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 in Chapter 3 describes existing conditions, before any of the alternatives are implemented. Chapter 4 describes the changes that are expected to occur from implementing the alternatives. 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.

3.1 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.

3.2 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 overlaying 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).

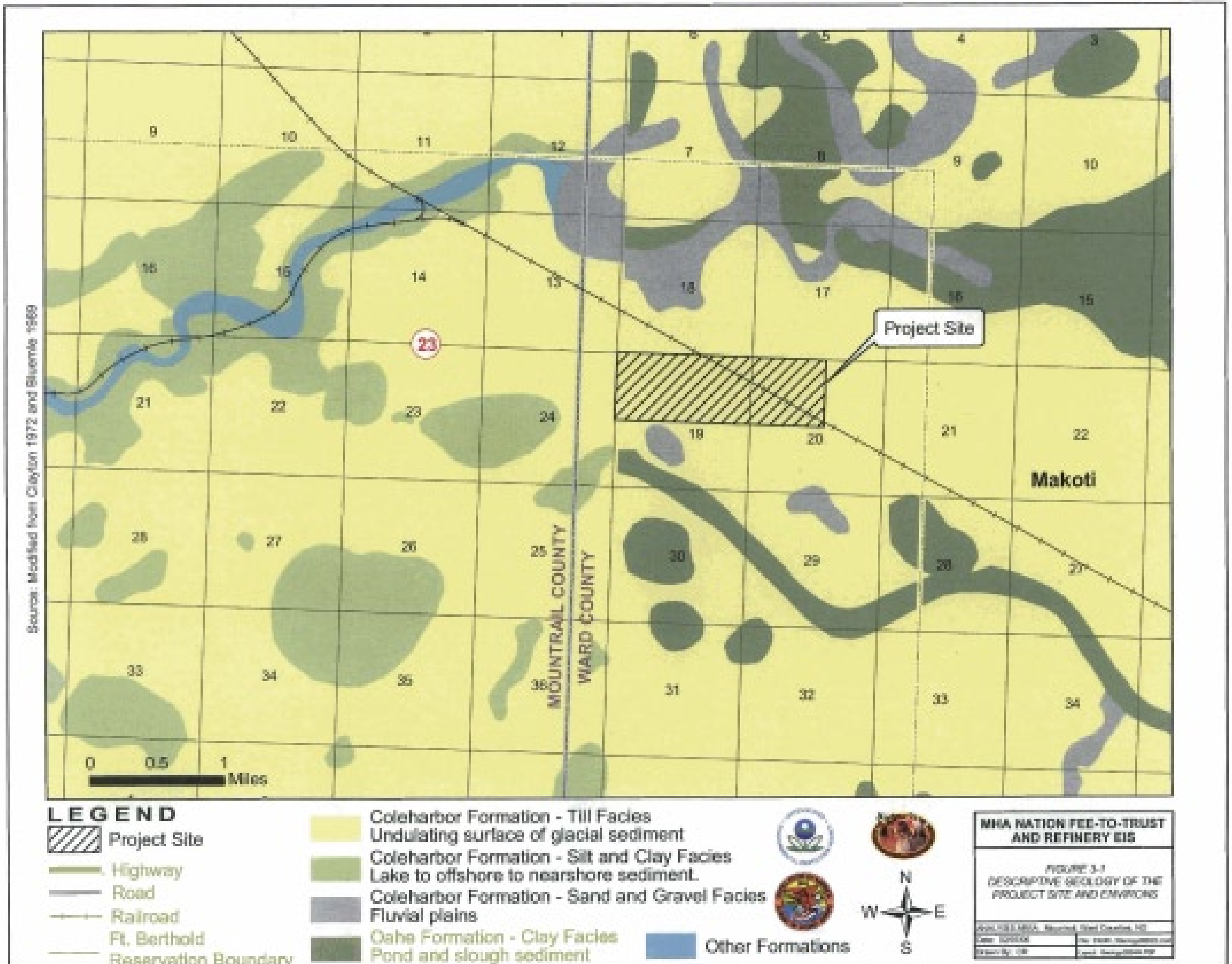
The Williston Basin, a structural feature centered west of the Reservation, affects the thickness of the bedrock units of Cretaceous age and older. The Tertiary-age units on the Reservation are relatively horizontal or have westward dips of less than 10 feet per mile, although some small structures have 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.

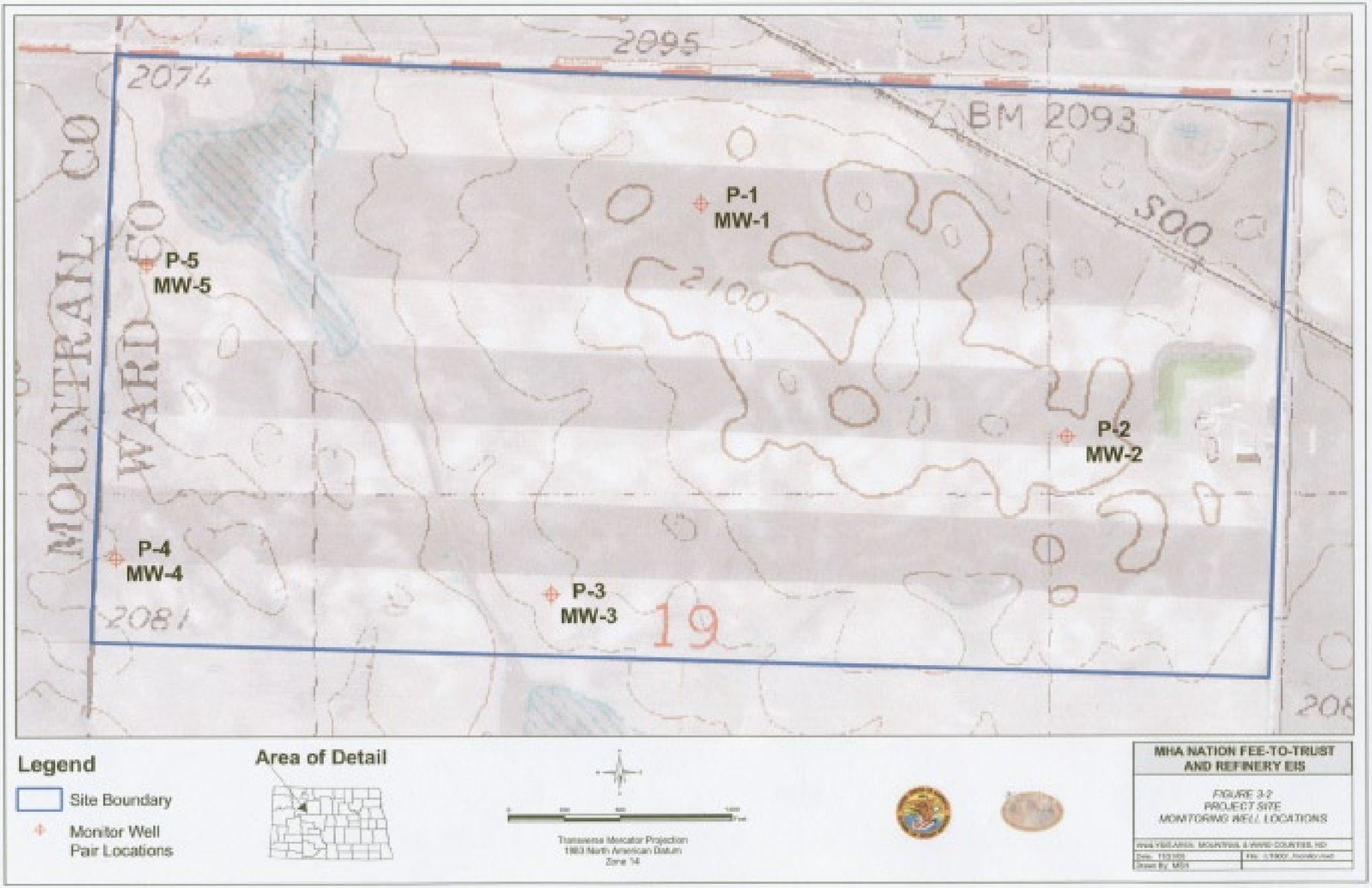
3.2.1 Geology at Project Site

In February 2005, GeoTrans completed five shallow (35-40 feet in depth) and five deep monitoring wells (110 to 125 feet deep) within the proposed refinery site (Figure 3-2). Based on the geologic logs from the five deep wells, the till deposits across the proposed refinery site range from 105 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). Based on the five deep wells, the thickest till occurs along the eastern boundary of the site. The geologic logs from the five deep wells indicate that the till is comprised primarily of clay from the surface to depths of 70 to 110 feet. In all five deep wells the logs describe silty sand to poorly graded sand layer that occurs beneath the clay. The sandy zones are about five to ten feet thick.

The Fort Union Formation under lays the glacial till layer at a depth of 105 to more than 125 feet below the ground surface. The Fort Union Formation is largely composed of layers of clay, silt, clayey sand, and silty sand. In four of the five deep wells, the first lignite deposit in the Fort Union Formation was encountered between 105 to 110 feet below the surface.



Source: Modified from Clayton 1972 and Bluemle 1989
Project Site
Makoti
23
MOUNTRAIL COUNTY
WARD COUNTY
0 0.5 1
Miles
LEGEND
Project Site
Highway
Road
Railroad
Ft. Berthold Reservation Boundary
Coleharbor Formation - Till Facies
Undulating surface of glacial sediment
Coleharbor Formation - Silt and Clay Facies
Lake to offshore to nearshore sediment.
Coleharbor Formation - Sand and Gravel Facies
Fluvial plains
Oahe Formation - Clay Facies
Pond and slough sediment
Other Formations
N
W
E
S
MHA NATION FEE-TO-TRUST AND REFINERY EIS
FIGURE 3-1
DESCRIPTIVE GEOLOGY OF THE PROJECT SITE AND ENVIRONS


2095
2074
BM 2093
500
2100
2081
19
MOUNTRAIL CO
WARD CO
P-1
MW-1
P-2
MW-2
P-3
MW-3
P-4
MW-4
P-5
MW-5
Legend
Site Boundary
Monitor Well
Pair Locations
Area of Detail
Transverse Mercator Projection
1983 North American Datum
Zone 14
MHA NATION FEE-TO-TRUST
AND REFINERY EIS
FIGURE 3-2
PROJECT SITE
MONITORING WELL LOCATIONS

3.2.2 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.

3.2.3 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).

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

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	Sentinel Butte
			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

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.

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

3.3 Ground Water Resources

EPA does not have the statutory authority to regulate ground water quality. To date, 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. Since the DEIS was published, the MHA Nation has started developing ground water quality standards.

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 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 to15 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. The geologic log for deep well P-5 does not indicate that the Sentinel Butte member was encountered. 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 upper part of 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 P–3, GeoTrans calculated a horizontal ground water flow velocity of 100 feet/year. This well is screened from 95 to 105 feet and is probably screened in the till. The log for well P-3 indicates that a poorly graded sand occurs from 95 to 103 feet and the first lignite is encountered is at 110 feet. The depth of the first lignite encountered is typically used to mark the top of the Sentinel Butte member of the Ft. Union formation. In the other four deep wells, horizontal ground water flow ranged from 0.03 to 0.5 feet/year. Wells P-1, P-2 and P-4 are screened below the first lignite and no lignite was encountered in well P-5. Ground-water flow velocities estimated from slug tests conducted on the shallow till wells MW-1, MW-2, MW-3 and MW-4 ranged from 0.37 to 2.36 ft/year. Geotrans (2006) concludes that, outside of the sand lens, the surrounding lower permeability of the silts and clays will determine the overall ground water flow velocity in the upper Fort Union formation of around 0.2 feet per year (GeoTrans, Inc. 2006).

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. The Tongue River formation is the next deepest layer of the Fort Union formation or group. As discussed above the upper layer of the Fort Union formation (Sentinel Butte formation) flows towards the southeast, a 90° difference in flow direction.

3.3.1 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 5x10-5 cm/sec to 3x10-6 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 2x10-2 cm/sec to 1x10-5 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. Thus to the extent that vertical ground water flow occurs through the till, the direction of the flow will be downward.

3.3.2 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).

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).

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
150-095-05BBA2[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
147-093-35CBC3[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

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).

