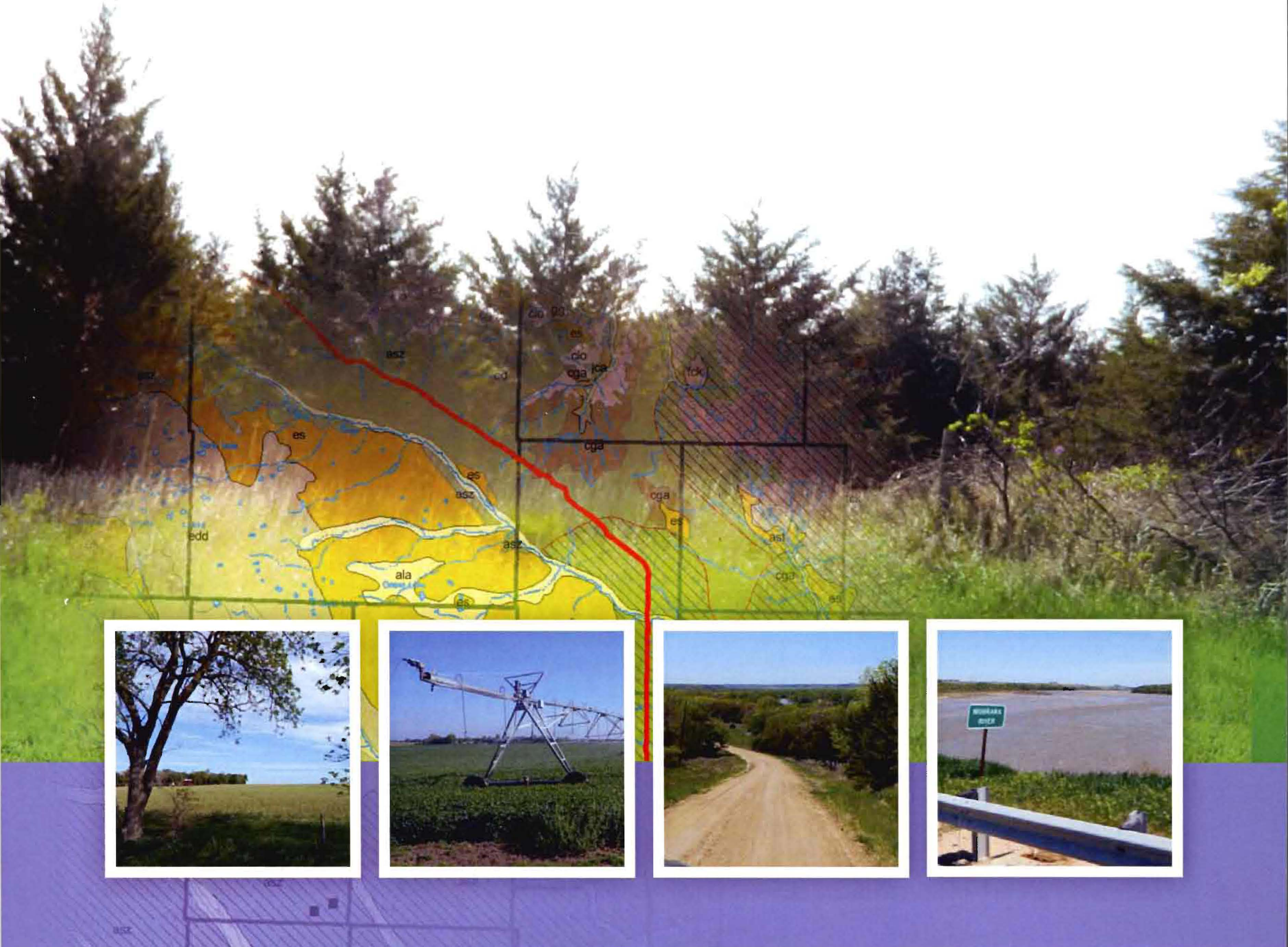
Nebraska Department of Environmental Quality

NEBRASKA's Keystone XL Pipeline Evaluation



NEBRASKA'S KEYSTONE XL PIPELINE EVALUATION

FINAL EVALUATION REPORT

VOLUME THREE | Appendix E

January 2013

Appendix E

Resource-Specific Data

Appendix E.1

Geology Technical Memorandum

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APPENDIX E.1

GEOLOGY TECHNICAL MEMORANDUM

This technical memorandum describes existing geological, mineralogical, and paleontological conditions along the proposed Nebraska Reroute; potential impacts from construction, operation, and maintenance of the Keystone XL Pipeline; and general mitigation measures to avoid or reduce potential impacts.

Based on evaluation of potential seismic hazards along the proposed Nebraska Reroute, the risk of potential impact to the pipeline from earthquake ground motion would be considered minimal. The proposed Nebraska Reroute would not cross any known active faults and would be located outside of known zones of high seismic hazard.

The general geologic conditions discussed in this technical memorandum are associated with topography, development of soils, and the location and availability of groundwater.

E.1.1 EXISTING CONDITIONS

The designated Study Area for reviewing impacts on geology for the proposed Nebraska Reroute consists of a 110-foot-wide temporary easement centered on the route that would extend from the Nebraska state line in Keya Paha County to York County, Nebraska.

E.1.1.1 Landscape

The proposed Nebraska Reroute would pass through the eastern third of Nebraska. Nebraska is located in the High Plains portion of the Great Plains physiographic province. The High Plains extend from southern South Dakota to northwestern Texas. The landscape of this region is described as a large, eastwardly tilted surface formed by weathered material deposited from erosion of the early Rocky Mountains, beginning about 65 million years ago. Gently sloping, smooth plains characterize the High Plains (U.S. Department of State [DOS], 2011; Gutentag et al., 1984). Elevations along the proposed Nebraska Reroute range from about 2,200 feet above mean sea level in the north to 1,750 feet above mean sea level near the south.

E.1.1.2 Geologic History of High Plains

Geologic history is measured on the geologic time scale. The geologic time scale comprises standard stratigraphic divisions based on rock sequences and is calibrated in millions of years (see Table E.1-1) (U.S. Department of the Interior, U.S. Geological Survey [USGS] Geologic Names Committee, 2007).

The geologic history of the High Plains focuses on the structural and depositional history of the east-central Rocky Mountains and adjacent plains, from the Late Cretaceous (about 65.5 million years ago) to the present. The Laramide Orogeny, or period of mountain building, began about 65.5 million years ago at about the same time as the great interior sea retreated (Gutentag et al., 1984). Mountain formation continued into Tertiary time.

The Tertiary Period (65.5 to 2.6 million years ago) began with a long period of no recorded placement of material in most of the High Plains. The oldest Tertiary rocks found on the High Plains are of Oligocene age (33.9 to 23.0 million years ago). During the Tertiary Oligocene

Epoch, volcanism was widespread in the mountains and enormous quantities of volcanic debris and sediment eroded from the mountain were deposited on the plains. During the Tertiary Miocene Epoch (23.0 to 5.3 million years ago), sedimentation on the plains continued with some volcanic material deposited as well as weathered debris from the mountains. Most of the sediments making up the High Plains Aquifer were deposited during this time. The Tertiary Pliocene Epoch (5.3 to 2.6 million years ago) was a period of continued uplift and erosion of the mountains.

Table E.1-1. Geologic Time Scale

Era	Period	Epoch	Million Years Ago
Cenozoic	Quaternary	Recent	0.01 to present
		Pleistocene	2.6 to 0.01
	Tertiary	Pliocene	5.3 to 2.6
		Miocene	23.0 to 5.3
		Oligocene	33.9 to 23.0
		Eocene	55.8 to 33.9
		Paleocene	65.5 to 55.8
Mesozoic	Cretaceous		145.5 to 65.5
	Jurassic		199.6 to 145.5
	Triassic		251.0 to 199.6
Paleozoic	Permian		299.0 to 251.0
	Pennsylvanian		318.0 to 299.0
	Mississippian		359.0 to 318.0
	Devonian		416.0 to 359.0
	Silurian		444.0 to 416.0
	Ordovician		488.0 to 444.0
	Cambrian		542.0 to 488.0

Source: Korus and Joeckel, 2011

The sculpting of the High Plains continued through the Quaternary Period (2.6 million years ago to present). Large quantities of sediment were eroded from the mountains and the plains. Giant braided streams (streams flowing in several channels that divide and reunite) transported large quantities of silt, sand, and gravel and deposited these sediments in stream valleys and terraces.

Winds blew sand and silt from the stream valleys and deposited them as dune sand and loess over large parts of the High Plains (Gutentag et al., 1984).

E.1.1.3 Geology of Nebraska

The surface of Nebraska is almost entirely covered by sand and gravel, silt, and clay of Quaternary age (see Table E.1-1 and Figure E.1-1). The rocks underlying the surface material are sedimentary rocks of Cretaceous and Tertiary age (see Table E.1-2 and Figure E.1-2).

Surface Geology of Nebraska Reroute

Sands and gravels and silts of Quaternary age characterize the general surface geology of Nebraska. Major surface deposits along the proposed Nebraska Reroute include alluvium (deposited by stream or body of moving water), loess (windblown silts), eolian (windblown sands) and colluvium (deposited or built up at the bottom of a low-gradient slope) (USGS, 2012a). The central and southern sections of the proposed Nebraska Reroute are largely overlain by loess. Sandy soils are found along the northern portion of the route. A relatively sharp line separates the boundary between the sandy soils and loess (see Figure E.1-1).

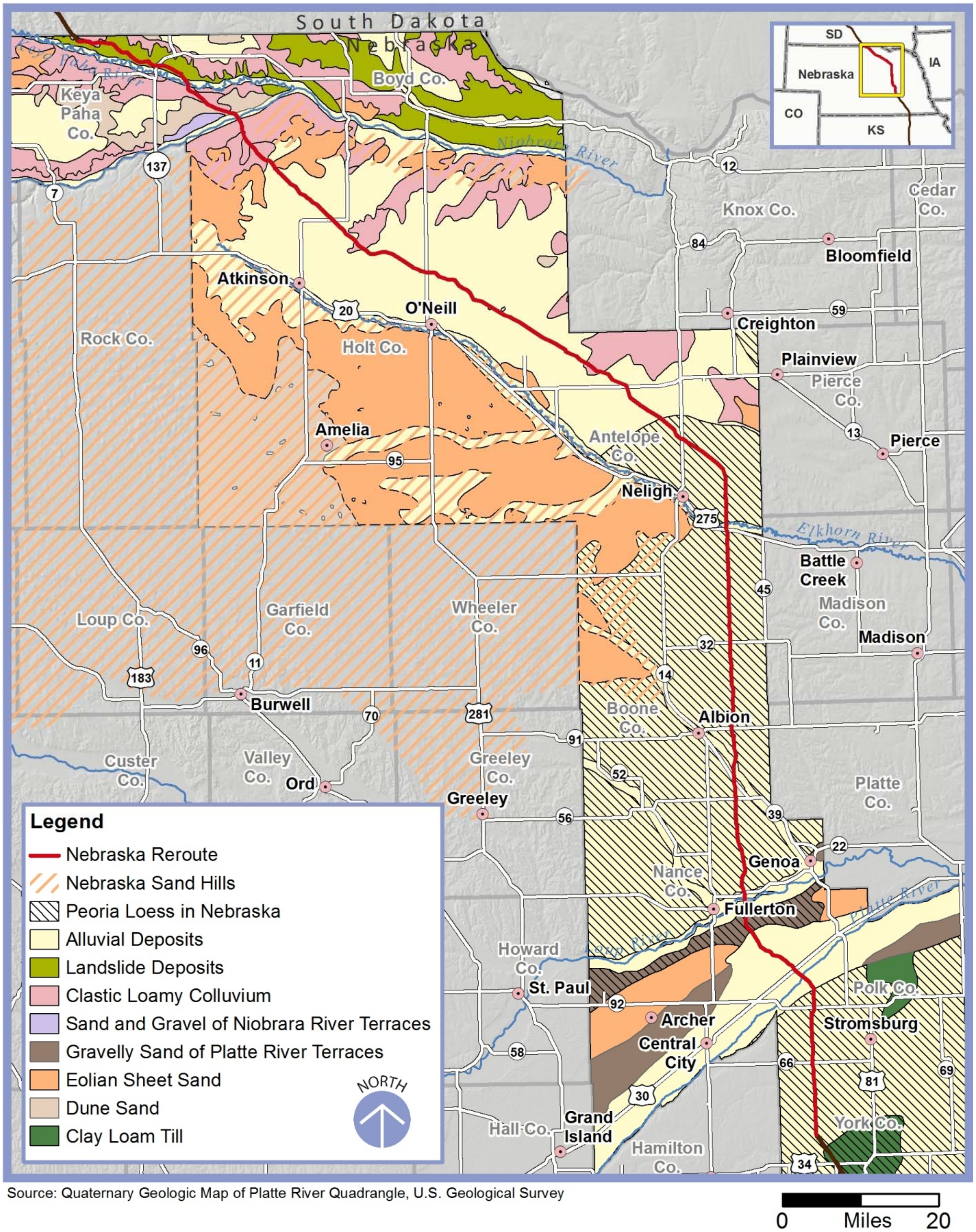
Table E.1-2. Geology of the High Plains

Era	Period	Epoch	Glacial Stage	Formations	Lithology
Surface Geology					
Cenozoic	Quaternary	Holocene		Sand Hills dune sands	Fine-to-medium-sized sands with small amounts of clay, silt, and coarse sand
				Bignell Loess	Fine silt with lesser amounts of very fine sand and clay
		Pleistocene	Wisconsin	Brady soil	Clay and silt
				Peoria Loess	Fine silt with lesser amounts of very fine sand and clay
				Gilman Canyon Formation	Fine silt with lesser amounts of very fine sand and clay
			pre-Wisconsin	Loveland Formation	Fine silt with lesser amounts of very fine sand and clay
				Beaver Creek Loess	Fine silt with lesser amounts of very fine sand and clay
				Grafton Loess	Fine silt with lesser amounts of very fine sand and clay
				Walnut Creek Formation	Coarse gravel composed of clasts of granitic and metamorphic rocks interbedded with sandstone and minor silt or clay beds

Era	Period	Epoch	Glacial Stage	Formations		Lithology
Bedrock Geology						
Cenozoic	Tertiary	Pliocene		Broadwater/Fullerton Formations		Sand, gravel, conglomerate, sandstone, siltstone, claystone, and mudstone
		Miocene		Ogallala Group		Poorly sorted mixture of sand, silt, clay, and gravel
				Arikaree Group	Upper Harrison Harrison Formation	Fine-grained silty sandstones. Large calcium carbonate concretions
		Oligocene			Monroe Creek Formation	Volcaniclastic conglomerate, sandstone, and ash beds
					Gering Formation	Volcaniclastics, sandstone, silty sandstone, and sandy siltstone
				White River Group	Brule Formation	Massive siltstone composed primarily of eolian silt, with some alluvial deposits
		Eocene			Chadron Formation	Tuffaceous claystone, siltstone, and mudstone, and relatively minor amounts of fossiliferous, coarse-grained sandstone and conglomerate
		Paleocene				
Mesozoic	Cretaceous			Pierre Shale		Dark gray shale
				Niobrara Formation		Chalk, limestone, and shale
				Carlile Shale		Shale, limestone, and sandstone
				Greenhorn Limestone		
				Graneros Shale		
				Dakota Group		Sandstones and shales

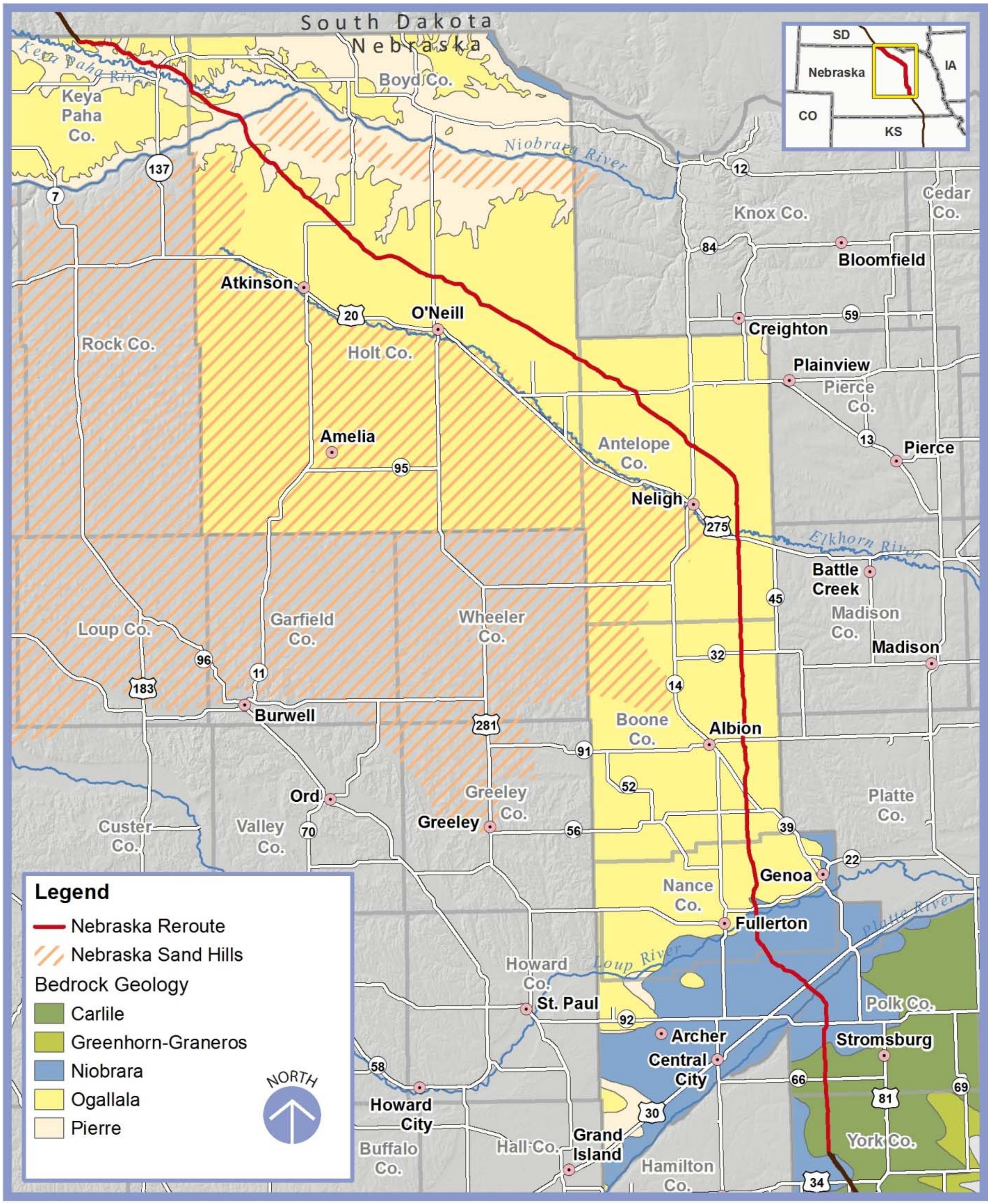
Source: Modified from Condon, 2005

Figure E.1-1. Surface Geology



Source: Quaternary Geologic Map of Platte River Quadrangle, U.S. Geological Survey

Figure E.1-2. Bedrock Geology



Source: Digitized Bedrock Geology, Conservation and Survey Division UNL

E.1.1.4 Bedrock Geology of Nebraska Reroute

The underlying bedrock identified in Nebraska is the Cretaceous-aged sedimentary Carlile Shale; Niobrara Formation and Pierre Shale; and Tertiary-aged White River Group, Arikaree Group, and Ogallala Group (see Table E.1-1).

Carlile Shale

The Carlile Shale is composed of shale, limestone, and sandstone. The approximate maximum thickness of the Carlile Shale is 300 feet. The upper 200-foot-thick layer of shale is dark gray to medium gray and can locally contain ironstone concretions and be interbedded with thin siltstone. The lower 80-foot-thick shale stratum is medium gray and calcareous and contains many very thin-bedded, fossiliferous, shaly limestone and calcareous shale layers (USGS, 2012a).

Niobrara Formation

The Niobrara Formation is composed of chalk, limestone, and shale (Condon, 2005). The approximate maximum thickness of the Niobrara Formation is 570 feet. The chalk is medium gray to white, interbedded with thin layers of chalky shale. The limestone is light gray to medium gray and yellowish gray, interbedded with medium-gray chalky shale (USGS, 2012a).

Pierre Shale

The Pierre Shale is the youngest and uppermost of the Cretaceous units. The approximate maximum thickness of the Pierre Shale is 1,970 feet. It consists of dark gray shale and was deposited in deepwater conditions. It also contains some layers rich in volcanic ash from eruptions in the western United States (Condon, 2005; USGS, 2012a).

White River Group

The White River Group includes the late- to mid-Eocene Chadron Formation and the Oligocene Brule Formation. The maximum thickness of the White River Group is 700 feet (Condon, 2005; USGS, 2012a).

Chadron Formation

The Chadron Formation consists mainly of tuffaceous claystone, siltstone, mudstone, and relatively minor amounts of fossiliferous, coarse-grained sandstone and conglomerate (Condon, 2005).

Brule Formation

The Brule Formation is a massive siltstone composed of primarily eolian silt with some alluvial deposits. Lenticular (lense-shaped) beds of volcanic ash, claystone, and fine sand are present. Maximum thickness of the Brule is about 600 feet (Condon, 2005).

Arikaree Group

The Arikaree Group includes late Tertiary deposits between the underlying Brule Formation and overlying Ogallala Formation. The Arikaree Group is a massive, very fine to fine-grained sandstone with localized beds of volcanic ash, silt, sand, and sandy clay, with a maximum thickness of 1,000 feet (Condon, 2005; USGS, 2012a).

Ogallala Group

The Ogallala Group is composed of a poorly sorted mixture of sand, silt, clay, and gravel (Condon, 2005). The Ogallala Group generally is unconsolidated or weakly consolidated, but contains layers of sandstone cemented by calcium carbonate. The maximum thickness of the Ogallala Group is 800 feet (Bleed and Flowerday, 1989).

E.1.1.5 County Geology

Surface geology and bedrock vary along the Nebraska Reroute. A brief description of the main surface material and underlying bedrock for each county is presented below.

Keya Paha and Boyd Counties

Loamy colluviums and alluvial sand, silt, clay, and gravel along the Niobrara River characterize the surficial geology of Keya Paha and Boyd Counties (see Figure E.1-1). The Ogallala Group and Pierre Shale are present at depth in Keya Paha and Boyd Counties (see Figure E.1-1). The Pierre Shale can be exposed in the northern part of Nebraska where the Keya Paha and Niobrara Rivers eroded overlying deposits (see Attachment A).

Holt County

The surficial geology in Holt County includes sand, gravel, and silt. The bedrock geology present at depth in Holt County is the Ogallala Group and Pierre Shale (see Figure E.1-2 and Attachment A). The Pierre Shale covers the upper northern portion of the county, while the Ogallala Group is expansive across the middle and southern portions of the county.

Antelope County

The surficial geology in Antelope County includes sands and gravel along the western portion of the county. Peoria Loess is present along the northcentral portion of the county (see Figure E.1-1). A thin line of alluvial sand is present along the Elkhorn River. The bedrock geology present at depth in Antelope County is the Ogallala Group (see Attachment A).

Boone County

The surficial geology of Boone County is Peoria Loess (see Figure E.1-1). The bedrock geology present at depth in Boone County is the Ogallala Group (see Attachment A).

Nance County

North of the Loup River, the surficial geology is characterized as Peoria Loess (see Figure E.1-1). Alluvial silt, clay, sand, and gravel are present along the Loup and Platte Rivers. The bedrock geology present at depth in Nance County is the Ogallala and Niobrara Formations (see Figure E.1-2 and Attachment A). The Ogallala Group exists under the northern and northwestern portions of the county, while the Niobrara Formation exists under the eastern and southeastern portions.

Merrick County

The surficial geology of Merrick County is characterized as gravelly sand of the Platte River terraces and alluvial silt, clay, sand, and gravel (see Figure E.1-1). The bedrock geology present at depth in Merrick County is the Niobrara Formation. The Niobrara Formation is expansive across Merrick County (see Figure E.1-2 and Attachment A).

Polk County

The surficial geology of Polk County is characterized as Peoria Loess (see Figure E.1-1). The bedrock geology in Polk County is the Niobrara Formation and the Carlile Shale. The Niobrara Formation is present in the northern part of the county and the Carlile Shale in the southern portion (see Figure E.1-2 and Attachment A).

York County

The surficial geology of York County is characterized as Peoria Loess (see Figure E.1-1). The bedrock geology in York County is the Carlile Shale (see Figure E.1-2 and Attachment A).

E.1.1.6 Mineralogical Resources

The major mineral resource within the proposed Nebraska Reroute is aggregate (sand and gravel) for road construction, concrete, and other building uses. No current oil, natural gas, coal, or mineral mining activity occurs along the Nebraska Reroute (Nebraska Oil and Gas Conservation Commission, 2008; University of Nebraska-Lincoln, 2012).

E.1.1.7 Paleontological Resources

Paleontological resources are physical remains of floral and faunal species that have mineralized into or left impressions in solid rock.

The surface geologic deposits may have identifiable fossils, as could the bedrock along the Nebraska Reroute. Surface deposits could be found within the Quaternary age deposits (TransCanada Keystone Pipeline, LP [Keystone], 2012). Fossils that may be found in the alluvial deposits include ostracod carapaces, clams, and aquatic and terrestrial snails. Fossilized evidence of horses, camels, and mammoths may be found in the loess deposits (Diffendal et al., 1996).

Nebraska's bedrock is all sedimentary in origin and therefore potentially fossil-bearing. Nebraska's fossil-bearing beds are very diverse. Fossil-bearing beds contain mammals such as four-tuskers and mastodons of Tertiary age; clams, oysters, and saltwater fish such as sharks and marine reptiles such as plesiosaurs of Cretaceous age; and marine invertebrate fossils, including corals, sea lilies, and lamp shells of Pennsylvanian age (Voorhies, 1994).

A significant paleontological resource is located in northern Antelope County. Numerous vertebrates, including three-toed horses, rhinos, camels, and other animals are preserved at the Ashfall Fossil Beds State Historical Park. Nearly 12 million years ago (Miocene Epoch), these vertebrates were buried by volcanic ash, preserving the skeletons until scientific discovery in the 1970s. The Ashfall Fossil Beds State Historical Park is located approximately 7 miles northeast of the closest portion of the proposed Nebraska Reroute (Keystone, 2012).

Fossils may be found in the Upper Cretaceous bedrocks (Niobrara Formation, Pierre Shale, and Carlile Shale). Fossils found in these formations may include ammonites, gastropods, fish, mosasaurs, bivalves, sea turtles, and sharks. Tertiary bedrock (Ogallala Group) may contain fossils of horses, rhinoceroses, proboscideans, mammoths, and other ruminants (see Table E.1-3).

Table E.1-3. Fossils Potentially Found in Study Area Geologic Formations

Geologic Formation/Deposit	Period	Description	Fossil Potential
Surficial geology			
Sand Hills	Quaternary-Holocene	Well-sorted sand; forms dunes and sand sheets	None
Loess	Quaternary-Pleistocene	Windblown dust deposits	Horses, camels and mammoths
Alluvial	Quaternary-Pleistocene	Gravelly sand of the Platte, North Platte, and South Platte River terraces and alluvial silt, clay, sand, and gravel	Ostracod carapaces, clams, and aquatic and terrestrial snails
Bedrock geology			
Ogallala Group	Tertiary-Miocene	Sand, silt, sandstone, gravel, and conglomerate; forms erosion-resistant "mortar beds" in some locations	Horses, rhinoceroses, proboscideans, mammoths, other ruminants
Pierre Shale	Upper Cretaceous	Dark gray to black fissile clay shale. Locally grades to thin beds or calcareous, silty shale or claystone, marl, shaly sandstone, and sandy shale. Prone to slumping, especially in beds rich in volcanic ash	Ammonites, gastropods, bivalves, fish, mosasaurs, sea turtles, sharks
Niobrara Formation	Upper Cretaceous	Chalk, limestone and shale; contains many fossil clams, oysters, and formaninifera	
Carlile Shale	Late Cretaceous	Shale, limestone, and sandstone ; contains many very thin bedded, fossiliferous, shaly limestone and calcareous shale layers	Invertebrates (mollusks) and marine vertebrates (fish, reptiles)

Sources: DOS, 2011; Diffendal et al., 1996

E.1.1.8 Geologic Hazards[1]

Seismic Hazards

Seismic hazards include faults, seismicity, and ground motion hazards. Collectively, these three phenomena are associated with seismic hazard risk. Faults are defined as a fracture along which

1 Flooding is also considered a geologic hazard. This discussion is found in Section 4.4 and Appendix E.4.

blocks of earth materials on either side of the fault have moved relative to each other. An active fault is one with demonstrable evidence of movement having taken place within the last 10,000 years (USGS, 2008). Seismicity refers to the intensity and the geographic and historical distribution of earthquakes. Ground motion hazards are defined as movement of the earth's surface as a result of earthquakes (USGS, 2008).

Seismically, Nebraska is in a relatively quiet and stable part of the continent. Eastern Nebraska historically has had minimal earthquake activity (USGS, 2012b). Earthquakes in Nebraska have ranged in magnitude from 2.5 to 4.3, as measured on the Richter magnitude scale (a logarithmic scale). The ancient Nemaha Uplift, the Humboldt Fault Zone, and deep-sealed faults in the Salina Basin are thought to be related to the few minor earthquakes that have occurred. There are no active faults along the proposed Nebraska Reroute (Crone and Wheeler, 2000; USGS, 2006). USGS ground motion hazard mapping indicates that the potential ground motion hazard along the proposed Nebraska Reroute is low.

