whooping crane (<i>Grus Americana</i>)	March 11, 1967; Endangered (32 FR 4001)	Migrates through west and central counties during the spring and fall. Prefers to roost on wetlands and stockdams with good visibility.	None designated.
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	September 6, 1990; Endangered (55 FR 36641–36647)	Known only to occur in the Missouri and Yellowstone Rivers.	None designated.
Bald eagle (<i>Haliaeetus leucocephalus</i>)	February 14, 1978; Threatened (43 FR 6233)	Migrates spring and fall statewide, but primarily along the major river courses.	None designated.
Piping plover (<i>Charadrius melodus</i>)	December 11, 1985; Threatened (FR 50726–50734)	Nests on midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands.	September 11, 2002 (67 FR 57637 – 57717) Critical habitat includes prairie alkali wetlands and surrounding shoreline, including 200 feet (61 meters) of uplands above the high water mark; river channels and associated sandbars, and islands; reservoirs and their sparsely vegetated shorelines, peninsulas, and islands; and inland lakes and their sparsely vegetated shorelines and peninsulas.
Gray wolf (<i>Canis lupus</i>)	Threatened	Occasional visitor in North Dakota and is most frequently observed in the Turtle Mountains area.	None designated.
Dakota skipper (<i>Hesperia dacotae</i>)	Candidate	Found in native mixed-grass prairie containing a high diversity of wildflowers and grasses. Primary habitat includes two prairie types: 1) low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas; 2) upland (dry) prairie on ridges and hillsides dominated by bluestem grasses, needlegrasses, pale purple and upright coneflowers and blanketflower.	None designated

Source: Towner 2003.

Whooping cranes breed and nest in wetlands along lake margins or among rushes and sedges in marshes and meadows. The water in these wetlands ranges in depth from 8 to 10 inches (20 to 25 cm) to as much as 18 inches (46 cm) (U.S. Fish and Wildlife Service 2004). Many of the ponds have border growths of bulrushes and cattails, which occasion-

ally cover entire bays and arms of the larger lakes. Nesting has also been reported on muskrat houses and on damp prairie sites. Whooping cranes feed on crabs, crayfish, frogs, and other small aquatic life as well as plants. Whooping cranes use native grasslands, wet meadows, and agricultural lands as upland feeding areas. They prefer sites with minimal human disturbance.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was listed as endangered on February 14, 1978, in all of the conterminous United States with the exception of Minnesota, Wisconsin, Michigan, Oregon, and Washington, where it was classified as threatened (U.S. Fish and Wildlife Service 1978). On July 12, 1995, the FWS reclassified the bald eagle from endangered to threatened throughout its range in the lower 48 states (U.S. Fish and Wildlife Service 1995). Most recently, on July 6, 1999, the bald eagle was proposed for delisting (U.S. Fish and Wildlife Service 1999). This proposal has not been finalized or withdrawn.

Bald eagles occur throughout North America from Alaska to Newfoundland and from the southern tip of Florida to southern California. The bald eagle is a bird of aquatic ecosystems. It frequents estuaries, large lakes, reservoirs, major rivers, and some seacoast habitats.

Bald eagles usually nest in trees near water, but are known to nest on cliffs and (rarely) on the ground. Nest sites are usually in large trees near shorelines in relatively remote areas that are free of disturbance. The trees must be sturdy and open to support a nest that is often 5 feet wide and 3 feet deep. Adults tend to use the same breeding areas year after year and often use the same nest, though a breeding area may include one or more alternate nests.

In winter, bald eagles often congregate at specific wintering sites that are generally close to open water and offer good perch trees and night roosts. Bald eagles tend to nest and roost away from residential development and human activity.

Fish and waterfowl are the primary sources of food where eagles occur along rivers and lakes. Big game and livestock carrion, as well as larger rodents (for example, prairie dogs) can also be important dietary components where these resources are available (Ehrlich et al. 1988).

Feeding areas, diurnal perches, and night roosts are fundamental elements of bald eagle winter habitats. Although eagles can fly as far as 15 miles (24 kilometers) to and from these elements, they primarily occur where all three elements are available in comparatively close proximity (Swisher 1964). The availability of food is probably the single most important factor in the winter distribution and abundance of the eagle (Steenhof 1978). The population of the bald eagles within the region is expected to increase during the winter, when migrating individuals and winter residents use roost sites and suitable foraging areas. Winter roost sites are typically associated with large cottonwood galleries located near areas of open water along the Missouri River.

This species is becoming a more common breeding resident in North Dakota, using mixed coniferous and mature cottonwood riparian areas near large lakes or rivers as nesting habitat (Collins 2004). The bald eagle is a documented breeder and winter resident

along the Missouri River, primarily between Garrison and Bismarck (Collins 2004). Nesting bald eagles are fairly common along the Missouri River between Bismarck and Garrison, as nine to ten pairs are known to nest along this stretch of river (Collins 2004). Depending on the amount of open water and availability of prey, the winter population along the Missouri River has varied between two and 60 individuals (Collins 2004).

The occurrence of winter roosts or nests in the project area has not been documented (Collins 2004). Data from the Breeding Bird Survey Trend Analysis indicate a non-significant trend for populations of this species in North Dakota during the period between 1966 and 2003 (Sauer et al. 2004). However, the trend for the United States during the same period is highly significant and positive.

Pallid Sturgeon

The pallid sturgeon was listed as endangered on September 6, 1990. Historically, the sturgeon was found in the Missouri River from Fort Benton, Montana, to St. Louis, Missouri; in the Mississippi River from above St. Louis to the Gulf of Mexico; and in the lower reaches of other large tributaries, such as the Yellowstone, Platte, Kansas, Ohio, Arkansas, Red, and Sunflower Rivers; and in the first 60 miles of the Atchafalaya River (U.S. Fish and Wildlife Service 2004). Dams on the Missouri River now fragment populations of the sturgeon.

Preferred habitat includes large rivers with high turbidity and a natural flow. The pallid sturgeon occurs in strong current over firm gravel or sandy substrate (U.S. Fish and Wildlife Service 1989). It feeds opportunistically on aquatic insects, crustaceans, mollusks, annelids, eggs of other fish, and sometimes other fish (U.S. Fish and Wildlife Service 1989).

Potential pallid sturgeon habitat occurs in the Yellowstone and Missouri Rivers in North Dakota (U.S. Fish and Wildlife Service 2004). However, the project site does not contain suitable habitat or occurrences of the pallid sturgeon.

Piping Plover

Piping plovers are known to breed in the Great Plains and Great Lakes region, and along the Atlantic Coast (Newfoundland to North Carolina). They winter on the Atlantic and Gulf of Mexico Coasts from North Carolina to Mexico and in the Bahamas (U.S. Fish and Wildlife Service 2004). In the Great Plains, it appears that the piping plover formerly was more widely distributed than it is today. Historically, breeding piping plovers occurred in at least 28 North Dakota counties. Plovers were observed in 20 counties during the 1990s (U.S. Fish and Wildlife Service 2004).

Piping plovers historically nest on prairie alkali lakes and along the Missouri River, Yellowstone, and Niobrara Rivers in North Dakota, South Dakota, and Nebraska (U.S. Fish and Wildlife Service 2004). Piping plover breeding habitat is composed of open, sparsely vegetated areas with alkali or unconsolidated substrate. In north-central North America, piping plovers nest on alkali wetlands, gravel shorelines, and river sandbars in the Great Plains. Several studies have suggested that beach width may affect habitat use by piping plovers breeding on inland lakes. Recorded minimum nest-to-water distances have ranged from 10 to 40 meters at various studies sites in the Great Plains. In addition, the amount and distribution of beach vegetation affects piping plover habitat selection and

reproductive success. Substrate composition may also affect habitat selection by piping plovers and influence nest success.

Piping plovers nesting on the Missouri, Platte, Niobrara, Yellowstone, and other rivers use reservoir beaches and large, dry, barren sandbars in wide, open channel beds. Vegetative cover on nesting islands is usually less than 25 percent (U.S. Fish and Wildlife Service 2004).

Open, wet, sandy areas provide feeding habitat for plovers on river systems and throughout most of the birds' nesting range. Piping plovers feed primarily on exposed substrates by pecking for invertebrates at or just below the surface (U.S. Fish and Wildlife Service 2004). The plover's diet consists of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates. Breeding territories of piping plovers generally include a feeding area such as a pond, slough, or lakeshore (U.S. Fish and Wildlife Service 2004).

FWS designated critical habitat for the Great Plains breeding population of piping plovers on September 11, 2002. North Dakota, Nebraska, and South Dakota contain critical habitat for the piping plover. Habitat included in the federal designation includes midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands (U.S. Fish and Wildlife Service 2004). North Dakota is the most important State in the U.S. Great Plains for nesting piping plovers. The State's population of piping plovers was 496 breeding pairs in 1991 and 399 breeding pairs in 1996 (U.S. Fish and Wildlife Service 2004). Several areas of designated piping plover critical habitat are located within a 7-mile radius of the project site. The closest area of critical habitat (Section 9, T. 152N., R 87W., Ward County) is approximately 3 miles northeast of the project site.