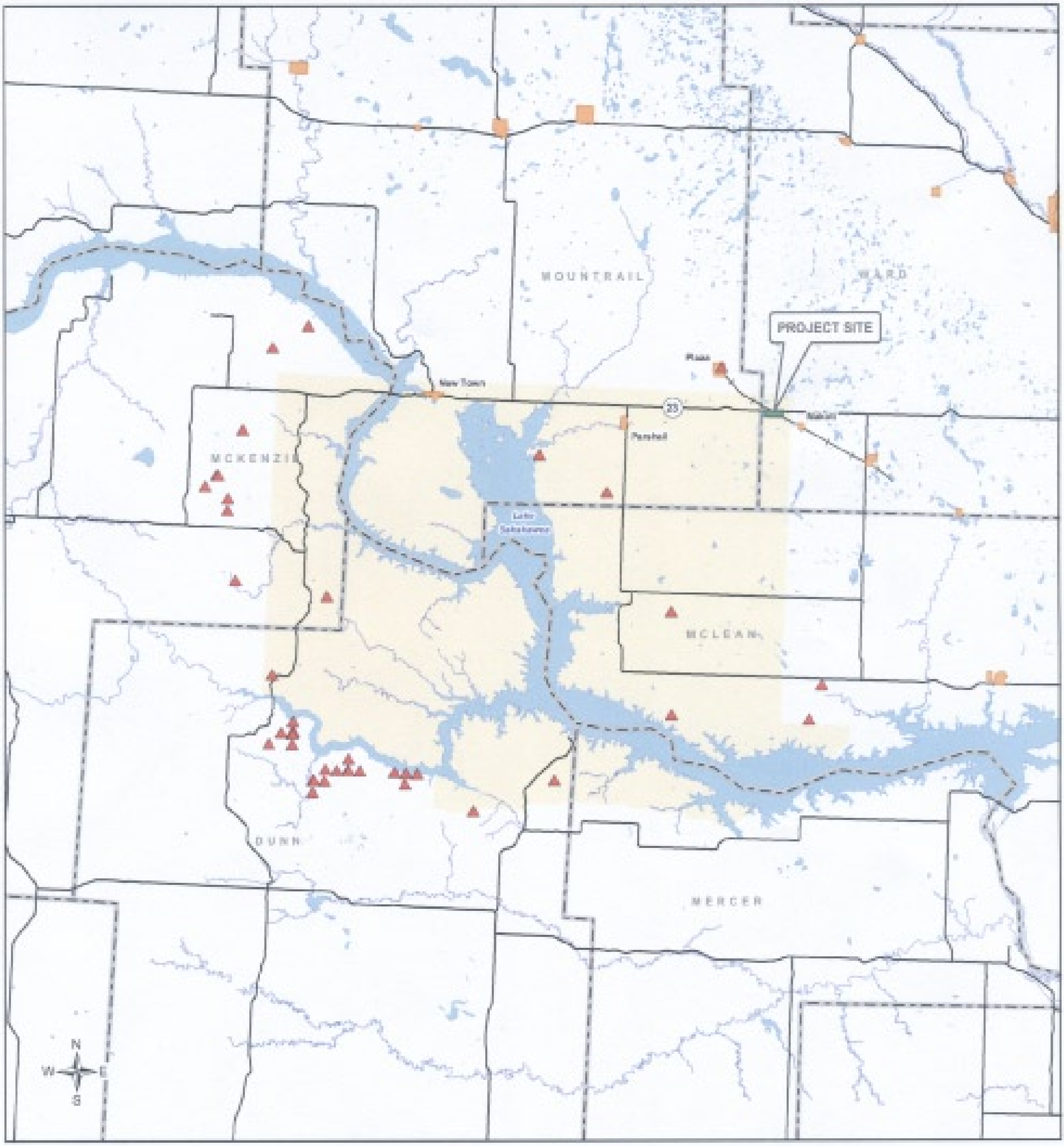
Recharge occurs primarily by infiltration of precipitation. Conversely, discharge is by lateral movement of water to adjacent areas, downward seepage into the Tongue River aquifer, seepage into streams and springs, and wells (Cates and Macek-Rowland 1998).

3.3.3 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).

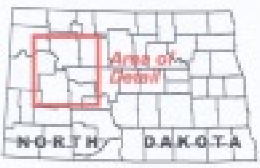
Yields from the above-mentioned aquifers are highly variable and water from these sources is typically very hard. The East Fork of Shell Creek aquifer was previously used by Parshall as their local water supply and yields from this aquifer may be as high 150 gpm, but typically will be less than 50 gpm (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).



LEGEND

- Railroad
- State Highway
- County Boundary
- Well Locations
- MHA Nation
- Project Site



0 2.5 5 10 15

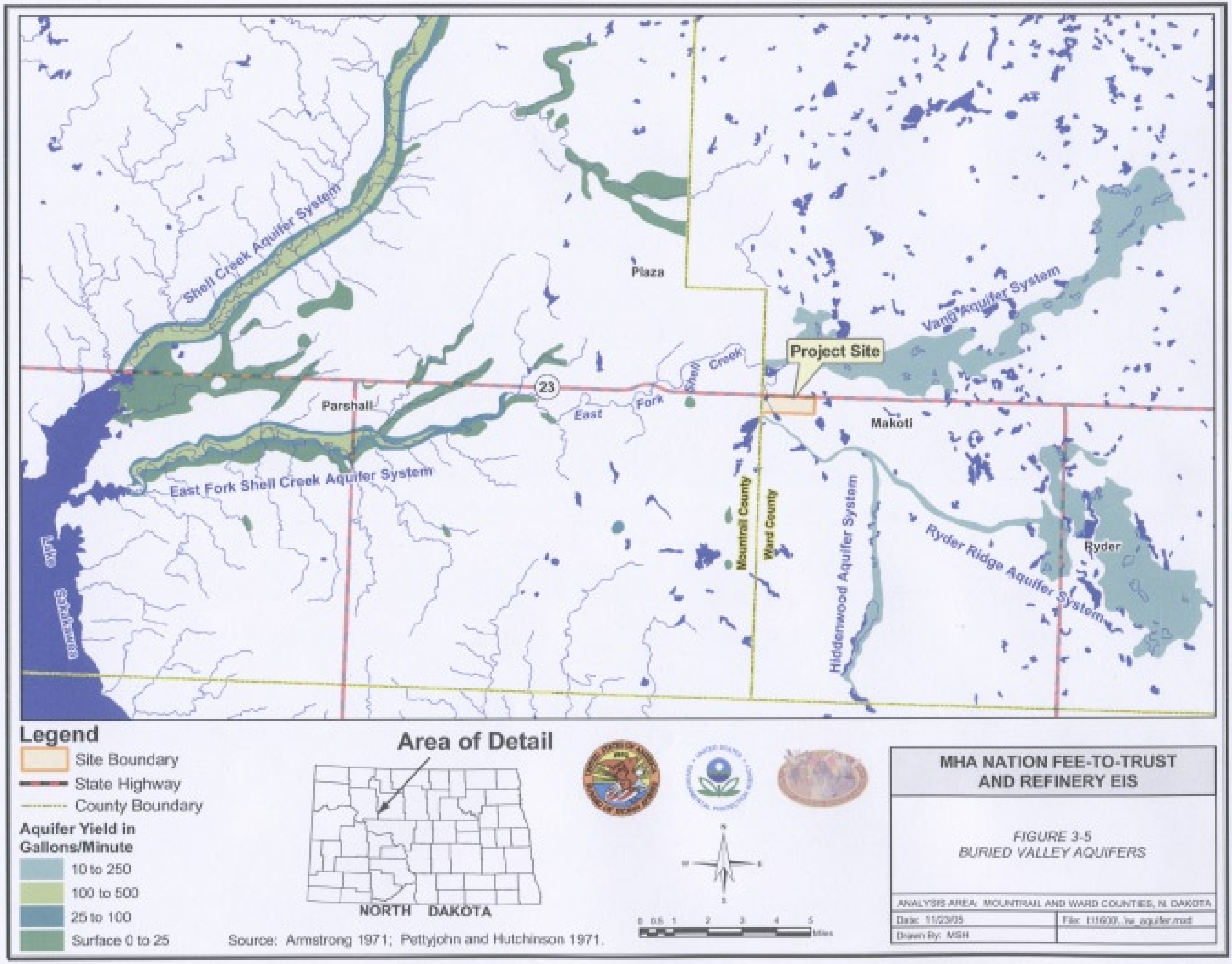
Miles

Well Data Source: Wald and Cates, 1995.

MHA NATION FEE-TO-TRUST AND REFINERY EIS

FIGURE 3-4
WELLS WITHIN THE FOX HILLS-HELL CREEK AQUIFERS

ANALYSIS AREA: MOUNTRAIL AND WARD COUNTIES, N. DAKOTA	
Date: 11/23/05	File: I:\1600L.[illegible]\Wells.mxd
Drawn By: CR	Wells.pdf



Shell Creek Aquifer System
Plaza
Vang Aquifer System
Project Site
Shell Creek
23
East Fork
Parshall
Makoti
East Fork Shell Creek Aquifer System
Mountrail County
Ward County
Hiddenwood Aquifer System
Ryder Ridge Aquifer System
Ryder
Legend
Site Boundary
State Highway
County Boundary
Aquifer Yield in Gallons/Minute
10 to 250
100 to 500
25 to 100
Surface 0 to 25
Area of Detail
NORTH DAKOTA
Source: Armstrong 1971; Pettyjohn and Hutchinson 1971.
0 0.5 1 2 3 4 5
Miles
MHA NATION FEE-TO-TRUST AND REFINERY EIS
FIGURE 3-5
BURIED VALLEY AQUIFERS
ANALYSIS AREA: MOUNTRAIL AND WARD COUNTIES, N. DAKOTA
Date: 11/23/05
Drawn By: MSH

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 ¾ 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 outwashes, 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 square feet 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.

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 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).

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 gpd (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).

3.3.4 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.

3.3.4.1 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 Total Dissolved Solid (TDS). TDS concentrations typically exceed 1,500 milligrams per liter (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 $CaCO_3$), 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.

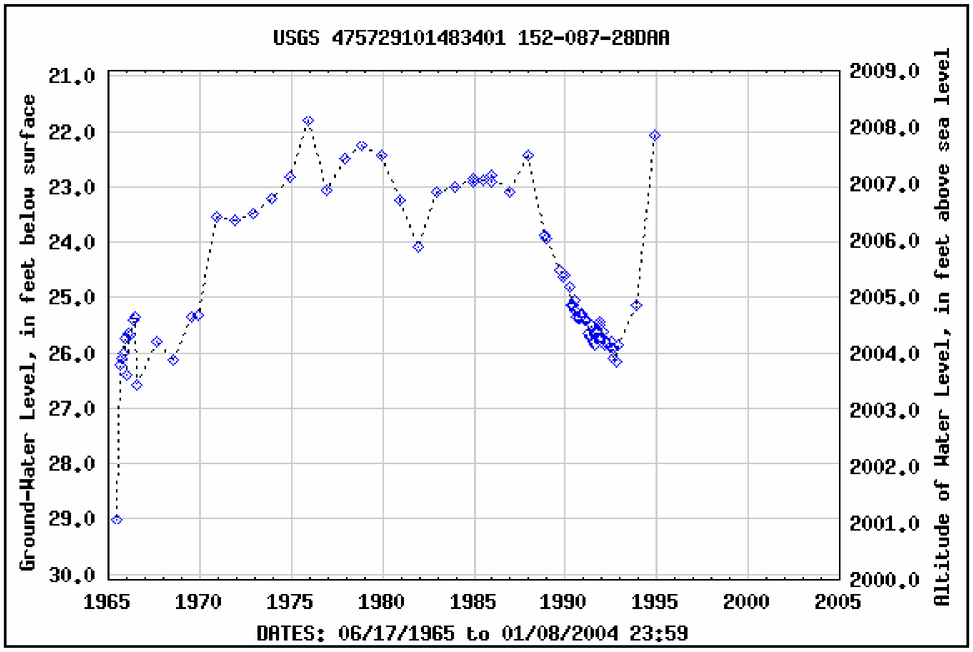


Figure 3-6 Ground Water Levels — Hiddenwood Lake Aquifer

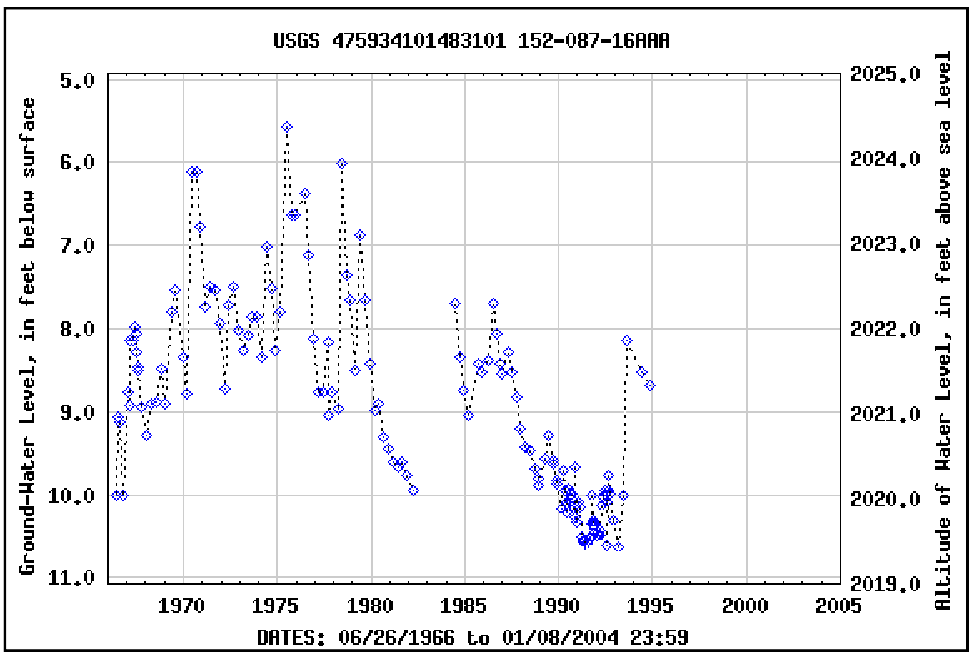


Figure 3-7 Ground Water Levels — Vang Aquifer

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 Formation typically has a very high sodium adsorption ratio (SAR) with values typically exceeding 80. The combination of high salinity (measured as 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 NDDH 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 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 NDDH, 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 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. TDS 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).

3.3.4.2 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 TDSs 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 µ S/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).

3.3.4.3 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 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
- TDS 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 18 O 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 18 O values for precipitation are more depleted (more negative) with increasing latitude. The delta 18 O 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 in the Fort Union Formation had higher TDS, total alkalinity, and sodium as compared to the shallow wells in the Coleharbor Formation.

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

3.4 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 northwestward 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 (Garrison 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.

3.4.1 Applicable Regulatory Requirements — Clean Water Act

3.4.1.1 Section 402 NPDES Permitting Requirements

Section 402 of the CWA establishes the NPDES regulatory program. Pursuant to Section 402, point sources discharging pollutants into "waters of the U.S." must obtain NPDES permits from the appropriate governmental body. EPA issues NPDES permits on the Fort Berthold Reservation because 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 will require an NPDES permit for discharges of stormwater associated with construction of the facility. The draft NPDES discharge permit for facility operations is attached in Appendix C.

3.4.1.2 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 USACE, 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 CFR 230, et seq.). 33 CFR 331 sets forth the CWA Section 404 permit appeal process. The USACE 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.

3.4.1.3 Section 401 Certification Requirement

Section 401 of the CWA 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 CWA Sections 301, 302, 303, 306 and 307. This includes any CWA 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, Section 401 certification must be obtained from EPA.