Landslides

Landslide is a term used to identify various processes involving the movement of earth material down slopes (USGS, 2004). Landslides can occur in a number of different ways in different geological settings. Large masses of earth can become unstable and be pulled downhill by the force of gravity. Instability can be caused by a combination of steep slopes, periods of high precipitation, undermining of support by natural processes (stream erosion), or unintentional undercutting or undermining the strength of unstable materials in the construction of roads and structures (USGS, 2004).

Landslide potential is greater on steeper slopes. The Cretaceous Pierre Shale (such as found in Keya Paha, Boyd, and Holt Counties along the proposed Nebraska Reroute) is especially susceptible to landslides. The Pierre Shale contains some layers rich in volcanic ash, which weaken the rock and make it even more susceptible to movement. The Pierre Shale can also contain appreciable amounts of bentonite (clay), which can expand dramatically when exposed to moisture and may cause soil and/or geologic formations to become unstable (University of Nebraska-Lincoln, 2012).

Subsidence

Land-surface subsidence can result from:

- Mining of groundwater that can cause aquifers to compact
- Drainage of organic soils
- Collapse of subsurface cavities (Galloway et al., 2000)

Historical declines in groundwater levels have been noted in Holt County; however, along the proposed Nebraska Reroute, the ground surface is not susceptible to subsidence because of the lack of local declines in groundwater levels that would have caused aquifers to compact. There is also a very limited extent of organic soils and relatively shallow bedrock with cavernous features. Also, the Niobrara Formation comprises shaly chalk and limestone and is classified as a secondary aquifer.

Subsidence can also occur in areas of karst, but no known karst features have developed along the proposed Nebraska Reroute. The National Atlas indicates that karst features exist in

Nebraska, but information provided by a University of Nebraska–Lincoln researcher confirms that the absence of karst-generative processes supports the absence of karst in Nebraska (Keystone, 2012).

E.1.2 POTENTIAL IMPACTS

Geological, mineralogical, and paleontological resources that have the potential to be adversely affected by the proposed Nebraska Reroute are described in this technical memorandum. Potential impacts for the Western Alternative were not evaluated for geology, because this resource would not be affected by the reroute.

Impacts along the proposed Nebraska Reroute could occur during both construction and operation and maintenance of the pipeline. The areas of potential impact identified are:

- Disturbance of topography
- Loss of access to underlying mineral resources
- Disturbance of paleontological resources
- Potential damage to the pipeline attributable to geological hazards

E.1.2.1 Topography

Construction

Construction impacts would include disturbances to the topography along the Nebraska Reroute resulting from grading and trenching activities. Most of the Nebraska Reroute would be within areas where bedrock is buried by unconsolidated sediments consisting of alluvium, loess, and/or eolian deposits.

Keystone has stated that "there appears to be some shallow bedrock, but is very limited in length along the preferred alternative route … which could necessitate ripping or blasting" (Keystone, 2012). Limited blasting would likely be needed in areas where shallow bedrock could be encountered or where boulders could not be removed with conventional excavation equipment (such as a track hoe or bulldozer) or be broken up with a track hoe-mounted hydraulic hammer. In shallow bedrock areas, impacts to bedrock would be expected to be minimal and limited to areas where bedrock is within 8 feet of the surface. Trench excavation would typically be to depths of between 7 and 8 feet (DOS, 2011).

The majority of construction along the Nebraska Reroute would not cause substantial short- or long-term, large-scale alteration of topography.

Operation

Routine pipeline operation and maintenance activities would not be expected to affect topography or bedrock geology.

E.1.2.2 Mineralogical Resources

Construction

Gravel and other borrow materials might be necessary for trench excavations and temporary sites. Trench excavation for placement of the pipeline would be expected to be to depths of between 7 and 8 feet (typical). The pipeline trench would be backfilled with materials derived from the trench excavation, but it might be necessary to obtain construction sand and gravel from local commercial sources for use as pipe bedding in certain sections, road base, surface ancillary facility pads, or temporary sites (storage, contractor yards, and temporary access roads). Construction materials might also be needed to stabilize the land for permanent facilities, including pump stations, mainline valves, and permanent access roads.

Keystone expects that borrow materials would be obtained from an existing, previously permitted commercial source located as close to the pipeline or contractor yard as possible. These short-term demands for sand and gravel would not substantially affect the long-term availability of construction materials in the area.

Operation

Operation of the proposed Nebraska Reroute would limit future access to sand, gravel, clay, and stone resources that would be within the width of the permanent pipeline easement and adjacent to the easement. Deep mining activities adjacent to the easement could cause slumping along the pipeline trench.

E.1.2.3 Paleontological Resources

Keystone has conducted paleontological surveys along the proposed pipeline route in Nebraska in areas where landowner permission has been granted. Keystone followed Bureau of Land Management paleontological survey protocols. To date, no scientifically significant resources have been identified; however, these surveys are not yet complete.

Construction

Potential impacts on paleontological resources during construction include damage or destruction of fossils by excavation activities, erosion of fossil beds by grading, and unauthorized collection of fossils.

Operation

Routine pipeline operation and maintenance activities could affect paleontological resources. Maintaining the in-place pipeline affects more soil/rock around the pipeline than construction of the pipeline. Resources in the soil/rock near the pipeline could be affected during maintenance.

E.1.2.4 Geologic Hazards

Construction

Seismic

Construction activities would not be expected to affect seismic activity because the proposed Nebraska Reroute would not cross any known active faults.

Landslides

The main hazard of concern during construction of the pipeline would be unintentional undercutting of slopes or construction on steep slopes causing or contributing to instability that could lead to landslides. Other hazards might result from construction on the Cretaceous Pierre

Shales that contain bentonite beds. The high swelling hazard might cause slope instability during periods of precipitation.

Along the proposed Nebraska Reroute, potentially unstable soils or geologic formations are present at crossings of the Keya Paha and Niobrara Rivers. The Pierre Shale is exposed in the northern part of Nebraska where the Keya Paha and Niobrara Rivers eroded overlying deposits. The Pierre Shale is susceptible to slumps and slides and cannot support slopes greater than 10 percent. Layers rich in volcanic ash are particularly unstable (Maher et al., 2003; University of Nebraska-Lincoln, 2012).

During construction activities, vegetation clearing and alteration of surface-drainage patterns could also increase landslide risk.

Subsidence

Construction of the pipeline would not be expected to cause land subsidence, because no known karst or other subsidence-prone geologic features are present along the proposed Nebraska Reroute.

Operation

Seismic

Based on evaluation of potential seismic hazards along the proposed Nebraska Reroute, the risk of potential impact to the pipeline from earthquake ground motion would be considered minimal. The Nebraska Reroute would not cross any known active faults and would be located outside of known zones of high seismic hazard.

Landslides

Routine pipeline operation and maintenance activities would not be expected to cause landslides.

Subsidence

Routine pipeline operation and maintenance activities would not be expected to cause subsidence.

E.1.3 MITIGATION

Keystone has committed to avoid or reduce impacts by implementing a Construction, Mitigation, and Reclamation Plan (CMRP) (see Appendix C). The CMRP prescribes construction, operation, and maintenance procedures that are designed to reduce the likelihood and severity of impacts along the proposed Nebraska Reroute. Keystone has committed to implementing construction, mitigation, and reclamation actions in the CRMP to the extent that they do not conflict with the requirements of any applicable federal, state, or local rules and regulations, or other permits and approvals applicable to the project. The CMRP includes the following commitments by Keystone:

- Keystone has committed to reasonably compensate landowners for damages to private property caused by construction and operation of the Nebraska Reroute and caused by future activities associated with maintenance and repairs to the pipeline.

- Keystone has committed to prepare and file plans addressing "significant finds" (as defined by the Bureau of Land Management) of vertebrate fossils, as required. In the event that scientifically significant paleontological resources are identified, Keystone will consult with the landowner who has ownership rights to the resource and also will advise the DOS, Nebraska SHPO, and the University of Nebraska State Museum, with landowner approval.
- Keystone has committed to incorporate the 57 Special Conditions recommended by the Pipeline and Hazardous Materials Safety Administration in Appendix U of the *Final Environmental Impact Statement for the Proposed Keystone XL Project* (DOS, 2011). Several of these conditions address design and manufacturing considerations that would minimize the likelihood of pipeline accidents caused by seismic activity.
- Keystone has committed to locally reroute the pipeline to avoid areas with high landslide potential, particularly areas with slopes greater than 15 percent and with unstable soil or rock conditions. If rerouting the pipeline is not practicable, Keystone has committed to implement measures that would decrease landslide risks.

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Attachment A

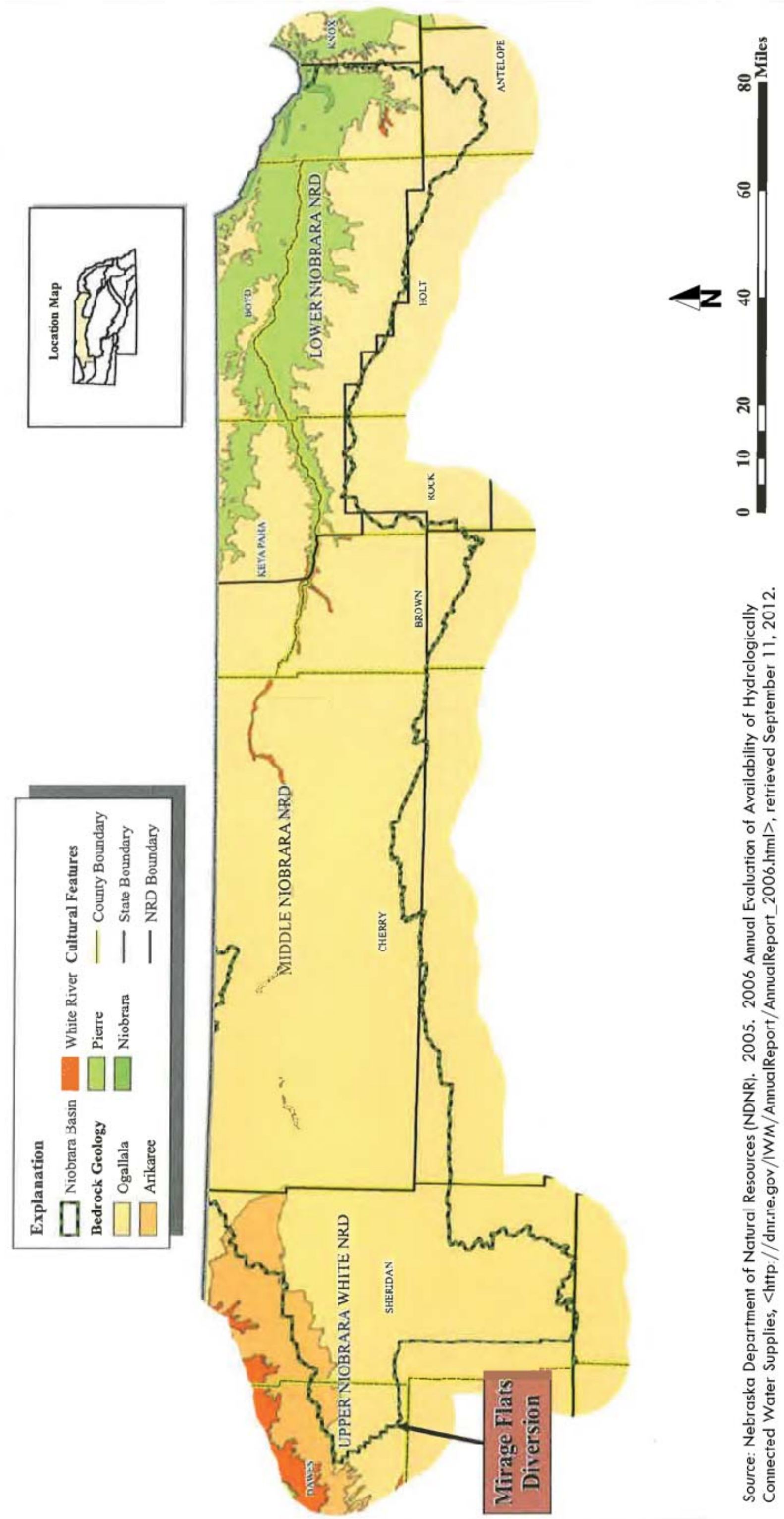
Abbreviations and Acronyms

Abbreviation, Acronym, or Short Form	Definition
DOS	U.S. Department of State
Keystone	TransCanada Keystone Pipeline, LP
NDNR	Nebraska Department of Natural Resources
UNL-CSD	University of Nebraska-Lincoln Conservation and Survey Division
USGS	U.S. Department of the Interior, U.S. Geological Survey

Attachment B

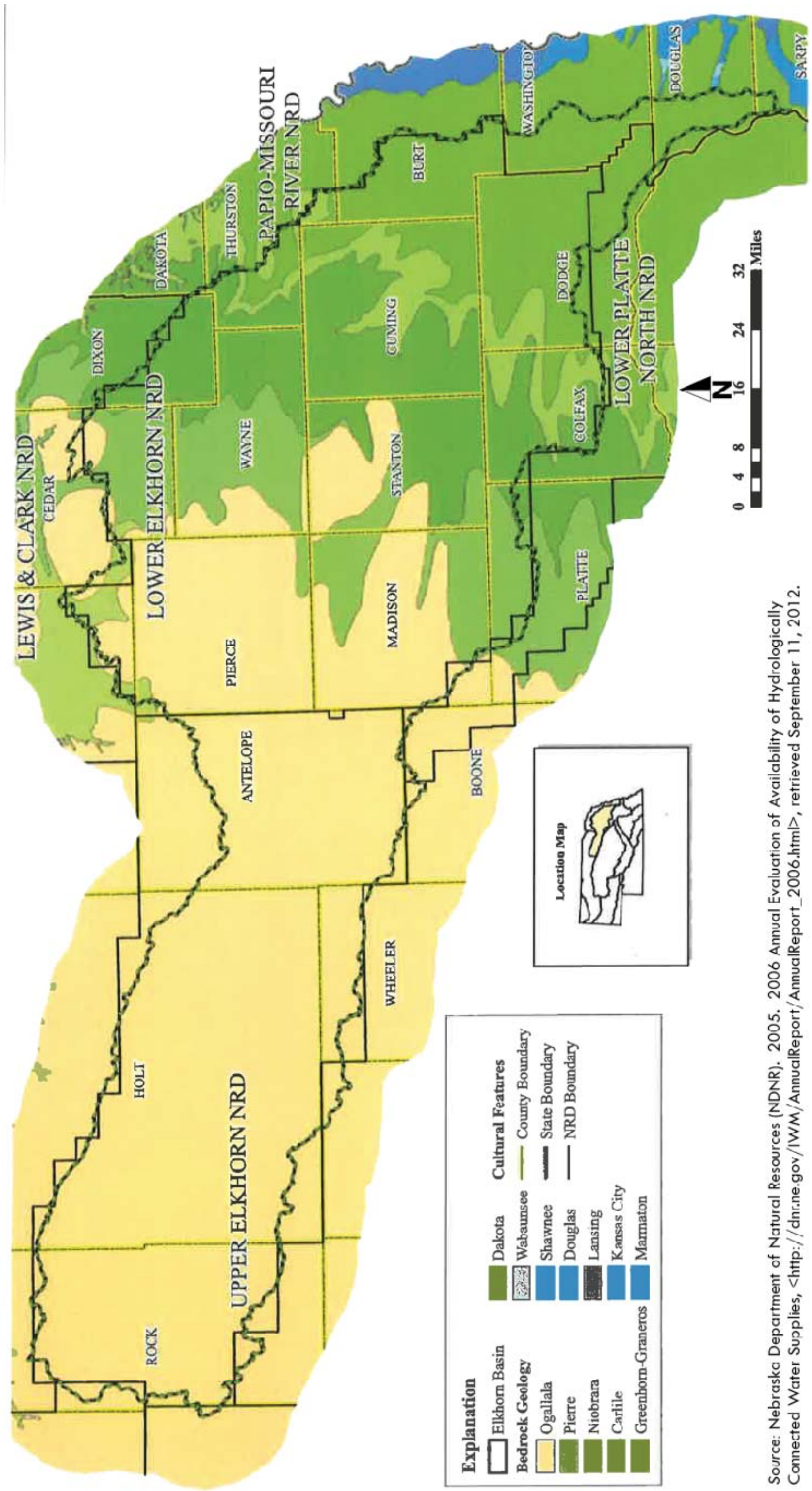
Bedrock Geology

Figure B-1. Bedrock Geology – Niobrara River Basin below Mirage Flats Diversion



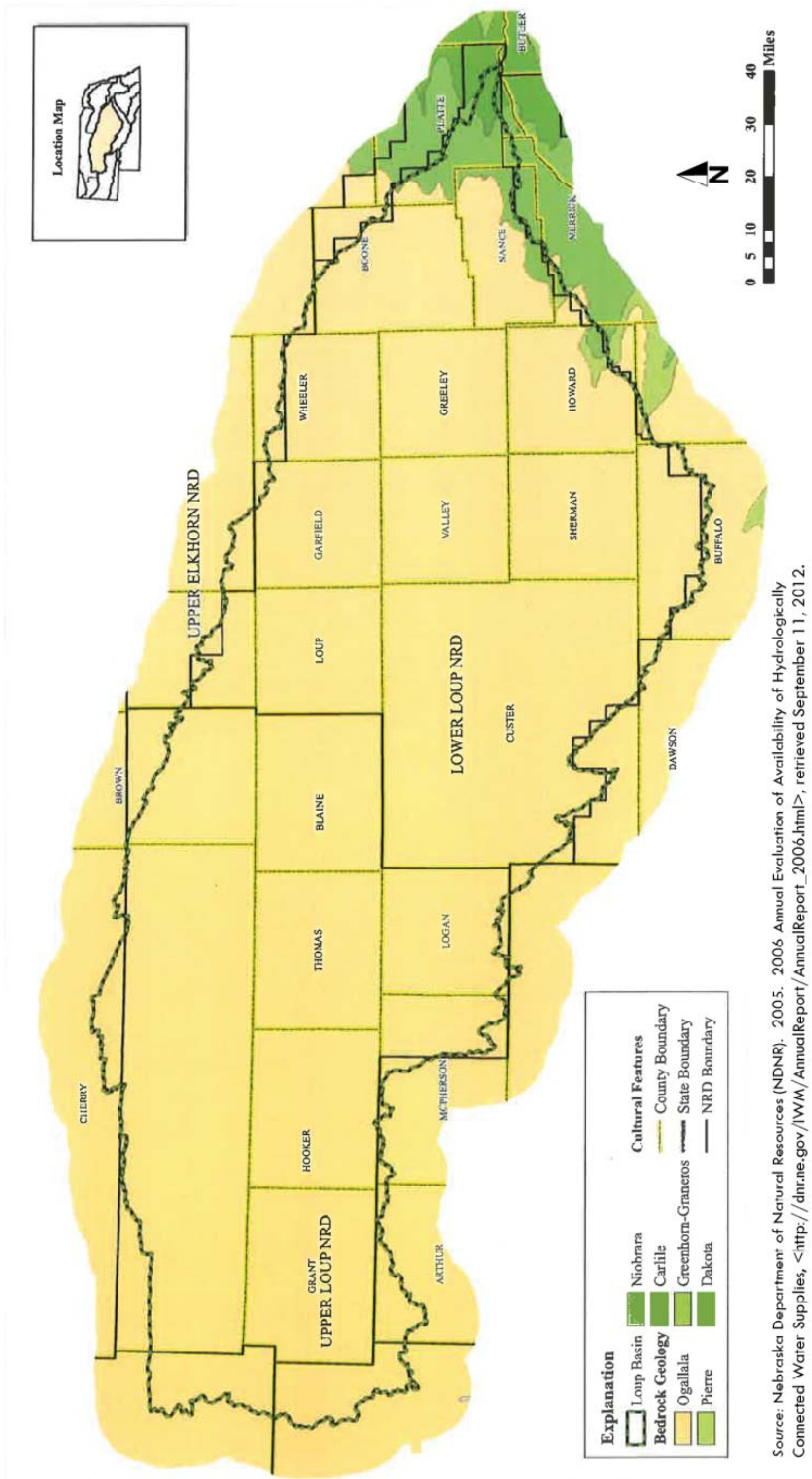
Source: NDNR map based on UNL-CSD Statewide Geologic Map

Figure B-2. Bedrock Geology – Elkhorn River Basin



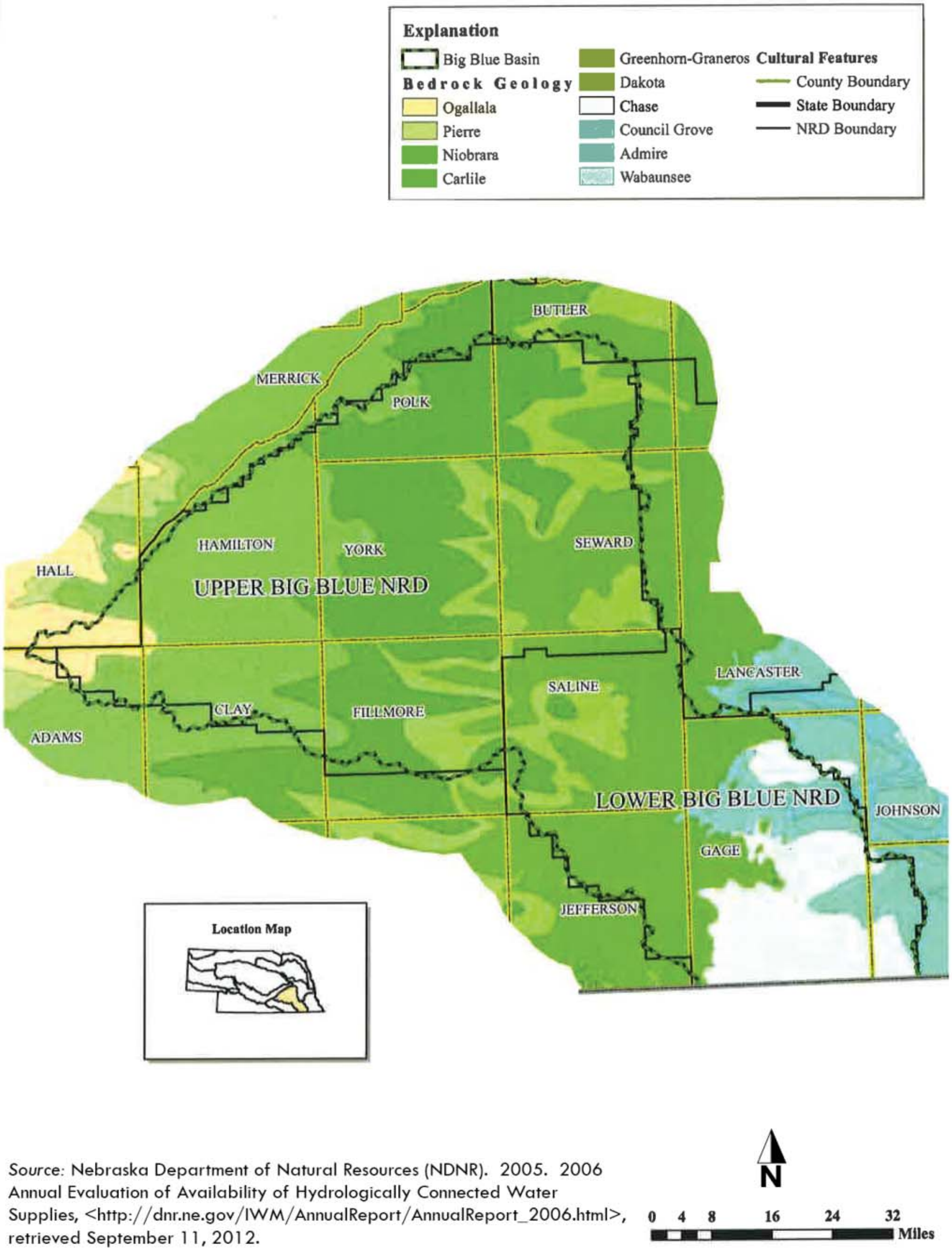
Source: NDNR map based on UNL-CSD Statewide Geologic Map

Figure B-3. Bedrock Geology – Loup River Basin



Source: NDNR map based on UNL-CSD Statewide Geologic Map

Figure B-4. Bedrock Geology – Big Blue River Basin



Source: Nebraska Department of Natural Resources (NDNR). 2005. 2006 Annual Evaluation of Availability of Hydrologically Connected Water Supplies, <http://dnr.ne.gov/IWM/AnnualReport/AnnualReport_2006.html>, retrieved September 11, 2012.

Source: NDNR map based on UNL-CSD Statewide Geologic Map

Appendix E.2

Soils and Sediment Technical Memorandum

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APPENDIX E.2

SOILS AND SEDIMENT TECHNICAL MEMORANDUM

This technical memorandum provides a description of the affected environment and environmental consequences concerning soils and sediment. The existing conditions along the proposed Nebraska Reroute are described first, then potential impacts from construction, operation, and maintenance of the Keystone XL Pipeline, and finally general mitigation measures to avoid or reduce potential impacts.

Although the proposed Nebraska Reroute is located outside of the Sand Hills, areas of fragile, highly erodible soils that have surface features very similar to the Sand Hills are present within the Nebraska Reroute corridor.

Soil is a natural body made up of solids (minerals and organic matter), liquid, and gases that is present on the land surface. Soil is characterized by one or both of the following qualities: horizons (layers of soil that are distinguishable from the initial parent material as a result of additions, losses, transfers, and transformations of energy and matter) and/or the ability to support rooted plants in a natural environment (U.S. Department of Agriculture, Natural Resources Conservation Service [NRCS], 1999).

Soils are formed during the following naturally occurring, external processes that are constantly occurring on the Earth's surface (NRCS, 2012a):

- Addition – placement or reaction of materials in soil
- Loss – physical removal of material by water or wind from its original position
- Transfer – movement of material downward in the soil by water and wind
- Transformation – alteration of rock or soil by physical, chemical, or biological processes

The five natural factors that influence soil formation are (NRCS, 2012a):

- Climate – the moisture content and temperature variations that cause different patterns of weathering and leaching
- Slope/topography – the steepness, shape, and length of slope, which influence the rate at which water flows into or off of the soil
- Parent material – the mineral material and unconsolidated organic matter in which soils form
- Biological factors – the combination of plants and organisms that affects soil formation by supplying upper layers with organic matter, recycling nutrients from lower to upper layers, and helping to control erosion
- Time – the interaction of all the factors that affect soil formation over time

E.2.1 EXISTING CONDITIONS

E.2.1.1 Climate

Climate is the primary influence and determines the physical, chemical, or biological nature of weathering as well as the rate at which weathering acts on parent material to form soil. Precipitation and temperature are the most important climatic elements for soil formation (Krzic et al., 2004). Eastern Nebraska has a humid, continental climate, which is characterized by hot summers, cold winters, and wide temperature variations between seasons (Gutentag et al., 1984).

Representative meteorological data for the Nebraska Reroute corridor are based on information obtained from the O'Neill and Albion meteorological stations in Nebraska. The hottest months are June through August, during which the average daily temperature is 75.0 degrees Fahrenheit (°F), the average minimum daily temperature is 56.3°F, and the average maximum daily temperature is 87.6°F. December through February are the coldest months, during which the average daily temperature is 22.0°F, the average minimum daily temperature is 10.9°F, and the average maximum daily temperature is 36.2°F. Annual average precipitation and snowfall at the O'Neill station are 25.3 and 26.3 inches, respectively. Annual average precipitation and snowfall at the Albion station are 27.9 and 27.6 inches, respectively.

E.2.1.2 Topography

The type of topography present influences soil formation. The degree of slope affects the rate at which water seeps into soil, the rate of surface runoff and its associated soil erosion, and the distribution of vegetation (Krzic et al., 2004).

The Nebraska Reroute would be located within two Land Resource Regions associated with soil resources (NRCS, 2006; U.S. Department of State [DOS], 2011). From north to south, these are:

- Western Great Plains Range and Irrigated Region
- Central Great Plains Winter Wheat and Range Region

The Western Great Plains Range and Irrigated Region is an elevated plain that includes portions of northern Nebraska. Gently rolling or rolling topography dominates the region, but flat-topped, steep-sided buttes and badlands are also present (DOS, 2011). Soils in this region are dominantly entisols and mollisols. Entisols are defined as soils that have little or no evidence of the development of horizons. Entisols are not in place long enough to form distinctive horizons and are basically unaltered from their parent material (which can be unconsolidated sediment or rock). Mollisols form in subhumid to semiarid areas on plains, typically under a grassland-type cover. The parent material is typically base-rich and calcareous and includes limestone, loess,[1] or windblown sand (NRCS, 1999). Soils are varied and range from very deep and organic to shallow with thin topsoil horizons. Most soils have mixed or clay mineralogy; however, some soils contain carbonate mineralogy.

[1] Loess is material that has been transported and deposited by wind and consists of predominantly silt-sized particles (Soil Science Society of America website, <https://www.soils.org/publications/soils-glossary/# retrieved September 4, 2012).

The Central Great Plains Winter Wheat and Range Region is characterized by nearly-level-to-gently-rolling slopes and by loess-mantled narrow ridges separated by steep slopes that border drainageways (DOS, 2011). Soils in this region are predominantly mollisols and are generally deep, silty soils formed in loess. Soils developed on steep slopes have weakly developed horizons, meaning that the layers are mixed. The soil mineralogy in this region is generally mixed; soils have clay or carbonate mineralogy (NRCS, 2012a).

E.2.1.3 Parent Material

Parent material is the original material from which a soil forms. It consists of unconsolidated and more or less chemically weathered mineral or organic material

Windblown silty material covers most of Nebraska in varying depth (the exception is the Sand Hills). The loess is primarily found in the subsoil zone (the layer of soil beneath the surface layer). In northeastern and central Nebraska, loess can be found to a depth of 90 feet, while in western and southeastern Nebraska, loess is typically thinner. Windblown sand material primarily covers bedrock in the Sand Hills; this material is typically several feet deep, but can be over 100 feet deep, and is found in both surface and subsoil zones. Alluvial deposits (materials transported from the parent material by water) are found in floodplain areas (such as the Platte River) and smaller watercourses (University of Nebraska–Lincoln, 1999).