Interior Least Tern

The interior least tern nests along the major tributaries throughout the interior U.S. from Montana to Texas and New Mexico to Louisiana (U.S. Fish and Wildlife Service 2004). In North Dakota, interior least terns occur throughout the Yellowstone and Missouri River drainages.

The interior least tern has distinct breeding and wintering areas. Most breeding occurs on the interior rivers. The occurrence of breeding interior least terns is localized and is highly dependent on the presence of dry, exposed sandbars, and favorable river flows that support a forage fish supply and that isolate the sandbars from the riverbanks. Characteristic riverine nesting sites are dry, flat, sparsely vegetated sand and gravel bars within a wide, unobstructed, water-filled river channel. The population is thought to winter on beaches along the Central American coast and along the northern coast of South America from Venezuela to northeastern Brazil.

The interior least tern population was estimated at about 7,000 individuals around 1990 (U.S. Fish and Wildlife Service 2004). In North Dakota, the least tern is found mainly on the Missouri River from Garrison Dam south to Lake Oahe and on the Missouri and Yellowstone Rivers upstream of Lake Sakakawea. Approximately 100 pairs breed in North Dakota (U.S. Fish and Wildlife Service 2004).

Gray Wolf

On March 9, 1978, gray wolves were listed as endangered in the lower 48 states and threatened in Minnesota (U.S. Fish and Wildlife Service 2004). The Great Lakes popula-

tion of gray wolves has been downlisted to a threatened status. In North America, gray wolves once ranged from coast to coast and from Canada to Mexico (U.S. Fish and Wildlife Service 2004). Today, the gray wolf is extirpated from the lower 48 states with the exceptions of Minnesota, Wisconsin, Michigan, Montana, Idaho, Washington, and an experimental population in Wyoming.

Historically, the gray wolf occupied almost all habitats in North America, including the Great Plains. In modern times, the gray wolf has been restricted to habitats with low densities of roads and people. Habitat for the gray wolf in North Dakota includes the forested areas in north central and northeast North Dakota. However, they may appear anywhere throughout the State (U.S. Fish and Wildlife Service 2004).

Gray wolves are a territorial, pack species that will keep other gray wolves and coyotes out of their 50- to 100-square-mile home range. Indirectly, wolves support a wide variety of other animals. Ravens, foxes, wolverines, vultures, and bears will feed on the remains of animals killed by wolves. Wolf prey includes antelope, elk, and mountain goats (U.S. Fish and Wildlife Service 2004).

The gray wolf is an occasional visitor in North Dakota and has been most frequently observed in the Turtle Mountains area, which is in north-central North Dakota along the Canadian border. The gray wolf has also been observed in McKenzie and Williams Counties (U.S. Fish and Wildlife Service 2004). The high densities of roads and humans in the eastern portion of North Dakota suggest that the rate of human-caused wolf mortality will remain high. The western portion of the state provides low densities of roads and humans; however, the non-forested habitat throughout this region makes wolves highly vulnerable to humans. The presence of wolves in most of North Dakota will likely remain sporadic and will only consist of occasional dispersed animals from Minnesota and Manitoba (U.S. Fish and Wildlife Service 2004).

Dakota Skipper

The Dakota skipper likely occurred throughout a relatively unbroken area of grassland in the north-central United States and south-central Canada. Currently, populations of the butterfly are restricted to small patches of natural habitat where they form metapopulations. A metapopulation is a set of local populations within some larger area where dispersal from one local population to at least some other patches is possible. Extant metapopulations of Dakota skippers are found in high-quality native prairie tracts that contain a high diversity of wildflowers and grasses. Habitats include two prairie types: 1) low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas; and 2) upland (dry) prairie dominated by bluestem grasses, needlegrass, coneflowers (*Echinacea* spp.), and blanket flower (*Gaillardia* spp.).

Nectar provides the Dakota skipper with both water and food and is crucial for the survival of both sexes during the flight period. Dakota skippers appear to prefer plants, such as purple coneflowers, whose nectar cannot be obtained by insects without a relatively long, slender feeding tube (proboscis). In the absence of preferred plant species, Dakota skippers attempt to obtain sufficient nectar from less preferred plants. Its current distribution straddles the border between tall-grass prairie ecoregions to the east and mixed-grass prairie ecoregions to the west.

In North Dakota, metapopulations exist in the north-central and southeastern regions. Specifically, Dakota skippers have been reported from 43 sites in 17 North Dakota counties, of which at least 11 sites and three county records have been extirpated since the 1980s and early 1990s. Of the 32 extant or possibly extant sites in North Dakota, 17 occur within two complexes: Towner–Karlsruhe in McHenry County (13 sites) and Sycenne Grasslands in Ransom and Richland Counties. The other 15 sites presumed extant are isolated from other sites. Land ownership of extant sites is largely private (19 sites); North Dakota Department of Lands owns five sites, FWS, U.S. Forest Service, and The Nature Conservancy each own two sites, and the state highway department owns one site. The extant metapopulation closest to the project site is the Eagle Nest Butte population in McKenzie County, which is more than 50 miles southwest of the project area. This population occurs on the very western edge of the Dakota skipper range, but it may be too small and isolated to be secure (Cochrane and Delphey 2002).

Sensitive Communities

Sensitive habitats/communities are those that are considered rare in the region, support sensitive species of plants and animals, and/or which are subject to regulatory protection through various federal, state, or local policies or regulations. In the case of sensitive habitats within the region, The Nature Conservancy, in a preliminary survey, identified rare plant assemblages across the Great Plains (Ostlie et al. 1997). Of the 633 assemblages in the Great Plains, 107 (17 percent) are considered rare (Ostlie et al. 1997). Great Plains forest assemblages include 16 rare assemblages that are largely cottonwood and oak floodplain forests on the eastern and western edges of the plains (Ostlie et al. 1997). Nineteen rare shrub land assemblages include many sagebrush, hawthorn, and willow species, and 13 rare grassland assemblages occur in the mixed-grass prairie.

Cultural Resources

Cultural Context

When European fur traders first entered what is now North Dakota, the area was occupied by several distinct Indian groups that were already involved at varying levels in the fur trade. The groups represented two adaptations to the plains environment. The Mandan, Hidatsa, and Arikara lived in relatively permanent earthlodge villages near the Missouri River. These groups maintained extensive gardens and hunted individually or in small groups. Some of their larger villages were already hubs in the fur trade, and European traders adopted a few of those locations.

In contrast, the Dakota, Lakota, Assiniboine, and Cheyenne were nomadic groups that focused on bison products for international trade and subsistence. When the horse became available in some numbers in the early 1800s, these nomadic groups quickly adapted this animal as a symbol of wealth and as an advantage in warfare and hunting. They also developed or expanded a pattern of raiding their trading competitors who had settled in villages.

All of the Native groups, settled or nomadic, focused their productive efforts on accumulating meat and hides of bison and other animals to trade for valued and exotic European

trade goods. Emerging industries, in turn, depended on bison hides for belts and whale oil for lubrication.

Prehistoric Context

The project area is within the Middle Missouri subarea of the Plains culture area. Evidence of Native American occupation of North Dakota can be traced back to the withdrawal of the last major ice advance of the Pleistocene about 12,000 years ago. The chronology of the Middle Missouri subarea is divided into four cultural periods: Paleoindian (11,500 to 8,000 years ago); Archaic (8,000 to 2,000 years ago); Woodland (2,000 to 1,000 years ago); and Plains Village (1,000 to 100 years ago).

Prehistoric cultural resources are scarce in pothole till plain areas like the present project area. Furthermore, these settings have little Holocene deposition that might contain buried cultural materials, and most have been cultivated.

Interaction between the Native tribes and European traders in the fur trade had been mostly peaceful. Armed skirmishes and raids involving trade goods and trading rights were often between tribes or between European trading groups. But conflicts increased as Euroamerican settlement moved west, emigrant wagon trains began leaving larger corridors of devegetation across the landscape, and the American government began seeking a route for a Pacific railroad. In the 1850s, increasing large emigrant wagon trains and military outposts disrupted the bison herds that the tribes had come to depend on for trade. By the 1860s, armed conflicts were increasingly breaking out, and Euroamericans began to settle in the plains in ever-increasing numbers, not just passing through to the west coast.

The Fort Berthold Indian Reservation was established early in this process under the Fort Laramie Treaty of 1851. However, the reservation boundaries have changed several times since then. First, a large tract was conveyed to the U.S. Government for roads, highways, and telegraphs pursuant to the Fort Berthold Agreement of July 27, 1866. Later, President Ulysses S. Grant established a far smaller reservation by Executive Order of April 12, 1870. Further, pursuant to the Agreement of December 14, 1886, a large tract was removed from the Reservation in exchange for an annual payment of \$80,000.00 for ten years and individual allotments. Congress ratified this 1886 Agreement by the Act of March 3, 1891. Finally, in 1949, the federal government took 156,000 acres of prime bottomland for the Garrison Dam & Reservoir Project to create the reservoir known as Lake Sakakawea. In addition to flooding traditional communities and prime agricultural land, the reservoir divided the reservation. Lake Sakakawea can only be crossed at the Four Bears Bridges west of New Town on State Highway 23 and about 60 miles east-southeast along the Garrison Dam in Pick City on State Highway 200.