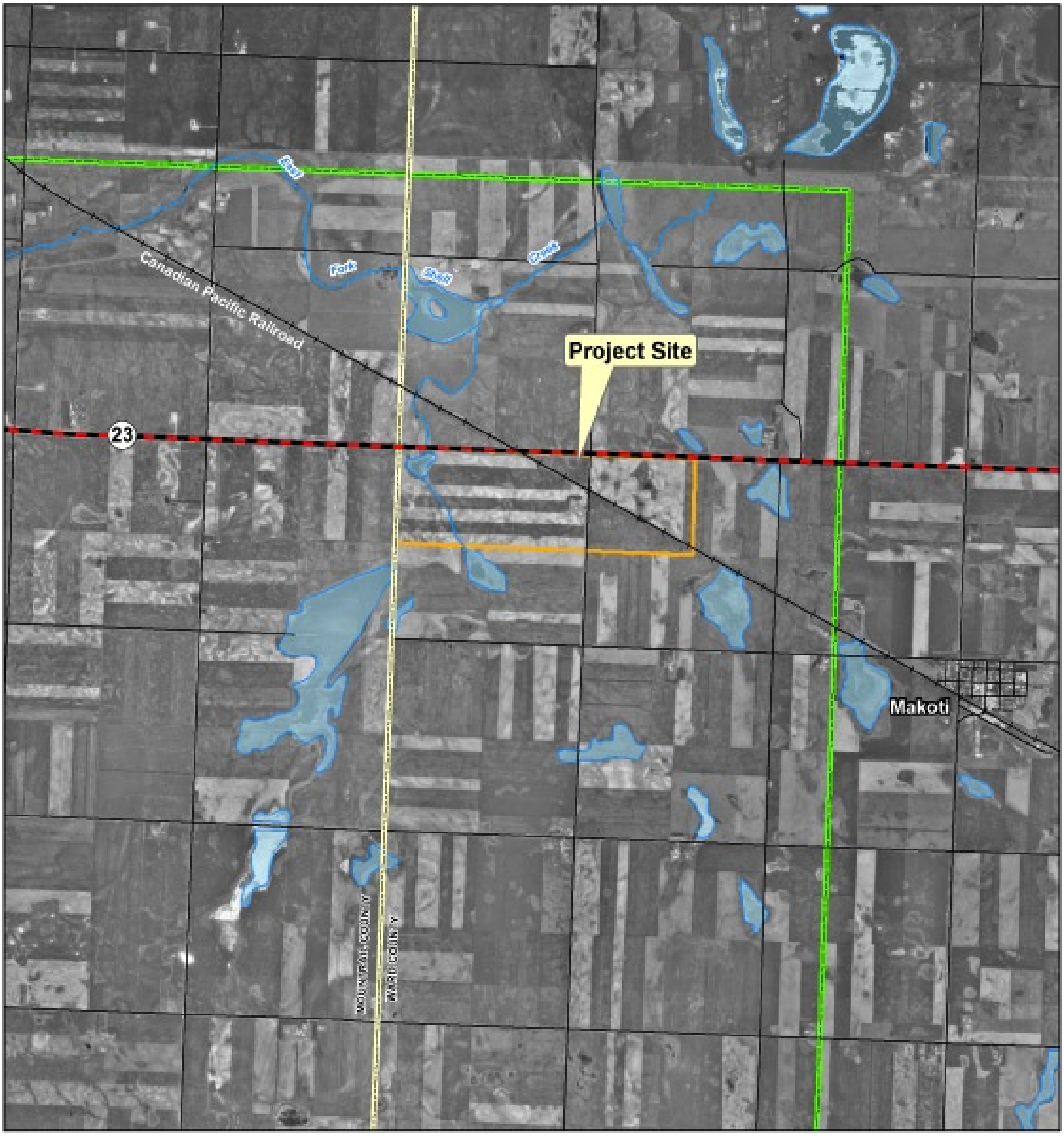
3.4.2 Water Quality Regulatory Requirements

Water quality standards are the foundation of the water-quality-based control program mandated by the CWA. Water quality standards define the goals for a water body 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) ***antidegradation policy*** to maintain and protect existing uses and high quality waters, and



Legend

- Site Boundary
- Railroad
- State Highway
- County Boundary
- Road
- Lake/Wetland
- River/Stream
- Reservation Boundary

Area of Detail

0 0.25 0.5 1 Miles

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FIGURE 3-8
SURFACE WATER RESOURCES ON THE PROJECT SITE AND ENVIRONS

ANALYSIS AREA: MOUNTRAIL AND WARD COUNTIES, N. DAKOTA

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(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. Under the CWA, the permitted discharge must include effluent limitations as stringent as necessary to meet the State of North Dakota surface water quality standards where the water crosses the boundary onto non-Indian country lands. EPA's CWA § 304(a) criteria recommendations form the basis for North Dakota's numeric criteria. Although EPA has not approved water quality standards for the Fort Berthold Indian Reservation waters, EPA considered the Tribal and State standards in determining appropriate effluent limitations for the NPDES permit. The specific water quality standards and criteria are shown in the Statement of Basis for the NPDES discharge permit attached in Appendix C.

3.4.2.1 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 water body 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 CWA purposes. Also, although EPA has approved North Dakota water quality standards for waters within the State of North Dakota, EPA has not approved the State's standards for waters that are within Indian country, as defined in 18 U.S.C. Section 1151. In addition, EPA has not approved a non-federal NPDES permit program for the Reservation under CWA Section 402. Therefore, EPA administers the CWA on the Fort Berthold Indian Reservation.

3.4.2.2 Impaired Water Bodies

Section 303(d) of the CWA 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 (TMDL), 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. While EPA has not approved water quality standards for the waters on the Reservation, EPA considers the Tribe's and State's standards in determining appropriate designated uses for 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 CWA Section 303(d) TMDL Waters in the Missouri River Basin (North Dakota Department of Health 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 CWA, 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 (SPCC Plans) and plans to respond to a worst case discharge of oil and to a substantial threat of such a discharge (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.

3.4.3 Applicable Regulatory Requirements — Safe Drinking Water Act

EPA implements the 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 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: 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.

3.4.4 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. Depending upon the saturation of the area and elevation of standing water in upstream areas, the tributary's drainage area is approximately 11,470 acres or 17 square miles. 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 at the project site.

3.4.5 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 06332523[2] (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 record 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.

[2] 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.

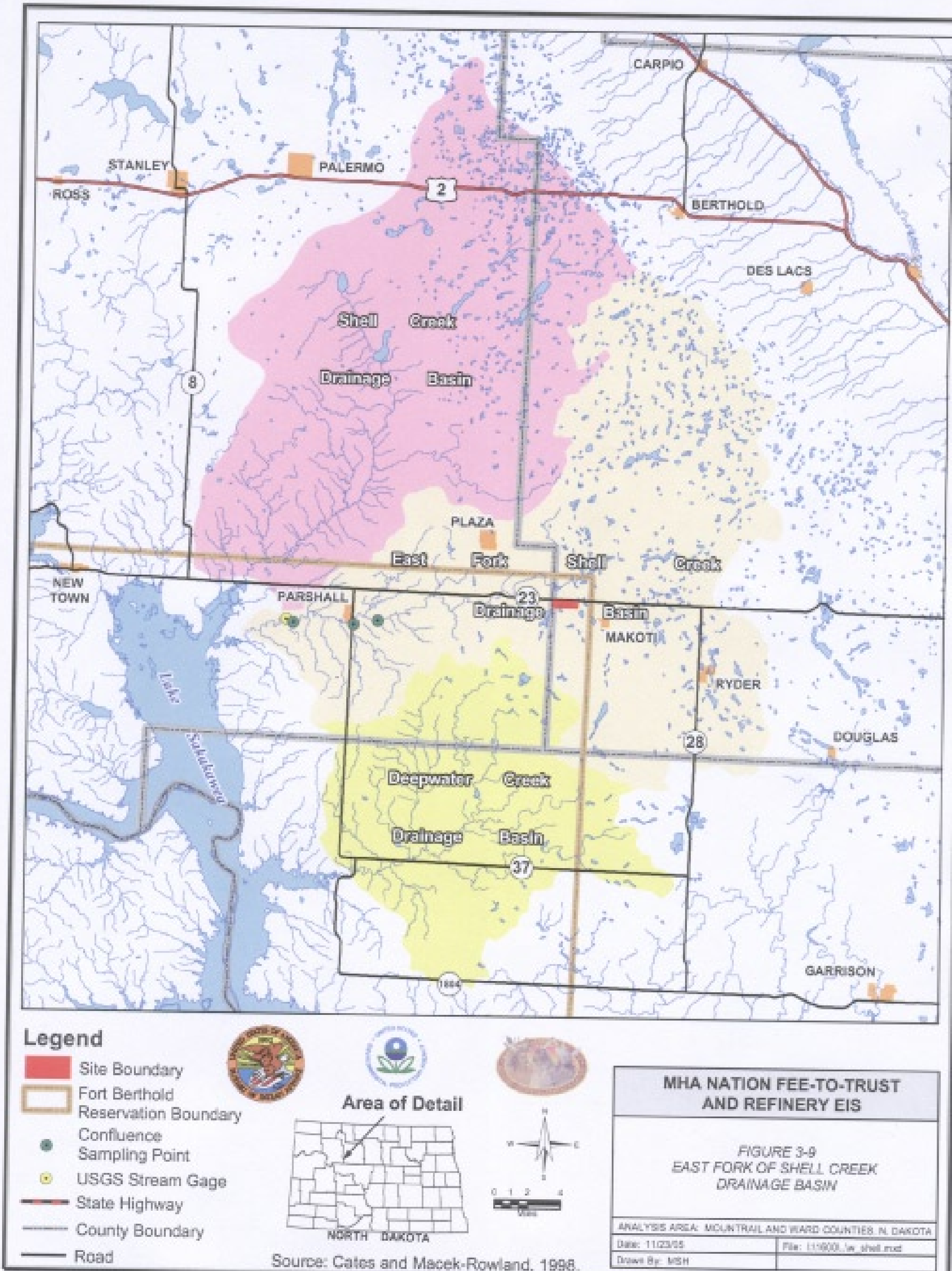
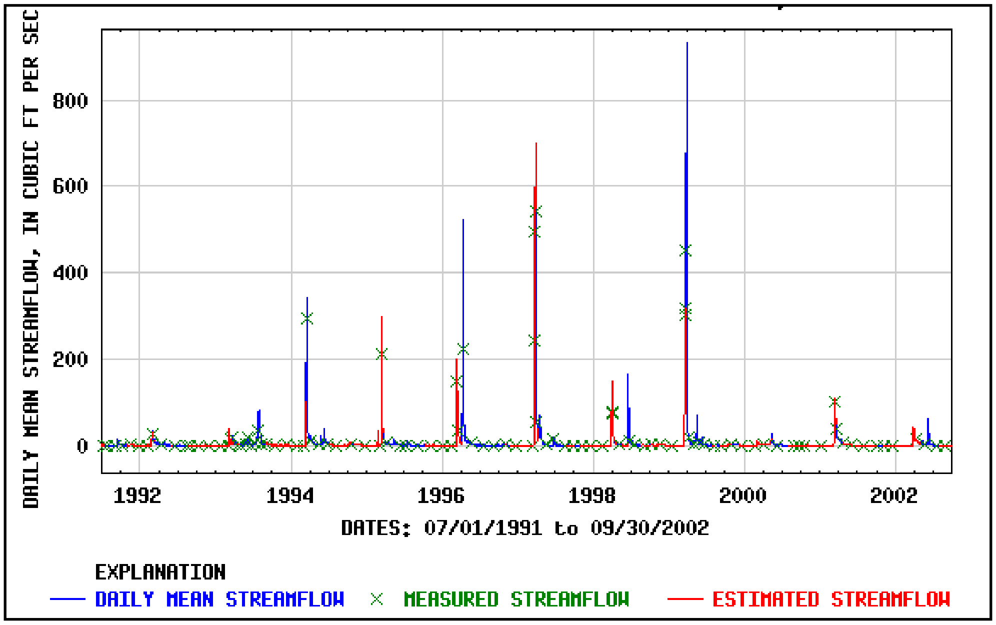


FIGURE 3-9
EAST FORK OF SHELL CREEK DRAINAGE BASIN

3.4.6 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.

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).

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 TDSs (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 µg/L) whereas arsenic concentrations (0 to 9 µ 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.

3.4.6.1 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).

3.4.6.2 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.