E.2.1.4 Biological Factors

Soil development is affected by both the type and number of organisms that live within the soil and on the surface. Vegetation and microorganisms, the most abundant living organisms in the soil, influence the kind of soil developed. The type of root system, plant size, aboveground vegetative volume, nutrient content, and plant life cycle all affect soil formation. Grassland soils tend to be darker, particularly to greater depths, and have a more stable structure than forest soils. Most Nebraska soils were formed beneath grasses (University of Nebraska–Lincoln, 1999).

E.2.1.5 Time

Soil formation is a slow process. Compared to older soils, younger soils retain more characteristics of the parent material (University of Nebraska–Lincoln, 1999). The loess soils in Nebraska are young geologically at 10 to 50 thousand years old (Gutentag et al., 1984).

E.2.1.6 Soil Associations

NRCS's soil survey geographic (SSURGO) databases (NRCS, 2012c–2012k) were used to create a soil association inventory map for the proposed Nebraska Reroute. A soil association is a landscape that has a distinctive pattern of soils. An association normally consists of one or more major soils (from which it is named) and at least one minor soil. Figure E.2-1 shows the soils located in the nine counties that would be crossed by the proposed Nebraska Reroute (see Figure E.2-1). Seventeen individual soils associations would be crossed by the proposed Nebraska Reroute (see Table E.2-1).

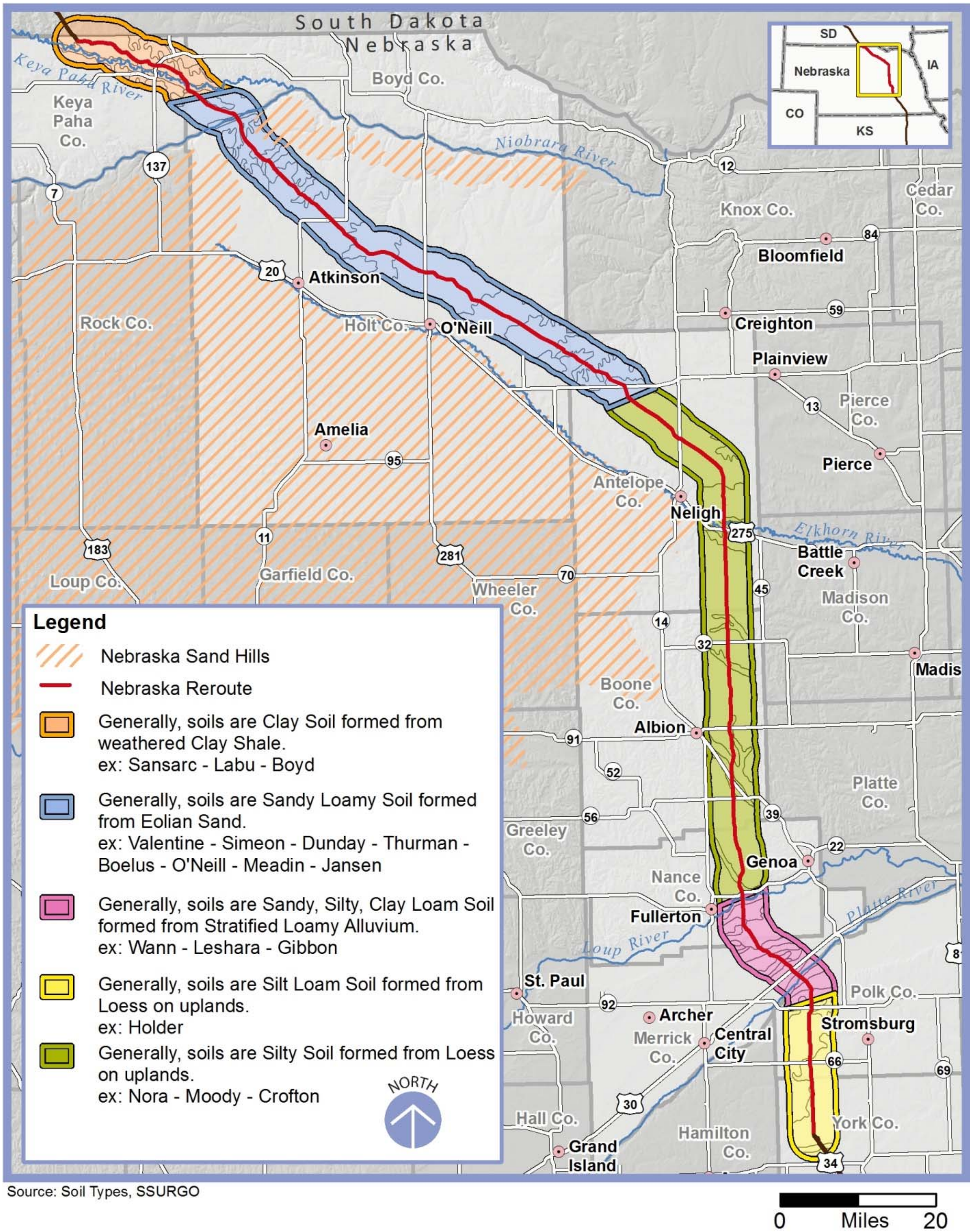
Table E.2-1. Soil Associations within the Proposed Nebraska Reroute Corridor

Soil Association	Soil Type	Acreage[a]	Linear Miles[b]
Reliance	Silty Clay Loam	8.8	0.7
Sansarc	Clay	240.6	18.2
Loup	Sandy	51.2	5.0
Valentine	Sandy	526.9	39.5
O'Neill	Sandy	368.1	27.7
Simeon	Sandy	132.9	10.0
Thurman	Sandy	130.3	9.8
Wewela	Sandy Loam	38.0	2.9
Nora	Silty	535.9	40.3
Hord	Silt Loam	166.5	12.7
Wann	Sandy Loam	87.2	6.7
Platte	Sandy	7.5	1.6
Wood River	Silt Loam	15.4	1.2
Hastings-Fillmore	Silt Loam	125.5	9.4
Holder	Silt Loam	106.4	8.0
Uly-Coly	Silt Loam	19.7	1.5
Water	Not applicable	0.0	0.0

[a] *Determined by using maps and digital measuring tools, using a study corridor of 110 feet. An additional 230 acres would be crossed within the temporary workspace and pump station areas. Acreages have been rounded to the nearest tenth.*

[b] *Determined by using maps and digital measuring tools. Linear miles have been rounded to the nearest tenth.*

Figure E.2-1. Soil Association along the Proposed Nebraska Reroute



Source: Soil Types, SSURGO

Major soil associations that would be crossed by the proposed Nebraska Reroute are discussed in the following sections. Other soil types are present along the alignment. General soil characteristics related to soil formation are also provided. Each soil association is separated into the individual soil series in the corresponding tables (by county). The soil series is the lowest category of the National Soil Classification System. The name of a soil series or the phase of a soil series is the most common reference term used in soil map unit names (NRCS, 2012a).

Keya Paha County

Soils in Keya Paha County along the proposed Nebraska Reroute are generally silty clays and are well-drained. The predominant soil in Keya Paha County along the proposed Nebraska Reroute is the Sansarc-Labu-Boyd Association (see Table E.2-2).

Table E.2-2. Keya Paha County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Sansarc	Clayey soil	Clay residuum weathered from shale within the dissected shale plain	Well-drained	2 to 60 percent or more
Labu	Silty clay soil	Residuum weathered from clay shales	Well-drained	2 to 30 percent
Boyd	Silty clay soil	Residuum weathered from clay shale on uplands	Well-drained	3 to 30 percent

Source: NRCS, 2012b

Boyd County

Soils in Boyd County along the proposed Nebraska Reroute are generally very deep and excessively drained sandy soils. The predominant soil in Boyd County along the proposed Nebraska Reroute is the Valentine-Simeon-Dunday Association (see Table E.2-3).

Table E.2-3. Boyd County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Valentine	Sandy soil	Sandy soils formed in eolian sand	Excessively drained	0 to 80 percent
Simeon	Loamy sand soil	Sandy alluvium and outwash material	Excessively drained	0 to 30 percent
Dunday	Sandy soil	Eolian sands on interdunes, low dunes and valley sides of sandhills	Somewhat excessively drained	0 to 11 percent

Source: NRCS, 2012b

Holt County

Soils in most of Holt County are generally very deep and excessively drained to somewhat poorly drained sandy soils. The predominant soil type in Holt County along the proposed Nebraska Reroute is the O'Neill-Meadin-Jansen Association (see Table E.2-4).

Table E.2-4. Holt County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
O'Neill	Loamy soils	Loamy sediments over sand and gravel	Well-drained	0 to 30 percent
Meadin	Sandy soils	Sandy sediments over sand and gravel on uplands	Excessively well-drained	0 to 35 percent
Jansen	Loamy soils	Loamy sediments over sand and gravel on uplands	Well-drained	0 to 30 percent

Source: NRCS, 2012b

Antelope County

Soils in Antelope County are characterized by well-drained sandy or silty soils in the north and west grading to deep loess deposits to the south and east. The main soil types along the proposed Nebraska Reroute in Antelope County are the Nora-Moody-Crofton and the Valentine-Thurman-Nora-Boelus Associations (see Table E.2-5).

Table E.2-5. Antelope County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Nora	Silty soils	Loess on uplands	Well-drained	0 to 30 percent
Moody	Silty soils	Loess on uplands	Well-drained	0 to 17 percent
Crofton	Silty soils	Calcareous loess on uplands	Well-drained	1 to 60 percent
Valentine	Sandy soils	Formed in eolian sand	Excessively drained	0 to 80 percent
Thurman	Sandy soils	Formed in eolian sand	Somewhat excessively drained	0 to 40 percent
Boelus	Sandy over loamy soils	Eolian sand over loess on uplands	Well-drained	0 to 11 percent

Source: NRCS, 2012b

Although the proposed Nebraska Reroute would be located outside the Sand Hills in Antelope County, the Reroute corridor has areas of fragile, sandy soils with surface features very similar to those of the Sand Hills (such as the Valentine Association; see Figure E.2-1). Valentine soils consist mainly of eolian, well-sorted sands, and sandy alluvium, with a smaller amount of loess.

Topsoil is typically sand mixed with organic matter, and the top 6 inches contain vegetative root systems and the native plant seed bank. Soils in the Valentine Association are generally excessively drained to somewhat poorly drained with intermittent wetland depressions. Rolling-to-hilly sand dunes, common in this area, have been stabilized by vegetative cover, where such cover exists (DOS, 2011).

Boone and Nance Counties

Soils in Boone and Nance Counties contain deep loess deposits, are well-drained, and silty. The Nora-Moody-Crofton Association is the dominant soil type along the proposed Nebraska Reroute in Boone and Nance Counties (see Table E.2-6).

Table E.2-6. Boone and Nance Counties Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Nora	Silty soils	Loess on uplands	Well-drained	0 to 30 percent
Moody	Silty soils	Loess on uplands	Well-drained	0 to 17 percent
Crofton	Silty soils	Calcareous loess on uplands	Well-drained	1 to 60 percent

Source: NRCS, 2012b

Merrick and Polk Counties

Soils in Merrick County are loamy and somewhat poorly drained. Loess deposits are not prevalent in Merrick County along the Loup and Platte Rivers. The Wann-Leshara-Gibbon Association is the dominant soil type along the proposed Nebraska Reroute in Merrick County (see Table E.2-7).

Table E.2-7. Merrick County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Wann	Fine sandy loam	Stratified calcareous alluvium; floodplains in river valleys of Central Loess Plains	Somewhat poorly drained	0 to 2 percent
Leshara	Silt loam	Stratified loamy alluvium	Somewhat poorly drained	0 to 2 percent
Gibbon	Silty clay loam	Stratified, calcareous alluvium; floodplains in river valleys of Central Loess Plains	Somewhat poorly drained	0 to 2 percent

Source: NRCS, 2012b

Soils in Polk County contain deep loess deposits and are well-drained and silty. The Holder Association is the dominant soil type along the proposed Nebraska Reroute in Polk County (see Table E.2-8).

Table E.2-8. Polk County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Holder	Silt loam	Interfluves and hill slopes on loess uplands in the Central Loess Plains	Well-drained	Typically less than 4 percent, but ranges from 0 to 11 percent

Source: NRCS, 2012b

York County

The soils in York County contain deep loess deposits, are well-drained to somewhat poorly drained, and are silty. The Hastings-Fillmore Association is the dominant soil type along the proposed Nebraska Reroute in York County (see Table E.2-9).

Table E.2-9. York County Soil Characteristics

Soil Series	Composition	Landscape	Drainage Classes	Slope
Hastings	Silt loam	Formed in loess on interfluves and hill slopes on loess uplands in the Central Loess Plains	Well-drained	0 to 17
Fillmore	Silt loam	Formed in loess in closed depressions on loess uplands and stream terraces in the Central Loess Plains	Somewhat poorly drained soils	0 to 2 percent

Source: NRCS, 2012b

E.2.1.7 Baseline Evaluation

A baseline evaluation using NRCS's SSURGO database (NRCS, 2012c–2012k) was completed to identify existing soil conditions that could be adversely affected during construction and operation of the proposed Nebraska Reroute. The following soil characteristics were evaluated:

- Highly erodible soils – soils prone to high rates of erosion when exposed to wind or water when vegetation has been removed.
- Hydric soils – soils designated by NRCS that, under normal conditions, are saturated for a sufficient period of time during the growing season to support the growth of plants that thrive in wet conditions (hydrophytic vegetation) (NRCS, 2006).
- Compaction-prone soils – soils with surface clay loam or finer textures.
- Gravelly/stony/rocky soils – soils with a cobbly, stony, bouldery, gravelly, or shaly modifier to the textural class; or soils that contain greater than 5 percent stones larger than 3 inches in the surface layer.
- Drought-prone soils – soils with a coarse texture (sandy loams and coarser).
- Low revegetation potential – soils listed as saline, sodic, or saline-sodic and containing horizons with a pH less than 3.5 (very acidic) or greater than 9.0 (very basic).

Summary of Soil Characteristics

Soils that would be crossed by the proposed Nebraska Reroute include 22 percent highly erodible by wind, 55 percent highly erodible by water, 16 percent hydric soils, 24 percent drought-prone, 17 percent gravelly/stony/rocky, 50 percent compaction-prone, and 2 percent with low revegetation potential (see Table E.2-10). A discussion of each of these soil characteristics is provided below.

Table E.2-10. Soil Characteristics Crossed by the Nebraska Reroute

Factor	Highly Erodible (Wind)	Highly Erodible (Water)	Hydric	Drought-Prone	Gravelly/ Stony/ Rocky	Compaction-Prone	Low Revegetation Potential
Miles[a]	44	107	32	41	33	98	4
Acres[b]	573	1,423	412	542	418	1,304	54
Percentage	22	55	16	21	17	50	2

Sources: NRCS, 2012c–2012k

[a] *Determined by using maps and digital measuring tools. Total Nebraska Reroute is approximately 195 miles.*

[b] *Determined by using maps and digital measuring tools, using a study corridor 110 feet wide.*

Highly Erodible Soils

Highly erodible soils are prone to high rates of erosion when exposed to wind or water if stabilizing vegetation is removed or damaged. The soil water erodibility factor (Kw) and wind erodibility group (WEG) were evaluated for the proposed Nebraska Reroute.

Kw is used to quantify the susceptibility of soil to being detached and moved by water. This erodibility factor is used to predict the long-term average soil loss from sheet and rill erosion under crop systems and conservation techniques (NRCS, 2012a). Soils with a Kw factor greater than 0.24 are considered highly erodible (Keystone, 2012).

WEG is a grouping of soils with similar properties that affect their susceptibility to being blown in cultivated areas (NRCS, 2012a). A WEG of 1 or 2 indicates highly wind-erodible soil. Soils included in WEG 1 and 2 indicate fine-grained textured soils that are particularly susceptible to wind erosion; these can be quantified as 134 to 310 tons/acre/year.

Highly Erodible (Water)

Soils that are highly susceptible to erosion by water were identified in the central portion of Holt County, the southeastern portion of Antelope County, and across Boone, Nance, Polk and York Counties (see Figure E.2-2). These soils are sandy soils in Holt County and loess soils in the other identified counties.

Highly Erodible (Wind)

Soils that are highly susceptible to erosion by wind were identified in Keya Paha, Holt, Antelope, and Merrick Counties (see Figure E.2-3). The primary soil in these counties is fine-grained sand.

Hydric Soils

Under normal conditions (average yearly temperature and precipitation), hydric soils are saturated for a sufficient period of time during the growing season to support the growth of plants that thrive in wet conditions (hydrophytic vegetation). Hydric soils were identified primarily in Boyd, Holt, Polk, and York Counties (see Figure E.2-4).

Drought-Prone Soils

Drought-prone soils are defined by texture designations that affect the soil's moisture-holding capacity. They are generally relatively coarse-grained soils that lack silt and clay needed to hold moisture, or soils that have an extremely high clay content (NRCS, 2006). Texture refers to the proportion of sand, silt, and clay present in a given soil. A sandy loam, for example, has much more sand and much less clay than does a clayey loam. A loam soil is a more balanced blend of sand, silt, and clay. Most soils are some type of loam (Sullivan, 2006).

Drought-prone soils were identified in Keya Paha, Boyd, Holt, Antelope, and Merrick Counties (see Figure E.2-5). Drought-prone soils are concentrated along the southern border of Keya Paha and Boyd Counties, across the northern half of Holt County, in the northwestern corner of Antelope County, and across Merrick County.

Gravelly/Stony/Rocky Soils

Gravelly/stony/rocky soils were identified in Keya Paha, Boyd, Holt, Antelope, and Merrick Counties (see Figure E.2-6). Along the proposed Nebraska Reroute, only gravelly soils are found.

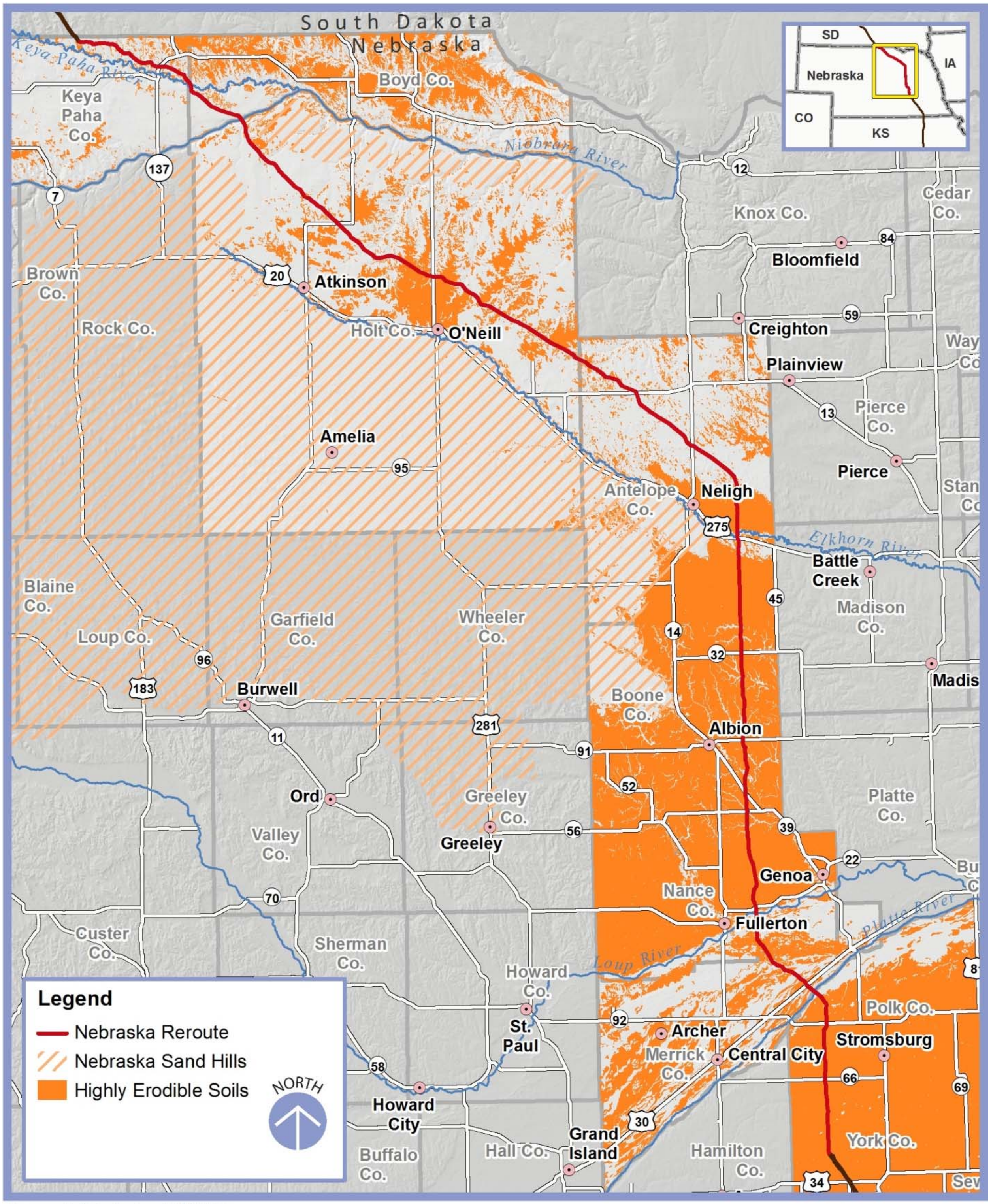
Compaction-Prone Soils

The degree of compaction depends on the moisture content and texture of the soil. Soils identified as compaction-prone are subject to rutting and displacement (DOS, 2011). Compaction-prone soils were identified along the entire proposed Nebraska Reroute but are concentrated in Antelope, Boone, Nance, Polk, and York Counties (see Figure E.2-7).

Low Revegetation Potential

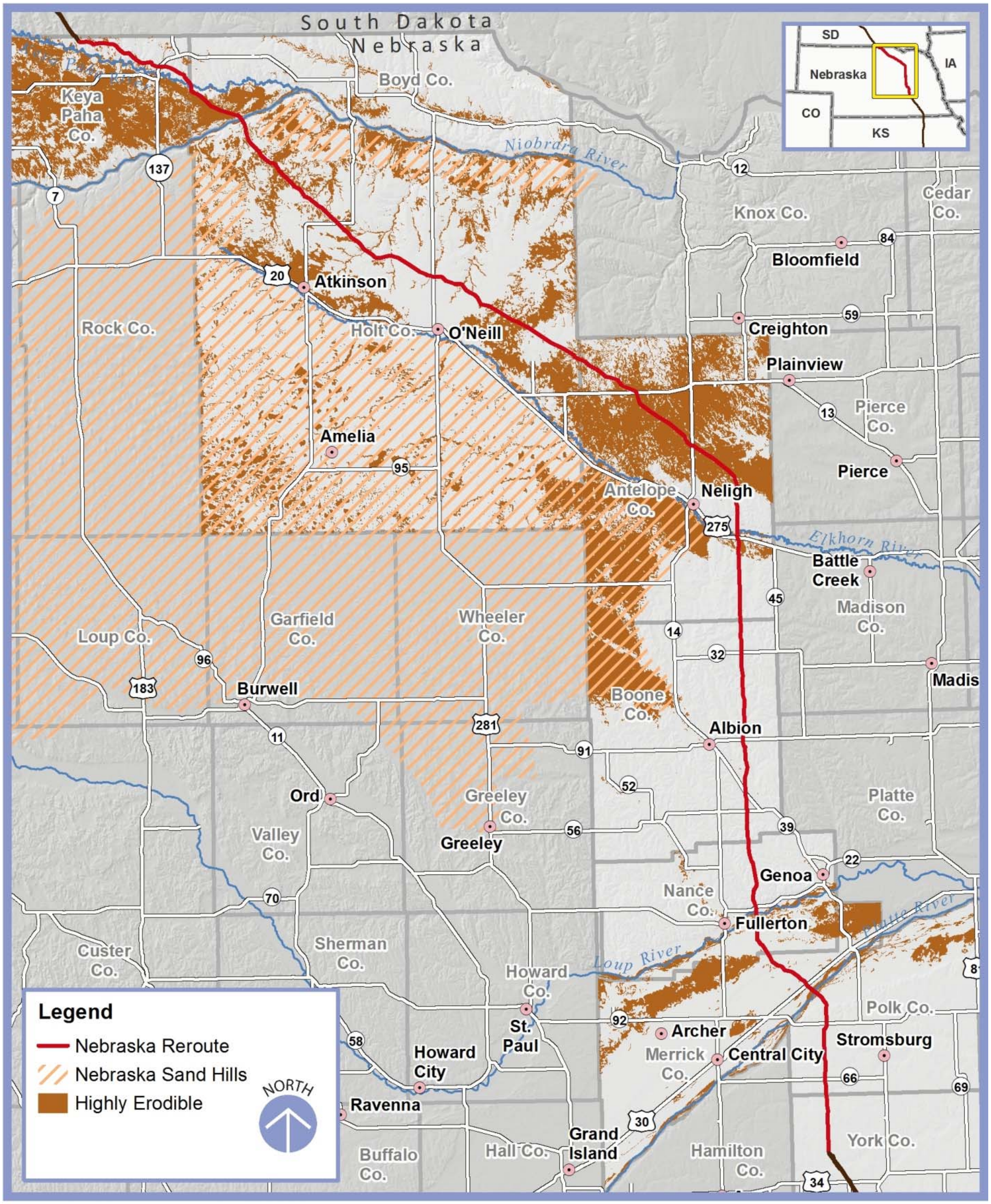
Areas along the proposed Nebraska Reroute were evaluated to identify areas of low revegetation potential where special handling and additional soil salvage techniques could be necessary to conserve agricultural capability. The chemical characteristics (such as salinity, sodicity, and pH) of individual soil horizons were evaluated. In general, soils considered for special handling contain suitable growing conditions in the topsoil horizon and upper sub-soil horizon (horizons immediately underlying the topsoil) but contain undesirable soil conditions at greater depths. These conditions could potentially degrade agricultural capability if not managed properly (DOS, 2011). These soils were identified in Nance, Merrick, Polk, and York Counties (see Figure E.2-8).