Historic Context

Sustained Euroamerican settlement in North Dakota began with the organization of the Dakota Territory in 1861 and accelerated with the completion of the Northern Pacific Railway to the Missouri River in 1872. Stimulated by the Homestead Act of 1862 and an operational railroad to eastern markets, farming expanded in North Dakota. Additional railroads entered the state in the late 1870s and the 1880s, and there were additional booms in settlement. Many of these waves of immigrants were distinctive ethnic groups,

including many of Scandinavian or Germanic origin. North Dakota was predominantly a farm-market economy.

In an attempt to “civilize” the tribes and bring them into the larger economy, the Allotment Act of 1888 had allotted homestead-like lots of Indian land to Indian families. After the allotments to Indian families lands deemed excess were opened to non-Indians. Over the years, interactions between the Allotment Act and the various Homestead Acts and some unscrupulous deals by speculators and politicians have reduced individual and tribal holdings on the reservation leaving much of the area east of the Missouri River fee status land. The project site and large portions of the project area are fee status lands instead of lands held in trust by the U.S. government for individual Indians or Indian Tribes.

The Minneapolis, St. Paul, and Sault Ste. Marie Railway (MStP&SSM) was known by the trade name Soo Line Railway. The main line of the Soo Line was completed from Fairmont, in the southeast corner of North Dakota, to Portal on the Canadian border in 1893. The line west to Wishek and northwest to Garrison was completed around 1900. The branch line from Max to Plaza, which crosses through the property, was built in 1910. Makoti was established along the Soo Line, now the Canadian Pacific Railroad, in 1911.

From 1905 through 1911, many land parcels in the area of the branch line were obtained as cash entry homesteads, anticipating the benefits of a railroad line. There was another brief peak in cash entries in 1914, after the line was completed to Plaza. After construction of the railroad began from Max, between 1910 and 1920, there were a few conventional homestead entries each year in the project area. At the project site, the northwest quarter of Section 20 and the northeast quarter of Section 19 were obtained by cash entries in 1914. The northwest quarter of Section 19 was patented in 1918, under the original Homestead Act of 1862.

Much of the rural settlement and development of agriculture took place in this area after the construction of the railroad to Plaza. In addition, the years between 1905 and 1920 represented a comparatively moist period on the northern plains, and many immigrants were seeking new starts in life by entering the agricultural market. The droughts and economic depression of the 1920s and 1930s devastated the state’s economy. Many banks closed and farms failed. Surviving farms had to expand in size and mechanize their operations.

The location of the project area near Makoti and Plaza provided access to major agricultural markets by way of the railroad. On the project site, the northeast quarter of Section 19 is higher and better drained than the quarter sections to the east and west. Farm buildings with a windbreak of trees to the northwest are still present on this parcel. It is likely that this farm complex, some outlying farming-related features, and, possibly, some remains of failed homesteads will constitute the bulk of cultural resources on the project site.

Along the pipeline and power line corridors, most of the farm complexes and windbreaks visible on topographic maps or aerial photographs are located 1,000 feet or more from the proposed corridors. However, there is one complex along the pipeline corridor and three along the eastern power line corridor that are much closer to the project. These areas are likely to have historical resources similar to the project site. The farm complex along the

pipeline corridor (T152N, R88W, Section 11) is within a parcel adjacent to the railroad that was homesteaded by cash entry in 1914. The three along the power line (T152N, R87W, Sections 13, 14, and 15) were all cash entries in 1905, 1906, and 1907. These locations along State Highway 23 have good access to the railroad at Makoti. The area of township T152N, R86W crossed by the power line corridor has many more pothole ponds and lakes than the rest of the project area and is not likely to have prehistoric or historic cultural resources because of the presence of water.

The small towns along the Soo Line north of Garrison and west of Drake owe their existence to the branch line to Plaza. In the 1950s, an additional branch line was built from the west end of the project area at Prairie Junction, west to Parshall and New Town. With the expansion of railroads and settlement, North Dakota's coal reserves also became important for in-state consumption and eventually for large-scale export. In more recent years, oil and gas development has also become a major element of the North Dakota economy.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act requires that federal agencies take into account the effects of a federal undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. According to Section 301 of the act, "undertaking" means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including (a) those carried out by or on behalf of the agency, (b) those carried out with federal financial assistance, (c) those requiring a federal permit license, or approval, and (d) those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency. Section 106 compliance also applies to non-federal lands when federal funding, licensing, permitting, and approval are required.

A records search for the project site was completed through the North Dakota State Historical Society. The records search indicated that no cultural resource investigations and no known sites are on file for the project area. A search of the land patent records of the General Land Office for the project area yielded 71 patent entries filed between 1905 and 1920. Fifty of these 71 patent entries were cash entries.

The project area is in an area of upland glacial till dotted with ponds and pothole lakes. The soils of the area are dominated by Williams series loams with local pockets of Bowbells, Parnell, Tonka, and Zahl-Max series loams (Howey et al. 1974: map 127). Williams series loams form on areas of deep, level to undulating glacial loam. The other soil series form in poorly to moderately well drained swales, basins and depressions in the till plain, including drainage ways and potholes. These soils are generally good for cultivation, but support a comparatively low diversity of natural resources. These conditions would generally correspond to a low potential for prehistoric cultural resources.

Unrecorded historic resources on the project site are the historic Soo Line Railway, a farm complex in Section 19, and, possibly, the remains of two failed farms. In the larger project area, there are also at least four farm complexes close to the pipeline and power line corridors. Additional rural agrarian resources may also be present. The potential for prehistoric resources in the project area is low.

Land Use

Project Area

Land uses within the project area include agriculture, transportation facilities, and rural residential. Agriculture in Mountrail and Ward Counties consists of field crops, such as barley, wheat, and corn (Souris Basin Planning Council 2002). Barley accounts for the majority of crops produced in the project area.

Six residences occur within 1 mile of the project site. All of these are isolated rural residences that are part of the agricultural operations surrounding the project site. Table 3–9 shows the distance and direction of each residence from the boundary of the project site.

Table 3–9 Residences within 1 Mile of Project Site Boundary

Number of Residences	Distance (miles)	Direction
1	0.42	E-NE
1	0.57	S
1	0.60	N
2	0.91	E-SE
1	0.98	W

Transportation facilities include a network of interstate and state highways and county roads. These facilities are discussed in more detail in the Transportation section. The proposed pipeline corridor would be located along the short line Canadian Pacific Railway (C.P.R.) to the intersection of 62nd Avenue. The corridor is located along 62nd Avenue north of the railroad. The short line connects to the main line northeast of the project site, and provides freight stops at grain elevators in Parshall and New Town. 62nd Avenue north of the short line is a gravel-surfaced county road (North Dakota Geographic Information Systems 2004). Cropland is the dominant land use along the road right-of-way.

The proposed power line corridor is located along State Highway 23 and 59th Avenue, which is a gravel-surface county road. Cropland is the dominant land use along the road rights-of-way.

Project Site

Land uses within the project site include agriculture, transportation facilities, and rural residential. The project site has been used for barley and forage production. Secondary uses of the site are transportation and rural residential. A branch line of the C.R.P. crosses the project site. A single residence and outbuildings used in farming operations are located within the project site. Some hunting may occur on the project site or in the general area during the fall months.

According to the 2002 agricultural statistics for Ward County, each acre planted in barley yields an average of 59.1 bushels. An estimated 400 acres of the project site are planted with malt barley, which would have a potential yield of 23,600 bushels (North Dakota Agricultural Statistics Service 2002). As of January 16, 2003, the average price for malt-

barley grown in North Dakota was \$2.10 per bushel. At this price, barley grown on the project site would sell for an estimated \$49,500.

Transportation

The analysis area for transportation includes roads and railroads in the transportation system that may serve as primary or alternative transportation routes for the construction and operation of the proposed refinery. The regional transportation system that serves the project area includes an established network of interstate and state highways and county roads. These roads provide access to U.S. Highway 83 (U.S. 83) and Interstate 94 (I-94), which are key routes for hauling freight and they connect communities in North Dakota with regional economic centers in the United States and Canada.

Roads that provide access to the project site and to U.S. 83 and I-94 include U.S. 85, State Highway (S.H.) 23, and S.H. 200. The project site is bounded on the north by S.H. 23, which would be the primary access route for the site. S.H. 23 connects the site with U.S. 83 to the east. U.S. 83 is the primary north-south transportation route in central North Dakota and connects with Minot to the north, and I-94 and Bismarck to the south. S.H. 23 also connects with S.H. 22, which provides an alternate connection with I-94 to the south. S.H. 22 north of the town of Killdeer to the McKenzie County line is the Killdeer Scenic Byway and provides scenic views of the Killdeer Mountains and the Little Missouri River breaks.

The North Dakota Department of Transportation (NDDOT) measures annual average daily traffic (AADT) on federal and state highways in North Dakota. Not surprisingly, U.S. 83 has the highest AADT for roads in the project area (Table 3-10). The relatively high AADT on S.H. 200 at Hazen is a result of traffic associated with the coal mines and other facilities present around Hazen.