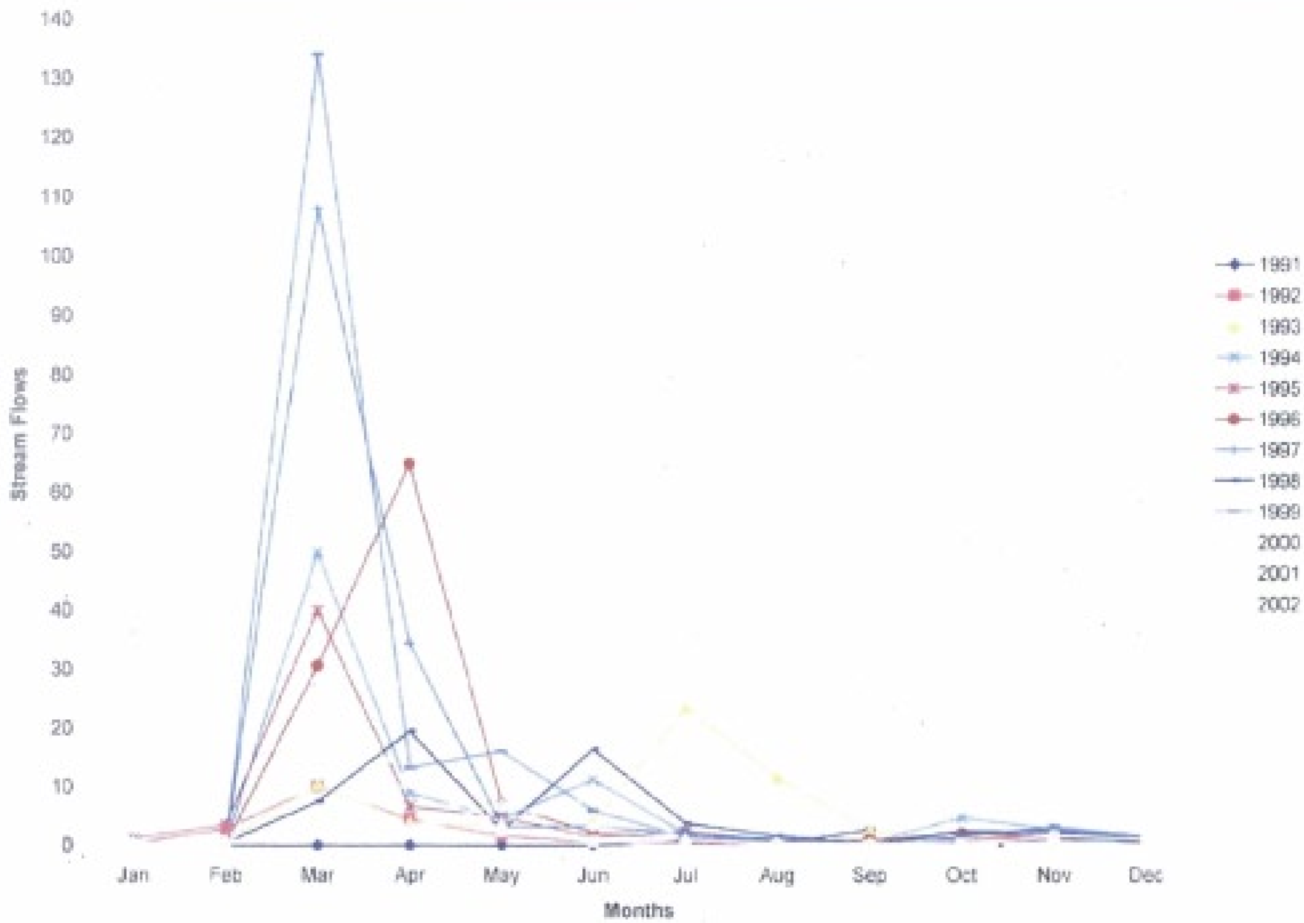


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FIGURE 3-11
HYDROGRAPH FOR MEASURED DAILY MEAN STREAM FLOW, MEASURED STREAM FLOW, AND ESTIMATED STREAM FLOW FOR THE EAST FORK OF SHELL CREEK

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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.

3.4.6.3 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.

3.4.6.4 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 13^{th} 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, herbicides, 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.

3.4.7 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.

3.4.7.1 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. Local residents in the area typically use the wells for their livestock only. Residents purchase and haul water, using a cistern system for household water use. In addition, most residents separately haul in water for drinking and cooking.

Horace Pipe (2006), an employee of the MHA Nation, 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 that 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.

3.4.7.2 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.

3.4.7.3 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.

3.4.7.4 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).

3.5 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 ⅔ of the land use is cropland with the remaining ⅓ 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).

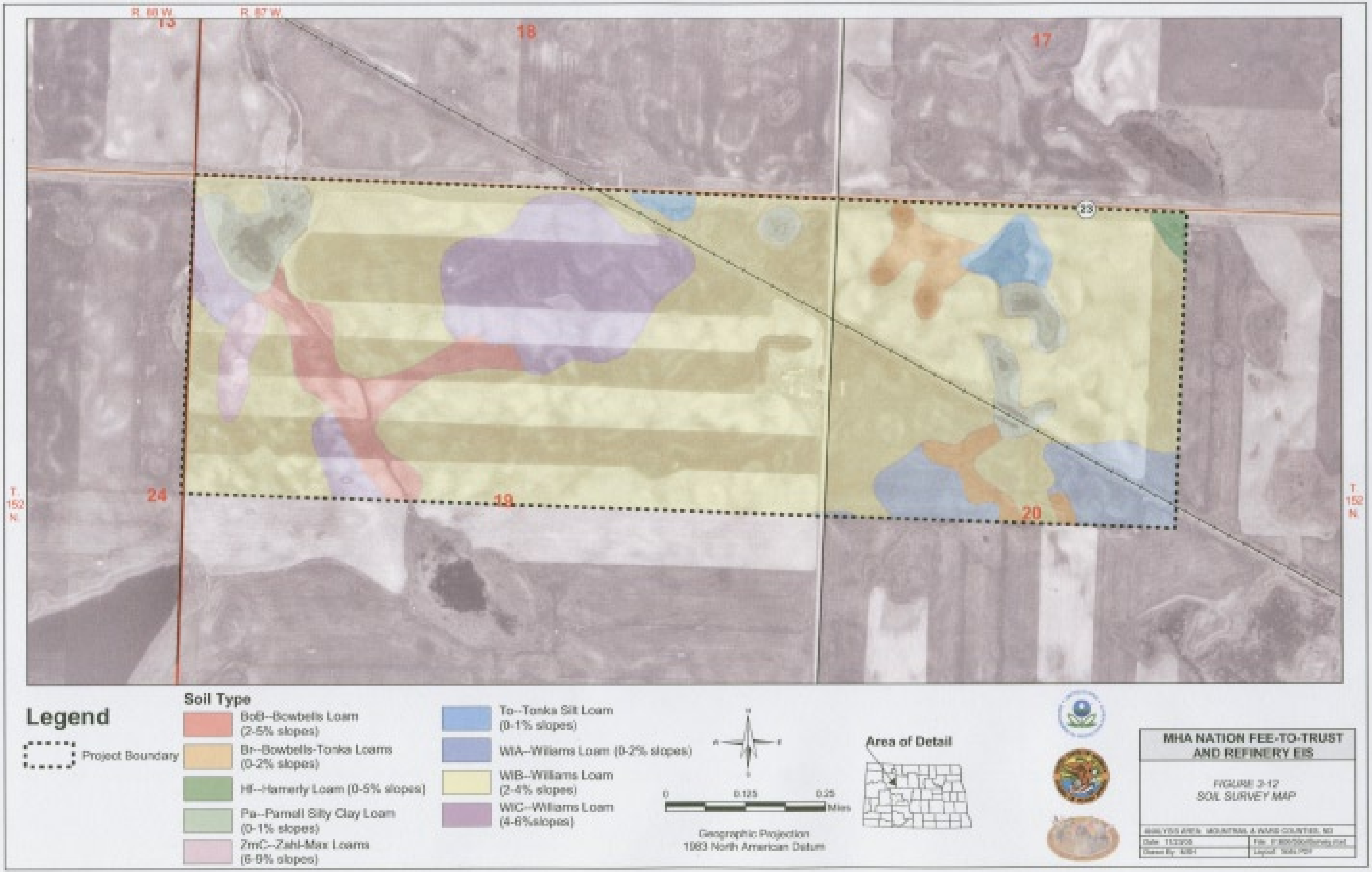
3.5.1 Soil Mapping Units

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.

3.5.1.1 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.



R. 88 W.
R. 87 W.
13
18
17
23
T.
152
N.
24
19
20
T.
152
N.
Legend
Project Boundary
Soil Type
BoB--Bowbells Loam (2-5% slopes)
Br--Bowbells-Tonka Loams (0-2% slopes)
Hl--Hamerly Loam (0-5% slopes)
Pa--Parnell Silty Clay Loam (0-1% slopes)
ZmC--Zahl-Max Loams (6-9% slopes)
To--Tonka Silt Loam (0-1% slopes)
WlA--Williams Loam (0-2% slopes)
WlB--Williams Loam (2-4% slopes)
WlC--Williams Loam (4-6%slopes)
0
0.125
0.25
Miles
Geographic Projection
1983 North American Datum
Area of Detail
MHA NATION FEE-TO-TRUST AND REFINERY EIS
FIGURE 3-12
SOIL SURVEY MAP

3.5.1.2 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.

3.5.1.3 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.

3.5.1.4 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

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.

3.5.1.5 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.

3.5.1.6 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.

3.5.1.7 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.

3.5.2 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

3.6 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**

3.6.1 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 ground water 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.

3.6.1.1 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 (FACW) species 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 wooly 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.

3.6.1.2 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 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 borders the basin associated within this wetland.

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.

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 18 O values shown for the two wetland locations are much more enriched in 18 O (-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).

3.6.2 Mixed-Grass Prairie

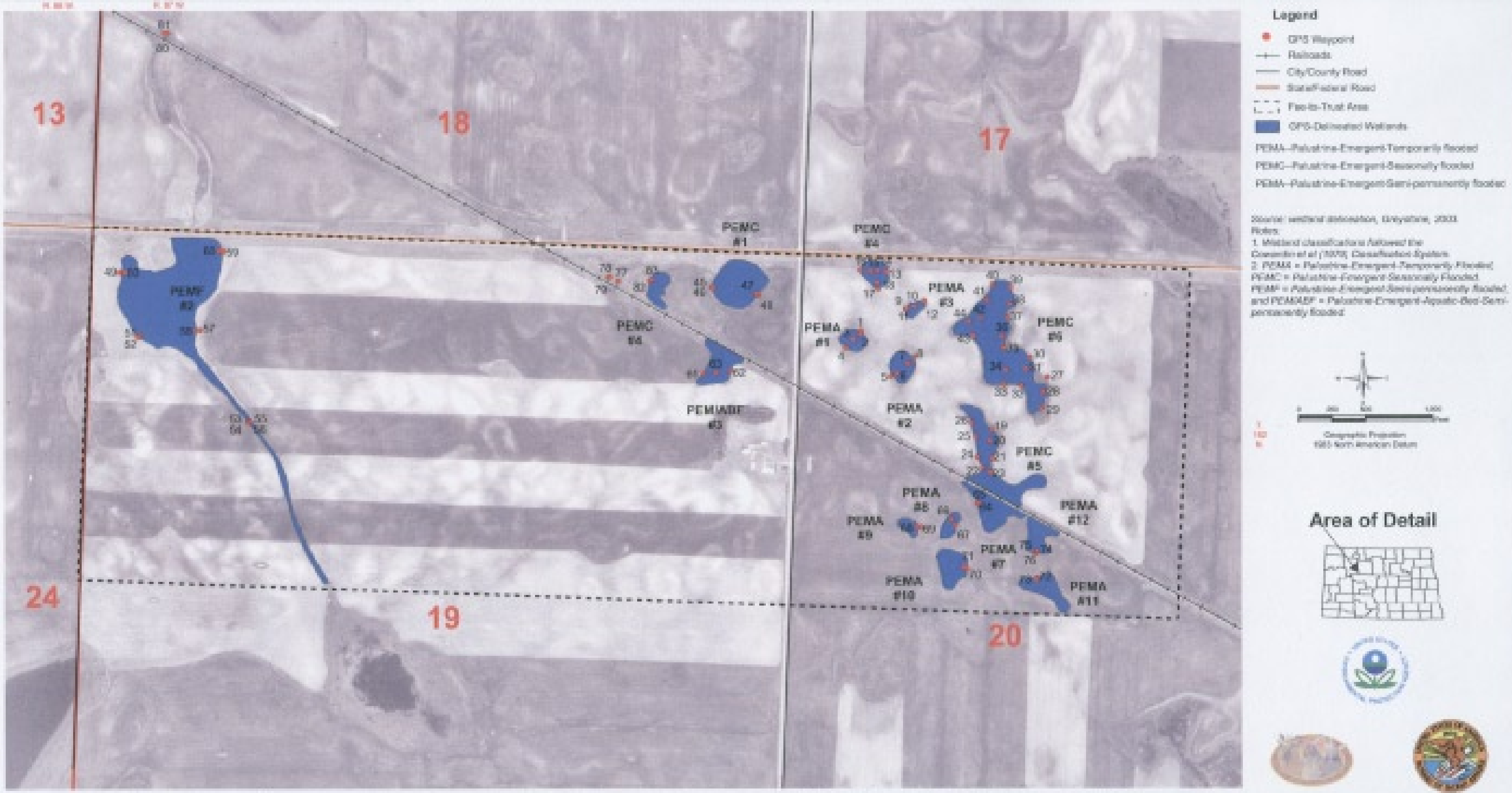
The mixed-grass prairie ecoregion occupies the northern limits of the boreal forests of Manitoba, Saskatchewan and Alberta, south to north-central Nebraska, and was historically one of the largest ecosystems in North America, originally covering about 69 million hectares or 171 million acres (Samson et al. 1998). Within both Ward and Mountrail Counties, most of the remaining mixed-grass prairie is used for rangeland[3]. 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 and subsequent soils are generally unsuited or, at best, poorly suited for producing cultivated agricultural crops. 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.

3.6.3 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.

[3] 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).



MHA NATION FEE-TO-TRUST AND REFINERY EIS

FIGURE 3-13
WETLANDS DELINEATION MAP

ANALYSIS AREA, MOUNTRAIL & WARD COUNTIES, ND

Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description	Waypoint	Description
1	[illegible]	11	[illegible]	21	[illegible]	31	[illegible]	41	[illegible]	51	[illegible]	61	[illegible]	71	[illegible]	81	[illegible]
2	[illegible]	12	[illegible]	22	[illegible]	32	[illegible]	42	[illegible]	52	[illegible]	62	[illegible]	72	[illegible]	82	[illegible]
3	[illegible]	13	[illegible]	23	[illegible]	33	[illegible]	43	[illegible]	53	[illegible]	63	[illegible]	73	[illegible]	83	[illegible]
4	[illegible]	14	[illegible]	24	[illegible]	34	[illegible]	44	[illegible]	54	[illegible]	64	[illegible]	74	[illegible]		
5	[illegible]	15	[illegible]	25	[illegible]	35	[illegible]	45	[illegible]	55	[illegible]	65	[illegible]	75	[illegible]		
6	[illegible]	16	[illegible]	26	[illegible]	36	[illegible]	46	[illegible]	56	[illegible]	66	[illegible]	76	[illegible]		
7	[illegible]	17	[illegible]	27	[illegible]	37	[illegible]	47	[illegible]	57	[illegible]	67	[illegible]	77	[illegible]		
8	[illegible]	18	[illegible]	28	[illegible]	38	[illegible]	48	[illegible]	58	[illegible]	68	[illegible]	78	[illegible]		
9	[illegible]	19	[illegible]	29	[illegible]	39	[illegible]	49	[illegible]	59	[illegible]	69	[illegible]	79	[illegible]		
10	[illegible]	20	[illegible]	30	[illegible]	40	[illegible]	50	[illegible]	60	[illegible]	70	[illegible]	80	[illegible]		

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 and 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.