Figure E.2-2. Highly Erodible Soils (by Water) along the Proposed Nebraska Reroute



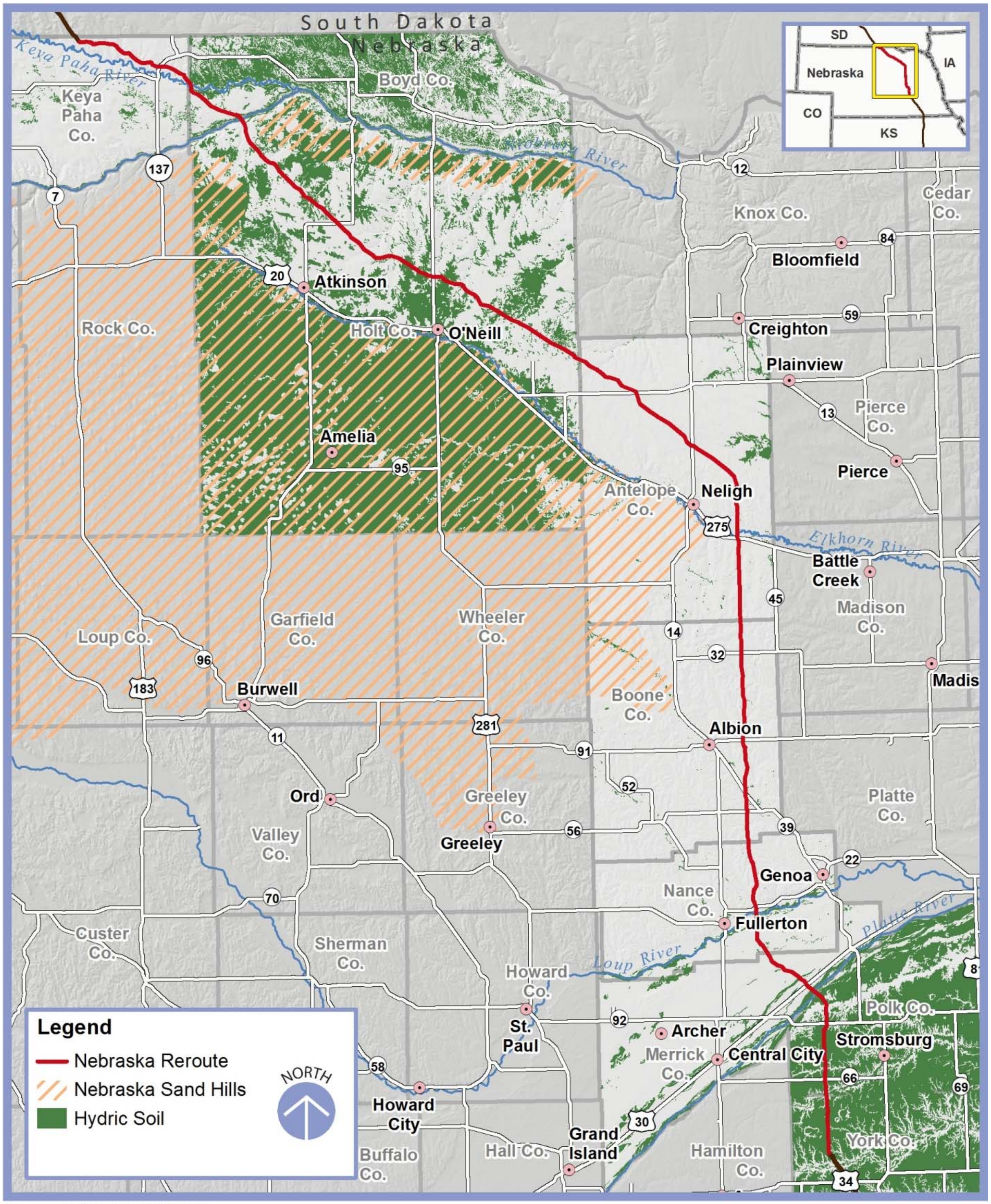
Source: Soil KwFactor, SSURGO

Figure E.2-3. Highly Erodible Soils (by Wind) along the Proposed Nebraska Reroute



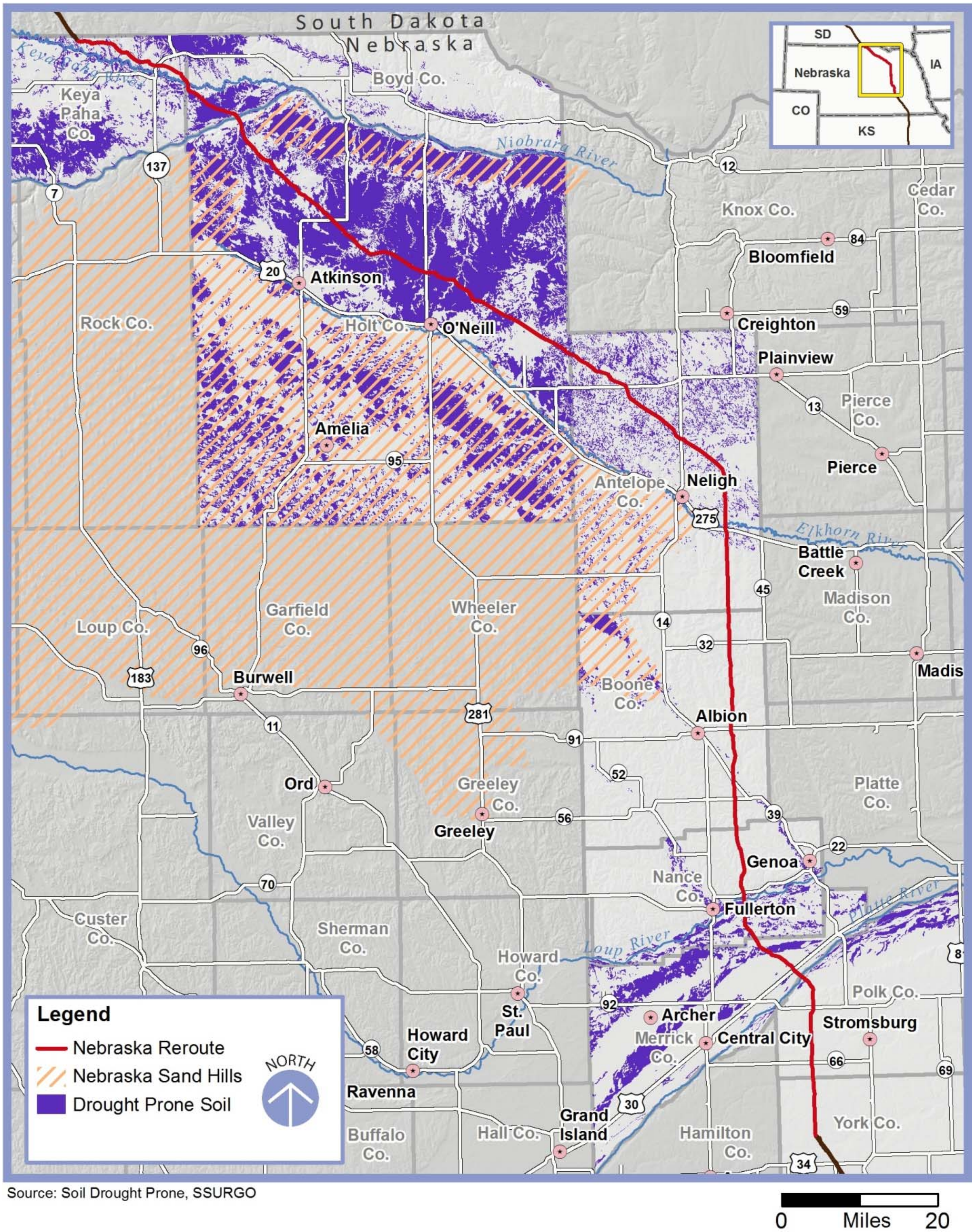
Source: Soil Wind Erodability Group, SSURGO

Figure E.2-4. Hydric Soils along the Proposed Nebraska Reroute



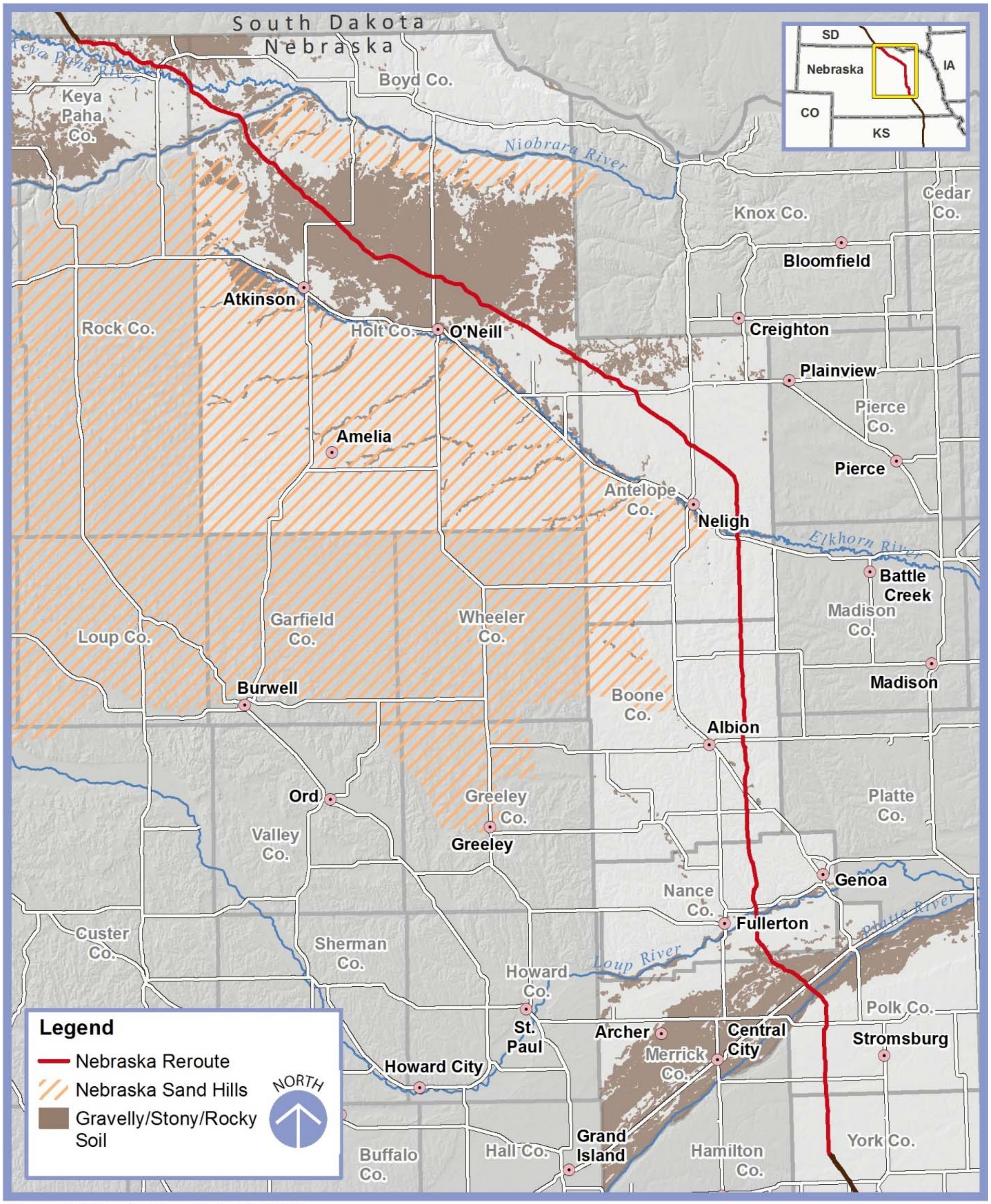
Source: Soil Hydric, SSURGO

Figure E.2-5. Drought-Prone Soils along the Proposed Nebraska Reroute



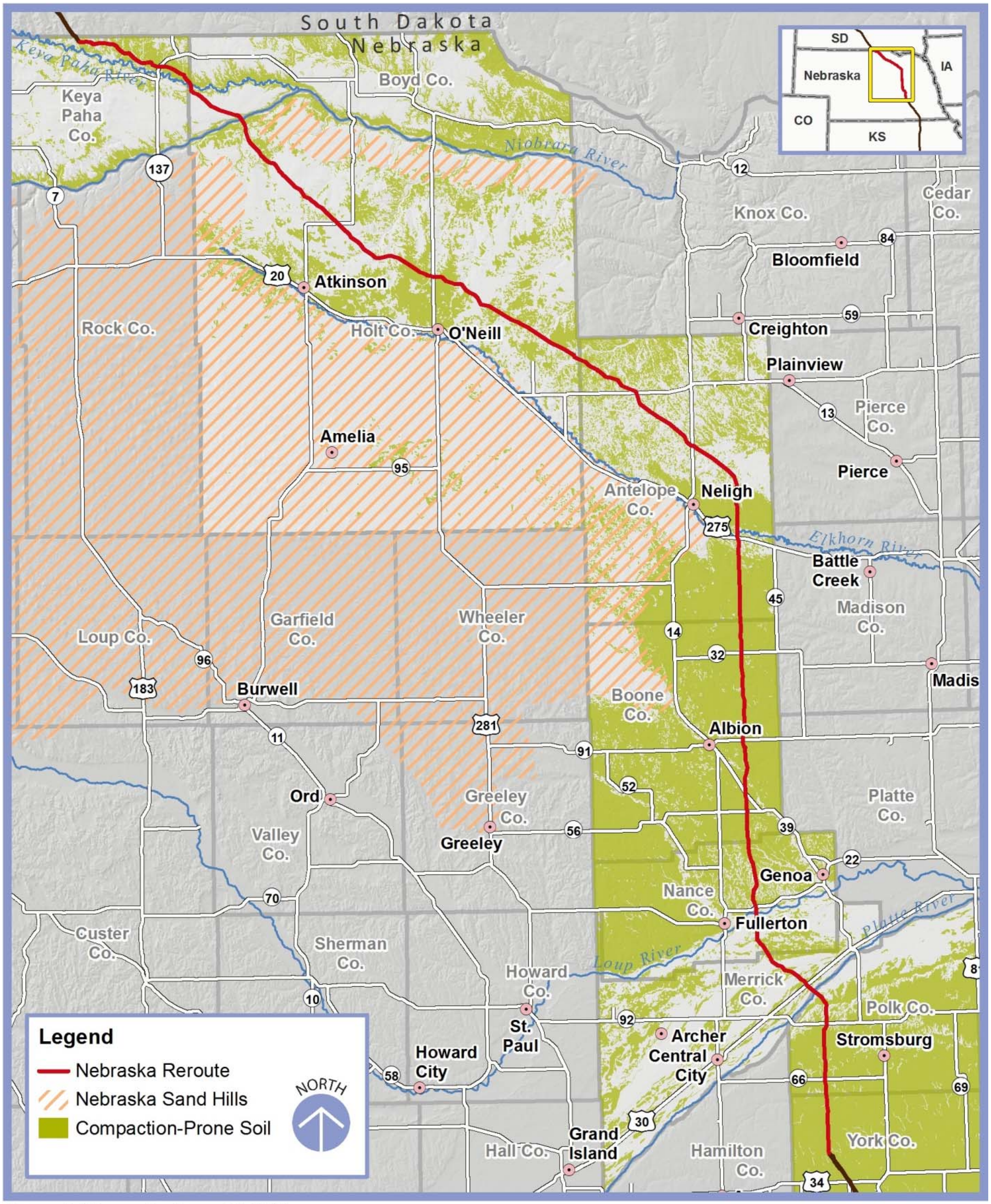
Source: Soil Drought Prone, SSURGO

Figure E.2-6. Gravelly/Stony/Rocky Soils along the Proposed Nebraska Reroute



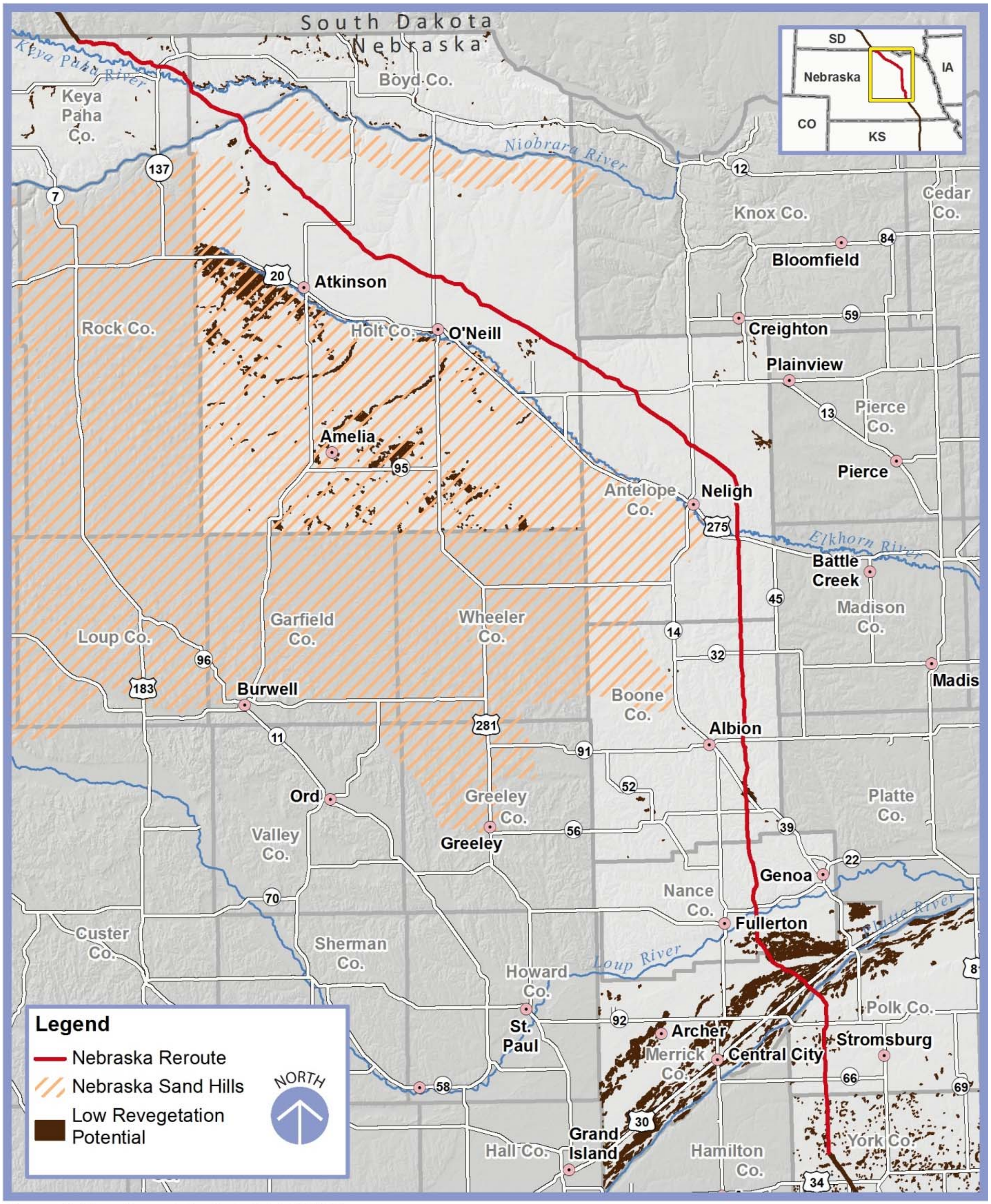
Source: Soil Gravelly Stony Rocky, SSURGO

Figure E.2-7. Compaction-Prone Soils along the Proposed Nebraska Reroute



Source: Soil Compaction Prone, SSURGO

Figure E.2-8. Low-Revegetation-Potential Soils along the Proposed Nebraska Reroute



Source: Soil Low Revegetation Potential, SSURGO

0 Miles 20

Soil Temperatures

Farm and ranch operators along the proposed Nebraska Reroute expressed concern about the possible effects the pipeline would have on soil temperatures. Soil temperatures are measured daily by the NRCS at a network of hydrometeorological stations across the United States. These measurements are recorded for depths of 2, 4, 8, 20, and 40 inches below ground surface (bgs). The nearest NRCS stations where soil temperatures are measured are located near Lincoln, Nebraska (approximately 60 miles east of the proposed Nebraska Reroute); Sioux City, Iowa (approximately 80 miles east of the proposed Nebraska Reroute); and Sioux Falls, South Dakota (approximately 145 miles northeast of the proposed Nebraska Reroute). Soil temperatures at these stations are:

- At Lincoln, soil temperatures at 2 inches bgs average approximately 30°F in January, 42°F in March, 60°F in May, 80°F in July, and 55°F in October. At a depth of 40 inches bgs, soil temperatures average approximately 40°F in January, 39°F in March, 50°F in May, 64°F in July, and 60°F in October.
- At Sioux City, soil temperatures at 2 inches bgs average approximately 30°F in January, 36°F in March, 56°F in May, 73°F in July, and 53°F in October. At a depth of 40 inches bgs, soil temperatures average approximately 40°F in January, 38°F in March, 49°F in May, 63°F in July, and 57°F in October.
- At Sioux Falls, soil temperatures at 2 inches bgs average approximately 24°F in January, 30°F in March, 53°F in May, 78°F in July, and 52°F in October. At a depth of 40 inches bgs, soil temperatures average approximately 37°F in January, 35°F in March, 46°F in May, 63°F in July, and 55°F in October (NRCS, n.d.).

The average depth to frost is approximately 5 feet bgs in the northern portion of the proposed Nebraska Reroute and 4 feet bgs in the southern portion (NOAA, 1978).

Minimum soil temperatures for corn seed germination are 55°F; soybean seed germination requires a minimum of 59°F. Soil temperatures of 55°F are typically reached in early May in the counties along the proposed Nebraska Reroute, while soil temperatures of 60°F are typically reached in mid-May (University of Nebraska–Lincoln, 1998).

E.2.2 POTENTIAL IMPACTS

This section describes the potential impacts on soil and sediment that could occur during construction, operation, and maintenance of the proposed Nebraska Reroute.

E.2.2.1 Construction

Construction activities associated with the Nebraska Reroute include clearing, grading, trench excavation, backfilling, equipment traffic, and restoration along the corridor. Similar activities would also occur during construction of pumping stations, access roads, a construction camp, and tank farms. These construction activities could adversely affect soil resources. Potential impacts include:

- Various impacts from construction camps
- Soil erosion
- Loss of sandy soil from cave-ins

- Topsoil loss or degradation
- Soil compaction
- Increased rock content in near-surface soil
- Damage to drainage systems
- Soil contamination from spills and leaks

Construction Camp

Rural Nebraska might not have enough temporary housing near the proposed Nebraska Reroute to house all construction personnel working in those areas. In remote and rural areas, a temporary work camp might be constructed to meet the housing needs of the construction workforce. The construction camp might be established on a site up to approximately100 acres in size. About 30 acres of that area might be used as a contractor yard, although the majority would be used for housing and administration facilities. The camp would require infrastructure and systems, including parking, for up to 900 workers.

Soil Erosion

Clearing for the proposed Nebraska Reroute would remove protective vegetative cover, which would increase soil erosion. Soil erosion could also occur during open-cut trenching and during temporary spoil storage.

Highly erodible soils along the proposed Nebraska Reroute corridor are especially prone to wind and water erosion during construction. These soils would need additional measures to control erosion during construction. Approximately 77 percent of the Nebraska Reroute would be constructed where the soils are characterized as highly erodible by either wind or water. Wind and/or water erosion could remove valuable topsoil. Although the proposed Nebraska Reroute would not be located in the Sand Hills, the Reroute corridor has areas of fragile (highly erodible – wind erodibility groups 1 and 2), sandy soils with surface features very similar to those of the Sand Hills. Removing the vegetative cover without effective, durable restoration could cause severe wind erosion. Severe wind erosion could create steep-sided, irregular or conical depressions referred to as “blowouts.” If severe erosion were to occur during construction, stabilization and revegetation would be more difficult after construction.

All soil types are susceptible to erosion by precipitation, particularly during intense storms or longer, less intense storms. Soils identified as compaction-prone are especially susceptible to rutting and displacement when construction vehicles are operated during wet weather. Compaction and rutting could reduce water infiltration and cause surface water pooling or surface water diversion, which could lead to increased local soil erosion and sedimentation. Stockpiled topsoil and trench spoils could cause water to pond during storms with precipitation.

Loss of Sandy Soil from Cave-Ins

Where the proposed Nebraska Reroute would be constructed in loose, sandy soils, cave-ins could occur during trench excavation, and unstripped topsoil along the edges of the trench could consequently be lost. Using a wider excavation trench would allow a greater angle of repose (more gently sloping sides), which would reduce the risk of cave-ins in sandy soils. However, a wider excavation trench would generate more spoil, which would increase the amount of material susceptible to wind and water erosion and to sediment transport.

Topsoil Loss or Degradation

During grading and excavation activities, a depth of up to 12 inches of topsoil would be removed and segregated. Improper segregation of the topsoil could lead to mixing with subsoil. Soil mixing could reduce the productivity of the topsoil through mixing with less fertile soils that are in poorer condition. Valuable topsoil might also be lost from its original location through wind and/or water erosion. In addition, wind erosion could cause fugitive dust, which could deposit subsoil on topsoil in areas outside the proposed Nebraska Reroute.

Soil Compaction

Soils with high clay and/or silt content could become compacted during construction from the use of construction vehicles and equipment within the permanent pipeline easement, temporary workspace areas, temporary access roads, and construction yards. The degree of compaction would depend on the texture and moisture content of the soil, the frequency and duration of construction activities, the types of equipment or vehicles used, and the use of pressure-diffusing devices (such as construction mats). Compaction would be greatest where equipment would operate on moist-to-wet soils with high clay content. Compaction can also occur in areas where construction equipment would make multiple passes, for instance, along temporary access roads and construction camps.

Impacts could also occur from decompacting soils. Compacted soil can be decompacted and pulverized to remove large clods, but the resulting soil lacks both the texture and general characteristics of undisturbed soil.

Increased Rock Content in Near-surface Soil

In areas where rocky soil or shallow bedrock is present, pipeline backfill activities could result in a concentration of large clasts (coarse gravel-, cobble-, or boulder-size material) near the surface. The presence of large clasts concentrated near the surface could reduce the productivity of the soil and damage farming equipment.

Soils Drained by Drainage Tile Systems

Construction of the proposed Nebraska Reroute would temporarily disrupt some existing drainage tile systems in active agricultural land. Where this occurs, existing soil could become saturated during wet weather. Improper dewatering techniques or failure to implement dewatering where necessary could also cause sediment to enter drain tile systems, possibly diminishing their effectiveness.

Soil Contamination from Leaks and Spills

Construction-related spills and leaks along the proposed Nebraska Reroute could release quantities of petroleum hydrocarbon products (for example, gasoline, diesel fuel, lubricating oils, and hydraulic fluids), cleaning solvents, paints, and other contaminants to the soil. These spills could result from vehicle and construction equipment leaks and fueling and maintenance activities along the right-of-way, at the construction camp, and at contractor staging and storage areas. Contractor staging areas would typically include aboveground gasoline-storage tanks and diesel-storage tanks as well as material trailers containing paints, epoxies, solvents, starter fluid, and cleansers.

Spills would have a direct effect on the soil in the area of the spill. The extent of the impact would be related to the size and surface area of the spill, the soil type(s), and the emergency response measures. Impacts related to spills are further discussed in Chapter 6.

E.2.2.2 Operations and Maintenance

Potential impacts during operation and maintenance of the pipeline could include:

- Soil erosion
- Compaction
- Temperature effects
- Contamination

Soil Erosion

Disturbance of surface soils from pipeline maintenance and incidental repairs (which could include excavation of the pipeline) could cause accelerated erosion. Excavation for pipeline repairs would generate spoil, which would increase the amount of material susceptible to wind and water erosion and sediment transport.

Maintenance and incidental repairs in areas with highly erodible soils could also adversely affect reclamation activities, such as erosion-control and revegetation procedures.

Compaction

Vehicle traffic could compact soils during maintenance activities and incidental repairs, particularly when the soil is wet.

Temperature Effects

NDEQ reviewed the DOS' study of the pipeline's effects on the surrounding soil temperatures. According to the Final EIS (Appendix L, Figure 1), maximum wintertime temperatures of the product would range from about 90 degrees Fahrenheit (°F) at the South Dakota-Nebraska border to about 95°F at the Nebraska-Kansas border. Summertime temperatures would range between 120°F and 130°F in Nebraska between South Dakota and Kansas (DOS, 2011a). This estimate is based on a flow of 900,000 barrels per day. At Keystone's estimated maximum flow of 830,000 barrels per day, the temperature would be expected to be less than this value. These modeled temperatures are also associated with maximum oil viscosities and ambient temperatures. Soil temperatures closer to the buried pipeline may be as much as 40°F warmer than the ambient surrounding soil temperatures. DOS modeled soil temperature profiles for January, March, May, July and October. In Nebraska, the January and March profiles show warming adjacent to the pipeline that decreases the frost depth. The May profile shows earlier frost-out above and adjacent to the pipeline. The July profile shows warmer temperatures surrounding the pipeline, with temperatures of up to 130°F at the pipeline casing. The October profile shows a gradual cooling at the soil surface consistent with ambient air temperatures (DOS, 2011).

The relatively high temperature of the crude oil in the pipeline would cause a localized increase in soil temperature and a decrease in soil moisture immediately above the pipeline. The true measure of these effects would be its impact on agricultural productivity. Additional discussion regarding potential impacts on agricultural crops can be found later in Chapter 4, Section 4.10, Agricultural and Land Use.

As part of its activities associated with the proposed Nebraska Reroute, Keystone has committed to implement procedures that are designed to reduce the likelihood and severity of impacts along the proposed Nebraska Reroute. Keystone presented these procedures in its Construction, Mitigation, and Reclamation Plan (Keystone, 2012b), which is attached with this Draft Evaluation Report as Appendix C. These measures would be implemented to the extent that they do not conflict with the requirements of any applicable federal, State, or local rules and regulations, or other permits and approvals applicable to the project. Highlights from the Construction, Mitigation, and Reclamation Plan (CMRP) and Final EIS are discussed below.

Contamination

Operational spills could originate from the pipeline, pumping stations, or delivery points. Spills would have a direct effect on soil in the area of the spill. The extent of the impact would be related to the size and surface area of the spill, the soil type(s), and the emergency response measures. Impacts related to spills are further discussed in Chapter 6.

E.2.3 MITIGATION

As part of its activities associated with the proposed Nebraska Reroute, Keystone has committed to implement procedures that are designed to reduce the likelihood and severity of impacts along the proposed Nebraska Reroute. Keystone presented these procedures in its Construction, Mitigation, and Reclamation Plan (Keystone, 2012), which is attached with this Draft Evaluation Report as Appendix C. These measures would be implemented to the extent that they do not conflict with the requirements of any applicable federal, State, or local rules and regulations, or other permits and approvals applicable to the project. Highlights from the Construction, Mitigation, and Reclamation Plan and Final EIS are presented below.

E.2.3.1 Soil Erosion

Local soil erosion will be reduced using best management practices (BMPs). NDEQ's NPDES Construction Stormwater permit requires BMP's that would reduce soil erosion. BMPs for sediment and water erosion might include installing sediment barriers (such as silt fencing, straw or hay bales, compost socks, or sand bags), trench plugs, temporary slope breakers, and drainage channels or ditches. BMPs for wind erosion might include applying water, matting, mulch, or tackifier. Straw or native prairie hay might be used as mulch and crimped into the soil to prevent wind erosion. Photodegradable matting might also be used on steep slopes or areas prone to extreme wind exposure, such as north- or west-facing slopes and ridge tops. These erosion-control measures will be implemented in areas with exposed soil, areas with steep slopes, or other areas with a high potential for erosion.

Precipitation might cause unavoidable soil erosion by water. In addition to the mitigation measures mentioned above, the potential for these impacts will be reduced by scheduling construction in sloped areas during drier months and outside the snowmelt season.

Mitigation measures will include stockpiling stripped topsoil along the edge of the construction workspace and any areas where topsoil would need to be removed. To minimize mixing of topsoil and subsoil, care should be taken when removing and stockpiling soil and when redistributing topsoil during backfilling. Information obtained during field investigations (including geotechnical investigations) will be used to further refine topsoil removal and stockpiling activities to prevent soil mixing.

Monitoring

Once construction is complete, mitigation activities will include monitoring areas highly susceptible to erosion to ensure successful reclamation and revegetation. Any areas adversely affected by construction will be regularly inspected to identify areas of erosion, settling, or poor seed germination. Erosion and settling will be monitored by aerial patrols and landowner reporting. Areas where initial reclamation and revegetation are unsuccessful will be revegetated promptly and monitored.

E.2.3.2 Sandy Soil Loss

Minor route realignments will be incorporated through highly erodible soils to avoid particularly erosion-prone locations such as ridgetops and existing blowouts as much as practicable. Where construction in loose, sandy soils is necessary, mitigation measures will include intensive monitoring and the prompt use of effective BMPs to reduce and control erosion. Specific construction, reclamation, and post-construction procedures have been developed to prevent erosion of sandy soils and loss of sandy soils to cave-ins during trenching. These procedures are described in the Keystone Construction/Reclamation Plans and Documentation in Appendix H of the Supplemental Environmental Report (Keystone, 2012).

E.2.3.3 Topsoil Loss or Degradation

Mitigation measures will be implemented to prevent soil mixing and to minimize the loss and degradation of topsoil from erosion. Specific construction methods will be implemented to ensure that disturbed areas are returned to preconstruction conditions. Mitigation measures will include conserving topsoil (through segregation and stockpiling) for postconstruction replacement and reclamation.

In areas with identified low-revegetation-potential soils, the recommended topsoil salvage depths will be designed to conserve the high-organic-content soils that do not contain physical or chemical conditions that could inhibit soil capability. In addition, if trench dewatering is necessary, care will be taken to discharge water away from stored topsoil.