Table 3-10 Highway Access, Annual Average Daily Traffic, 2003

Highway Segment	AADT	Commercial Truck Traffic (# of vehicles)
U.S. 83 north of junction with S.H. 23	4,400	700
U.S. 83 north of junction with S.H. 200	2,900	470
U.S. 85 south of Watford City (S.H.23)	2,250	525
S.H. 23 between Makoti and S.H. 37	1,550	180
S.H. 23 at intersection with U.S. 83	1,175	160
S.H. 22 north of Killdeer (& S.H.200)	1,000	95
S.H. 200 at Killdeer	500	75
S.H. 200 at Hazen	3,400	300
S.H. 200A at intersection with U.S.83	1,110	190

Source: North Dakota Department of Transportation 2003

Lake Sakakawea bisects the Reservation, which limits the north-south flow of traffic between these portions of the Reservation. The only crossing of Lake Sakakawea on the Reservation is the Four Bears Bridge (S.H. 23), which is west of New Town in the

northwest corner of the Reservation. The southern crossing is almost 100 miles south east along the Garrison Dam on S.H. 200. North south travel on the west side of the Reservation is primarily along S.H. 22. North south travel on the east side of Lake Sakakawea is along U.S. 83.

In 2003, the North Dakota Department of Transportation (NDDOT) began replacing the Four Bears Bridge, which was built in 1955. The new Four Bears Bridge was constructed 100 feet north of the old bridge and was scheduled completed in 2005. Following completion of the new bridge, NDDOT demolished the old bridge. The new bridge is designed to accommodate more traffic than the old bridge, and it has two 12-foot-wide driving lanes with 8-foot-wide shoulders and a 10-foot-wide walkway. The new bridge replaces the old 20-foot-wide roadway that had a vertical clearance at the portals of 15 feet, 7 inches.

NDDOT has developed restrictions for loads and sizes of vehicles for state highways. General restrictions for width, height, length, weight, and loads are shown on Table 3-11. These restrictions apply to all vehicles on state highways unless otherwise stated.

Table 3-12 summarizes load restrictions for specific state highways that are in the transportation project area. Loads that exceed the North Dakota size and load restrictions require special transit permits. Restrictions on oversized loads include limiting travel on highways to certain times and requiring the use of special equipment, such as “wide load” signs, flashing lights, and flags. Pilot vehicles or police escorts may be required for some oversized loads.

A branch line of the C.P.R. crosses the project site. The line through the project site connects freight stops at grain elevators in local communities, including New Town, Parshall, Plaza, and Makoti, to C.P.R.’s main line at a point near Velva, which is east of the project area and U.S. 83. C.P.R. transports freight in Canada and the Midwestern United States and the lines in North Dakota provide transportation to Minneapolis to the southeast and Canada to the north. The only shipper on the line is the Plaza-Makoti Equity Elevator, located at Plaza. The elevator annually ships 500 to 800 carloads of grain via C.P.R. on an as-needed basis. (Surface Transportation Board 1997)

Aesthetics

The affected viewshed for the visual resource assessment is the refinery site and the surrounding area that is within a 6-mile radius of the site. This area includes most if not all of the potential viewing areas from which the proposed refinery may be visible. Communities included in the viewshed are Makoti and Plaza. Makoti is 2 miles southeast of the project site’s boundary and Plaza is slightly more than 5 miles northwest of the project site.

Table 3–11 North Dakota General Vehicular Size and Load Restrictions

Parameter	Restrictions
Width	Total outside width of vehicle may not exceed 8 feet, 6 inches. Loads may not extend beyond fender lines on the left side of the vehicle or more than 12 inches beyond the right fender lines.
Height	Maximum height for vehicles is 14 feet.
Length	A single-unit vehicle may not exceed 60 feet in length. A towed vehicle may not exceed a length of 60 feet. A three- or four-unit combination may not exceed 75 feet in length. Equipment designed to move buildings is exempt from length restrictions.
Weight	Single axle – maximum load of 20,000 lbs. or a wheel load of 10,000 lbs. Tandem axle – maximum load of 19,000 lbs. per axle but gross weight of a tandem grouping may not exceed 34,000 lbs. or 48,000 lbs. on a grouping of three or more axles. Maximum gross weight on state highways is 105,000 lbs., unless posted for less. Maximum gross weight on interstate highways is 80,000 lbs. without a permit. The wheel load may not exceed 550 pounds per inch of tire width. Wheel load must not exceed one-half. Vehicles may not be operated in excess of the registered gross weight. The minimum gross weight for which a vehicle can be registered is double the unloaded weight of the vehicle.
Load ¹	In daylight hours, tie a 12-inch-square red cloth to the end of the load. At night or in times of poor visibility, attach a red light on the end of the load. The light must be visible for 600 feet. No load may extend beyond the fender lines on the left side of vehicle, or more than 12 inches beyond right fender lines.
Note:	
1. Requirements are for loads projecting 4 or more feet beyond rear of the vehicle.	

No unique lands, unique vistas, or other special areas that require protection of scenic resources occur at or near the project site. The site does not occupy public lands that are managed for visual resources. The project site and the surrounding area east consist of flat to gently rolling, glaciated, hummocky landscape. Topographic relief is generally less than 25 feet.

Table 3–12 Load Restrictions for Highways in the Project Area

Highway	Load weight restricted by:	Load restriction on gross weight			
		Single axle not to exceed (lbs/axle)	Tandem axles not to exceed (lbs/axle)	Three axles or more on divisible loads	
				Individual axles not to exceed (lbs/axle)	Axle group not to exceed (lbs)
U.S. 83	Legal weight	20,000	17,000	17,000	48,000
U.S. 85	Legal weight	20,000	17,000	17,000	48,000
S.H. 23	Class A load restriction	18,000	16,000	14,000	42,000
S.H. 22	No. 1 Load restriction	15,000	15,000	12,000	36,000
S.H. 200	Class A load restriction	18,000	16,000	14,000	42,000
S.H. 200A	No. 1 Load restriction	15,000	15,000	12,000	36,000

Typical views are expansive panoramas that are irregularly interrupted by vegetation, topography, or man-made structures. The dominant vegetation types in the wetland areas that are not cultivated are grasses and forbs. Predominant vegetation colors in early spring are green and gray green, changing to buff/ochre as grasses and forbs cure in the summer and fall. Trees and shrubs are sparse, located intermittently along drainages and wetland areas.

The affected viewshed has been highly modified by agricultural and other human activities, and is characterized by a rural/agricultural landscape setting. Existing visual modification to the natural setting of the affected viewshed consists of agriculture, transportation facilities, utilities, oil development, and rural residential uses. The quality of the landscape is low because of the lack of variety and contrast in landform, vegetation, and interesting features, and because the characteristic rural/agricultural setting is common throughout the affected viewshed and the surrounding alluvial plain. The sensitivity level, which is a measure of public concern for quality, is low because of the small number of people that would view the refinery site and because there are no significant scenic resources near the refinery site. The nearest location that would provide views of the plant site to a significant number of people is more than two miles from the site.

Most of the land within the analysis area and in the general region is cropland planted with barley, wheat, and other dryland crops. Other agricultural modifications include grain silos and other farm structures.

Transportation facilities in the analysis area consist of paved highways, unpaved local roads, and a railroad. The refinery site is bound on the north side by State Highway (S.H.) 23. Other roads in the analysis area are unpaved BIA or county roads. The Canadian Pacific Railroad crosses through the project site.

Isolated rural residences are scattered throughout the analysis area at an approximate density of one to two residences per 640-acre section. These residences are generally associated with other agricultural structures. The Town of Makoti is located about 2.5 miles southeast of the project site along the Canadian Pacific Railroad corridor.

Oil wells are located primarily in the northwest quadrant of the analysis area. Some of the wells are abandoned.

Sensitive viewpoints consist of locations from which a significant number of people who have a concern for scenic resources will view a landscape, or will be exposed to project activities. Sensitive viewpoints are generally located on transportation routes, residential areas, and recreational use areas. There are recreational or other special management areas that provide views of the refinery site.

The primary views of the refinery site would be from S.H. 23, surrounding local roads, and rural residences. The project site is within the foreground to middleground views of motorists traveling east or west on S.H. 23. Foreground views are within 0 to 0.5 miles between the viewer and the site. Middleground views are between 0.5 to 5 miles from the viewer. The site is also within the viewshed of BIA and county roads within the analysis area.

The rural residence closest to the site is slightly less than 0.5 miles northeast of the site on the north side of S.H. 23. In addition, there is a residence about 0.5 miles south of the

southeast property boundary. The project site is within foreground views of these two residences.

The site is within the middleground of views from several rural residences within the affected viewshed. Residences in the east and northeast parts of the Town of Makoti are also within the middleground distance zone of the viewshed.

At night, the affected viewshed is characterized by a low level of ambient lighting. The area is sparsely populated, so residential lighting is sparse. Existing nighttime lighting is from safety lighting at some transportation facilities. There is no ambient night lighting on the refinery site, with the exception of lights from residential and farm buildings at the east side of the project site.