3.6.4 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 ROW 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.

3.6.5 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.

3.7 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.

3.7.1 Mammals

A number of terrestrial mammalian species may occur in the project area. Big game mammals, such as pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphania*) and other prairie-adapted species primarily occur as transients because of the conversion to agricultural lands from prairie grassland. 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.

3.7.2 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 (*Zenaida 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.

3.7.3 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.

3.7.4 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.

3.7.5 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.

3.7.6 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 ESA 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.

3.7.6.1 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).

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 occasionally 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.

3.7.6.2 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). On July 6, 1999, the bald eagle was proposed for delisting (U.S. Fish and Wildlife Service 1999), and this proposal was made effective August 8, 2007, (72 *Federal Register* 37345-37372). While the bald eagle has been removed from the list of threatened and endangered species, it is still afforded special protections under the Bald Eagle Protection Act, the Migratory Bird Treaty Act and is a special status species for many states, tribes and agencies.

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 (*Sterna antillarum*)	May 28, 1985; Endangered (50 *Federal Register* 21784–21792)	Nests along midstream sandbars of the Missouri and Yellowstone Rivers.	None designated.
Whooping crane (*Grus Americana*)	March 11, 1967; Endangered (32 *Federal Register* 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 (*Scaphirhynchus albus*)	September 6, 1990; Endangered (55 *Federal Register* 36641–36647)	Known only to occur in the Missouri and Yellowstone Rivers.	None designated.

Species	Federal Listing Status	Habitat	Critical Habitat
Bald eagle (*Haliaeetus leucocephalus*)	February 14, 1978; Threatened (43 *Federal Register* 6233) Delisted August 8, 2007 (42 *Federal Register* 37346-37372)	Migrates spring and fall statewide, but primarily along the major river courses.	None designated.
Piping plover (*Charadrius melodus*)	December 11, 1985; Threatened (*Federal Register* 50726–50734)	Nests on midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands.	September 11, 2002 (67 *Federal Register* 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 (*Canis lupus*)	Threatened	Occasional visitor in North Dakota and is most frequently observed in the Turtle Mountains area.	None designated.
Dakota skipper (*Hesperia dacotae*)	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.

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 roosts 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.

3.7.6.3 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.

3.7.6.4 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.

3.7.6.5 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).

3.7.6.6 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 population 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).

3.7.6.7 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 Sheyenne 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).

3.7.7 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.

3.8 Cultural Resources

3.8.1 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.

3.8.2 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 plains 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 and 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.

3.8.3 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.

The Allotment Act of 1888 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 other actions 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 C.P.R., 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 highway 23 have good access to the railroad at Makoti. The area of 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.

3.8.4 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.

3.9 Land Use

3.9.1 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 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 ROW.

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

3.9.2 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.P.R. 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 and 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.

3.10 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, highway 23, and highway 200. The project site is bounded on the north by highway 23, which would be the primary access route for the site. highway 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. Highway 23 also connects with highway 22, which provides an alternate connection with I–94 to the south. Highway 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 highway 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 highway 23	4,400	700
U.S. 83 north of junction with highway 200	2,900	470
U.S. 85 south of Watford City (highway 23)	2,250	525
Highway 23 between Makoti and highway 37	1,550	180
Highway 23 at intersection with U.S. 83	1,175	160
Highway 22 north of Killdeer (and highway 200)	1,000	95
Highway 200 at Killdeer	500	75
Highway 200 at Hazen	3,400	300
Highway 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 (highway 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 highway 200. North south travel on the west side of the Reservation is primarily along highway 22. North south travel on the east side of Lake Sakakawea is along U.S. 83.

In 2003, the 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 3-11 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.

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)

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

		Load restriction on gross weight			
				Three axles or more on divisible loads	
Highway	Load weight restricted by:	Single axle not to exceed (lbs/axle)	Tandem axles not to exceed (lbs/axle)	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
Highway 23	Class A load restriction	18,000	16,000	14,000	42,000
Highway 22	No. 1 Load restriction	15,000	15,000	12,000	36,000
Highway 200	Class A load restriction	18,000	16,000	14,000	42,000
Highway 200A	No. 1 Load restriction	15,000	15,000	12,000	36,000

3.11 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.

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.

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 highway 23. Other roads in the analysis area are unpaved BIA or county roads. The C.P.R. 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 C.P.R. 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 Highway 23, surrounding local roads, and rural residences. The project site is within the foreground to middleground views of motorists traveling east or west on Highway 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 highway 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 C.P.R. 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 Highway 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 Highway 23, and three residences are located along the corridor along 59th Avenue.

3.12 Air Quality

3.12.1 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.

3.12.1.1 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 season (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

	Precipitation by Station (inches)		
Period	**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.

3.12.1.2 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

	Temperature by Station[1] (°F)	
Month	**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 Climate Center 2004a and 2004b, North Dakota Agricultural Weather Network 2004

3.12.1.3 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.

3.12.2 Clean Air Act Regulations and Permit Requirements

3.12.2.1 Criteria Pollutants – National Ambient Air Quality Standards (NAAQS)

EPA has established NAAQS for the “criteria pollutants”: ozone, nitrogen dioxide (NO_2), CO, sulfur dioxide (SO_2), particles finer than 10 microns in size (PM_{10}), particles finer than 2.5 microns in size ($PM_{2.5}$) and airborne lead (Pb). These standards were developed to protect public health with an adequate margin of safety and to protect public welfare.

The CAA also directed EPA to develop regulatory programs aimed at reducing criteria pollutant emissions from stationary sources. EPA developed regulations that apply to both large and small sources of criteria pollutants.

Large Sources of Criteria Pollutants

Large sources of criteria pollutants are called "major sources." The term "major source" means any stationary source that has the potential to emit 100 tons per year or more of any criteria pollutant from specifically identified sources such as coal-fired power plants, refineries, and chemical plants and 250 tons per year or more for those sources not specifically listed by EPA.

Small Sources of Criteria Pollutants
Small sources of criteria pollutants are called "minor sources." The term "minor source" means any stationary source of criteria pollutants that is not considered a major source (see above). The proposed Clean Fuels Refinery would be classified as a new minor source.

EPA has developed requirements for specific categories of criteria pollutant emitting stationary sources at 40 CFR Part 60 of the EPA regulations. Approximately 100 different regulations have been developed for sources emitting criteria pollutants. These regulations apply to both major and minor sources.

3.12.2.2 Hazardous Air Pollutants

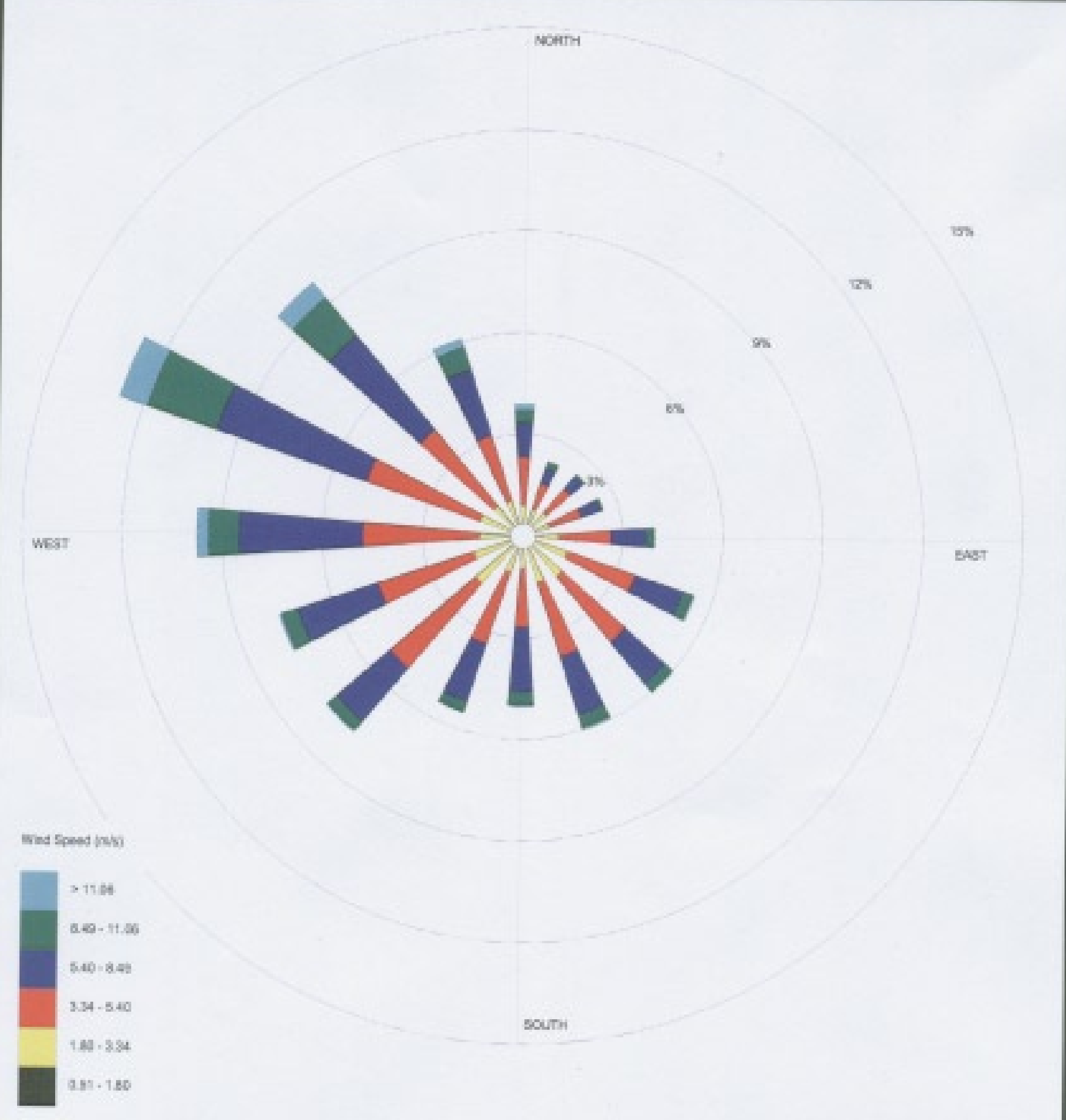
HAPs are regulated by EPA under authority of Title I, part A, Section 112 of the CAA. HAPs are those pollutants that are known to cause or are suspected of causing cancer, birth defects, reproduction problems, and other serious illnesses. Exposure to certain levels of some of these HAPs can cause difficulty in breathing, nausea or other illnesses. Exposure to certain HAPs can even cause death. The CAA identifies 189 individual HAPs and directs EPA to develop regulations to mitigate these HAPs. The list of HAPs can be found in the CAA at Section 112(b).

The majority of HAPs come from manmade sources, such as factory smokestack emissions and motor vehicle exhaust. HAPs are also released from industrial sources, such as chemical factories, refineries, and incinerators, and even from small industrial and commercial sources, such as gas stations, dry cleaners and printing shops. EPA has developed regulations for both large and small sources of HAPs, but has mainly focused its efforts on larger sources.

Large Sources of HAPs
Large sources of HAPs are called "major sources." The term "major source" means any stationary source that has the potential to emit 10 tons per year or more of any single HAP or 25 tons per year or more of all combined HAPs emitted from a stationary source.

Small Sources of HAPs
Small sources of HAPs are called "area sources." The term "area source" means any stationary source of HAPs that is not a considered a major source (see above). These are minor sources of HAPs, but are referred to as “area sources.” Based on the information submitted, the refinery is expected to be an "area source".

EPA has developed requirements for specific categories of HAP emitting stationary sources at 40 CFR Part 63 of the EPA regulations. Approximately 118 different types of sources have HAP regulations that apply to them and each one of those regulations may have requirements for both major and area sources of HAPs.



Station 24013 (Minot/FAA Airport, ND)

Avg. Wind Speed	5.49	m/s
Percent Calm Winds	3.16	percent
Wind Direction	Blowing From	

Years: 1984, 1985, 1987, 1988

MHA NATION FEE-TO-TRUST AND REFINERY EIS

FIGURE 3-14

SURFACE WIND SPEED WIND ROSE

Date: 9/21/2004 | File: min-rose.xls

3.12.2.3 Clean Air Act Permitting

There are three different types of permits that are issued to stationary sources of air pollution:

- Major source pre-construction permits (Major New Source Review (NSR) or more commonly called a PSD permit);
- Minor source pre-construction permits (Minor NSR); and
- Major source operating permits (Title V).

Major NSR or PSD Permitting
Major NSR permitting is required for proposed new or modified major sources of criteria pollutants before the source has been constructed. Both EPA and States have the authority to issue these permits. EPA issues these permits in Indian Country, which are not expected to apply to the refinery.

Minor NSR Permitting
Minor NSR permitting is required for proposed new or modified minor sources of criteria pollutants and new or modified area sources of HAPs before the source has been constructed. Minor NSR permitting can also be used by proposed major sources of criteria and HAP pollutants to create artificially minor sources.

States have minor NSR permitting programs and those programs vary considerably from state to state. However, there is no minor NSR permitting program for sources proposing to operate in Indian Country, although EPA has developed a program that has not yet become a final rule.

Title V Operating Permits
Title V permits apply emission limits, operational controls and practices, equipment requirements, reporting etc., to sources within the facility during day-to-day operations, after it has been built. The permitting agencies (State, Local, Tribal, and EPA) must issue Title V operating permits for all sources that emit 100 tons per year or more of criteria air pollutants, all major HAPs sources, and some smaller criteria and HAP sources as specified in regulation.

Emission limits and requirements to install air pollution control equipment are generally not created in Title V permits. Unlike NSR permits, Title V permits generally do not create new requirements. Basically, the Title V permits consolidate all the federally enforceable applicable requirements from the CAA for a particular facility. This makes it easier for facilities to comply with their air quality obligations, for agencies to track compliance, and for the public to review permits and monitoring data for specific facilities. The proposed refinery will need a Title V permit.