E.2.3.4 Soil Compaction

Mitigation measures will be used during construction to minimize soil compaction. These will include ripping to relieve compaction in adversely affected areas (for example, subsoils that have experienced substantial construction traffic) prior to replacing and respreading topsoil.

E.2.3.5 Increased Rock Content in Near-surface Soil

Mitigation measures will screen soils prior to pipe backfilling and removing all excess rocks exposed during construction activity. The size and concentration threshold for rock removal will be consistent with the quantity, size, and distribution of rocks found in adjacent undisturbed areas (outside the construction workspace).

E.2.3.6 Drainage System Damage

Drainage tile systems will be identified prior to construction and avoided where possible. Any drainage systems damaged during construction will be repaired or replaced. These procedures will minimize the damage to drainage systems or will compensate landowners for any long-term impacts on the functionality of the drainage tile system.

E.2.3.7 Soil Contamination from Leaks and Spills

Potential spills from construction activities and operation will be addressed by specific prevention and mitigation measures. Spill prevention and containment applies to the use and management of hazardous materials on the construction right-of-way and all ancillary areas during construction. This includes the refueling or servicing of all equipment with diesel fuel, gasoline, lubricating oils, grease, and hydraulic and other fluids during normal upland applications.

Keystone will prepare a project-specific Spill Prevention, Containment, and Countermeasure (SPCC) Plan. Information will be provided to complete the SPCC Plan for each construction spread, and the Plan will provide site-specific data that meet the requirements of 40 Code of Federal Regulations (CFR) Part 112 for every location used for staging fuel or oil storage tanks and for every location used for bulk fuel or oil transfer. Each SPCC Plan will be prepared prior to introducing the subject fuel, oil, or hazardous material to the subject location. Further information regarding this plan is provided in Section 3.0 of Keystone's CMRP.

Mitigation measures also include processes, procedures, and systems to prevent, detect, and mitigate potential oil spills that could occur during the operation of the pipeline.

E.2.4 WESTERN ALTERNATIVE

Although highly erodible soils were not identified along the Western Alternative, there may be isolated areas that exhibit this characteristic or one or more of the identified soil characteristics (such as hydric, drought-prone, stony/rocky, shallow bedrock, compaction-prone, and LRP). BMPs should be used to reduce impacts to soils along the Western Alternative.

E.2.5 REFERENCES

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Attachment A

Abbreviations and Acronyms

Abbreviation, Acronym, or Short Form	Definition
°F	degrees Fahrenheit
BMP	best management practice
CFR	Code of Federal Regulations
CMRP	Construction, Mitigation, and Reclamation Plan
DOS	U.S. Department of State
Kw	soil water erodibility factor
NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
SPCC Plan	Spill Prevention, Containment, and Countermeasure Plan
SSURGO	soil survey geographic database
WEG	wind erodibility group

Appendix E.3

Groundwater Technical Memorandum

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APPENDIX E.3

GROUNDWATER TECHNICAL MEMORANDUM

Groundwater provides approximately 85 percent of the water used for human consumption in Nebraska (University of Nebraska–Lincoln [UNL], 2012).

This technical memorandum describes the existing conditions for groundwater resources along the proposed Nebraska Reroute corridor; the potential impacts from construction, operation, and maintenance of the Keystone XL Pipeline; and general mitigation measures to avoid or reduce these potential impacts. The resource impacts that are evaluated include impacts on major and shallow aquifers, groundwater use and water quality, and registered groundwater well survey and wellhead protection areas.

The term *groundwater* refers to water that is below the land surface and in the saturated zone. The *saturated zone* is the zone in which all of the cracks in the rock and all of the pore spaces between the grains of rock or within the soil are filled with water. The upper limit of the saturated zone is known as the *water table*. The zone above the water table, where pore spaces contain both air and water, is known as the *unsaturated zone* (UNL, 2012).

In Nebraska, usable groundwater is present in voids or pore spaces in various layers of geologic material such as sand, gravel, silt, sandstone, and limestone. Where such geologic units yield enough water for human use, these layers are referred to as *aquifers*. In parts of Nebraska, groundwater might be encountered just a few feet below the surface, while in other areas it might be a few hundred feet underground. The amount of water that can be withdrawn from a given aquifer can range from a few gallons per minute (which is just enough to supply a typical household) to many hundreds or even thousands of gallons per minute (which is the yield of large irrigation, industrial, or public water supply wells) (Nebraska Department of Environmental Quality [NDEQ], 2011).

As groundwater is pulled by gravity and pushed by the force of the water, it flows through pore spaces and cracks in the rock. The water moves from an area where it enters the aquifer (a *recharge zone*) to an area where water exits the aquifer (a *discharge zone*). Aquifers are recharged primarily from precipitation and to a smaller extent by surface water. Water infiltrates the land surface and percolates down through the unsaturated zone until it reaches the *zone* of saturation (where groundwater flow occurs). The rate of infiltration and percolation is a function of the soil type, rock type, and time (UNL, 2012).

The maximum slope of the water table at a given location is called the *hydraulic gradient*. This slope determines the direction and relative rate of groundwater flow. Groundwater flows from areas with a higher water table elevation (upgradient) to areas with a lower water table elevation (downgradient). Groundwater generally flows much more slowly than surface water (NDEQ, 2011).

The movement of groundwater depends on the hydraulic properties of the rock and sediment and on the hydraulic gradient. Two hydraulic properties, transmissivity and specific yield, are important for estimating groundwater flow. *Transmissivity* is an aquifer's ability to allow the movement of fluids. Transmissivity depends on the size and connectivity of pore spaces and the saturated thickness of the water-bearing zone. Aquifers that have a high transmissivity will yield and transmit more water than similar aquifers with a low transmissivity. *Specific yield* is the amount of water that the aquifer releases when the water table is lowered. Specific yield accounts for the change from saturation to unsaturation due to the lowering of the water table (Ingebritsen and Sanford, 1998).

E.3.1 EXISTING CONDITIONS

E.3.1.1 Regional Hydrogeology

In Nebraska, the principal aquifer underlying the proposed Nebraska Reroute corridor is the High Plains Aquifer (Gutentag et al., 1984; Weeks et al., 1988). The High Plains Aquifer consists mainly of hydraulically connected geologic units of late Tertiary or Quaternary age. The Tertiary rocks include the Brule Formation, Arikaree Group, and Ogallala Group. The Quaternary deposits in the aquifer consist of alluvial, dune-sand, and valley-fill deposits (Gutentag et al., 1984).

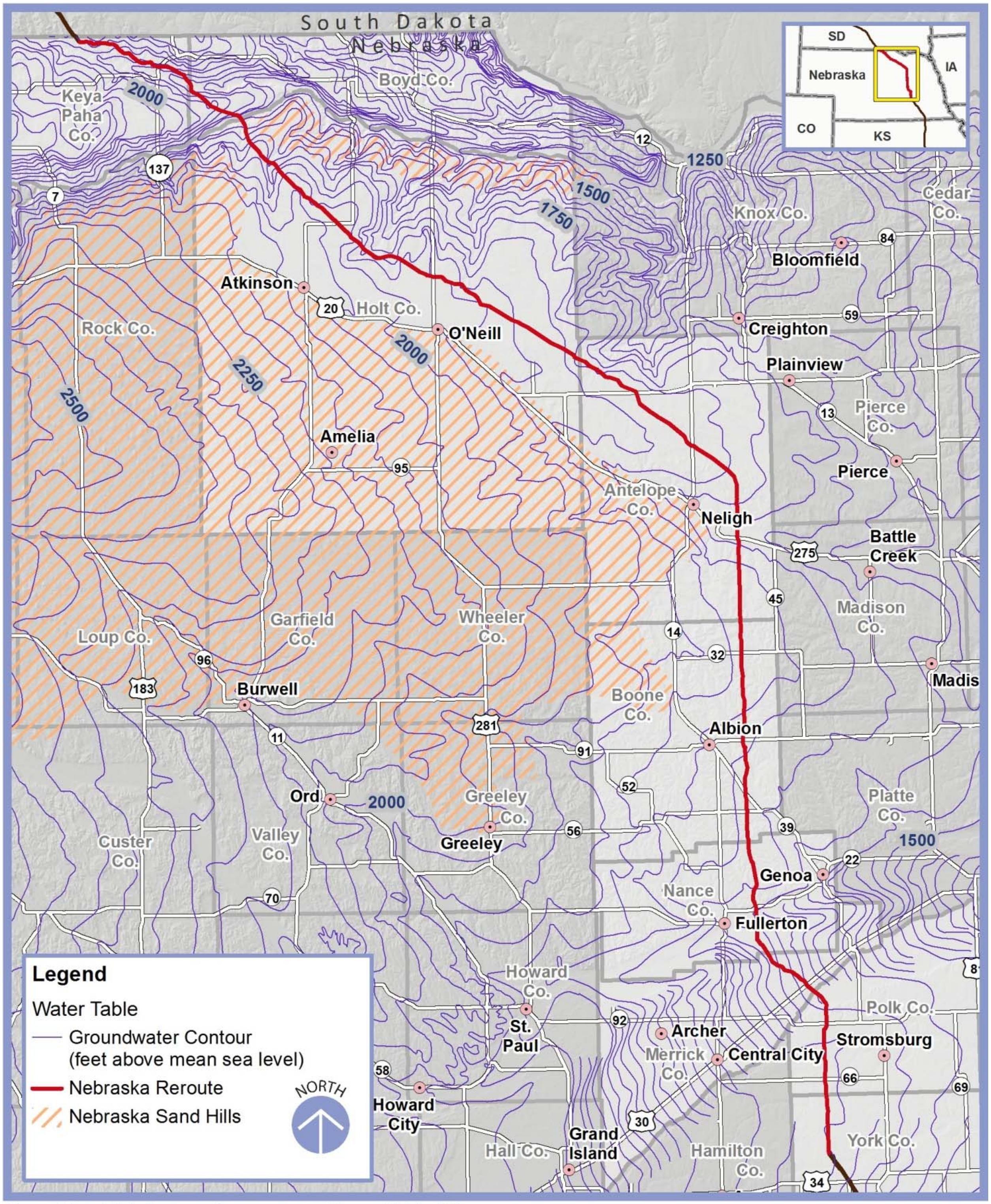
The High Plains Aquifer is a regional water-table aquifer that extends from south-central South Dakota to the southern part of the panhandle of Texas. The High Plains Aquifer contains about 3.25 billion acre-feet of water in storage. Approximately 66 percent of the water stored in the High Plains Aquifer is located in Nebraska (Gutentag et al., 1984). Most of this water is in the Sand Hills.

The geologic units that make up the High Plains Aquifer could be hydraulically interconnected, and this interconnection supports a continuous water table throughout most of the region (see Figure E.3-1). The aquifer has an average saturated thickness of 200 feet and a maximum saturated thickness of about 1,000 feet. The hydraulic conductivity and specific yield of the aquifer depend on the type of sediment, which varies greatly, both horizontally and vertically. Hydraulic conductivity typically ranges from less than 25 to 300 feet per day and averages 60 feet per day. Specific yield ranges from less than 10 to 30 percent and averages about 15 percent (Gutentag et al., 1984).

Groundwater elevations in the High Plains Aquifer along the proposed Nebraska Reroute corridor range from about 2,400 feet above mean sea level (amsl) in Keya Paha County near the Niobrara River to about 1,600 feet amsl in Merrick County near the Platte River. Water in the High Plains Aquifer generally is unconfined. The configuration and slope of the water table are similar to the configuration and slope of the land surface, but they are influenced by significant pumping and recharge. Across Nebraska, groundwater generally flows from northwest to southeast. Water moves in response to the slope of the water table, which typically averages between 10 and 15 feet per mile. On the basis of this average slope and the hydraulic properties of the aquifer, the velocity of water that moves through the aquifer is estimated to average about 1 foot per day (Gutentag et al., 1984).

The Ogallala Group is the principal geologic unit in the High Plains Aquifer. Other important geologic deposits that form the aquifer are Quaternary-age wind-deposited loess and fine-grained sand, alluvial silt, sand, and gravel, and Tertiary-age silts, sands, and gravels (Condra and Reed, 1943, Korus and Joeckel, 2011). The Ogallala Group consists of a heterogeneous sequence of clays, silts, siltstone, sands, sandstone, and gravels deposited by streams that flowed eastward from the Rocky Mountains. Within the Ogallala Group, sediment zones cemented with calcium carbonate are resistant to weathering and form escarpments that typically mark the boundaries of the High Plains (Gutentag et al., 1984). The saturated thickness of the Ogallala Group ranges from 10 to 200 feet in the northern part of Nebraska to more than 800 feet in central Nebraska beneath the Sand Hills (Bleed and Flowerday, 1990).

Figure E.3-1. Regional Groundwater along the Proposed Nebraska Reroute



Source: Water Table Contours, Conservation and Survey Division UNL

0 Miles 20

Hydrogeologic Units

The High Plains Aquifer consists of all or parts of several geologic units of Quaternary and Tertiary age. Table E.3-1 shows the stratigraphic column of the aquifer, including the formation name, generalized rock type, and age of the geologic units that make up the aquifer.

Table E.3-1. Stratigraphic Column of the High Plains Aquifer

<table>
<tr><th>Period</th><th>Epoch</th><th colspan="2">Geologic Unit</th><th>Lithology</th><th>Hydrogeologic Unit</th></tr>
<tr><td rowspan="2">Quaternary</td><td>Holocene</td><td colspan="2">DeForest Formation</td><td>Dune sands, alluvium</td><td rowspan="6">High Plains Aquifer</td></tr>
<tr><td>Pleistocene</td><td colspan="2">Multiple loesses and alluvial units</td><td>Sand, gravel, silt and clay</td></tr>
<tr><td rowspan="5">Tertiary</td><td>Pliocene</td><td colspan="2">Broadwater Formation</td><td>Sand and gravel</td></tr>
<tr><td>Miocene</td><td colspan="2">Ogallala Group</td><td>Sandstone and siltstone</td></tr>
<tr><td rowspan="2">Oligocene</td><td colspan="2">Arikaree Group</td><td>Sandstone and siltstone</td></tr>
<tr><td rowspan="2">White River Group</td><td rowspan="2">Brule Formation</td><td rowspan="2">Siltstone, sandstone and claystone</td></tr>
<tr><td>Eocene</td><td></td></tr>
</table>

Source: Modified from Korus and Joeckel, 2011

Brule Formation

The Brule Formation of Oligocene age is the oldest geologic unit in the aquifer. The Brule Formation is the upper unit of the White River Group and is primarily massive siltstone with beds and channel deposits of sandstone. The Brule Formation underlies most of western Nebraska and generally has little permeability (which is the rate at which water moves through an aquifer). However, in some locations, the permeability of the formation has been increased by dissolution or fracturing (secondary porosity) of the formation. The Brule Formation is considered part of the aquifer only in areas where it contains saturated zones that result from interconnected secondary porosity. Where secondary porosity has not been developed, the top of the Brule Formation is considered the base of the High Plains Aquifer (Gutentag et al., 1984). Major thicknesses of this formation are found primarily in the panhandle of Nebraska.

Well yields in the Brule Formation are highly variable because the yield depends on the degree to which secondary porosity has been developed. Groundwater wells in the Brule Formation can yield up to 1,500 gallons per minute (gal/min), but wells in this formation typically yield less than 300 gal/min (Gutentag et al., 1984). Very few wells within the Nebraska Reroute are in the Brule Formation, as this units is not a major source of groundwater because of their consolidated nature (Gutentag et. al, 1984)

Arikaree Group

The Arikaree Group comprises the late Tertiary deposits between the underlying Brule Formation and the overlying Ogallala Group. The Arikaree Group of Miocene and Oligocene age is above the Brule Formation and consists primarily of massive, very fine to fine-grained sandstone. Locally, the Arikaree Group includes beds of volcanic ash, siltstone, claystone, and marl. The Arikaree Group is exposed at the surface in western Nebraska and pinches out to the south and east as does the Brule Formation. The maximum thickness of the Arikaree Group is about 1,000 feet in Nebraska (Gutentag et al., 1984). Major thicknesses of this formation are found primarily in the panhandle of Nebraska.

Wells completed in the Arikaree Group generally do not yield large amounts of water. Well yields of about 350 gal/min can be expected from about 200 feet of saturated thickness. Secondary porosity, similar to that in the Brule Formation, also occurs in the Arikaree Group.

Ogallala Group

The Ogallala Group is all Miocene rock that is younger than that in the Arikaree Group. The Ogallala Group is the principal geologic unit in the High Plains Aquifer. The Ogallala Group consists of consolidated and unconsolidated gravel, sand, silt, and clay. The Ogallala Group was deposited by an extensive eastward-flowing system of braided streams that drained the eastern slopes of the Rocky Mountains during late Tertiary time. The Ogallala Group has an average thickness of 200 to 400 feet and a maximum thickness of about 1,800 feet (Miller and Appel, 1997; Bleed and Flowerday, 1990). The aquifer thins from west to east across Nebraska.

Saturated sediments in the Ogallala Group are not distributed evenly throughout the formation. In some areas, irrigation wells that yield about 1,000 gal/min can be developed at a depth of about 100 feet in saturated sand and gravel, while in other areas, wells that yield 100 gal/min can be developed at a depth of as little as 20 feet in saturated sand and gravel (Gutentag et al., 1984).

Broadwater Formation

The Broadwater Formation is comprised of Pliocene rocks. The Broadwater Formation consists of mainly sand and gravel (Condon, 2005).

Surface Deposits

Unconsolidated deposits of Quaternary age overlie the Ogallala Group. These Quaternary-age deposits consist of gravel, sand, silt, and clay, much of which is reworked material that was derived from the Ogallala Group. These Quaternary alluvial deposits have a maximum thickness of about 400 feet. Where these unconsolidated sediments are saturated, they make up part of the High Plains Aquifer.

Deposits of loess overlie the Ogallala Group or the unconsolidated Quaternary sediments in some locations. The loess was deposited as windblown material and consists mostly of silt with small quantities of very fine-grained sand and clay. Where the loess is thick, it forms the upper unit of the High Plains Aquifer.

Sand sheets of Quaternary age make up part of the aquifer where they are saturated. The sand sheets are most extensive in north-central Nebraska where they have a thickness of about 100 feet. The sand sheets are highly porous and permeable and, therefore, quickly absorb rainfall that recharges the High Plains Aquifer (Bleed and Flowerday, 1990). Valley-fill deposits along the channels of streams, such as the Platte River, also are considered to be part of the aquifer where they are hydraulically connected. In such places, the valley-fill deposits directly link the streams to the High Plains Aquifer and allow water to move freely between the aquifer and the surface water streams.

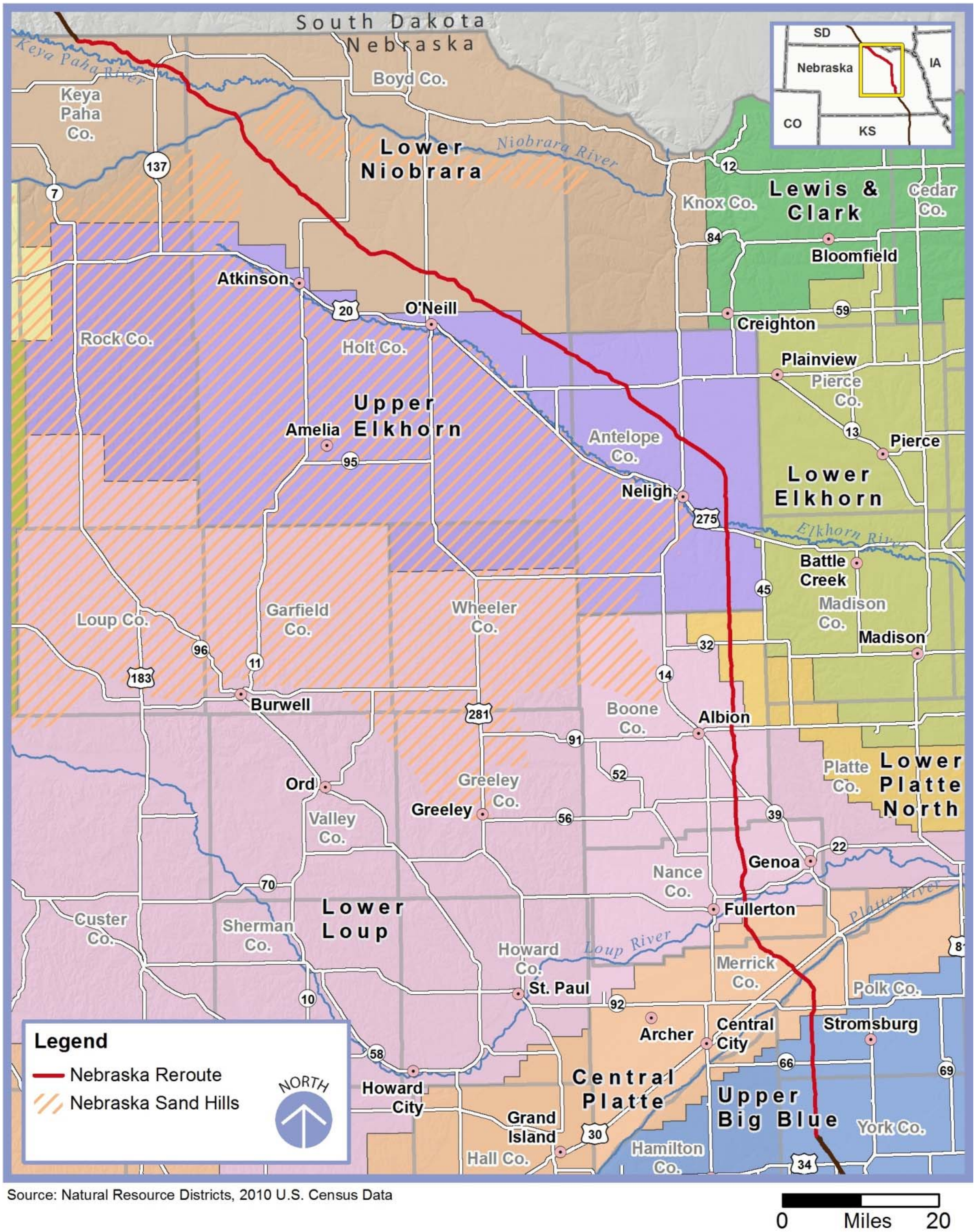
E.3.1.2 Groundwater Basins

The proposed Nebraska Reroute corridor passes through five Natural Resources Districts (NRDs) (see Figure E.3-2). The major river basins are:

- Lower Niobrara
- Upper Elkhorn
- Lower Loup
- Lower Platte North
- Central Platte
- Upper Big Blue

The local hydrogeology is discussed in further detail for each NRD following the figure.

Figure E.3-2. Natural Resources Districts along the Proposed Nebraska Reroute



Source: Natural Resource Districts, 2010 U.S. Census Data

Lower Niobrara NRD

The proposed Nebraska Reroute corridor enters Nebraska in Keya Paha County, which is part of the Lower Niobrara NRD. This NRD includes Keya Paha and Boyd Counties.

The general hydrogeology of this NRD (see Table E.3-2) is typical for an area dominated by sediments of recent origin (Quaternary-age sands, gravel, and silt). The principal aquifer is defined as all saturated sediments of Quaternary age and the Tertiary Ogallala Formation (see Attachment B). Secondary aquifers are made up of the remaining bedrock aquifers, which range in age from Tertiary to Cretaceous. The bedrock aquifers supply a small amount of water but are an important source locally (Nebraska Department of Natural Resources [NDNR], 2005). Refer to Attachment B for the bedrock aquifer table and figures for this NRD (saturated thickness and depth to water).

The principal aquifer is generally unconfined and is hydrologically connected to the streams in the NRD (NDNR, 2005). The groundwater table reflects a pattern of groundwater movement toward the Niobrara River and its tributaries. Groundwater tends to move from the uplands to streams (NDNR, 2005).

Table E.3-2. Lower Niobrara Hydrogeology

Saturated Thickness (feet)	Depth to Groundwater (feet below ground surface)	Transmissivity (gallons per day per foot)	Specific Yield (%)
0–900	0–200	20,000–150,000	5–20

Groundwater is used for a variety of purposes including domestic, industrial, livestock, and irrigation. The main use of groundwater is for irrigation.

Upper Elkhorn NRD

The Upper Elkhorn NRD includes parts of Holt and Antelope Counties. The proposed Nebraska Reroute corridor continues through area underlain by the Ogallala Group in Holt County. The general hydrogeology of this NRD (see Table E.3-3) is complex because of the wide range of depositional environments from eolian in the west to glacial in the east. The principal aquifer units include all unconsolidated sediments of Quaternary age and the Tertiary Ogallala Group (see Attachment B). The bedrock aquifers are considered secondary aquifers that range in age from Tertiary to Cretaceous (NDNR, 2005). Refer to Attachment B for additional figures for this NRD (saturated thickness and depth to water).

Table E.3-3. Upper Elkhorn Hydrogeology

Saturated Thickness (feet)	Depth to Groundwater (feet below ground surface)	Transmissivity (gallons per day per foot)	Specific Yield (%)
0–800	0–200	20,000–250,000	5-20

The western and central parts of this NRD are hydrologically connected to the surface water streams and are unconfined (NDNR, 2005). The groundwater reflects a normal gaining stream pattern in the west and central areas and reflects the complicated nature of the glaciated area in the east. Groundwater tends to move from the uplands to the streams (NDNR, 2005).

Groundwater is used for a variety of purposes including domestic, irrigation, industrial, and livestock. The main use of groundwater is for irrigation.

Lower Loup NRD

The Lower Loup NRD includes most of Boone and Nance Counties. Nance County borders the Platte River Valley and the Loup River Valley aquifers. The depth to water is 50 to 100 feet bgs in the highland areas and less than 50 feet bgs in the lowland areas (Miller and Appel, 1997).

The general hydrogeology of this NRD (see Table E.3-4) reflects the nature of the eolian and fluvial origin of the recent sediments. The principal aquifer includes all saturated unconsolidated sediments of Quaternary age and the Tertiary Ogallala Formation (see Attachment B). The bedrock aquifers are considered secondary aquifers that range in age from Tertiary to Cretaceous. Refer to Attachment B for additional figures for this NRD (saturated thickness and depth to water).

The principal aquifer is generally unconfined and is hydrologically connected to the surface streams (NDNR, 2005). The groundwater table reflects the regional nature of the area, in which groundwater tends to move from the uplands to the streams (NDNR, 2005).

Table E.3-4. Lower Loup Hydrogeology

Saturated Thickness (feet)	Depth to Groundwater (feet below ground surface)	Transmissivity (gallons per day per foot)	Specific Yield (%)
0–1,100	0–200	20,000–250,000	5–20

Groundwater is used for a variety of purposes including domestic, irrigation, industrial, and livestock. The main use of groundwater is for irrigation (NDNR, 2005).

Lower Platte North NRD

The Lower Platte North NRD encompasses parts of seven counties in east central Nebraska. The Lower Platte North NRD Groundwater Management Plan subdivides the district into four regions with distinct hydrogeology. The Nebraska Reroute passes through the Shell Creek Region which extends from the Sand Hills to the Platte River. In the upper reaches of the Shell Creek Region, the principal source of groundwater is from the Ogallala Group.

The north extent of the Shell Creek Region is designated as the Upper Newman Grove. The Upper Newman Grove has a saturated thickness of 50–150 feet. Over most of the Shell Creek Region groundwater very deep and is not directly connected to surface water (Lower Platte North NRD, 2009).

Central Platte NRD

The Central Platte NRD includes most of Merrick County. This NRD is part of the Cooperative Hydrology Study (COHYST), which is a geohydrologic study of surface and groundwater resources of the Platte River Basin upstream from Columbus, Nebraska. The Cooperative Hydrology Study divides the High Plains Aquifer into eight hydrostatic units (see Attachment B). Hydrostatic units are geologic units that have been grouped based on hydraulic properties such as water storage capacity and permeability (Cannia et al., 2006). The principal aquifer consists of various Quaternary-age deposits and deposits of the Ogallala Formation of Tertiary age. Wells in these alluvial deposits yield large amounts of water (Peterson, 2007).

Upper Big Blue NRD

The Upper Big Blue NRD includes Polk and York Counties. Groundwater originates mainly as infiltration from precipitation. The basin hydrogeology is complex due to the glacially influenced origin of the sediments (see Table E.3-5). The principal aquifer includes all saturated unconsolidated sediments of Quaternary age and the Tertiary Ogallala Formation (see Attachment B). Most of the principal aquifer in the upper part of the NRD is capped by a thick mantle of loess that either does not supply a significant amount of water or is not saturated (NDNR, 2005). The bedrock aquifers are considered secondary aquifers that range in age from Tertiary to Cretaceous. Refer to Attachment B for additional figures for this NRD (saturated thickness and depth to water).

Table E.3-5. Upper Big Blue Hydrogeology

Saturated Thickness (feet)	Depth to Groundwater (feet below ground surface)	Transmissivity (gallons per day per foot)	Specific Yield (%)
0–400	0–200	20,000–200,000	5–25

Groundwater is used for a variety of purposes including domestic, irrigation, industrial, and livestock. The main use of groundwater is for irrigation (NDNR, 2005).

E.3.1.3 Regulatory Requirements

Permits, licenses, approvals, and consultations are required prior to construction in each of the five NRDs.

Lower Niobrara NRD

Well construction in the Lower Niobrara NRD would require a Ground Water Well Permit for a well that pumps over 50 gal/min. This permit would allow groundwater to be pumped and used for an approved beneficial use.

Upper Elkhorn NRD

Well construction in the Upper Elkhorn NRD would require a Ground Water Well Permit and a Request for Variance. The Ground Water Well Permit would permit a well that pumps over 50 gal/min. The Request for Variance would allow groundwater to be used where water rights are limited for new development. These permits would allow groundwater to be used for an approved beneficial use.