The pipeline corridor is located along the Canadian Pacific short line and 62nd Avenue. The corridor is within the foreground views of motorists on 62nd Avenue and ten rural residences that are located within 0.5 mile of the corridor.

The proposed power line corridor is located along S.H. 23 for about 8 miles east of the project site, and south along 59th Avenue for about 2 miles. Four residences and one commercial retail business are located within 0.5 mile of the corridor along S.H. 23, and three residences are located along the corridor along 59th Avenue.

Air Quality

Climate

North Dakota's location at the geographic center of North America results in a typical continental climate. Primarily because of location, the climate of the state is characterized by wide annual and day-to-day fluctuations in temperature; light to moderate precipitation, which tends to be irregular in time and coverage; low relative humidity; plentiful sunshine; and nearly continuous air movement (Jensen 1998).

The Rocky Mountains act as a barrier to the prevailing westerly flow of air in the atmosphere. This mountain barrier modifies the temperature and moisture characteristics of air masses originating over the Pacific Ocean when they flow over the mountains in ways that reinforce the continental characteristics of the climate (Jensen 1998). Conversely, there are no mountainous barriers to air mass originating in the polar areas to the north or the Gulf of Mexico to the south. Therefore, air masses originating in these regions easily overflow North Dakota, sometimes with only minor changes in the basic weather pattern.

North Dakota has varied weather in all seasons based on cold and dry air masses that originate in the polar regions; warm and moist air masses from tropical regions; or mild and dry air from the northern Pacific (Jensen 1998). The rapid progression of these air masses over North Dakota from the different source regions usually results in frequent and rapid changes of weather patterns.

Precipitation

In Ward and Mountrail Counties, the occurrence of precipitation varies seasonally. Most of the annual precipitation (70 percent) occurs during the May to September growing sea-

son (Table 3–13). The more limited precipitation that occurs during the rest of the year may fall as rain or snow. The 100-year, 24-hour storm event for the portion of North Dakota that encompasses the project site is about 5 inches (Hershfield 1961).

With the arrival of spring, the amount of precipitation begins to increase. Monthly precipitation amounts increase as spring wears on because the storm systems that traveled south of the state in winter tend to follow more northerly tracks during spring and summer. The first substantial rains of spring sometimes occur in late March, but usually occur in early April.

Both counties are usually quite warm in the summer, with frequent spells of hot weather and occasional cool days interspersed. Thunderstorms, which occur on about 34 calendar days per year, become more frequent (VanderBusch 1991). These thunderstorms deliver most of the total annual precipitation. Rainfall typically hits its peak in June (Table 3–13).

Table 3–13 Summary of Monthly Precipitation at the National Weather Service and North Dakota Agricultural Weather Network Meteorological Stations

Period	Precipitation by Station (inches)		
	Plaza	Parshall	Ryder
January	0.47	0.38	0.39
February	0.4	0.33	0.42
March	0.67	0.42	0.56
April	1.37	1.35	1.47
May	2.24	2.3	2.12
June	3.2	3.66	3.61
July	2.58	2.27	2.52
August	1.68	1.89	1.79
September	1.7	1.95	1.65
October	1.28	0.72	0.68
November	0.65	0.42	0.44
December	0.42	0.38	0.38
Annual (total)	16.66	16.06	16.04

Sources: High Plains Regional Climate Center 2004a, High Plains Regional Climate Center 2004b, North Dakota Agricultural Weather Network 2004

Precipitation decreases rapidly through the fall months and is minimal during the winter. Winter precipitation typically occurs as snowstorms and the occasional blizzard. The first significant snowfall of the season usually occurs during the middle or latter part of November. However, measurable amounts of snow (0.1 inch or more) may fall in September about once every 10 years. In this portion of North Dakota, the average seasonal snowfall is 40 inches (VanderBusch 1991). On average, 43 days of the calendar year have at least 1 inch of snow on the ground.

Temperature

Temperature data from the weather stations also show a seasonal pattern that is characteristic of a continental climate. Average temperatures peak during July and August (Table 3–14). In contrast, January is the coldest month. The difference between the average temperatures for January and July is more than 60°F (Table 3–14). The highest temperature ever recorded at the Parshall station was 107°F on August 7, 1949 and the lowest temperature recorded was -45°F on January 18, 1950.

Table 3–14 Summary of Monthly Temperatures at the National Weather Service and North Dakota Agricultural Weather Network Meteorological Stations

Month	Temperature by Station ¹ (°F)	
	Plaza	Parshall
January	9	5.3
February	17	12.7
March	28	24.3
April	42	40.8
May	55	53.6
June	64	62.9
July	69	68.6
August	68	67.3
September	57	56.2
October	44	45.3
November	26	27.3
December	14	13.4
Average	41	39.8

Notes:

1. Data from the Ryder Station were insufficient for inclusion in the tabular summary.

Sources: High Plains Regional Climate Center 2004a, High Plains Regional Climate Center 2004b, North Dakota Agricultural Weather Network 2004

Wind Speed and Wind Direction

Figure 3-14 presents a wind rose that was generated from the 4 years of meteorological data described above for the Minot Airport which is about 30 miles from the project site. In this figure, each wind vector is apportioned by wind speed categories. Thus, the prevailing winds are from the west-northwest.

Figure 3-14 Surface Wind Speed Wind Rose

Ambient Air Quality Standards

EPA has established National Ambient Air Quality Standards (NAAQS) for ozone, nitrogen dioxide (NO₂), carbon monoxide (CO), sulfur dioxide (SO₂), particles finer than 10 microns in size (PM₁₀), particles finer than 2.5 microns in size (PM_{2.5}) and airborne lead. These standards were developed to protect public health and welfare with an adequate margin of safety. The NAAQS are presented on Table 3–15 as well as the State of North Dakota’s ambient air quality standards. These are the regulatory limits that concentrations of pollutants must not exceed during the specific averaging period for an area to be considered in attainment for air quality.

Table 3–15 Summary of Regulatory Ambient Air Quality Concentrations (µg/m³)¹

Pollutant	Averaging Period	NAAQS ²	North Dakota AAQS
NO ₂	Annual	100	100
CO	1-Hour	40,000	40,000
	8-Hour	10,000	10,000
PM _{2.5}	24-Hour	65	
	Annual	15	
PM ₁₀	24-Hour	150	150
	Annual	50	50
SO ₂	3-Hour	1,300	1,300
	24-Hour	365	365
	Annual	80	80
Ozone	1-Hour	235	
	8-Hour	157	
Pb	Calendar Quarter	1.5	1.5
H ₂ S	1-Hour		280
	24-Hour		140

Notes:
 1. µg/m³ = micrograms per cubic meter
 2. National Ambient Air Quality Standards (40 CFR 50)

Federal Prevention of Significant Deterioration (PSD) requirements provide three area classifications that establish the amount of allowable air quality deterioration in areas where the air quality meets the National Ambient Air Quality Standards. Deterioration is determined by the increase of a pollutants ambient concentration above a baseline concentration. This allowable increase is referred to as an “increment”.

In practice, only two classifications are currently used throughout the U.S. – Class I areas and Class II areas. Class I areas are undeveloped public areas that include many of the National Parks and Wilderness Areas. Class II areas are all other areas that are not Class I.

As shown in Table 3–16, PSD regulations have established much lower increments for Class I areas than for Class II areas.

Table 3–16 Summary of PSD Increment Standards ($\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Period	PSD Increments	
		Class I	Class II
NO ₂	Annual	2.5	25
	24-Hour	8	30
PM ₁₀	Annual	4	17
	3-Hour	25	512
SO ₂	24-Hour	5	91
	Annual	2	20

The general vicinity surrounding the project site is classified as Class II. Regional Class I areas include Lostwood Wilderness (58 kilometers north of the project site) and Theodore Roosevelt National Park (112 kilometers southwest of the project site).

National Emission Standards for Hazardous Air Pollutants Requirements

Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. EPA is working with state, local, and tribal governments to reduce HAPs releases of 189 pollutants to the environment. Examples of HAPs include benzene, which is found in gasoline; perchlorethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries.

Most HAPs originate from human-made sources, including mobile sources (such as cars, trucks, and buses) and stationary sources (such as factories, refineries, and power plants), as well as indoor sources (building materials and activities such as cleaning). EPA classifies the types of stationary sources that emit HAPs into two groups:

- “Major” sources are defined as sources that emit 10 tons per year of any of the listed HAPs, or 25 tons per year of a mixture of air toxics. These sources may release air toxics from equipment leaks, when materials are transferred from one location to another, or during discharge through emission stacks or vents.
- “Area” sources consist of smaller-size facilities that release lesser quantities of toxic pollutants into the air. Area sources are defined as sources that emit less than 10 tons per year of a single air toxic, or less than 25 tons per year of a combination of air toxics. Though emissions from individual area sources are often relatively small, collectively their emissions can be of concern, particularly where large numbers of sources are located in heavily populated areas.

Existing Ambient Air Quality

PM₁₀ and SO₂ ambient air quality data have been collected at White Shield, North Dakota. This location is 25 miles (40 kilometers) south of the project site.