3.12.2.4 Criteria Pollutants and Ambient Air Quality Standards

The NAAQS and the State of North Dakota's ambient air quality standards are presented in Table 3–15. 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[2,3]	NAAQS[4]	North Dakota AAQS[5]
NO_2	Annual	100	100
CO	1-Hour	40,000	40,000
	8-Hour	10,000	10,000
$PM_{2.5}$	24-Hour	35	
	Annual	15	
PM_{10}	24-Hour	150	150
SO_2	1-Hour		715
	3-Hour	1,300	
	24-Hour	365	260
	Annual	80	60
Ozone	1-Hour	235	235
	8-Hour	157	
Pb	Calendar Quarter	1.5	1.5
H_2S	1-Hour		280
	24-Hour		140

Notes:
1. µg/m³ = micrograms per cubic meter
2. For 1-, and 8-, and 24-hour standards the modeled impacts are 1st highest short term values, except $PM_{2.5}$.
3. For the 24-hour $PM_{2.5}$ standard the modeled impacts are the 98th percentile value, per the standard requirements.
4. National Ambient Air Quality Standards (40 CFR 50).
5. AAQS = Ambient Air Quality Standards

Federal PSD requirements provide three area classifications that establish the amount of allowable air quality deterioration in areas where the air quality meets the NAAQS. Deterioration is determined by the increase of a pollutant's 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 PSD areas that are not Class I. As shown in Table 3–16, the CAA and PSD regulations have established much lower increments for Class I areas than for Class II areas

Table 3-16 Summary of PSD Increment Standards (µg/m³)

Pollutant	Averaging Period	PSD Increments	
		Class I	Class II
NO_2	Annual	2.5	25
PM_{10}	24-Hour	8	30
SO_2	3-Hour	25	512
	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 (LW) (58 kilometers north of the project site) and Theodore Roosevelt National Park (TRNP) (112 kilometers southwest of the project site).

Existing Ambient Air Quality

SO_2 and PM_{10} 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 SO_2 Monitoring Data

	SO_2 Ambient Concentrations ($\mu g/m^3$)[1]		
Year	**3-Hour Maximum**	**24-Hour Maximum**	**Annual Average**
2006	42.6	16.0	3.7
2005	45.3	16.0	3.7
2004	66.6	24.0	4.0
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
Maximum	**106.5**	**31.9**	**4.3**

Note: 1 ($\mu g/m^3$) = micrograms per cubic meter

Table 3-18 Summary of White Shield PM_{10} Monitoring Data

Year	PM_{10} Ambient Concentrations ($\mu g/m^3$) [1] 24-Hour Maximum
2006	29
2005	16
2004	16
2003	33
2002	27
2001	37
2000	23
1999	19
Maximum	**37**

Note: 1 ($\mu g/m^3$) = micrograms per cubic meter

The nearest nitrogen dioxide (NO_2) and $PM_{2.5}$ monitoring sites are in Beulah, North Dakota, which is 47 miles (76 kilometers) south of the project site. Table 3–19 and Table 3-20 present summaries of the ambient concentration data collected at this monitoring site.

Table 3-19 Summary of Beulah $PM_{2.5}$ Monitoring Data

	$PM_{2.5}$ Ambient Concentrations ($\mu g/m^3$) [1]	
Year	**24-Hour 98th Percentile**	**Annual Arithmetic Mean**
2006	18.9	6.26
2005	18.5	5.58
2004	10.8	5.63
2003	24.5	7.24
2002	15.5	5.93
2001	16.1	5.86
2000	11.5	6.12
1999	20.9	6.91

Note: 1 ($\mu g/m^3$) = micrograms per cubic meter

Table 3-20 Summary of Beulah NO_2 Monitoring Data

Year	NO_2 Ambient Concentrations Annual Average (μg/m^3)
2006	5.0
2005	4.8
2004	5.7
2003	5.7
2002	6.5
2001	6.9
2000	7.1
1999	6.9
Maximum	**7.1**

Note: 1 (μg/m^3) = micrograms per cubic meter

Ambient concentration data for CO is presented in Table 3-21 for the monitoring site in Fargo, North Dakota.

Table 3-21 Summary of Fargo CO Monitoring Data

	CO Ambient Concentrations (μg/m^3) [1]	
Year	1-Hour Maximum	8-Hour Maximum
1994	8386	5474
1993	10,832	3727
1992	6290	3378
1991	6988	4309
1990	4193	2097
Maximum	**10,832**	**5474**

Note: 1 (μg/m^3) = micrograms per cubic meter

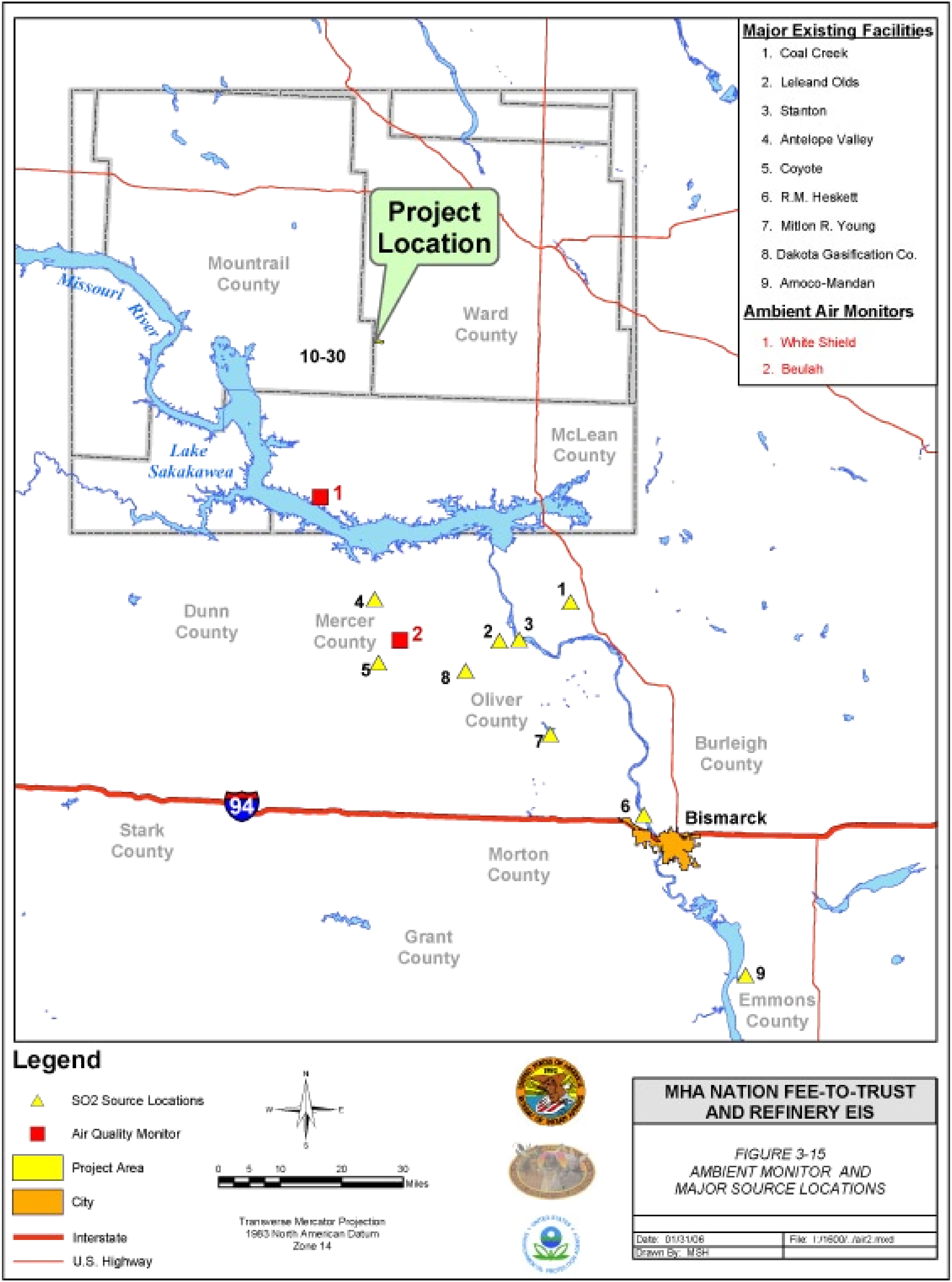


FIGURE 3-15
AMBIENT MONITOR AND
MAJOR SOURCE LOCATIONS

3.12.3 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 3-22 shows the federal air quality designations for criteria pollutants for the project site and its environs.

Table 3-22 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

3.12.3.1 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 3–23 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.

Wet deposition is measured as concentrations of sulfate ion (SO_4) and nitrate ion (NO_3) in precipitation. The wet deposition values shown in Table 3-23 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 3-23 Measurements of Standard Visual Range

Year	Class I Area	Standard Visual Range (SVR) (km)[3] Best 20% SVR	Mid 20% SVR	Worst 20% SVR	Wet Deposition – Annual Total (kg/ha)[4] Nitrogen NO_3	As N	Sulfur 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 TRNP=Teddy Roosevelt National Park
2 LW=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

3.12.4 Global Climate Change

Over the past 200 plus years, the burning of fossil fuels, such as coal and oil, and deforestation has caused the concentrations of heat-trapping "greenhouse gases" to increase significantly in our atmosphere. These gases prevent heat from escaping to space, somewhat like the glass panels of a greenhouse.

Greenhouse gases are necessary to life as we know it, because they keep the planet's surface warmer than it otherwise would be. But, as the concentrations of these gases continue to increase in the atmosphere, the Earth's temperature is climbing above past levels. According to National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) data, the Earth's average surface temperature has increased by about 1.2 to 1.4ºF (0.7 to 0.8ºC) since 1900. The warmest global average temperatures on record have all occurred within the past 15 years, with the warmest two years being 1998 and 2005. Figure 3-16 shows mean annual temperatures trends from 1880-2006. Most of the warming in recent decades is likely the result of human activities. Other aspects of the climate are also changing such as rainfall patterns, snow and ice cover, and sea level.

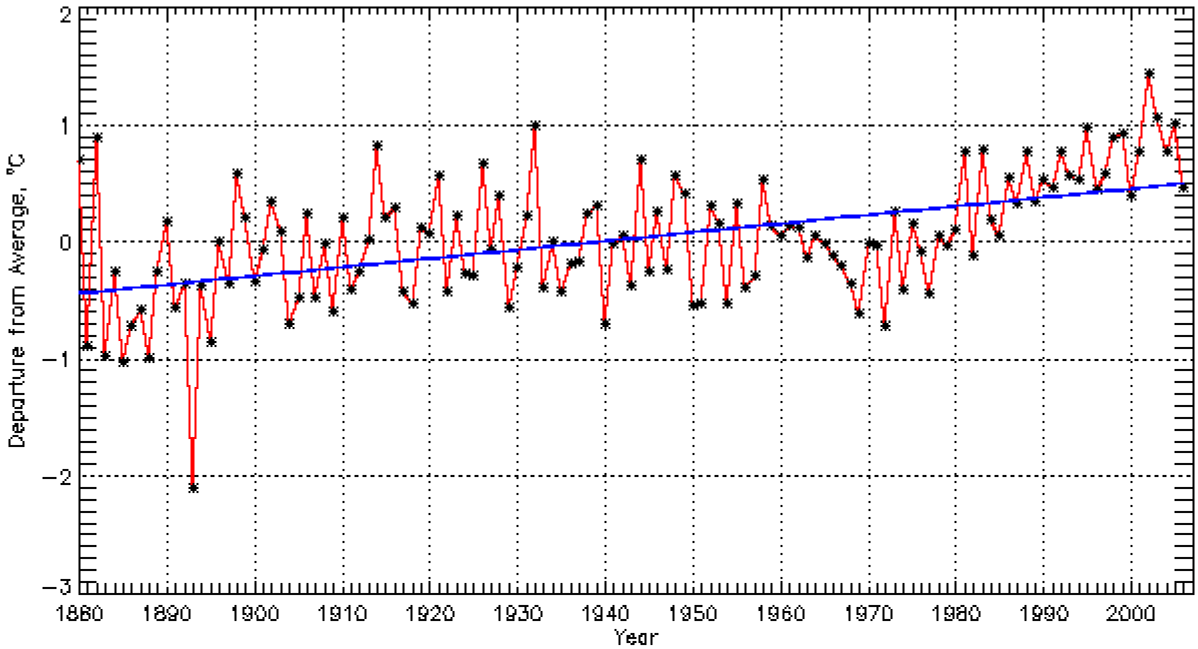


Figure 3-16 Global Mean Annual Land Temperatures 1880-2006, NOAA, NCDC
(NOAA- National Oceanic and Atmospheric Administration, NCDC - National Climate Data Center)

The Intergovernmental Panel on Climate Change (IPCC) has recently completed a comprehensive assessment of the current state of knowledge on climate change, its potential impacts and options for adaptation and mitigation. This assessment is available on the IPCC website at http://www.ipcc.ch/

The primary greenhouse gas emitted by human activities in the U.S. is carbon dioxide (CO_2). As shown in Figure 3-17, CO_2 is about 84% of U.S. greenhouse gas emissions. Other greenhouse gases include: methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). As shown in Figure 3-18, the largest source of CO_2 is from the combustion of fossil fuels such as coal and gasoline for generating electricity and transportation.