Lower Loup NRD

Well construction in the Lower Loup NRD would require a Well Construction Permit for a well that pumps over 50 gal/min. This permit would allow groundwater to be used for an approved beneficial use.

Lower Platte North NRD

The Lower Platte North NRD has established a groundwater management area (GWMA) for quality purposes. As part of the GWMA requirements, permits are required prior to the construction of wells pumping greater than 50 gallons per minute (NDNR, 2005).

Central Platte NRD

Well construction in the Central Platte NRD would require a Request of Variance, which would allow groundwater to be used where rights are fully appropriated. This Request for Variance would allow groundwater to be used for an approved beneficial use.

Upper Big Blue NRD

Well construction in the Upper Big Blue NRD would require a permit to construct a water well and an authorization to transfer groundwater. Water use in the Upper Big Blue NRD is also subject to the Kansas-Nebraska Big Blue River Compact.

E.3.1.4 Water Quality

Safe Drinking Water Act

The Safe Drinking Water Act was originally passed by Congress in 1974 to protect Americans' health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and groundwater wells. Under the Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) sets legal limits on the levels of certain contaminants in drinking water. The legal limits reflect both the level that protects human health and the level that water systems can achieve using the best available technology (EPA, 2012).

National Primary Drinking Water Regulations

National Primary Drinking Water Regulations (primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water (EPA, 2012).

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (secondary standards) are non-enforceable guidelines regulating contaminants that can cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards for water systems, but these standards are not enforceable. However, States may choose to adopt them as enforceable standards (EPA, 2012).

Title 118 – Ground Water Quality Standards and Use Classification

Groundwater quality in Nebraska is regulated by Nebraska Department of Environmental Quality (NDEQ) through Title 118 – Ground Water Quality Standards and Use Classification (Standards). The Standards are intended to be the foundation for other groundwater regulatory programs and are implemented in conjunction with other regulatory programs. If other regulatory programs do not exist, these Standards alone may be used as the basis for remedial action of groundwater contamination. The groundwater standards and groundwater classifications apply to all groundwaters of the state with the exception of an aquifer or a part of an aquifer that has been exempted through the Rules and Regulations of the Nebraska Oil and Gas Conservation Commission, or through NDEQ Title 122 – Rules and Regulations for Underground Injection and Mineral Productions Wells (NDEQ, 2006).

Numerical standards (maximum contaminant levels) apply to groundwater in Nebraska. The numerical standards are intended to protect the beneficial uses of groundwater. The standards apply if beneficial uses of groundwater would be impaired, if public health and welfare would be threatened, or if the beneficial use of hydrologically connected groundwaters would be impaired. Any substance introduced directly or indirectly by human activity is not allowed to enter groundwater if one or more of the numerical standards would be exceeded or if it degrades the present groundwater quality. Any pollutant introduced directly or indirectly by human activity that would impair the beneficial uses of groundwater due to unacceptable color, corrosivity, odor, or any other aesthetic characteristic is also not allowed (NDEQ, 2006).

High Plains Aquifer Water Quality

The quality of the water in the High Plains Aquifer generally is suitable for irrigation use, but, in many places, the water does not meet EPA's drinking-water regulations. Excessive concentrations of dissolved solids (see Table E.3-6), fluoride, chloride, and sulfate are present in parts of the aquifer (Gutentag et al., 1984).

The dissolved-solids concentration in groundwater is a general indicator of the chemical quality of the water. Dissolved-solids concentrations in water from the High Plains Aquifer are less than 500 milligrams per liter (mg/L) in most of Nebraska, but locally they can exceed 1,000 mg/L. Generally, dissolved-solids concentrations are lowest in areas covered by sand because of relatively high rates of recharge and because the sand contains few readily soluble minerals.

Excessive concentrations of sodium in water can adversely affect plant growth and soil properties, and they also present salinity and sodium hazards that can limit irrigation and the associated agriculture development. Sodium concentrations in water from the High Plains Aquifer in Nebraska are less than 25 mg/L (Gutentag et al., 1984).

Table E.3-6. Water Quality Standards for Total Dissolved Solids

Contaminant	Secondary Standard[a]	Maximum Contaminant Level[b]
Total dissolved solids (TDS)	500 milligrams per liter	500 milligrams per liter

[a] *Source: National Secondary Drinking Water Regulations*
[b] *Source: Nebraska Department of Environmental Quality, Title 118 – Ground Water Quality Standards and Use Classification*

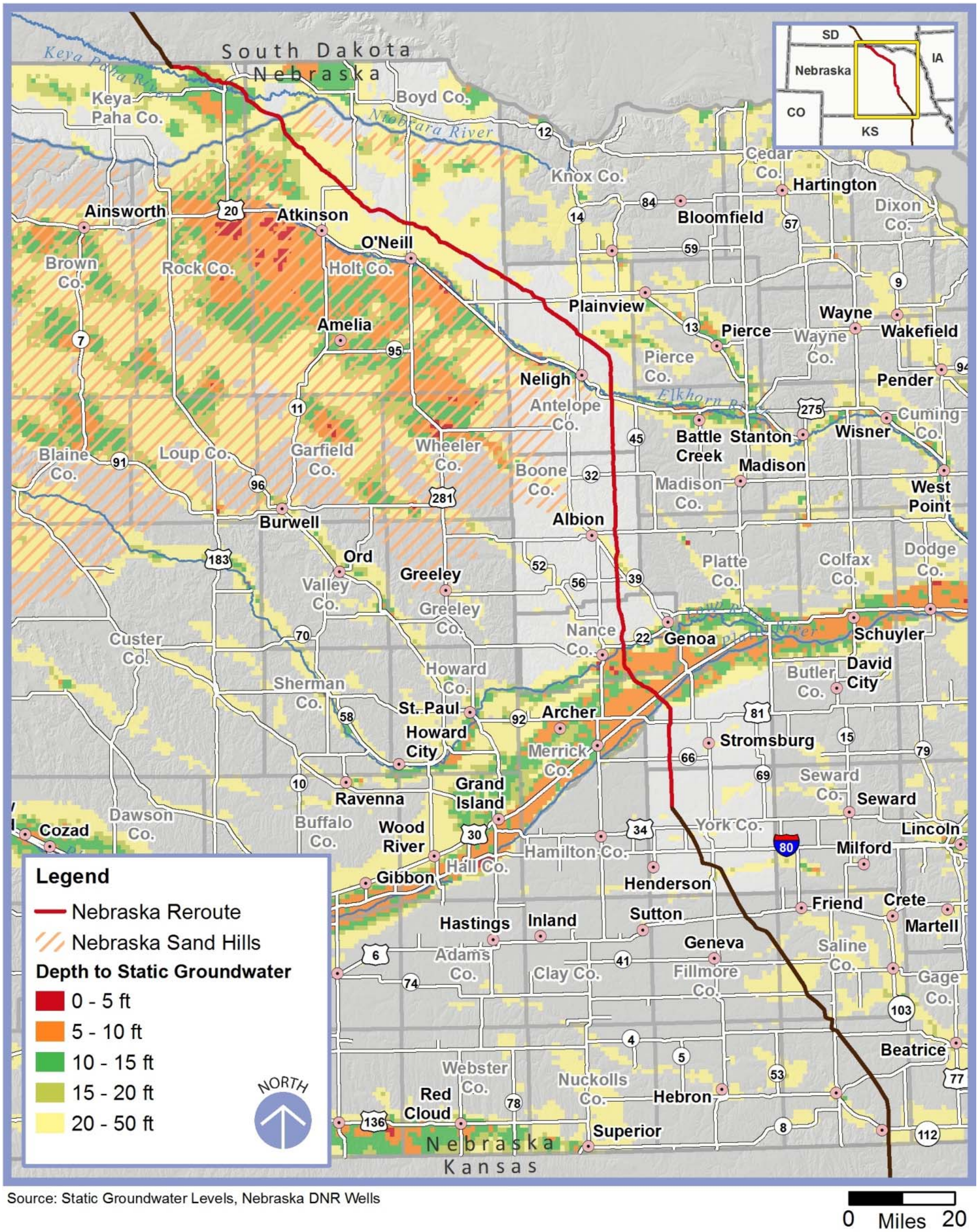
Farming and livestock operations affect shallow groundwater. Where crops are irrigated in areas with shallow groundwater, there are elevated levels of fertilizers, pesticides, and herbicides. Concentrations of these constituents are generally higher in the near-surface groundwater (Stanton and Qi, 2006).

E.3.1.5 Shallow Aquifers

Shallow aquifers are areas where the groundwater is less than 50 feet bgs. Shallow aquifers were identified using digital data provided by NDNR. The database from which this data was taken includes data from 1957 to the present and is regularly updated by NDNR. The digital data used in the interpolation were downloaded in July 2012. Figure E.3-3 shows the average groundwater depth below the surface.

Review of the average groundwater depth indicated that shallow aquifers within the 110-feet permanent easement are present in Keya Paha, Holt, and Merrick Counties.

Figure E.3-3. Static Groundwater Levels along the Proposed Nebraska Reroute



Source: Static Groundwater Levels, Nebraska DNR Wells

E.3.1.6 Groundwater Use and Registered Well Survey

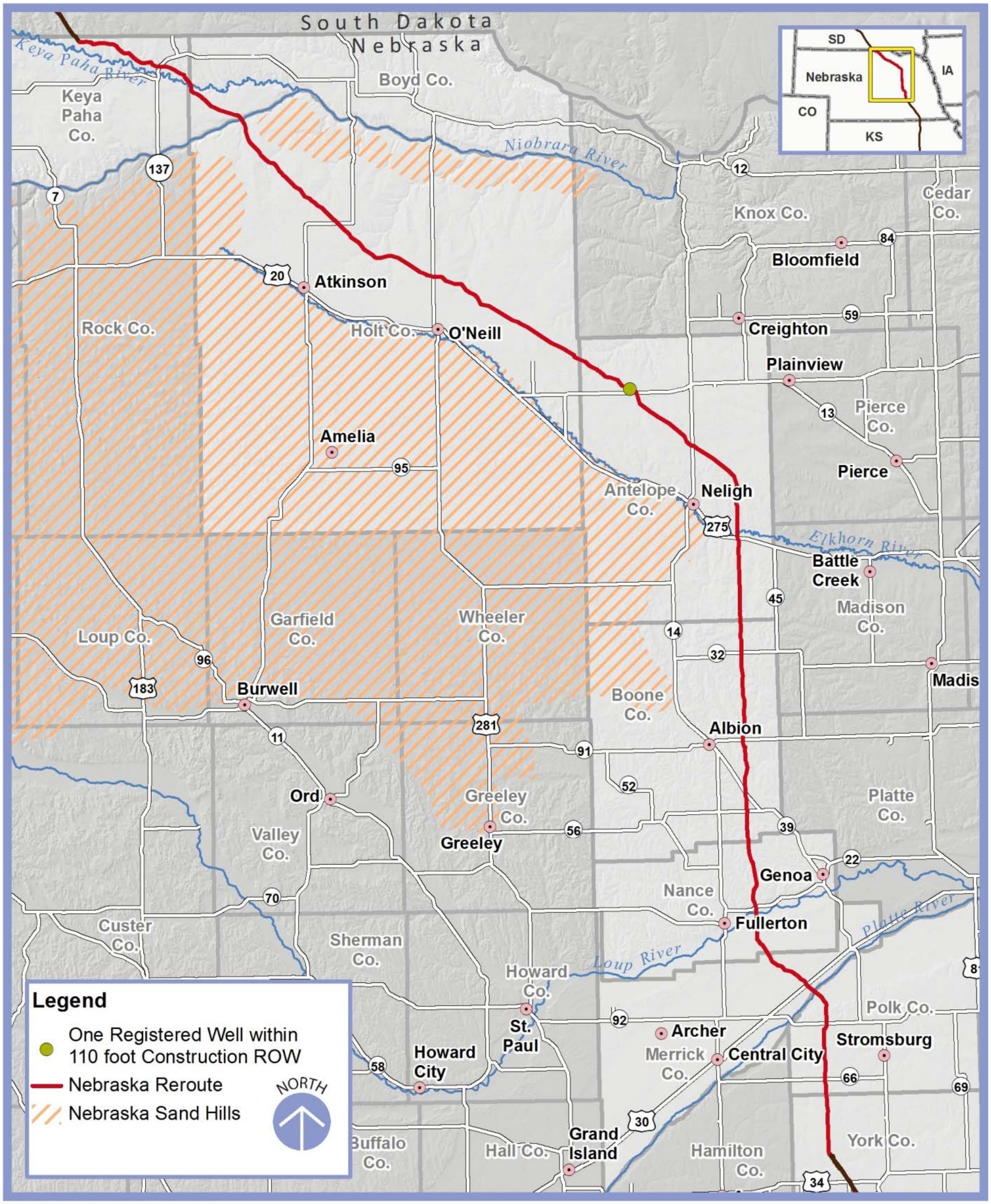
A database analysis was conducted to determine the presence of water wells within the 110-foot temporary construction easement. The database used was a publicly available and searchable database maintained by NDNR. The database was queried for data about domestic, livestock, irrigation, and public water supply wells.

Table E.3-7 lists the only registered groundwater well within the temporary pipeline construction easement as of the date of the search (see Figure E.3-4) (NDNR, 2012). The Draft Evaluation Report listed five groundwater wells within or very close to the temporary easement. It was confirmed in the FER development process that these four wells are outside the 150 foot construction ROW and were removed from the Final Evaluation Report. The remaining identified well within the temporary easement is an irrigation well. The main use of groundwater along the proposed Nebraska Reroute corridor is for irrigation (NDNR, 2012). Not all wells are registered in the NDNR database. In particular, stock and domestic wells drilled before 1993 are not required to be registered. Certain dewatering and other temporary wells are also not required to be registered.

Table E.3-7. Registered Groundwater Well within the Temporary Pipeline Construction Easement for the Proposed Nebraska Reroute

Well Registration Number	County	Latitude	Longitude	Total Depth (feet)	Static Water Level (feet)	Use	Pumping Rate (gallons per minute)
G-108715	Antelope	42.34230	–98.1791	360	78	Irrigation	900

Figure E.3-4. Registered Groundwater Well within the Temporary Construction Easement for the Proposed Nebraska Reroute



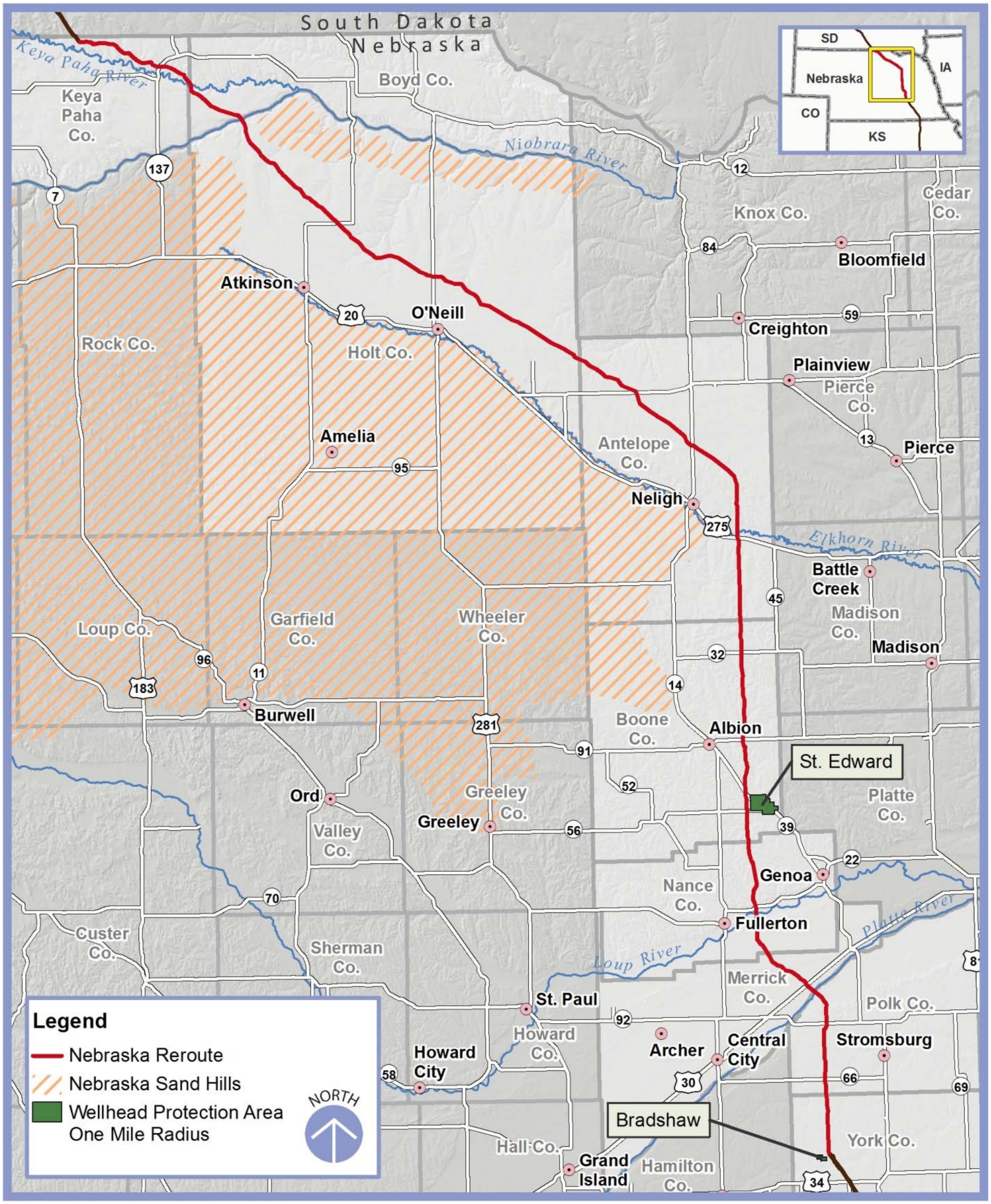
Source: Wells, Nebraska DNR

E.3.1.7 Wellhead Protection Areas

In Nebraska, Wellhead protection areas (WHPAs) and protection activities (including Wellhead Protection Area Plans) are established on a voluntary basis by local communities and state governments to protect municipal groundwater resources. WHPAs are generally defined as surface and subsurface areas that surround a water well or well field supplying a public water system and through which contaminants are reasonably likely to move toward and reach the water well or well field (NDEQ, 2001). The Nebraska Wellhead Protection Program generally includes a 20-year time of travel area in WPAs for community wells. This time of travel area is determined based on computer modeling that accounts for geologic information and the amount of groundwater pumped annually from the specific well or wells in the system (TransCanada Keystone Pipeline, LP [Keystone], 2012).

WPAs within 1 mile of the proposed Nebraska Reroute corridor were evaluated. The Keystone XL Pipeline would not pass through any mapped WHPAs, but the proposed Nebraska Reroute would pass within 1 mile of the WHPAs for St. Edward (Boone County) and Bradshaw (York County). The Nebraska Reroute would be within a half mile downgradient of the St. Edward WHPA boundary and approximately a half mile upgradient of the Bradshaw WHPA boundary (see Figure E.3-5).

Figure E.3-5. Wellhead Protection Areas along the Proposed Nebraska Reroute



Source: Wellhead Protection Areas, NDEQ

E.3.1.8 Irrigation Infrastructure

Nebraska is an important national agricultural area, and groundwater withdrawn from the High Plains Aquifer is the principal water resource for most of Nebraska. Irrigation in Nebraska is possible because of the availability of large quantities of groundwater that are suitable for irrigation. In the 1960s, the development of center-pivot irrigation systems that were adapted to sandy soils and rolling terrain made land available for irrigation that previously was not suitable for furrow irrigation (Gutentag et al., 1984).

As Table 4.10-5 shows, there are approximately 1,644 acres of cropland within the width of the temporary pipeline easement. A large portion of this cropland is irrigated with center-pivot systems.

E.3.2 POTENTIAL IMPACTS

Potentially affected groundwater resources within the proposed Nebraska Reroute corridor include shallow aquifers, WHPAs, and groundwater wells. Potential impacts on groundwater resources from construction, operation, and maintenance of the pipeline were evaluated.

E.3.2.1 Construction

Potential impacts on groundwater during construction activities would include:

- Aquifer impacts due to water use and dewatering during construction
- Contamination of shallow aquifers from releases of fuel or other chemical contamination from construction-related equipment

Water for Construction

Water will be used during construction of the pipeline. Water will be used to control dust, perform hydrostatic testing of the pipeline and facility piping (described further below), and perform horizontal directional drilling (HDD) activities. Other potential uses of water during construction include washing equipment, providing water when placing backfill or embankment, and hydromulching. Potable water might also need to be supplied from groundwater sources for potential construction camps. Groundwater resources along the proposed Nebraska Reroute corridor might be used for these activities. Groundwater recharge and production in domestic and irrigation wells could decrease.

Hydrostatic Testing

Groundwater might need to be withdrawn for hydrostatic testing where surface water or municipal sources are not available or cannot be used. Hydrostatic testing of the pipeline would need to comply with the requirements of a National Pollutant Discharge Elimination System (NPDES) Permit (NEG672000) that authorizes the discharge of water used for hydrostatic testing to upland areas or into surface waters. NDEQ administers this permit to control the pollutant discharges from hydrostatic testing.

Construction Camp

Rural Nebraska might not have enough temporary housing near the proposed Nebraska Reroute corridor to house all the construction personnel working in those areas. In those remote and rural areas, a temporary work camp might be constructed to meet the housing needs of the construction workforce. The construction camp site (and associated contractor yard) could be up to 100 acres in size. Part of that area might be used as a contractor yard, while the majority would be used for housing and administration facilities. The camps would require systems and infrastructure, including parking, for up to 900 workers (Keystone, 2012).

Potable water would be provided by drilling a well where feasible. If enough water could not be obtained from a well, water would be obtained from municipal sources or trucked to the camp. A self-contained wastewater treatment facility would be included in each camp except where a licensed and permitted publically owned treatment works could practicably be used (U.S. Department of State [DOS], 2011). Permits would also need to be obtained as necessary for drilling wells and withdrawing and using groundwater.

Required permits include a permit from Nebraska Department of Health and Human Services to operate a public water system for the construction camp and an Onsite Wastewater Permit or Wastewater Construction Permit to build a wastewater treatment system at the construction camp.

Groundwater Contamination

Aquifers are susceptible to contamination from a variety of human activities. The vulnerability of an aquifer to contamination depends on a number of factors: the type and thickness of the overlying deposits (both soil and geology), the thickness of the unsaturated zone (that is, the depth to the water table), the speed with which the water flows through both the unsaturated and saturated zones, and contaminant characteristics such as solubility, mobility, toxicity, and durability.

Certain areas within the Ogallala Group of the High Plains Aquifer have soil or lithologic zones that inhibit the downward migration of contaminants (Gurdak et al., 2009). In these areas, dissolved chemicals from the land surface are transported to the water table more slowly, taking decades to centuries (Gurdak et al., 2009). However, even in these areas, local preferential flow paths could allow dissolved chemicals to move faster through the unsaturated zone to the water table. These preferential flow paths are more likely to be present beneath topographic depressions, where precipitation or surface water collects. Preferential flow paths with lower infiltration rates are more likely to be present in areas of fine-grained sediments or beneath flat terrain where free-standing water does not pool or collect (Gurdak et al., 2009).

Shallow Aquifers

Shallow groundwater is at a higher risk of being adversely affected by human activities than deep aquifers. Surface spills, agricultural chemicals, feedlot wastes, and other sources of contamination will affect shallow groundwater faster than deeper groundwater.

It might be necessary to dewater trenches while lowering in and backfilling areas with shallow groundwater. Dewatering could temporarily draw down the aquifer.

Wellhead Protection Areas

WPAs downgradient of the proposed Nebraska Reroute corridor could be at risk of contamination. A WHPA might be the only source of drinking water for local residents and livestock.

E.3.2.2 Spills and Leaks

Construction and operation activities that could reduce groundwater quality include inadvertent releases from the refueling and maintenance of construction equipment, leaks from equipment hoses and seals, and the storage, transportation, and use of petroleum and hazardous materials. Chapter 5 discusses the mitigation associated with construction impacts on groundwater resources associated with spills and leaks of hazardous liquids.

E.3.2.3 Normal Operation

Spills during operation of the pipeline could reduce the quality of groundwater. Operational spills could originate from the pipeline, pumping stations, or delivery points. The extent of the impact would be related to the quantity of product released, the topography, the weather and soil conditions (such as temperature, precipitation, soil saturation, ground frost, etc.), the soil type(s) above the groundwater table, the characteristics of the contaminant (its solubility, permeability, toxicity, durability, etc.), the depth to groundwater, and the speed and effectiveness of emergency response measures. Groundwater wells located outside the pipeline easement could be adversely affected by surface or subsurface releases of contaminants.

E.3.3 MITIGATION

Keystone has committed to implement the procedures in its Construction, Mitigation, and Reclamation Plan (CMRP) (Keystone, 2012). This plan provides several measures that would reduce or avoid the impacts described above. A brief summary of the commitments relative to groundwater is presented below.

The potential for contamination of water supplies is a major concern for Nebraskans. The impacts of a spill are discussed in detail in Chapter 6, Pipeline Safety and Potential Spills. Keystone has also committed to conducting baseline water quality testing for domestic and livestock wells within 300 feet of the final centerline of the approved route in Nebraska, upon the request of individual landowners who provide the necessary access to perform the testing. These baseline samples would be collected prior to placing the pipeline in service. Subsequently, in the event of a significant spill in the area, Keystone would conduct water well testing as required by NDEQ pursuant to Title 118 of the Nebraska Administrative Code. Keystone would also provide an alternative water supply for any well in which water quality was found to be compromised by the spill.

Keystone has also committed to ensuring the safe operation of its pipeline to prevent any incidents from occurring. Should a release occur from the Keystone XL pipeline, Keystone has committed to clean up any releases that may occur. Keystone is also legally required to clean up spills under Title 118 and the Oil Pollution Act of 1990. In addition to all of the above, and in response to public concerns, Keystone would commit to file annually with the NDEQ, by May 1 of each year:

(a) A certificate of insurance as evidence that it is carrying a minimum of $200 million in third-party liability insurance adjusted by calculating the GDP-IPD from the date of a Presidential Permit is issued for the project and adjusting the amount of third-party liability insurance policy by this percentage. The third-party liability insurance shall cover sudden and accidental pollution incidents from Keystone XL Pipeline in Nebraska, and

(b) A copy of Keystone's Securities and Exchange Commission (SEC) Form 10-K and Annual Report.

Keystone has also committed to keeping abreast of the latest developments in external leak-detection technologies (above and beyond those already proposed to be implemented on the project, as described in the August 2011 Final Environmental Impact Statement), that could be installed along the pipeline at sensitive locations. Keystone would report to, and discuss with, the NDEQ the status of innovation in such pipeline leak-detection equipment and methods on or before January 1, 2014, and at such times thereafter until 2024 as the NDEQ shall specifically request, but in no case more frequently than once in every 3 years.

Once a final project route would be determined in Nebraska, Keystone will conduct a detailed spill risk assessment for the section of the Keystone XL Pipeline in the state. Utilizing that assessment, Keystone will determine the optimal location of spill response equipment and resources, taking into account response times to sensitive areas and receptors. The spill response locations will be reflected in the Emergency Response Plan that Keystone will submit to the federal Pipeline and Hazard Materials Safety Administration for review and approval.

E.3.3.1 Water for Construction

The use of water for construction will comply with all water-use and water-rights regulations. Because construction activities would move and the construction in any area would be relatively brief, no long-term effects on groundwater levels are expected.

E.3.3.2 Hydrostatic Testing

Hydrostatic test water will be tested and discharged in accordance with state and federal permits. All applicable water withdrawal and discharge permits will be acquired prior to hydrostatic testing. Hydrostatic testing is not expected to cause long-term effects on groundwater levels. Hydrostatic testing would be a one-time event and would not entail a prolonged used of water resources.

E.3.3.3 Wellhead Protection Areas

Route variations were made to avoid WHPAs. Even with the route variations to avoid WHPAs, mitigation activities will include the use of best management practices (BMPs) to reduce potential impacts that would impair water quality, decrease yield, or potentially disrupt service.

E.3.3.4 Shallow Aquifers

Dewatering activities for trench construction in shallow aquifers will be completed in accordance with NPDES requirements and BMPs.

Groundwater contamination in shallow aquifers from pipeline leaks and potential spills from construction activities would be addressed by the procedures in Keystone's Spill Prevention, Containment, and Countermeasure Plan (SPCC), which would be prepared specifically for the Nebraska Reroute. An outline of this plan is provided in Section 3.0 of the CMRP, which is shown in Appendix C of this Draft Evaluation Report.

The SPCC would provide detailed requirements for preventing spills and would include such issues as managing hazardous materials during construction in staging areas and in the construction right-of-way. The SPCC requires developing emergency response procedures for all incidents involving hazardous materials that could pose a threat to human health or the environment. The SPCC also prescribes requirements for emergency response equipment (such as first aid supplies, radios, hand-held fire equipment, and so forth) in all areas where hazardous materials are handled or stored.

The SPCC would also establish emergency notification procedures. These procedures would identify the individuals and agencies to be contacted in the event of a spill that meets government reporting requirements.

Finally, the SPCC would prescribe the procedures to be followed in the event of a spill. For example, when notified of a spill, Keystone would immediately ensure that:

- Action is taken to control danger to the public and personnel at the site.
- Spill contingency plans are implemented and necessary equipment and personnel are mobilized.
- Measures are taken to isolate or shut down the source of the spill.
- All resources necessary to contain, recover, and clean up the spill are available.
- Any resources requested by the contractor from Keystone are provided.
- The appropriate agencies are notified. For spills on public land, into surface water, or into sensitive areas, the appropriate federal or State managing office would also be notified and involved in the incident.

E.3.3.5 Spills and Leaks

Groundwater contamination from potential operational pipeline leaks and spills will be addressed by specific preventive and mitigative measures discussed in Chapters 5 and 6.