Figure 3-15 shows the location of the White Shield monitoring station relative to the project site as well as other major sources in North Dakota. Because White Shield is closer

to most of the existing major sources than the proposed refinery would be, it can be assumed that these data are a conservative representation of the existing air quality at the project site. Table 3–17 and Table 3–18 present summaries of the data collected at this monitoring site.

Table 3–17 Summary of White Shield SO₂ Monitoring Data

Year	SO ₂ Ambient Concentrations (µg/m ³) ¹		
	3-Hour Maximum	24-Hour Maximum	Annual Average
2003	53.2	21.3	3.7
2002	53.2	16.0	3.5
2001	87.9	29.3	4.0
2000	61.2	31.9	4.3
1999	106.5	26.6	4.3
1998	90.5	29.3	4.8
Maximum	106.5	31.9	4.8

Note:

1 (µg/m³) = micrograms per cubic meter

Table 3–18 Summary of White Shield PM₁₀ Monitoring Data

Year	PM ₁₀ Ambient Concentrations (µg/m ³) ¹	
	24-Hour Maximum	Annual Average
2003	33.2	7.7
2002	26.6	9.2
2001	37.2	11.2
2000	23.3	7.7
1999	18.7	6.9
1998	45.0	11.6
Maximum	45.0	11.6

Note:

1 (µg/m³) = micrograms per cubic meter

The nearest nitrogen dioxide (NO₂) monitoring site is in Beulah, North Dakota, which is 47 miles (76 kilometers) south of the project site. Table 3–19 presents a summary of the NO₂ ambient concentration data collected at this location.

Table 3–19 Summary of Beulah NO₂ Monitoring Data

Year	NO ₂ Ambient Concentrations Annual Average (µg/m ³)
2003	5.7
2002	6.5
2001	6.9
2000	7.1
1999	6.9
Maximum	7.1

Air Quality Designation

According to federal air quality criteria, the air quality in the general vicinity of the project site has a federal designation of attainment or unclassifiable for all criteria air pollutants. Table 3–20 shows the federal air quality designations for criteria pollutants for the project site and its environs.

Table 3–20 Federal Air Quality Designations

Pollutant	Designation ¹
NO ₂	Unclassifiable/Attainment
CO	Unclassifiable/Attainment
PM _{2.5}	Unclassifiable/Attainment
PM ₁₀	Unclassifiable
SO ₂	Attainment
Ozone	Unclassifiable/Attainment

Note:

1. Unclassifiable/Attainment = monitoring of the pollutant is insufficient to classify and the pollutant is assumed to be in attainment of the NAAQS. Attainment = monitoring and modeling demonstrates the pollutant is in attainment of the NAAQS.

Source: 40 CFR 81.335

Class I Area Air Quality Related Values

Class I area air quality related values (AQRVs) include visual range and sulfur (S) and nitrogen (N) deposition. Table 3–21 presents recent measurements of standard visual range (SVR) and N and S deposition at Theodore Roosevelt National Park and Lostwood Wilderness.

SVR is defined as the greatest distance at which a standard observer can discern a large black object against the horizon sky under uniform lighting conditions. This value is calculated (rather than measured), using Interagency Monitoring of Protected Visual Environments (IMPROVE) methodology. This calculation uses measured ambient air concentrations of aerosols that include sulfate, nitrate, organic carbon, elemental carbon, and soil material.

Figure 3-15 Ambient Monitor and Major Source Locations

8½ x 11 figure

Figure 2 in the air quality technical report

Wet deposition is measured as concentrations of sulfate ion (SO₄) and nitrate ion (NO₃) in precipitation. The wet deposition values shown in Table 3-22 are also presented as elemental nitrogen and sulfur, using the ratios of molecular weights, since deposition impacts are referenced in terms of elemental nitrogen and sulfur.

Table 3–21 Measurements of Standard Visual Range

Year	Class I Area	Standard Visual Range (SVR) (km) ³			Wet Deposition – Annual Total (kg/ha) ⁴			
		Best 20% SVR	Mid 20% SVR	Worst 20% SVR	Nitrogen		Sulfur	
					NO ₃	As N	SO ₄	As S
2001	TRNP ¹	182.2	112.1	65.3	3.43	0.77	2.51	0.84
2002	TRNP	181.5	123.6	72.6	4.17	0.94	2.77	0.92
2003	TRNP	187.4	114.8	64.8	4.42	1.00	3.15	1.05
2004	TRNP	188.4	125.8	71.3	2.07	0.47	1.67	0.56
2001	LW ²	173.5	98.5	51.6	NA ⁵	NA	NA	NA
2002	LW	181.5	109.3	60.5	NA	NA	NA	NA
2003	LW	179.3	103.0	61.6	NA	NA	NA	NA
2004	LW	179.0	114.5	55.6	NA	NA	NA	NA
1 Teddy Roosevelt National Park 2 Lostwood Wilderness 3 Source: Interagency Monitoring of Protected Visual Environments (IMPROVE) Aerosol data, Visibility Information Exchange Web System (VIEWS) (http://vista.cira.colostate.edu/views/) 4 Source: National Atmospheric Deposition Program (NADP) (http://nadp.sws.uiuc.edu/) 5 NA – Data not available								

Socioeconomics

The analysis area for the socioeconomic analysis includes the Reservation and Ward County. Ward County is included in the analysis because most of the goods and services for the project would come from the Reservation or the city of Minot. Minot, which is about 30 miles from the project site, is the closest center for population and trade. It is also the seat for Ward County, the home of Minot Air Force Base, and the center of economic activity in north-central North Dakota.

Population, Employment, Earnings and Income

The existing population, employment, earnings, and income characteristics for the analysis area are summarized in this section.

Population

Recent population figures for the analysis area are shown on Table 3–22. The table includes recent population data for the Reservation and Ward County. Minot has historically been a farm and ranch community, and is the home of the Minot Air Force Base, which is an integral part of the local economy.

The 1990s were a period of low population growth in North Dakota and Ward County (Table 3–22). The modest growth rates of the 1990s reversed the declining growth rates of 1980 through 1990, when the state lost population. However, population projections indicate that the population of North Dakota will continue to decline over the next 20 years (Table 3–23). The projected decline in population for the state is small, indicating that declines will level off to some extent relative to the declines in population for the last two decades. However, in Ward County, population declines are projected to increase relative to the past two decades. This is because it is anticipated that the rural population will continue to follow current trends of migration to urban areas. Declining population in North Dakota mirrors similar trends throughout the Great Plains states. Rural residents have been migrating to larger cities, depopulating the largely rural Great Plains states. Many of the people migrating out of the state are young adults and families, which results in fewer people of childbearing age, and therefore, fewer children. This trend also contributes to the increasing proportion of the elderly population in the state (North Dakota State Data Center 2002).

Table 3–22 Changes in the Populations of the Fort Berthold Indian Reservation, Ward County, and State of North Dakota, 1980–2002

Area	Population				Change in Population (percent)		
	1980	1990	2000	2004	1980–1990	1990–2000	2000–2004
Fort Berthold Indian Reservation	5,577	5,395	5,874	5,915	-3.3	8.9	0.20
Ward County	58,392	57,921	58,795	56,224	-0.8	1.5	-4.4
State of North Dakota	652,717	638,800	642,200	634,366	-2.1	0.5	-1.2

Note:

1. na = not available.

Source: North Dakota State Data Center 2006. North Dakota Indian Affairs Commission, 2006.

Table 3–23 Projections of Changes in the Populations of the Fort Berthold Indian Reservation, Ward County, and North Dakota, 2000–2020

Area	Population			Change in Population (percent)	
	2000	2010	2020	2000–2010	2010–2020
Fort Berthold Indian Reservation	5,874	na ¹	na	na	na
Ward County	58,795	56,728	55,809	-3.5	-1.6
North Dakota	642,200	645,325	651,291	<0.01	<0.01

Note:

1. na = not available.

Source: North Dakota State Data Center 2002b

The Reservation has an estimated population of more than 5,900. In 2004, there were 10,400 enrolled members of the Three Affiliated Tribes. The majority of these members live outside of the Reservation. Members account for 3,986 (67.4%) of the total population living on the Reservation. Between 1980 and 1990, the population of the Reservation declined, mirroring the declines of the state and Ward County (Table 3–22). However, the Reservation’s population grew considerably faster than those of the state or Ward County during the 1990s. This is likely because increased economic opportunities on the Reservation have made it a more attractive place to live. There are no population projections for the Reservation; however, current population data shows that there are different economic factors affecting population growth from those factors identified for the state and the county. It is likely that the population of the Reservation will continue to grow over the next two decades.

The City of Makoti is the community closest to the project site. The population of Makoti was 145 in 2000. The population declined to 141 (2.9 percent) by 2004. Makoti is not located on the Reservation.

The racial composition of the populations of the State of North Dakota and Ward County are similar, but differs considerably from that of the Reservation (Table 3–24). In 2000, the minority population was low in the state as a whole, accounting for 7.6 percent of the total population. The American Indian component of this total was 4.9 percent. In contrast, American Indians were the majority on the Reservation, accounting for 76.7 percent of the Reservation’s total population. The white population accounted for 30.7 percent, whereas other populations of a single race and people of Hispanic origin each accounted for less than 1 percent (Table 3–24). People of two or more races accounted for 5.7 percent of the Reservation’s population.