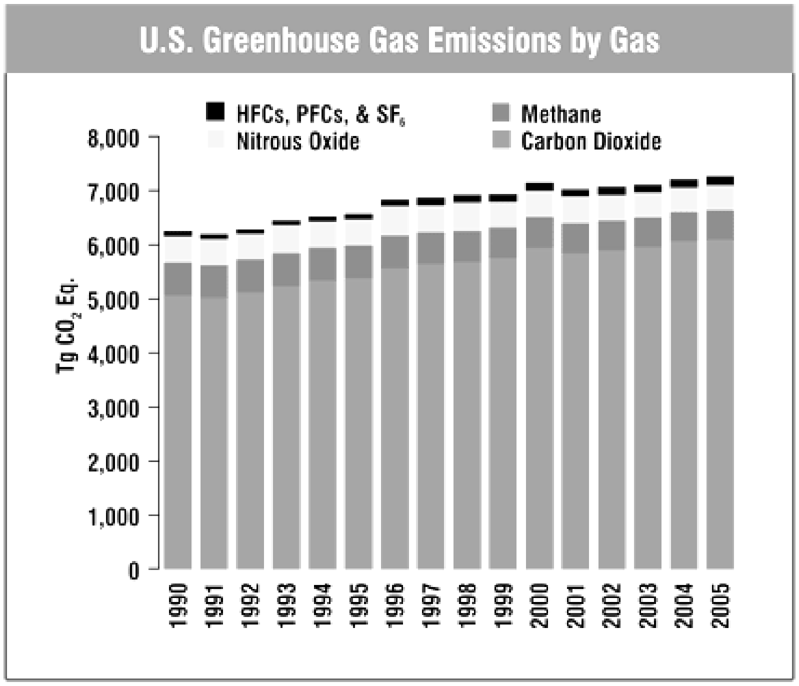


Figure 3-17 US Greenhouse Gas Emissions by Gas in teragrams (1 teragram = 1 million metric tones) USEPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005

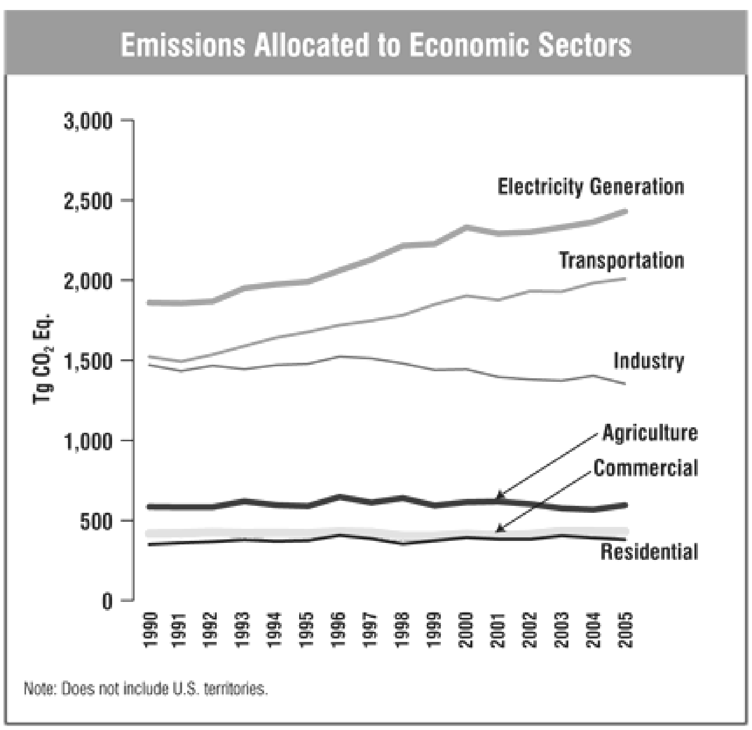


Figure 3-18 US Greenhouse Gas Emissions by Sector in teragrams or millions of metric tonnes, USEPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005

The IPCC has documented ongoing global climate change and projected that climate change will continue as atmospheric concentrations of greenhouse gases increase. (IPCC 2007, Summary for Policymakers. Impacts, Adaptation and Vulnerability; Contribution of Working Group II to the Fourth Assessment Report of the IPCC). If greenhouse gases continue to increase, climate models predict that the average temperature at the Earth's surface could increase from 3.2 to 7.2ºF (1.8 to 4.0ºC) above 1990 levels by the end of this century. (EPA's Climate Change –Basic Information website at http://www.epa.gov/climatechange/basicinfo.html). There is consensus among climate scientists that human activities are changing the composition of the atmosphere, and that increasing the concentration of greenhouse gases has changed, and will continue to change the planet's climate.

Observational evidence from all continents and most oceans indicates that many natural systems are being affected by regional changes in climate, specifically increases in air and water temperatures. Some of the observed impacts in marine and freshwater ecosystems associated with rising water temperatures as well as changes in ice cover, salinity and oxygen levels have lead to shifts in the aquatic biological community (e.g., phytoplankton, zooplankton, and fish). Increased air temperatures have been observed to affect the terrestrial biological community. As an example, there has been a shift to an earlier timing of spring events such as bird migration and egg-laying. (IPCC 2007).

Direct observations of recent climate change identify an overall increase in the average global temperature and sea level rise and a decrease in snow cover, especially in the Northern Hemisphere. During the 20th century, glaciers and ice caps have experienced widespread losses, contributing to sea level rise. Numerous long-term climate change observations include decrease in arctic temperature, snow, ice and frozen ground cover, increase in precipitation amounts, decrease in ocean salinity, and an increase in wind patterns, intensity and duration of extreme weather events like droughts, heat waves, and tropical cyclones.

The IPCC anticipates that the global effects of future climate change will include increased temperatures, changes in precipitation, and sea level rise. Further decline of mountain glaciers is projected to reduce the availability of water in many regions. These changes will impact water resources, forestry, agriculture, ecosystems, coastal management, human health, industry, settlements, and societies on a global scale, and could lead to some impacts that are abrupt or irreversible. (EPA's Climate Change, Health and Environmental Effects website at http://www.epa.gov/climatechange/effects/index.html)

Projected climate changes are expected to affect human health and an increase in the incidence of some infectious diseases like malaria is predicted as a result of the altered spatial distribution of some infectious disease vectors. (IPCC 2007, Summary for Policymakers. Impacts, Adaptation and Vulnerability; Contribution of Working Group II to the Fourth Assessment Report of the IPCC).

Coastal communities and habitats are projected to be increasingly stressed by climate change impacts interacting with development and pollution. For human communities in the Arctic, impacts, particularly those resulting from changing snow and ice conditions are projected to be mixed; detrimental impacts would include those on infrastructure and traditional indigenous ways of life. (IPCC 2007)

The projected climate changes for most areas of North America include a warming trend and an increase in precipitation, as well as a decrease in snow season length and depth on an annual basis. (IPCC 2007, The Physical Science Basis. Contribution of Working Group I to the Fourth

Assessment Report of the IPCC). Among other things, the IPCC report projects the following specific changes in North America:

- Warming in the 2010 to 2039 time period was modeled to be in the range of 1 to 3 °C.
- Simulated future surface and bottom water temperatures of lakes, reservoirs, rivers, and estuaries throughout North America consistently increase from 2 degrees to 7 °C. Warming is likely to extend and intensify summer thermal stratification, contributing to oxygen depletion.
- Decreases in snow cover and more winter rain on bare soil are likely to lengthen the erosion season and enhance erosion, increasing the potential for water quality impacts in agricultural areas.
- Moderate climate change will likely increase yields of North American rain-fed agriculture. Most studies project likely climate-related yield increases of 5 to 20% over the first decades of the century, with overall positive effects of climate on agriculture persisting through much or all of the 21^{st} century.
- Major challenges are projected for crops that are near the warm end of their suitable range or which depend on highly utilized water resources.
- During the course of this century, cities that currently experience heat waves are expected to be further challenged by an increased number, intensity, and duration of heat waves during the course of the century, with potential for adverse health impacts.

A comprehensive summary of the health and environmental effects of climate change is on EPA's Climate Change, Health and Environmental Effects website at http://www.epa.gov/climatechange/effects/index.html. The website also includes links to more detailed information on impacts to specific resource areas such as human health, agriculture, and water resources.

3.13 Socioeconomics

The socioeconomic analysis area 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. Data for the State of North Dakota are also included in the analysis, to provide a point of reference for the area experiencing socioeconomic impacts from the proposed project.

3.13.1 Population, Employment, Earnings and Income

3.13.1.1 Population, Employment, Earnings and Income

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

3.13.1.2 Population

Recent population figures for the socioeconomic analysis area are shown on Table 3-24. The table includes recent population data for the Reservation, Ward County, and the State of North

Dakota. 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 3-24). 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 3-24). 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 3-24 Changes in the Populations of the Fort Berthold Indian Reservation, Ward County, and State of North Dakota, 1980–2002

	Population				Change in Population (percent)		
Area	**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:
Source: North Dakota State Data Center 2006, North Dakota Indian Affairs Commission, 2006.

Table 3-25 Projections of Changes in the Populations of the Fort Berthold Indian Reservation, Ward County, and North Dakota, 2000–2020

	Population			Change in Population (percent)	
Area	**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 3-24). 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 and may also reflect improvements in census data reporting. There are no population projections for the Reservation; however, recent census socioeconomic data indicate that there are different economic factors affecting population growth from those factors identified for the state and the county.

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 3-26). 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 67.4 percent of the Reservation's total population. The white population accounted for 26.9 percent and the Hispanic population was 2.6 percent. Other populations of a single race each accounted for less than 1 percent (Table 3-26). People of two or more races accounted for 5.0 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 3-26) 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 30, younger than the state median of 36.2 and the Ward County median of 32.4. Nearly 40 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 3-26).

Table 3-26 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	48.6	29,284	49.8	320,524	49.9
Female	3,038	51.4	29,511	50.2	321,676	50.1
Age Distribution						
Under 5 years	536	9.1	4,348	7.4	39,400	6.1
5-19	1,782	30.1	13,158	22.4	144,064	22.4
20-44	1,778	30.1	22,667	38.6	225,394	35.1
45-64	1,171	19.8	11,281	19.2	138,864	21.6
65 +	648	11.0	7,341	12.5	94,478	14.7
Race Distribution						
White	1,594	26.9	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	67.4	1,215	2.1	31,329	4.9
Asian or Pacific Islander	9	0.1	519	0.9	3,836	0.6
Other	26	0.4	428	0.7	2,540	0.4
Two or more races	294	5.0	1,001	1.7	7,398	1.2
Hispanic Origin (of any race)	152	2.6	1,125	0.0	7,786	1.2

Source: U.S. Census Bureau 2001

3.13.1.3 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 3-27). 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 3-27). 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 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 3-27 Summary of Housing Units on the Fort Berthold Indian Reservation and in Ward County, North Dakota, 2000

	Housing Units			
	Fort Berthold Indian Reservation		Ward County	
Status of Housing Unit	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

3.13.1.4 Employment

The economies of the Reservation and Ward County largely 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 tribal members. Industrial economic activity includes two tribally chartered corporations (Fort Berthold Library 1994). Although there are large deposits of coal that have the potential for economically feasible development on the Reservation, they have not been leased or developed. Reserves of oil also exist, and some historical and recent 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 29 percent between 1990 and 2000 (Table 3-28). 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 3-28). 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 3-28 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 (all people)	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

BIA publishes biennially the American Indian Population and Labor Force Report. This report compiles data on tribal enrollment, service population and labor force information for federally recognized Indian tribes. The 2005 version of this report for the Fort Berthold Indian Reservation (BIA 2005), included as Table 3-29, identified 8,773 Indian people in the area on or near the reservation eligible for BIA services. The report also includes information on the available work force. In 2005, the MHA Nation estimated the available work force from the service population to be 4,381. Of the available MHA Nation work force, 71% were not employed.

Table 3-29 Local Estimates of Indian Service Population and Labor Market Information -- Three Affiliated Tribes

	Service Population: on-or-near Reservation	
	Population	Percent
Tribal Enrollment	11,897	
Total Eligible for Services	8,773	
Age Distribution		
Under 16	3,962	
16-64	4,509	
65 & Over	302	
Labor Force Data		
Not Available for Work	430	
Available for Work (Total Workforce)	4,381	
Employed	1,287	
Not Employed	3,094	
Not Employed as Percent of Available Work Force		71%
Total Employment	1,287	
Tribal	1,169	
Private	118	
Employed, but Below Poverty Guidelines	708	55%

Source: American Indian Population and Labor Force Report, BIA 2005

The North Dakota Department of Commerce (North Dakota Department of Commerce 2002) conducted a study of available labor for the area within a 60-mile radius of Minot. This geographic area included portions of Ward, Bottineau, McHenry, McLean, Mountrail, and Renville counties. The Reservation east of Lake Sakakawea is also included in this study area. The 60-mile radius was identified as the median maximum distance that those people involved in the study were willing to commute.

The study characterized the available labor force within the geographic area and identified the individuals' 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 geographic 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 3-30), followed by jobs in health services and manufacturing. Finally, jobs in engineering and machine trades or construction were the least desirable to individuals in the available labor force.

Table 3-30 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 another 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 the 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 3-31). The services sector represented 37.8 percent of the jobs on the Reservation in 1990 and grew to 48.4 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 3-31). Employment in the retail trade declined 26.9 percent, and employment in the agriculture, forestry, and mining sector declined 45.1 percent. Despite the decline in these sectors, overall employment on the Reservation increased from 1990 to 2000 (Table 3-31).

In Ward County, the largest employment sector from 1990 to 2000 was the service sector, which represented 30.6 percent and 42.6 percent of the employed workforce in those years, respectively. 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 3-31 Summary of Total Estimated Employment on the Fort Berthold Indian Reservation and in Ward County, 1990 and 2000

	Ft. Berthold Indian Reservation				Ward County			
	Number of Employees		Portion of Total (percent)		Number of Employees		Portion of Total (percent)	
Sector	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**
Agriculture, Forestry and Mining	308	169	17.2	8.3	1,271	1,154	4.5	3.8
Construction	118	78	6.6	3.8	1,204	1,445	4.3	4.8
Manufacturing	119	113	6.6	5.5	794	723	2.8	2.4
Transportation, Communication, and Utilities	111	162	6.2	7.9	1,790	2,047	7.3	6.8
Wholesale	23	14	1.3	0.7	1,303	1,085	4.7	3.6
Retail Trade	216	158	12.0	7.7	5,978	3,935	21.4	13.1
Finance, Insurance, and Real Estate	63	89	3.5	4.4	1,194	1,593	4.3	5.3
Services	679	989	37.8	48.4	8,540	12,832	30.6	42.6
Public Administration	158	273	8.8	13.3	1,504	1,289	5.4	4.3
Military Service (Based)					4,357	4,032	15.6	13.4
Total	**1,795**	**2,045**			**27,935**	**30,134**		

Source: U.S. Census Bureau 2001, 1990

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 (50.3 percent) during the decade (Table 3-31). The retail trade sector experienced a decrease in employment over the same period.