E.3.4 WESTERN ALTERNATIVE

The Western Alternative was developed to avoid the WHPA near Western. The Final EIS alignment is now located upgradient of the WHPA near Western.

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Attachment A

Abbreviations and Acronyms

Abbreviation or Acronym	Description
bgs	below ground surface
BMP	best management practice
COHYST	Cooperative Hydrology Study
EPA	U.S. Environmental Protection Agency
gal/min	gallons per minute
HDD	horizontal directional drilling
mg/l	milligrams per liter
NDEQ	Nebraska Department of Environmental Quality
NDNR	Nebraska Department of Natural Resources
NPDES	National Pollutant Discharge Elimination System
NRD	Natural Resources District
TDS	total dissolved solids
UNL	University of Nebraska–Lincoln
WPA	wellhead protection area

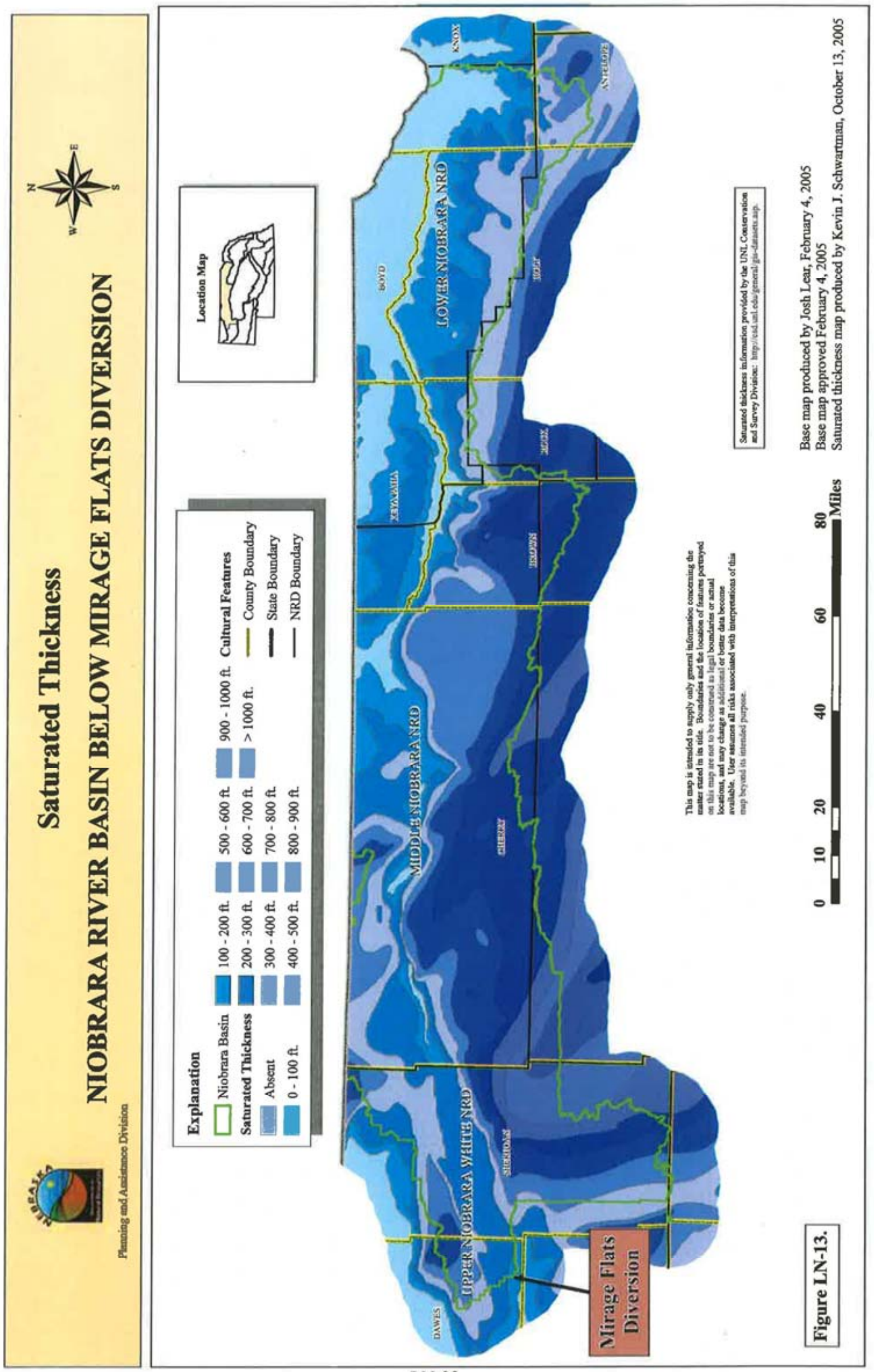
Attachment B

Natural Resources District Maps

Lower Niobrara

System	Hydrogeologic Unit	Character and Description	Maximum Thickness (feet)	Hydrogeologic Characteristics
Quaternary	Recent to Late Pleistocene Deposits	Gravel, sand, silt and clay. Includes dune sand and loess in upland areas and think alluvial deposits below the floors of principal valleys.	150	An important source of water where saturated. Beds of sand and gravel below bottom land yield small to moderate amounts of water to wells. Some deposits mantling upland areas may also serve as water sources. Variable water quality, generally suitable for livestock and domestic use.
	Early Pleistocene Deposits	Gravel, sand, silt and clay in upland areas. Generally south of the Niobrara River.	175	Thick saturated deposits of sand and gravel yield moderate to large quantities of water to wells.
	Dune Sand	Wind-blown very fine to fine sand	200	Yields large supplies to stock wells tapping thick sequences of saturated sand.
	Grand Island Formation	Cross-bedded sand and gravel deposits derived mostly from granitic crystalline rocks.	100	Yields moderately large to large amounts of water tapping thick sequences of saturated material.
	Holdrege Formation	Sand and gravel made up mostly of reworked Tertiary material and some quartz and granitic crystalline material.	50	Yields large supplies of water.
Tertiary	Ogallala Group	Fine to medium sand and silt containing volcanic ash; calcareous in places.	400	Yields small to moderately large amounts of water to wells tapping thick beds of saturated material.
	Miocene Silt Beds	Silt, Clay, siltstone and claystone beds	80	Source of water to stock and domestic wells in some places. Excellent water quality.
	Brule Formation	Sandy siltstone.	350	Not a source of water
Cretaceous	Pierre Shale	Claystone, shale, chalk to chalky shale	800	Yields little to no water to wells, generally very poor quality
	Niobrara Formation	Chalk, shaly chalk, shale and limestone	220	Not an important source of water
	Carlile Shale	Sandstone, siltstone and clayey siltstone	60	Yields water, satisfactory for livestock and domestic purpose

Source: Modified from NDNR, 2005



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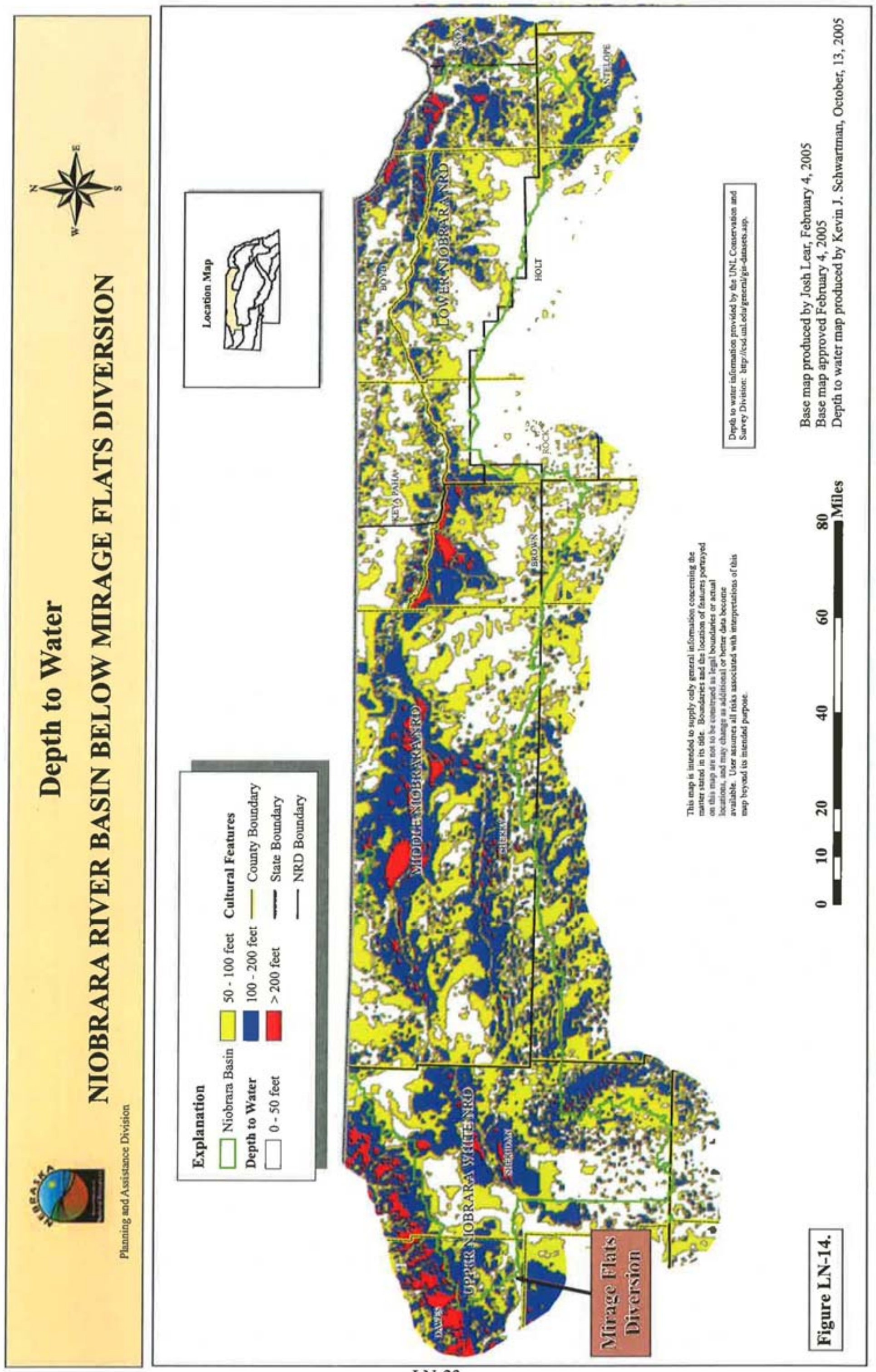
LN-22



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LN-23

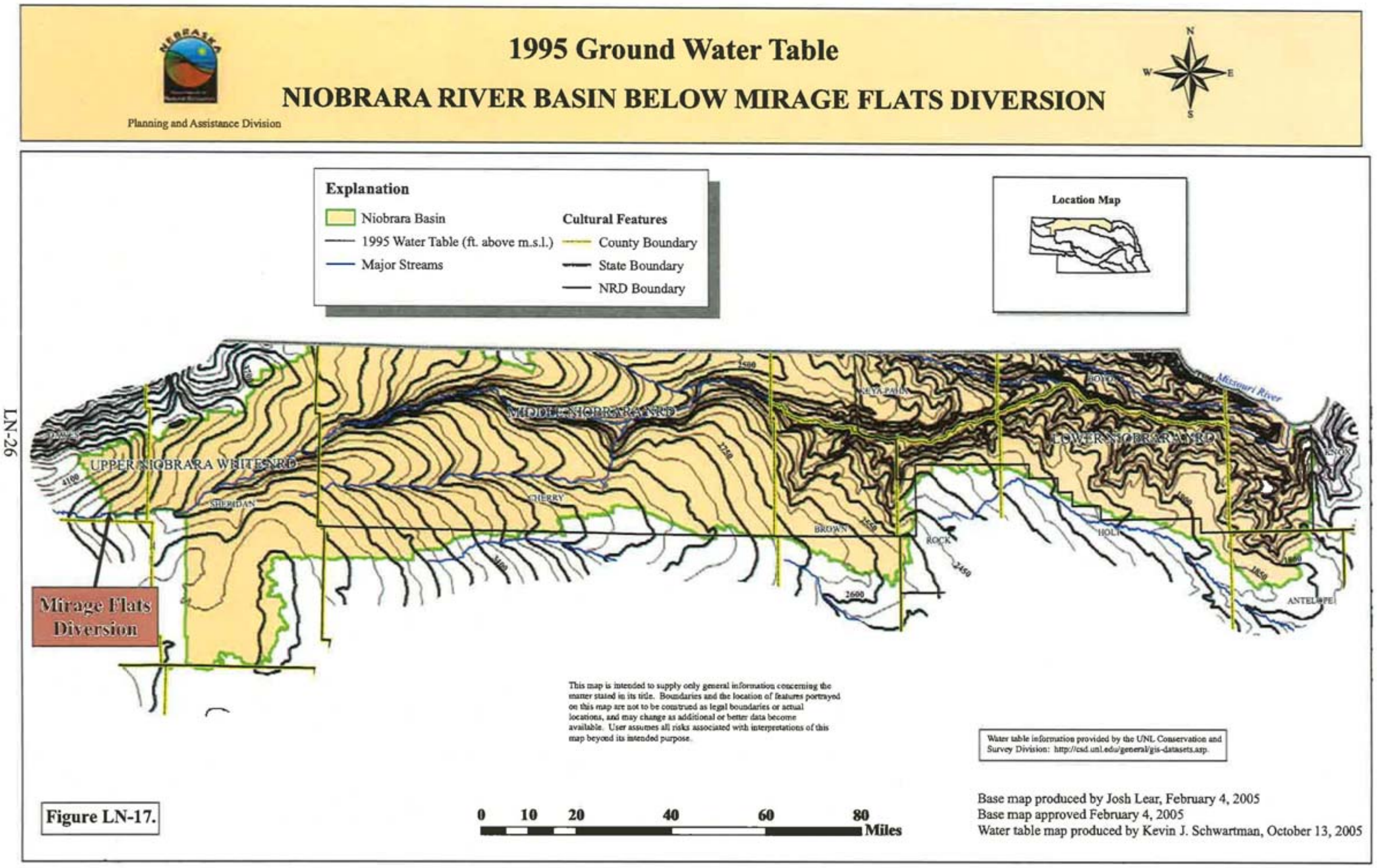


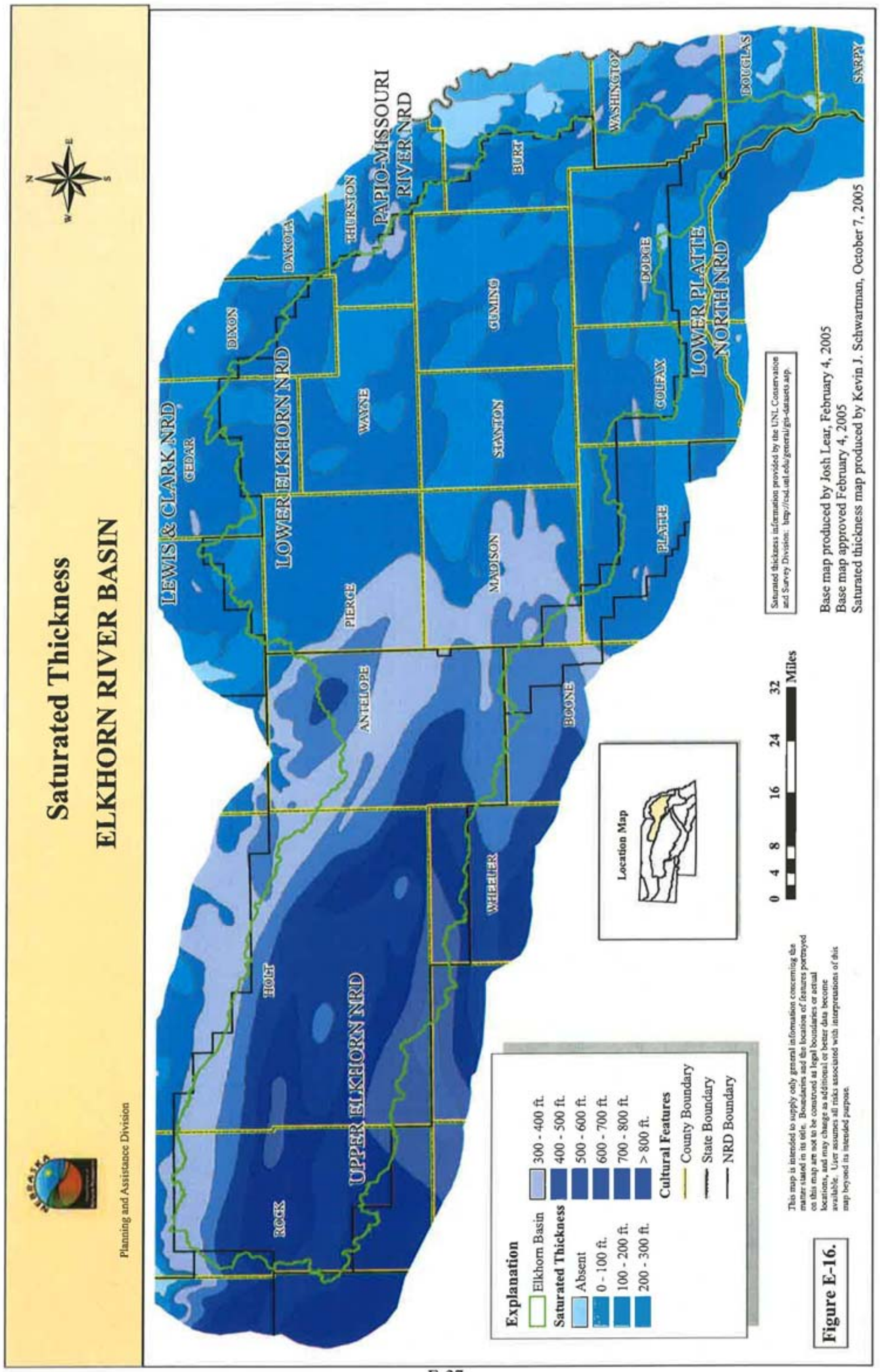
Figure LN-17.

LN-26

Upper Elkhorn

System	Hydrogeologic Unit	Character and Description	Maximum Thickness (feet)	Hydrogeologic Characteristics
Recent	Alluvium, loess, dune sand and soil	Clay, silt, sand and gravel alluvium in reworked stream valley lands and sand and gravel in stream channels. Loess deposited on valley terraces and upland surfaces	30	Not an important source of water except in areas where the water table is close to land surface.
Quaternary	Peorian Loess	Wind deposits of massive clay on uplands an on terraces; some dune sands	45	Yields water slowly to wells in areas where it occurs below the water table
	Todd Valley Formation	Eolian or alluvial sand and gravel. Dune-like topography on upper surfaces.	50	May yield water to wells where it occurs below the water table.
	Loveland Formation	Stratified silt and clay and fine sand laminae in valleys. Massive silt and clay (loess) in uplands.	50	Yields water slowly to wells in areas where it occurs below the water table
	Crete Formation	Sand and gravel deposited as channel fill. Modified by local materials.	30	May yield water to wells in areas where it occurs below the water table.
	Kansan (Glacial) Drift	Boulder till	100	Not an important source of water.
	Grand Island Formation	Sand and gravel deposited by streams	75	Yields abundant good quality water to wells in areas where it occurs below the water table.
	Holdrege Formation	Fluvial sand and gravel	15	Yields abundant supplies of good quality water to wells.
Tertiary	Ogallala Group	Fluvial gravel, sand, silt and clay	200	Yields abundant supplies of good quality water to wells.
Cretaceous	Pierre Shale	Shale that is generally weathered at the top.	400	Not an important source or water but may yield small amounts of poor quality water were fractured.
	Niobrara Formation	Soft shaley limestone or impure chalk with some clay	250	Not an important source by may yield small amounts of water to wells

Source: Modified from NDNR, 2005



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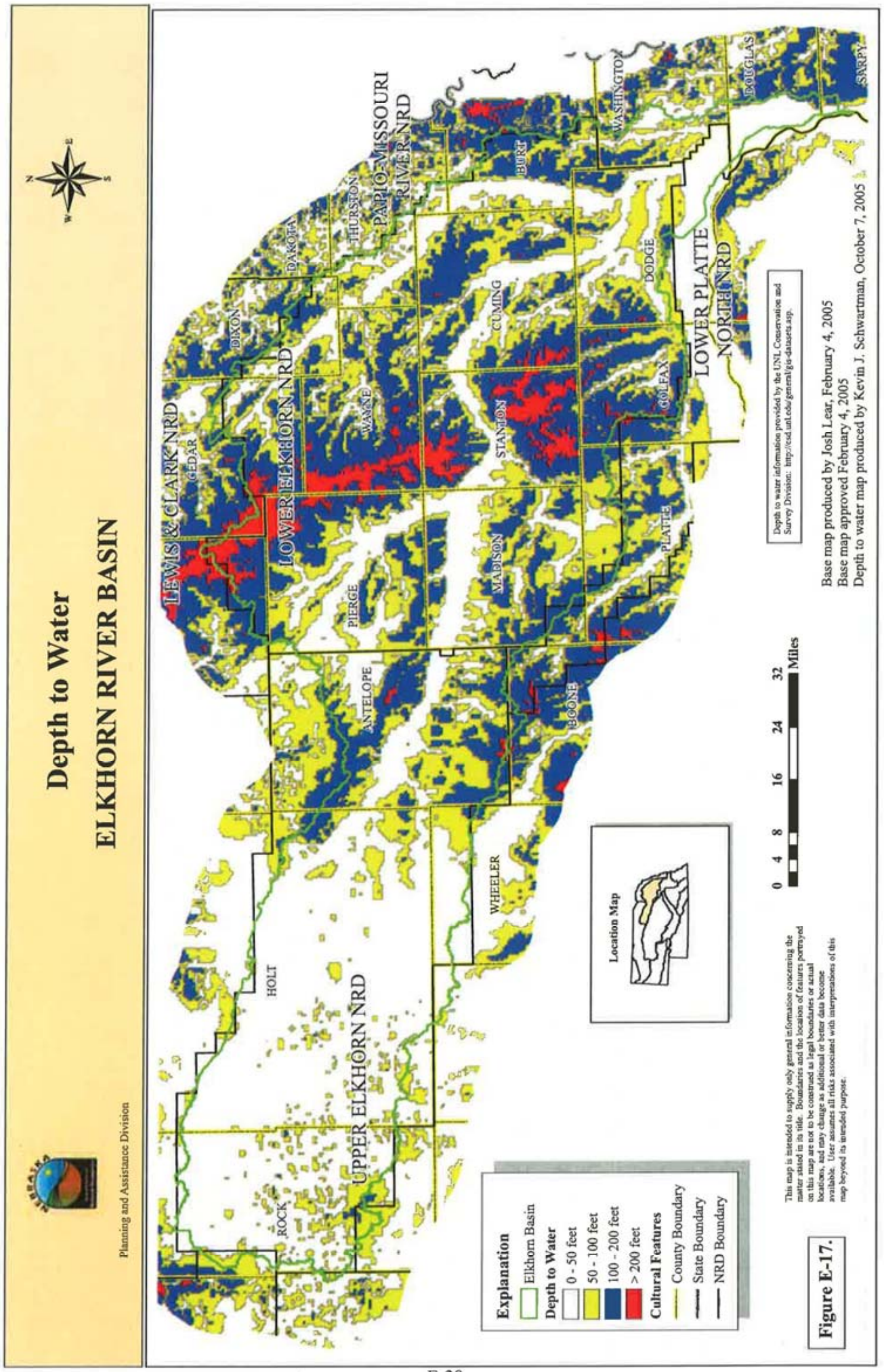

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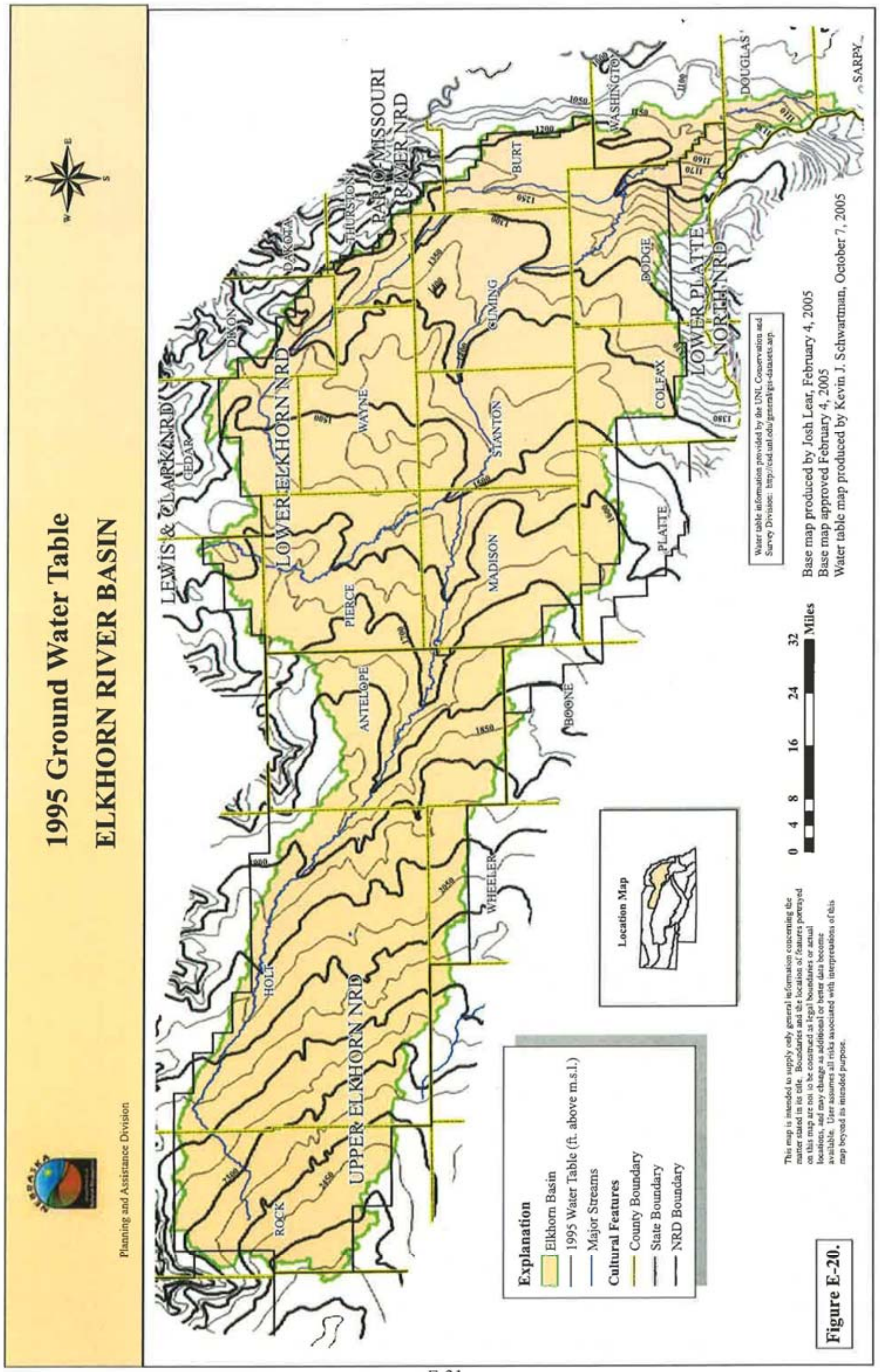


Figure E-20.

E-31

Lower Loup

System	Hydrogeologic Unit	Character and Description	Maximum Thickness (feet)	Hydrogeologic Characteristics
Recent to Quaternary	Undifferentiated sand, gravel, silt and clay	Eolian (dune) sand and alluvial fill. Sandy and clayey silt and sandy clay	180	Provides moderate to high well yields
	Todd Valley Sand	Fine sand and gravel deposited as valley fill.	50	Yield water to wells in areas where it is saturated
	Crete Formation	Sand and gravel deposited as channel fill. Modified by local materials.	30	Yield water to wells in areas where it is saturated
	Grand Island Formation	Sand and gravel deposited by streams	60	Yield water to wells in areas where it is saturated.
	Holdrege Formation	Sand and gravel deposited by streams.	15	Yields abundant supplies of water to wells
Tertiary	Plio-Pleistocene sands and gravels	Sand and gravel interbedded with silt.	>100	High capacity wells
	Ogallala Group	Sand, silty sand, sandy and clayey silt, sandstone, siltstone and some gravel	600	Hydraulically connected to unconsolidated sediments, part of the primary aquifer.
Cretaceous	Niobrara Formation	Shaley chalk and limestone	400	Secondary aquifer where fractured.