The age structure of the population in Ward County is comparable to that of the State of North Dakota (Table 3–24) and to the country as a whole. The middle age group of the population (35 to 64) increased in number between 1990 and 2000, while the youngest third (under 5 to 34) decreased, which is consistent with the aging of the general population. The median age of the population on the Reservation was 29.3, younger than the state median of 36.2 and the Ward County median of 32.4. Nearly 45 percent of the population on the Reservation was under the age of 20 in 2000, a considerably higher percentage than Ward County or the state, which both have less than 30 percent of the population under 20 (Table 3–24).

Table 3–24 Demographic Characteristics of Fort Berthold Indian Reservation and Ward County, 2000

	Fort Berthold Indian Reservation		Ward County		North Dakota	
	Number	Portion (percent)	Number	Portion (percent)	Number	Portion (percent)
Total Population	5,195		58,795		642,200	
Sex Distribution						
Male	2,877	55.4	29,284	49.8	320,524	49.9
Female	3,038	58.5	29,511	50.2	321,676	50.1
Age Distribution						
Under 5 years	536	10.3	4,348	7.4	39,400	6.1
5-19	1,782	34.3	13,158	22.4	144,064	22.4
20-44	1,778	34.2	22,667	38.6	225,394	35.1
45-64	1,171	22.5	11,281	19.2	138,864	21.6
65 +	648	12.5	7,341	12.5	94,478	14.7
Race Distribution						
White	1,594	30.7	54,327	92.4	593,181	92.4
Black	6	0.1	1,305	2.2	3,916	0.6
American Indian, or Alaska Native	3,986	76.7	1,215	2.1	31,329	4.9
Asian or Pacific Islander	9	0.2	519	0.9	3,836	0.6
Other	26	0.5	428	0.7	2,540	0.4
Two or more races	294	5.7	1,001	1.7	7,398	1.2
Hispanic Origin (of any race)	152	0.0	1,125	0.0	7,786	1.2

Source: U.S. Census Bureau 2001

Housing

The total number of housing units available, the rates of vacancy, and median rents vary for the Reservation and Ward County. Ward County has almost 9 times as many housing units as the Reservation (Table 3–25). However, a much larger portion of housing units are vacant on the Reservation (34 percent) compared with Ward County (8 percent). On both the Reservation and in Ward County, more than half of the occupied housing units are occupied by owners rather than renters (Table 3–25). In 2000, median monthly rent in Ward County was \$408 whereas median rent on the Reservation was \$245 (U.S. Census Bureau 2001).

In addition to more permanent housing, the Reservation and Ward County have temporary housing, such as motels and campgrounds. Temporary housing present near the project site includes four motels in New Town, one motel in Parshall, and one motel in Garrison. No motels exist in Makoti; however, a campground provides 100 sites with electrical hookups. The City of Minot provides a wide range of motels and campgrounds.

Table 3–25 Summary of Housing Units on the Fort Berthold Indian Reservation and in Ward County, North Dakota, 2000

Status of Housing Unit	Housing Units			
	Fort Berthold Indian Reservation		Ward County	
	Total Number of Units	Portion of Total (percent)	Total Number of Units	Portion of Total (percent)
Occupied by:				
Owner	1,122	58.8	14,434	62.6
Renter	786	41.2	8,607	37.4
Total	1,908	66.2	23,041	91.8
Vacant	973	33.8	2,056	8.2
Total (occupied/vacant)	2,881	100.0	25,097	100.0

Source: U.S. Census Bureau 2001

Employment

The economies of the Reservation and Ward County are based on natural resources. Basic economic sectors that bring revenues into the Reservation and county include agriculture, oil production, some manufacturing, and recreational opportunities.

Agriculture historically has been and currently is the primary base industry in North Dakota, including on the Reservation and in Ward County. Fifty-five percent of that portion of the Reservation that is not covered by Lake Sakakawea is used for grazing (cattle and buffalo) and cropland. Consequently, livestock ranching and farming are primary economic activities on the Reservation. Nearly 94 percent of the land use in Ward County is in farms (North Dakota Agricultural Statistics Service 1997).

Beyond agricultural activities, few economic opportunities exist on the Reservation. The Four Bears Casino and Lodge, which is on the shore of Lake Sakakawea west of New Town, is owned and operated by the MHA Nation. The Casino and Lodge employ more than 300 people, of which more than 90 percent are tribe members. Industrial economic activity includes two tribally chartered corporations (Fort Berthold Library 1994). Although there are large deposits of coal with the potential for economically feasible development on the Reservation, they have not been leased or developed. Reserves of oil also exist, and some development of this resource has occurred on the Reservation.

In 2000, the labor force participation rate on the Reservation was 57.6 percent. This means that the proportion of all people age 16 years or older who are employed or available for work was 2,301 out of 3,993 people. The labor force participation rate for Indians living on the Reservation was 56.9 percent.

The unemployment rate on the Reservation decreased by 29 percent between 1990 and 2000 (Table 3–26). This decrease occurred because of an increase in economic opportunities. These opportunities included the opening of the Four Bears Casino and Lodge in 1994, a large increase in the number of people employed by the Three Affiliated Tribes Lumber Construction Manufacturing Corporation (a tribally owned corporation), and the establishment of the Mandaree Enterprise Corporation (formerly the Mandaree Electronics Corporation). The Mandaree Enterprise Corporation manufactures electronics and provides information technology services, hardware/software, and supplies.

In contrast with the decrease in unemployment on the Reservation, statewide unemployment rose slightly, and unemployment in Ward County remained constant between 1990 and 2000 (Table 3–26). However, even with the reduction in unemployment on the Reservation, the unemployment rate on the Reservation in 2000 was 6.6 percent higher than for Ward County.

Table 3–26 Resident Labor Force, Employment and Unemployment for the State of North Dakota, Ward County, and the Fort Berthold Indian Reservation, 1990-2000

Category	1990	2000	Change 1990–2000
North Dakota			
Labor Force	318,054	338,982	3.72%
Employed	305,272	316,632	19.36%
Unemployed	12,782	15,257	15.00%
Unemployment Rate	4.0	4.6	15.0%
Ward County			
Labor Force	26,420	31,374	3.32%
Employed	25,264	26,102	7.27%
Unemployed	1,156	1,240	2.27%
Unemployment Rate	4.4	4.5	2.3%
Fort Berthold Indian Reservation			
Labor Force	2,130	2,301	13.93%
Employed	1,795	2,045	-23.88%
Unemployed	335	255	-29.30%
Unemployment Rate	15.7	11.1	-29.9%

Source: U.S. Census Bureau 2001

A study of available labor was conducted for the area within a 60-mile radius of Minot. This area included portions of Ward, Bottineau, McHenry, McLean, Mountrail, and Renville Counties. The Reservation east of Lake Sakakawea is also included in the analysis area. The 60-mile radius was identified as the median maximum distance that those involved in the study were willing to commute.

The study characterized the available labor force within the analysis area and identified the desirability of employment in different types of industries. The available labor force included those individuals looking for work, planning to seek work, or who would consider a different or alternative job. There were 21,160 individuals in the available labor force in the analysis area (North Dakota Department of Commerce 2002). Approximately 2,870 of these individuals were actively seeking work during the time the study was conducted.

The study determined that individuals in the available labor force most desired jobs in the information computer technology and business services operation industries (Table 3–27). Jobs in health services and manufacturing were in the middle. Finally, jobs in engineering and machine trades or construction were the least desirable to individuals in the available labor force.

Table 3–27 Industries of Interest to the Available Labor Force

Industry	Number of Individuals ¹	Portion of Available Labor (percent)
Information Computer Technology	14,114	66.7
Business Services Operation	12,992	61.4
Health Services	9,755	46.1
Manufacturing	9,755	46.1
Engineering	8,125	38.4
Machine Trades or Construction	7,702	36.4

Note:

1. The number of individuals does not add up to the total available labor force because individuals may be interested in more than one industry.

Source: North Dakota Department of Commerce 2002

Employment by economic sector is a common measure of economic activity. On the Reservation, the largest annual average change in job sectors between 1990 and 2000 was in the government and services sectors. Although it involved a relatively small number of jobs, the number of jobs in the government sector increased by 73 percent. Government employers on the Reservation include the MHA Nation, Fort Berthold Community College, BIA, and IHS. In the services sector, the number of jobs increased by 59 percent.

In addition to experiencing one of the largest increases in the number of jobs, industries in the services sector employed the largest number of individuals in the decade between 1990 and 2000 (Table 3–28). The services sector represented 37.8 percent of the jobs on the Reservation in 1990 and grew to 53.0 percent of all employment on the Reservation by 2000. The primary stimulus for growth in the services sector was the 1994 opening of the Four Bears Casino and Lodge, one of the largest employers on the Reservation.

In contrast with the government and service sectors, employment in most of the other sectors declined from 1990 to 2000 (Table 3–28). Employment in the retail trade declined by 39 percent, employment in the agriculture sector declined by 27 percent, and employment in the mining and extractive industries declined by 100 percent. Despite the decline in these sectors, overall employment on the Reservation increased from 1990 to 2000 (Table 3–28).