3.13.1.5 Income

In 1990 and 2000, the per capita personal income in the socioeconomic analysis area trailed that of Ward County and the State of North Dakota (Table 3-32). 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 3-32).

In both 1990 and 2000, a high portion of all people living on the Reservation had incomes that placed them below the poverty line (Table 3-32). In addition, one-third to one-half 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 3-32).

Table 3-32 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

3.13.2 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 paragraphs 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 post-secondary 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. Post-secondary 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).

3.13.3 Social Values

The quality of life in a particular 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 socioeconomic analysis area and the west, central North Dakota, have experienced impacts to air and water quality from nearby coal-fired power plants, energy development, and other industrial activities. There is a perception among some individuals that other energy-related industrial activities may be incompatible with maintaining the quality of the natural environment. Other people, however, in the area support industrial development for its positive economic effects.

3.14 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was published in February 1994 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. Since its issuance in 1994, EPA's Office of Environmental Justice (EJ) has developed policies and guidance further clarifying the intent of the Executive Order and the Agency's strategy for incorporating EJ concerns into its actions. Such actions include the issuance of a wastewater discharge permit, as the MHA Nation has requested for the proposed refinery.

EPA defines EJ as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

Because of the infinitely variable nature of EJ problems and stakeholders, as well as the resources available to address any particular situation, there are no nationally applicable standards that identify specific tools and data for performing an EJ analysis. Rather, the Agency must develop them on a case-by-case basis. For purposes of this EJ analysis, EPA based the identification of the affected area on an evaluation of the potential impacts to air, surface water, ground water, soils, and the community resulting from construction and operation of the proposed refinery. The socioeconomic sections of this chapter and Chapter 4 further discuss data used to identify socioeconomic impact areas and the nature of those impacts.

Three different geographic regions were considered for the potentially affected area. The area within a 1-mile radius of the project site is the area where environmental impacts are most likely to occur. This is based on an evaluation of modeled air emissions from the proposed refinery and a determination that, while well below health-based standards, there is some potential for exposures to occur in this area. In order to provide a conservative analysis of possible environmental and socioeconomic impacts, the DEIS expanded the affected area to include a 10-mile radius around the site. The FEIS, in response to comments on the DEIS, has broadened the geographic scope of the affected area, so that it now extends beyond 10 miles to the four zip code areas surrounding the project site: 58756, 58770, 58771, and 58779. This expanded scope allows comparisons of potentially impacted populations to reference populations based on U.S. Census data, which are sorted by zip codes, allows the FEIS to include relatively populated areas in the analysis, and provides a conservative analysis for both environmental and socioeconomic impacts, as they relate to potential EJ populations.

As stated above, EPA must select which data it will use for each EJ analysis on a case-by-case basis. These data, referred to as Environmental Justice Indicators, may include: environmental indicators, health indicators, social indicators, and economic indicators. These indicators highlight some aspect of current conditions and trends in the environment or within a community. They provide information that can be used in the EJ analysis to supplement, as appropriate, information more specific to the environmental decision being evaluated (e.g., impacts from a facility being sited or permitted). For this EJ analysis, EPA is basing its identification of communities with potential EJ indicators on two types of data: ethnicity and income status. This analysis assumes that populations residing within the affected area constitute indicators of an EJ community, if the percentage of population in minority and/or poverty status is greater than that of the reference community, which in this case is the State of North Dakota. Since the Executive Order on EJ explicitly identifies "low-income populations" as groups of concern regarding EJ issues, it is important to point out that this EJ analysis incorporates poverty threshold levels determined by the U.S. Census as a proxy for low income populations in the affected area and in the reference community.

Taking into account the indicators described above, EPA used relevant census data on the four zip code areas to determine whether any populations residing within the affected area constitute a potential "environmental justice population." This was done by comparing the affected area to the reference community, which is defined as the state of North Dakota.

Figure 3-19 depicts the project site, 1- and 10-mile radii, and the four zip code areas surrounding the project site. Six residences occur within a 1-mile radius of the project site. All of these are isolated rural residences that are part of the agricultural operations surrounding the project site. Table 3-33 shows population numbers and percentages of the non-white, American Indian, and poverty populations for the four zip code area comprising the affected area and for the reference community. The non-white population data are defined by the U.S. Census to include Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, and Hispanic or Latino populations. American Indian data captures only single ethnicity populations and does not include people with two or more ethnicities. Therefore, the U.S. Census estimates of Native American populations are lower than actual population figures.

Table 3-33 Affected Area Environmental Justice Indicators

	Population	Non-White Population*	American Indian	% Non-White*	% American Indian	Poverty Population	% in Poverty
Zip Codes Within 10-Mile Radius and Major Towns Within Each Zip Code							
58756 *(includes Makoti)*	260	34	1	13%	0%	45	18%
58771 *(includes Plaza)*	463	22	14	5%	3%	54	11%
58770 *(includes Parshall)*	1,273	706	559	55%	44%	286	23%
58779 *(includes Ryder)*	477	30	22	6%	23%	111	22%
4 Zip Code Area	**2,473**	**792**	**596**	**32%**	**24%**	**496**	**20%**
State Statistics							
North Dakota	**642,200**	**49,019**	**31,329**	**8%**	**5%**	**73,457**	**12%**

American Indian population is included in the non-white population
Source: American Fact Finder, Census 2000

The information shown in Table 3-33 suggests that each of the zip codes demonstrate indicators of an EJ community. Overall, the four zip code areas comprise 32 percent non-white and 24 percent American Indian population (compared to eight percent and five percent for the State, respectively) and 20 percent poverty population (compared to 12 percent for the State). The communities that fall closest to the project location within these zip codes are Makoti (2.5 miles) and Plaza (6 miles).

The affected area includes 596 Native Americans, which represents 24 percent of the total population. This is a higher concentration of Native Americans than is represented throughout North Dakota, which reports five percent of the population as Native American. The affected area also has a higher percentage of population that is considered low income compared to the State. In North Dakota, 12 percent of the population is considered living below the poverty threshold, while 20 percent of the population in the affected area has been characterized as living in poverty.

The median age in the affected area ranges from 36.4 years (zip code 58770) to 48.8 years (zip code 58756) (compared to 36.2 years for the State). The median value of homes among the four zip codes ranged from $34,156 (zip code 58771) to $66,611 (zip code 58756) in 2007 dollars (compared to $105,443 in 2007 dollars for the State.).

The following section provides additional information on each of the four zip code areas, with respect to demographic, social, and economic statistics. The source of the data was the 2000 census.

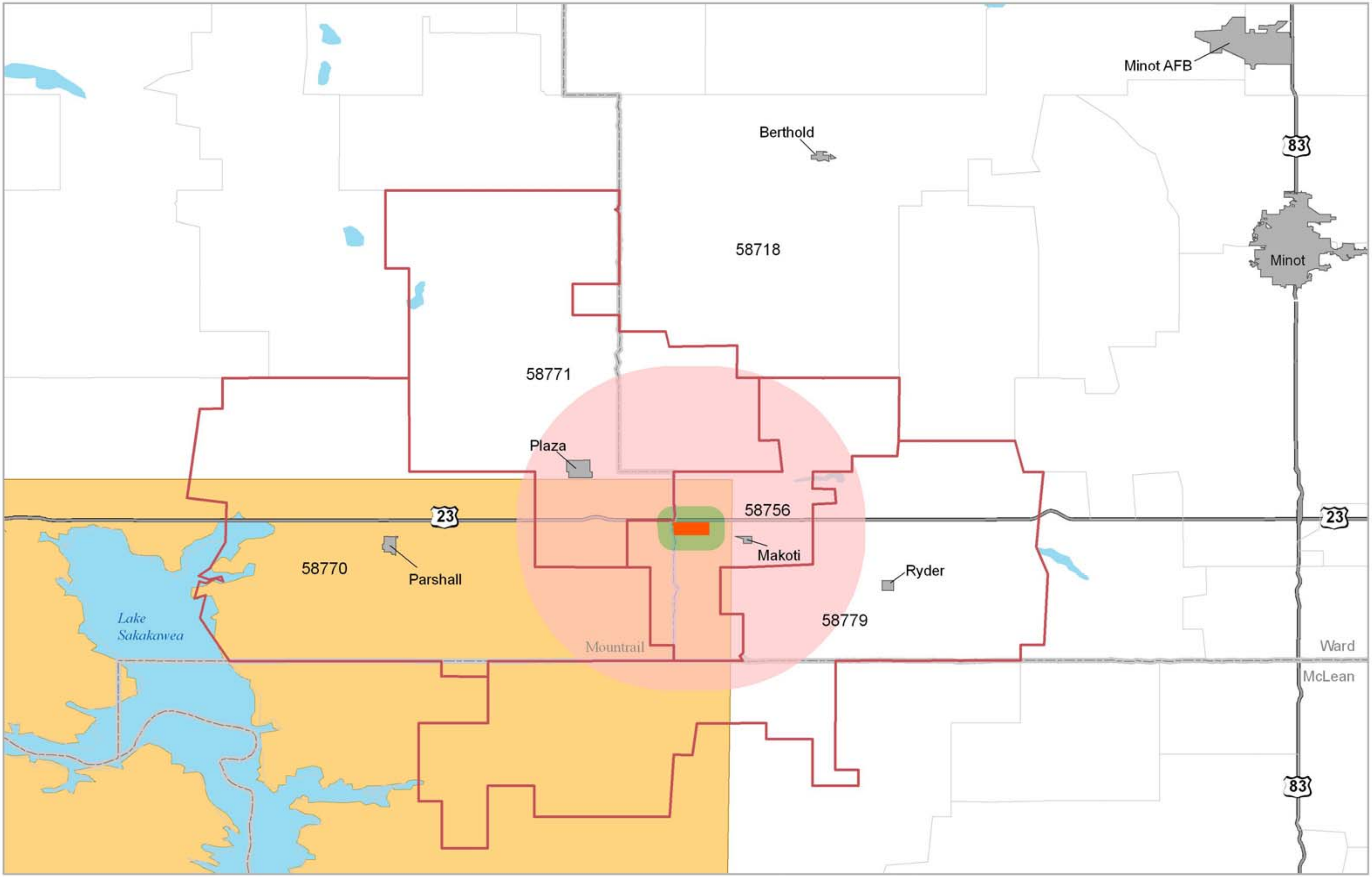
58756: Zip code 58756 encompasses the project location and the community of Makoti. The population of this area in 1999 was 260, with over half of the population residing in Makoti. This area has a very low population density, approximately two people per square mile. Makoti is 2.5 miles southeast of the proposed refinery and is the closest community to the site. It has 145 residents, of which 95.9 percent are white and 4.1 percent are non-white. Nineteen percent of the population falls within poverty status. The median age in Makoti is 47.3 years. The community has a lower unemployment rate of 2.5 percent compared to 3.0 percent for the State (1999). The largest percentages of employment by industry are in education, health, and social sciences (27.8%), agriculture (22.2%), and wholesale trade (11.1%).

58771: Zip code 58771 is located to the northwest of the project site, encompassing the community of Plaza. Plaza is located 6 miles northwest of the proposed refinery. In 1999 there were 167 residents within the community of Plaza. Of these, 91 percent are white and 7.3 percent fall below the poverty threshold. The median age in Plaza is 42.7 years. The community has a lower unemployment rate of 1.4 percent compared to 3.0 percent for the State (1999). The three largest employers by industry are education, health, and social sciences (31.6%), retail trade (13.2%), and wholesale trade (11.8%).

58770: Zip code 58770 is located west and southwest of the project site and includes the town of Parshall, which is located approximately 13 miles west of the project location on Fort Berthold Indian Reservation. Parshall is the closest community on Tribal Land. It reported 981 residents in the 2000 census. Of these, 58.2 percent are non-white, and 27.7 percent fall below the poverty threshold. The median age in Parshall is 32.7 years. The community has a higher unemployment rate of 3.7 percent compared to 3.0 percent for the State (1999). The three largest employers by industry are education, health, and social science (30.4%), arts, entertainment, recreation, accommodation and food services (14.2%), and information (11.7%).

58779: Zip code 58779, which includes the town of Ryder and a small portion of Fort Berthold Indian Reservation, is located south to southeast of the project location. Ryder is located approximately 10 miles from the project location with a recorded population of 92 residents in the 2000 Census. The population is 97.8 percent white, and 30 percent fall below the poverty threshold. The median age in Ryder is 46.0 years. The community has a lower unemployment rate of 2.4 percent compared to 3.0 percent for the State (1999). The three largest employers by industry are education, health, and social sciences (27.1%), retail trade (14.6%), and transportation and warehousing, and utilities (14.6%).

For more information, see EPA's Environmental Justice Tier One Analysis for the Mandan, Hidatsa, and Arikara Nation's "Clean Fuels Refinery" Project (Tier One Analysis), December, 2007.



Legend

- Project Site
- 1-Mile Radius of Project Site
- 10-Mile Radius of Project Site
- Fort Berthod Indian Reservation
- City Boundary
- County Boundary
- Zip Code Boundary
- Water

5 2.5 0 5 10 15 Miles

Transverse Mercator Projection
1983 North American Datum
Zone 14

Booz Allen Hamilton

Figure 3-19
Zip Codes within a 10-Mile Radius of Project Site

Analysis Area: Montrail, Ward & McLean Counties, ND

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Health and Safety

Several factors contribute to the health and safety of Native Americans in North Dakota including 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 Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS).
- 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.

The Socioeconomic and EJ sections of Chapter 3 and Chapter 4 of this FEIS discuss the current status and potential impacts of factors such as employment/income, housing, access to health care, and proximity to pollution sources. In addition, the ATSDR has compiled baseline data on the health status of Native Americans living on the Fort Berthold Reservation, with an emphasis on asthma and specific types of cancer. These data are included in Appendix D.

Safety issues affecting populations living near the refinery are discussed in the Transportation, Spills and Releases, and Human Health sections of this FEIS. Occupational safety issues for refinery workers are discussed in the Human Health section of Chapter 4 of this FEIS.