In Ward County, the largest employment sector from 1990 to 2000 was the government sector. The government sector represented 32 to 37 percent of the jobs during the 1990s (The Minot Air Force Base is the largest government employer in the county, accounting for nearly 80 percent of federal employment and nearly 40 percent of all government employment in Ward County).

Table 3–28 Summary of Total Estimated Employment on the Fort Berthold Indian Reservation and in Ward County, 1990 and 2000

Sector	Ft. Berthold Indian Reservation				Ward County			
	Number of Employees		Portion of Total (percent)		Number of Employees		Portion of Total (percent)	
	1990	2000	1990	2000	1990	2000	1990	2000
Agricultural Production and Services	233	169	13.0	8.3	167	314	0.5	0.7
Mining and Extractive Industries	75		4.2	0.0	172	315	0.5	0.7
Construction	118	78	6.6	3.8	1,204	1,933	3.4	4.5
Manufacturing	119	113	6.6	5.5	794	833	2.2	2.0
Petroleum & Coal Products								
Transportation, Communication, and Utilities	23	14	1.3	0.7	1,673	1,978	4.7	4.6
Wholesale	216	158	12.0	7.7	1,776	1,741	5.0	4.1
Retail Trade	111	68	6.2	3.3	6,367	7,528	18.0	17.7
Finance, Insurance, and Real Estate	63	89	3.5	4.4	1,791	2,732	5.1	6.4
Services	679	1,083	37.8	53.0	8,402	11,604	23.7	27.3
Government	158	273	8.8	13.3	13,044	13,563	36.9	31.9
Total	1,795	2,045			35,390	42,541		

Source: U.S. Census Bureau 2001

The services and retail trade sectors also were sources of substantial employment in the county. Considered together, the government, services, and retail trade sectors accounted for almost 80 percent of employment in Ward County between 1990 and 2000. The services sector experienced the largest gain in employment (38 percent) during the decade (Table 3–28). The retail trade sector experienced an 18 percent increase in employment over the same period.

Income

In 1990 and 2000, the per capita personal income in the analysis area trailed that of Ward County and the State of North Dakota (Table 3–29). Although per capita personal income in Ward County was less than that for the state in both years, the difference increased from 1990 (3 percent less) to 2000 (5 percent less). In both years, the per capita personal income on the Reservation was substantially lower than that for the state and Ward County (Table 3–29).

In both 1990 and 2000, a high portion of residents living on the Reservation had incomes that placed them below the poverty line (Table 3–29). In addition, $\frac{1}{3}$ to $\frac{1}{2}$ of tribal members on the Reservation had incomes that placed them below the poverty line. During the same period, 11 to 14 percent of residents of Ward County and North Dakota had incomes that placed them below the poverty line (Table 3–29).

Table 3–29 Per Capita Personal Income and Poverty Rates in Analysis Area

Area	Per Capita Personal Income (\$)		Poverty Rate (percent)	
	1990	2000	1990	2000
North Dakota	11,051	17,767	14.40	11.90
Ward County	10,708	16,926	12.70	10.80
Forth Berthold Indian Reservation				
American Indians	6,925	8,414	51	36
All people	10,667	10,940	35	28

Source: U.S. Census Bureau 2001

Facilities and Services

Development has the potential to affect existing community facilities and infrastructure. The use of existing facilities or infrastructure, including roads, may affect the capacity of service agencies or transportation systems, or may require installation of new facilities. Growth in population and employment may also affect local community services in the project area. The following sections characterize existing infrastructure and services in the project area.

Fire protection on the reservation is provided in the communities and rural areas by volunteers using BIA equipment. The nearest Fire Protection District is the Minot Rural Fire District, which serves a portion of Ward County that does not include the project site.

The Fort Berthold Rural Water Project provides water to the Four Bears, Mandaree, White Shield, and Twin Buttes locations on the Reservation. Construction on the project began in the late 1990s, and consists of water intake systems and small water treatment plants at Mandaree, White Shield, Twin Buttes, and Four Bears. Other communities and rural areas on the Reservation use water supply wells. Individuals in some areas use untreated surface water.

Educational facilities on the Reservation provide primary, secondary, and some tertiary education. Primary and secondary education is provided by three BIA Contract Schools, which are located at Mandaree, Twin Buttes, and White Shield. These schools provide education for grades 1 through 12. Nearby schools include a high school in Makoti and an elementary school in Ryder. Tertiary education is provided by the Fort Berthold Community College in New Town and at satellite locations.

Health care on the Reservation is provided by IHS. The primary health care facility is the Minne-Tohe Health Center in New Town. However, IHS also has satellite health stations at Mandaree, White Shield, and Twin Buttes. The Tribal Health Department provides a Community Health Representative Program and the Ambulance Service for emergency health care services. There is also a Dialysis Center on the Reservation. Hospitals and a wide range of other health services are available in Minot.

An Emergency Action Plan for the Reservation in general is under development that will provide direction, including mitigation, for a variety of hazards (Federal Emergency Management Agency 2003).

Social Values

The quality of life in the area and the reasons people live there are subjective measures of a person's happiness with a geographic location, based on a variety of self-defined values. The analysis area has experienced impacts to air and water quality from nearby coal-fired power plants. There is a perception that other energy-related industrial activities may be incompatible with the quality of the natural environment. However, many people support industrial development for its positive economic effects.

Environmental Justice

On February 11, 1994, Executive Order 12898 (Order) was published and requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The concept of Environmental Justice (EJ) first became an expressed consideration for the federal government with the publication of Executive Order 12898 on February 11, 1994. The Executive Order (EO) requires each Federal Agency to make achieving environmental justice part of its mission by "identifying and addressing...disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations in the United States." (Executive Order No. 12898, §59 Fed.Reg.7629 [1994]). The broad goal of EO 12898 is tempered in §6-609, which cautions that, "this order is intended only to improve the internal management of the executive branch and is not intended to...create any right...enforceable against the United States." These instructions for Federal agencies were then further clarified in the "Memorandum for the Heads of all Departments and Agencies": Mitigation measures outlined or analyzed in an environmental assessment, environmental impact statement, or record of decision, whenever feasible, should address significant and adverse environmental effects of proposed Federal actions on minority communities and low-income communities (President's Memorandum for the Heads of All Departments and Agencies, 30 Weekly Comp. Pres. Doc. 6 [Feb. 11, 1994]).

The affected area selected for the EJ analysis includes the population of residents within a 10-mile radius of the project site. This area was selected to include areas that may be affected by the proposed project. It is anticipated that potential contaminants may affect primarily the area within a 1-mile radius of the project site; however, the 10-mile radius was selected to provide a more conservative analysis.

The project site contains portions of four Census 2000 tracts (Figure 3-16). Within each tract are one or more block groups that are wholly or partially within a 10-mile radius of the project site. Portions of three counties (Ward, Mountrail, and McLean) are covered by the block groups within the 10-mile-radius affected area. The racial characteristics for the population within each block group within the 10-mile radius area are shown in Table 3-30. The Geographic Information System (GIS) was used to determine the areas and demographics of each block group within the affected area.

Figure 3-16 Distribution of Census Block Tracts in the Affected Area

The State of North Dakota has been determined to be the geographic area to compare the demographic data for the population in the 10-mile affected area with respect to race and income for this environmental justice evaluation. This determination was based on the need for a larger geographic area encompassing affected area Census Tracts in which equivalent quantitative resource information is provided. The state is the smallest area that contains those portions of the three counties within the 10-mile-radius area that has Census data for demographic characteristics. Table 3-30 provides demographic and poverty level data that are used to compare minority and poverty level comparisons of the population within the 10-mile affected area and the state. The data identify minority and low-income populations that may be affected by the alternatives within the affected area.

Health and Safety

Native American residents of the reservation have shown higher instances of chronic diseases such as cancer and asthma in comparison with the general population of the United States. Several factors that contribute to the health of Native Americans include poverty, access to adequate healthcare, sanitation, proximity of pollution sources, and social behaviors. According to the North Dakota Indian Affairs Commission (1999):

- 78 percent of young Indian women, ages 14 to 24, are at high risk for contracting the HIV/AIDS virus.
- Indian youth, ages 15 to 24 years, have a 382 percent higher suicide rate than the white suicide rate. (67.5/100,000 compared with 17.7/100,000)
- The poverty rate for Indians in North Dakota is more than three times the rate for North Dakota all-races population - 38 percent compared with 11 percent.
- In the Northern Plains, the Median Household Income for Indians is \$12,310 as compared with the U.S. all-races median of \$30,056.
- Indians are nearly 7.5 times as likely to live in households without adequate sanitation facilities as the general North Dakota population.

Table 3–30 Population Demographics — Minority and Low Income Populations

Population	Portion of Population That is Minority or Low Income for the State and by Census Tract					
	State of North Dakota (percent)	Census Tract 960500 (percent)	Census Tract 940300 (percent)	Census Tract 011100 (percent)	Census Tract 955200 (percent)	Census Tract Averages (percent)
Minority	8.3	3.8	58.1	2.8	2.8	16.8
Low Income	11.9	13.5	0	9.2	14	9.1

Source: U.S. Census Bureau 2001