Source: Modified from NDNR, 2005

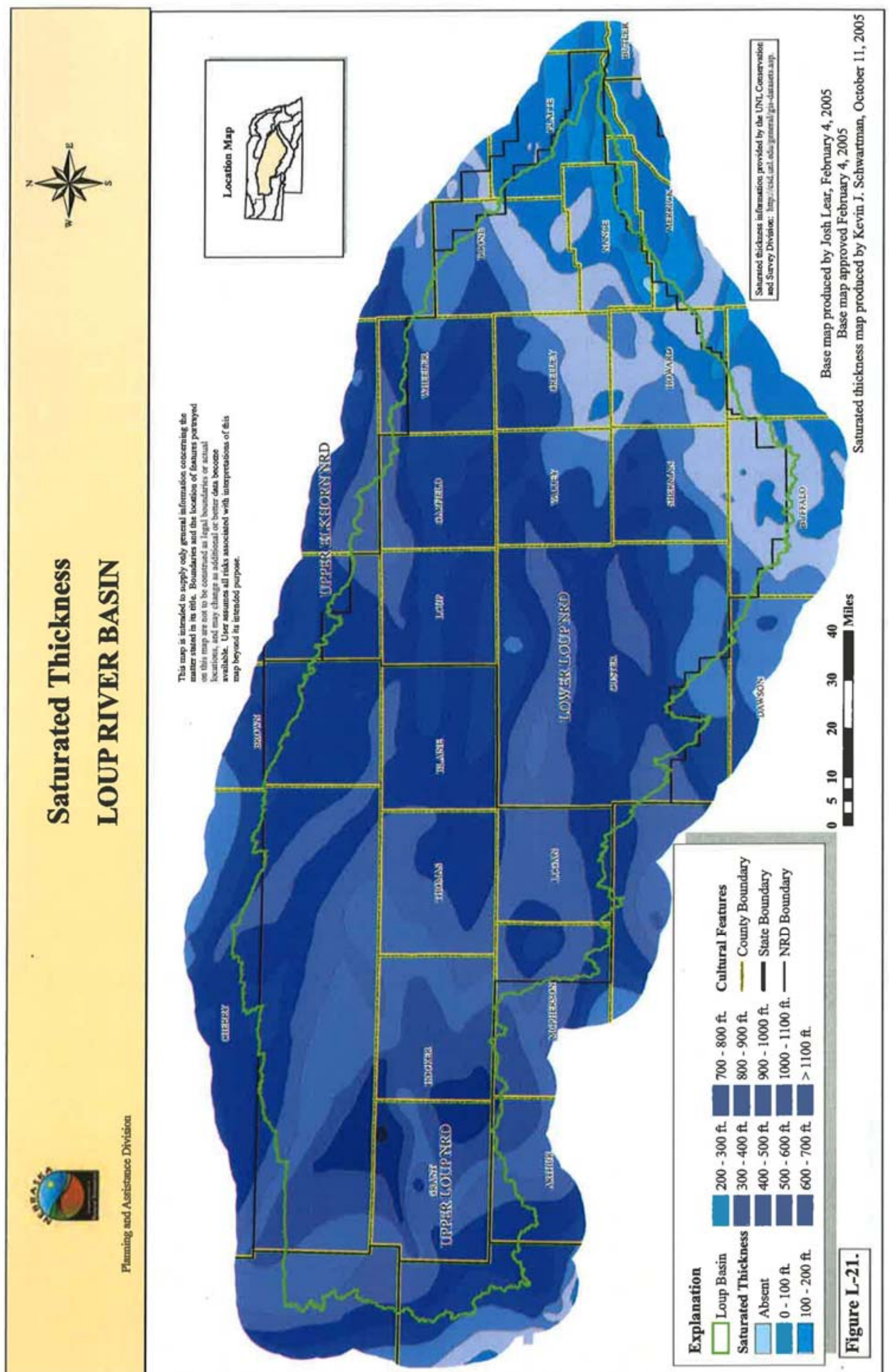
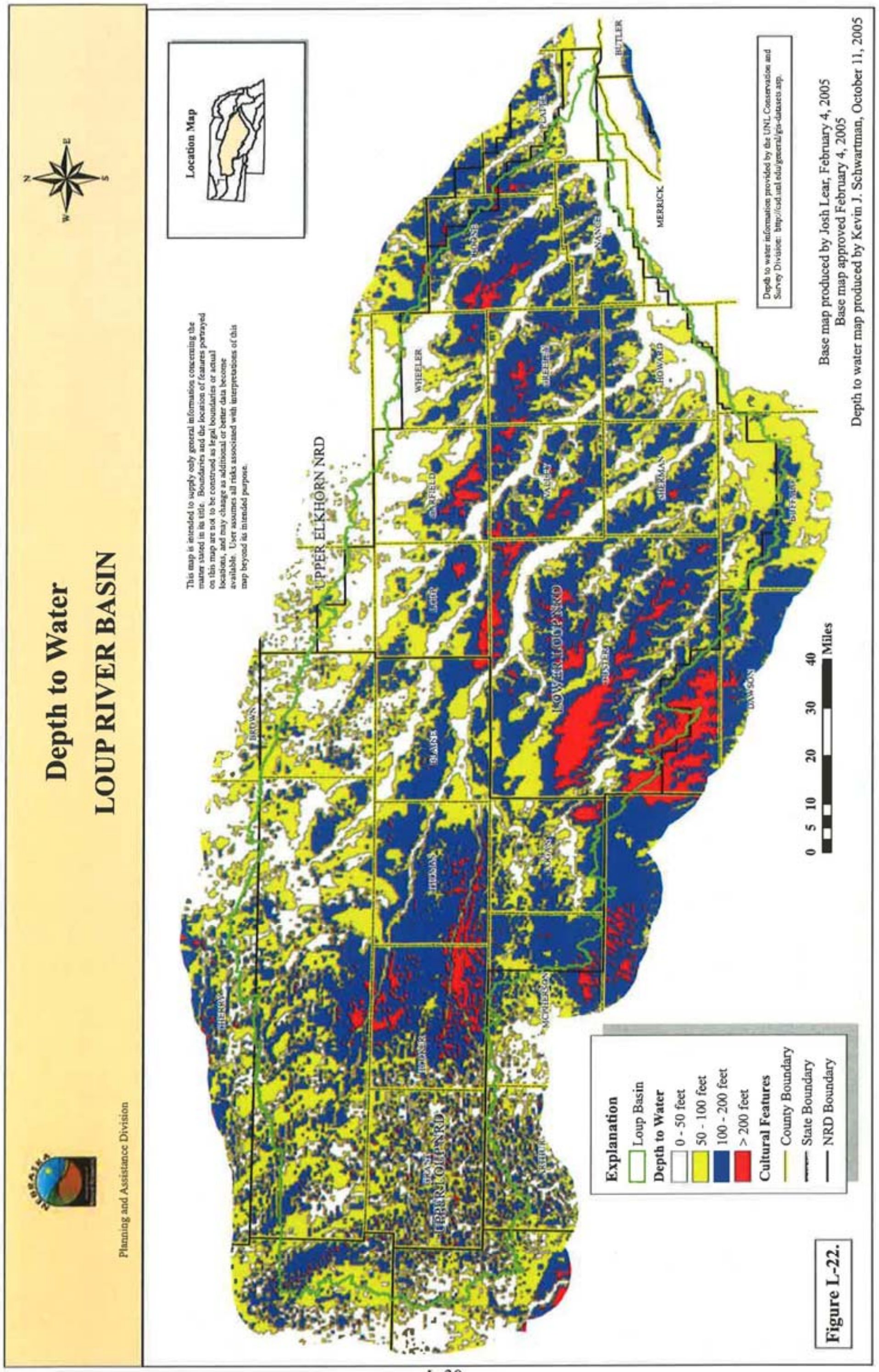


Figure L-21.

L-29



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L-30

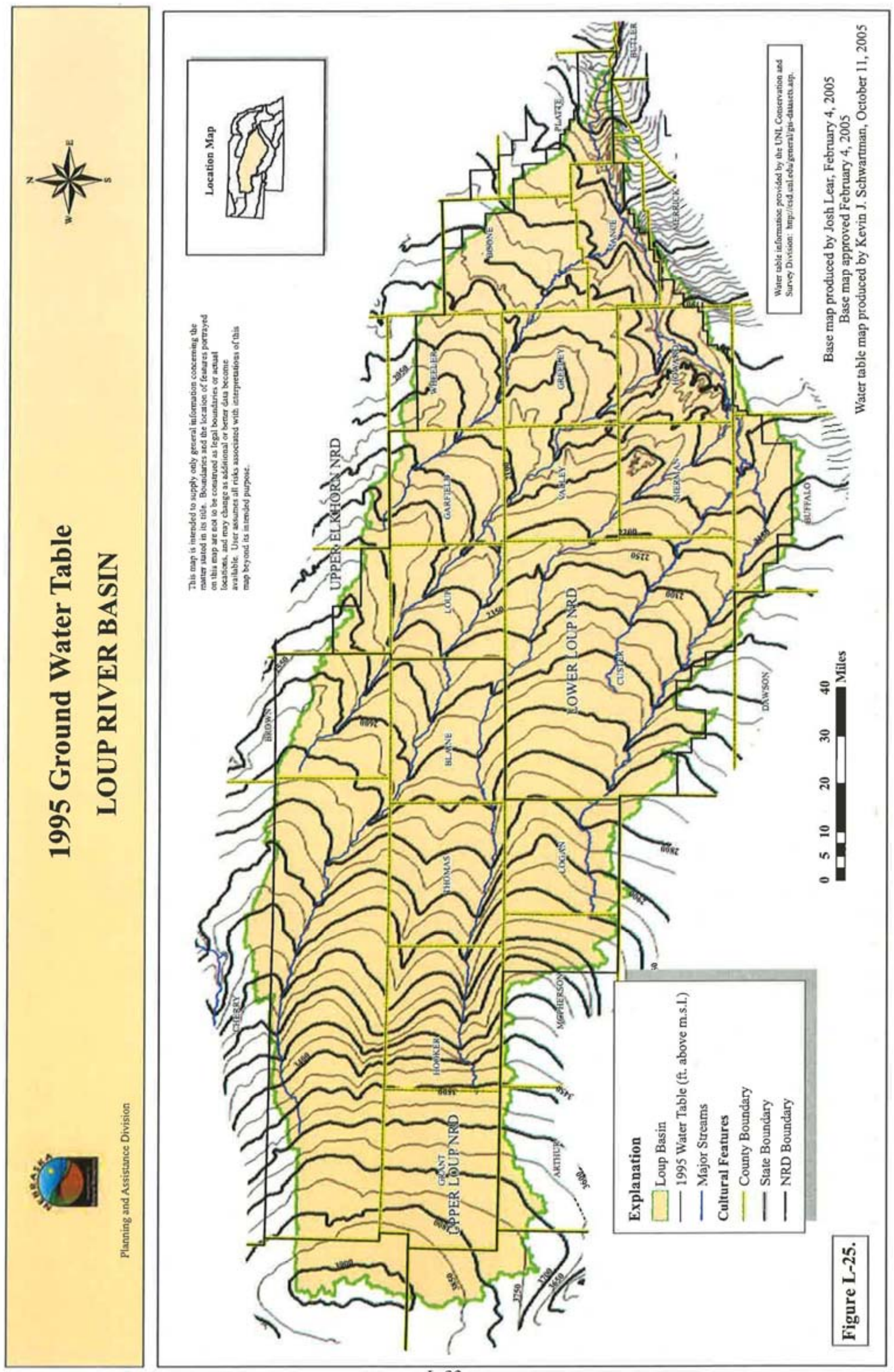


Figure L-25.

L-33

Central Platte

System	Hydrogeologic Unit[1]	Character and Description	Hydrogeologic Characteristics
Quaternary	Valley-fill deposits	Gravel, sand silt and clay	Source of major supply of water in the alluvial valleys
	Dune Sands	Generally fine sand but may contain some medium to coarse sand. Wind blown deposits	Source of water to livestock and domestic wells. Usually shallow groundwater
	Loess Deposits	Generally silt, but may contain some very fine sand and clay. Deposited as wind blown dust.	Rarely used as water source for low yielding wells
	Alluvial Deposits	Gravel, sand, silt, and clay	Major source of water
Tertiary	Broadwater Formation	Coarse fluvial gravel and sand with some silt and clay	Major source of water where saturated thickness is sufficient for large capacity wells
	Ogallala Group	Heterogeneous mixture of gravel, sand, silt, and clay. Generally stream deposits, but also contains wind blown deposits	Major source of water
	Arikaree Group	Very fine to fine-grained sandstone, but may also contain siltstone	Not a major source of water in eastern model unit
	Brule Formation of White River Group	Predominately siltstone, but may contain sandstone and channel deposits	Generally an aquiclude except where fractured or alluvial channel deposits exist
	Chadron Formation of White River Group	Silt, siltstone, clay and claystone	Generally an aquiclude for basal fluvial sediments
Cretaceous	Undifferentiated	Shale, chalks, limestone, siltstone and sandstone	Generally an aquiclude except for sand deposits.

[1]Stratigraphic description of geologic and hydrostatigraphic units used in the Cooperative Hydrology Study
Source: Modified Gutentag et al. 1984

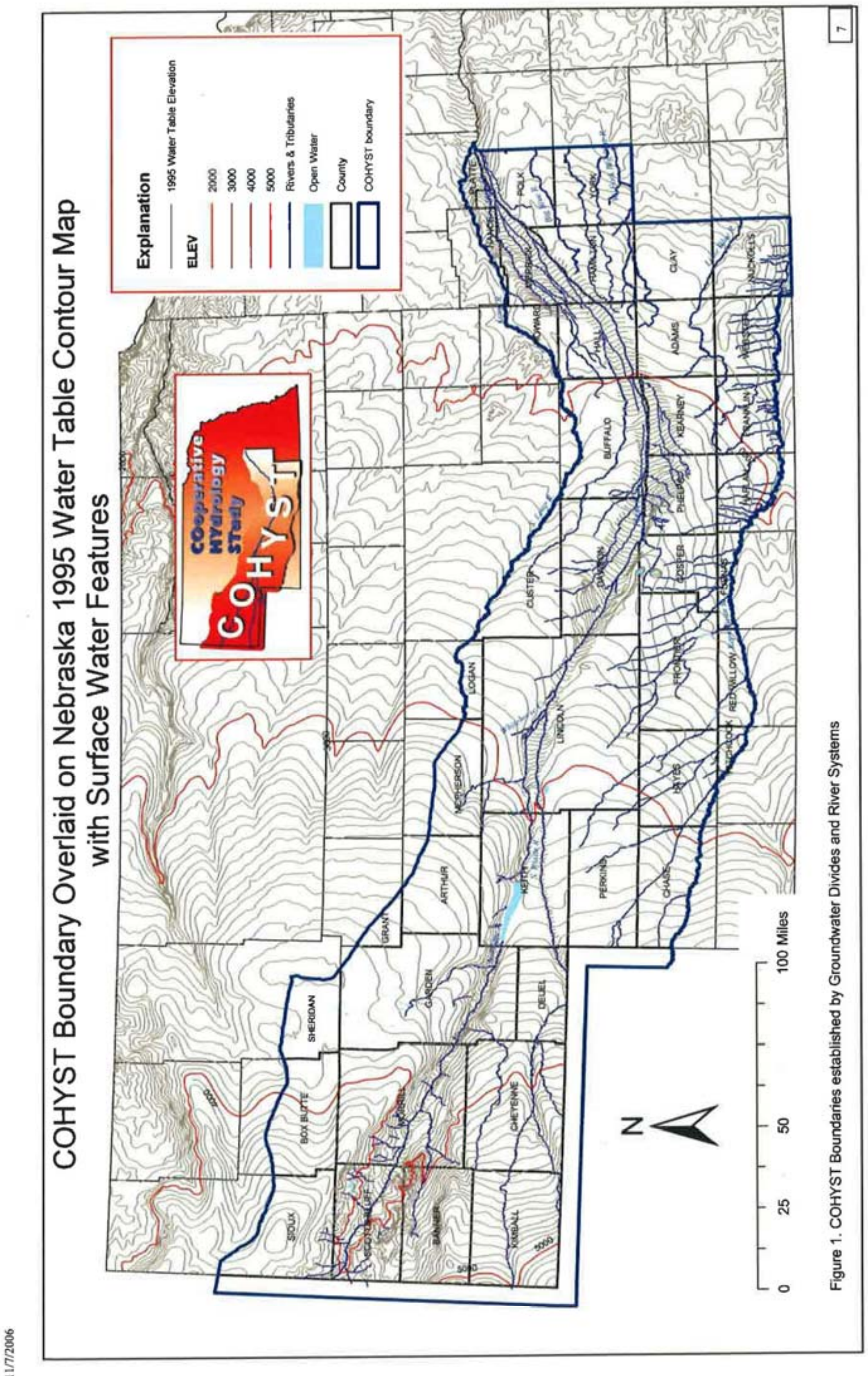


Figure 1. COHYST Boundaries established by Groundwater Divides and River Systems

Upper Big Blue

System	Hydrogeologic Unit	Character and Description	Maximum Thickness (feet)	Hydrogeologic Characteristics
Quaternary	Undifferentiated fluvial and terrace deposits, Todd Valley Sand	Clay, silt, sand and fine gravel; underlie valley-side terraces and valley floor of drainage courses. Sand and gravel valley and terrace deposits, mostly along stream valleys	30	Generally saturated, wells yield water at a moderate rate.
	Crete Formation, Undifferentiated fluvial, lacustrine and eolian deposits.	Sand and gravel channel-fill deposits. Silt, sand and gravel restricted to broad valleys.	130	Generally saturated where thick and coarse textured, yields water to wells at a high rate.
	Sappa Formation	Stratified deposits of silt, clay sand and gravel	60	Sand lenses yield water at a slow rate in wells.
	Grand Island Formation	Stream deposited sand and gravel with a persistent aqueous-eolian deposited silt and clay later	200	Yields abundant water to wells.
	Red Cloud sand and gravel and Holdrege Formation	Stream deposited sand and gravel with nonpersistant silt and clay, probably of aqueous eolian origin	200	Yields abundant water to wells.
Tertiary	Ogallala Group	Silt, sandy and clayey silt with lenses of sand and gravels, partly calcareous	200	Not an important supply of water. May yield sufficient water to domestic wells
Cretaceous	Niobrara Formation	Chalky shale, weathered in parts	380	Generally not known as a source of water but yields water to wells at a moderate rate where it is fractured.

Source: Modified from NDNR, 2005

Planning and Assistance Division

Saturated Thickness
BIG BLUE RIVER BASIN

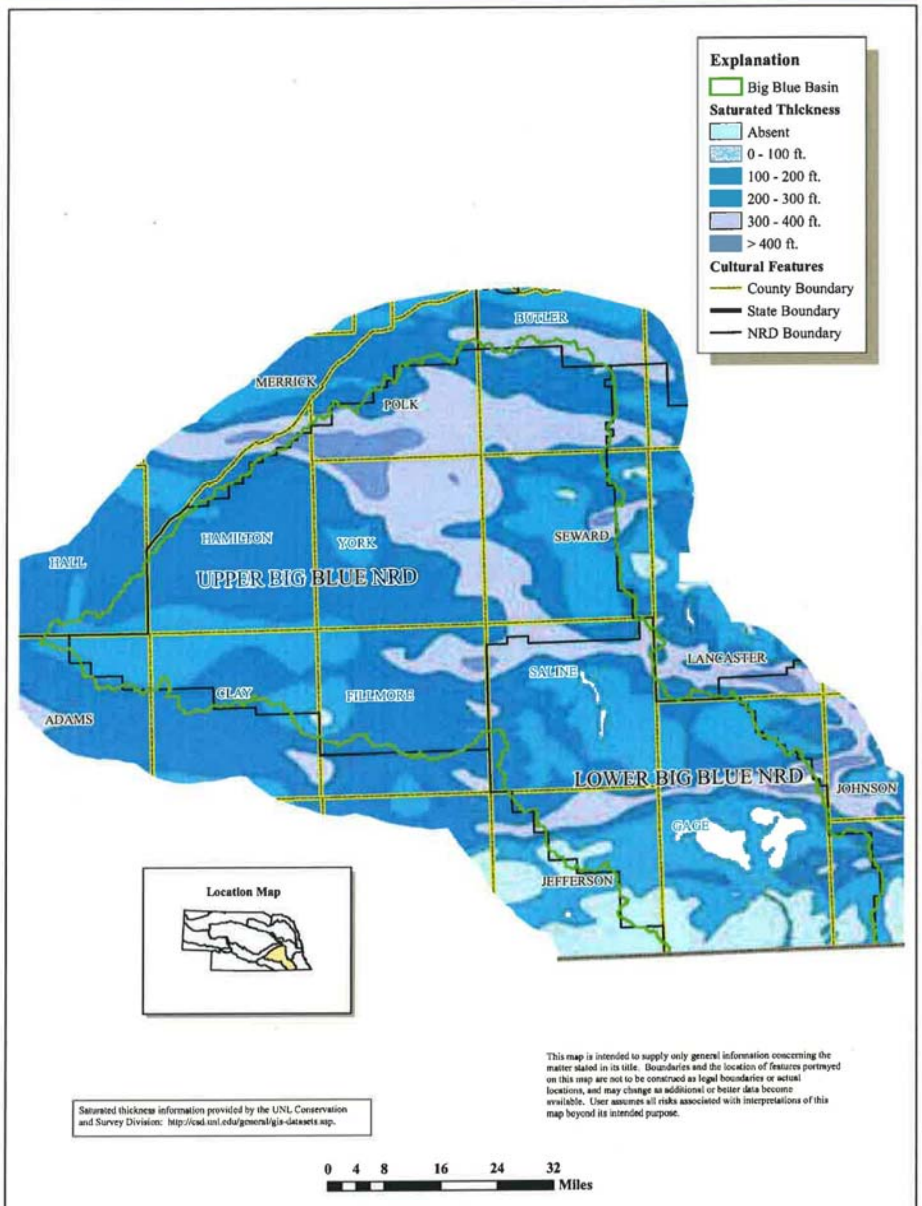
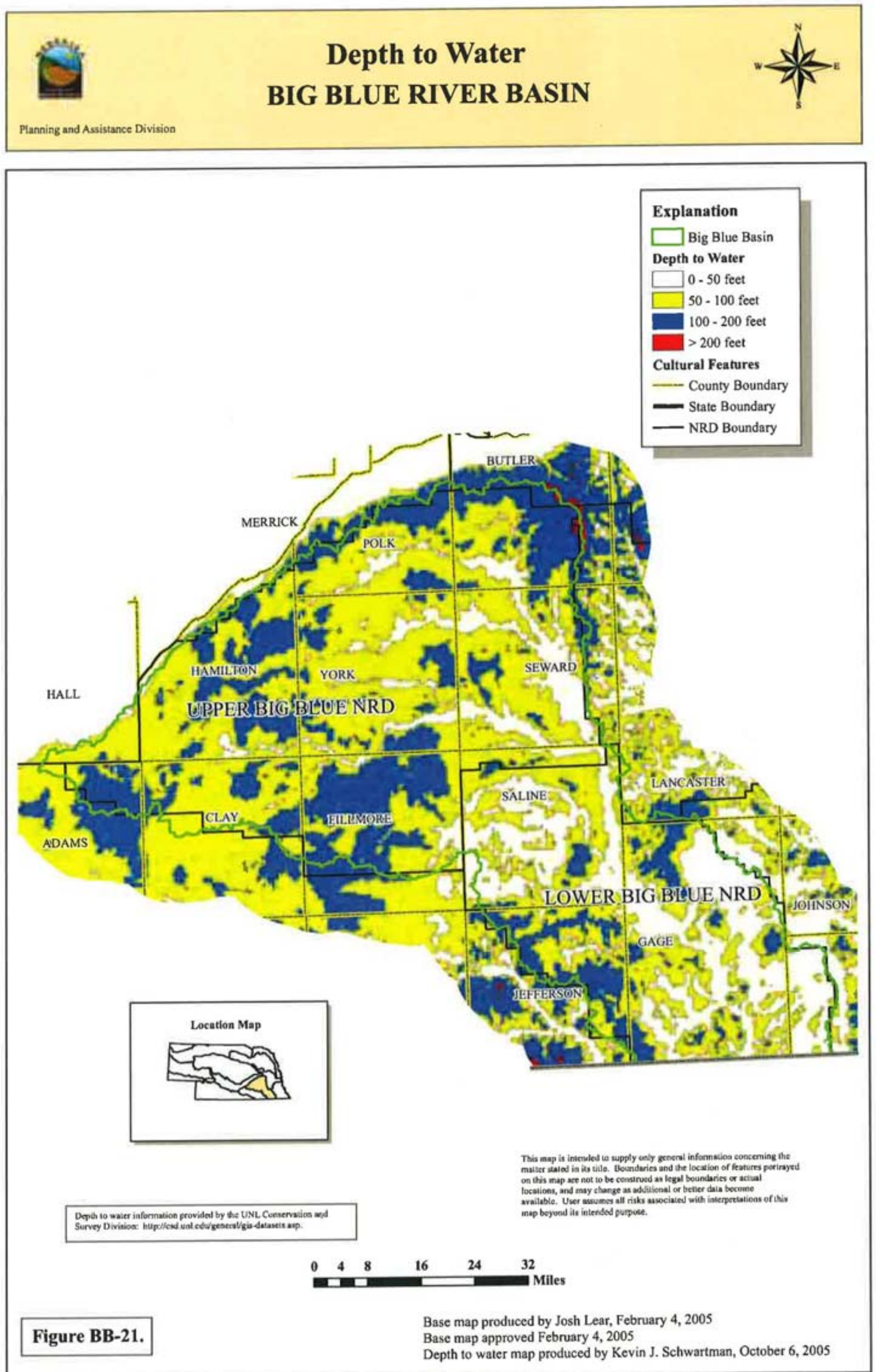


Figure BB-20.

Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Saturated thickness map produced by Kevin J. Schwartman, October 6, 2005

BB-31



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BB-32

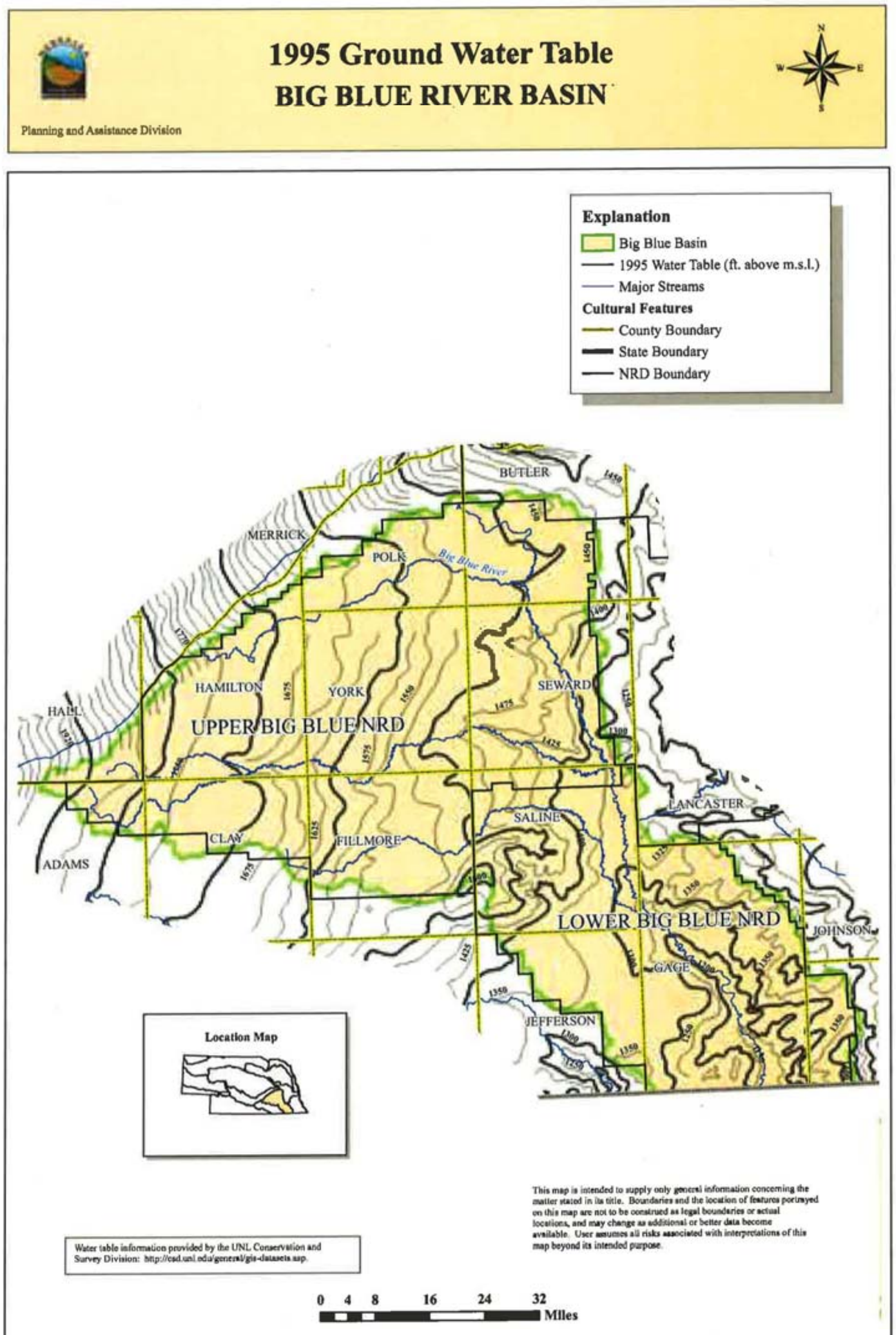


Figure BB-25.

BB-36

Lower Platte North

System	Hydrogeologic Unit	Character and Description	Maximum Thickness (feet)	Hydrogeologic Characteristics
Quaternary	Platte River Aquifer	Alluvial sand, gravel and silt deposited within incised bedrock valley of the Platte River	70	Unconfined and hydraulically connected with Platte River. Yields 900 to 2,000 gal/min of water to wells.
	Missouri River Aquifer	Alluvial sand, gravel and silt deposited within incised bedrock valley of the Missouri River	80	Wells generally yield 300 to 700 gal/min, and locally yield as much as 1,500 gal/min.
	Paleovalley Alluvial Aquifers	Fluvial silt, sand, gravel and clay deposits within bedrock valleys. Commonly underlying thick fine-grained deposits of glacial till and loess	275	May yield 400 to 1,200 gal/min of water to wells
	Loess	Silt with a little very fine sand and clay deposited as wind-blown dust	Unknown	May provide small amounts of water to shallow stock or domestic wells.
	Till	Ice deposited silty, sandy clay with some gravel, pebble and cobbles	Unknown	Relatively impermeable, but may contain small perched groundwater or sand deposits that yield water to small capacity wells.
Tertiary	Ogallala Group	Gravel, sand, silt, clay, with some lime-cemented beds	0-200	Not an important source of water in the Lower Platte River Basin
Cretaceous	Dakota Sandstone	Massive to crossbedded friable sandstone interbedded with clayey to slightly sandy shales.	<140	Wells can yield 50 to 750 gal/min of water to wells. Water is of variable quality. Used as a primary water source only when other sources are not available.

Source: Modified from NDNR, 2005

Planning and Assistance Division

Saturated Thickness
LOWER PLATTE RIVER BASIN

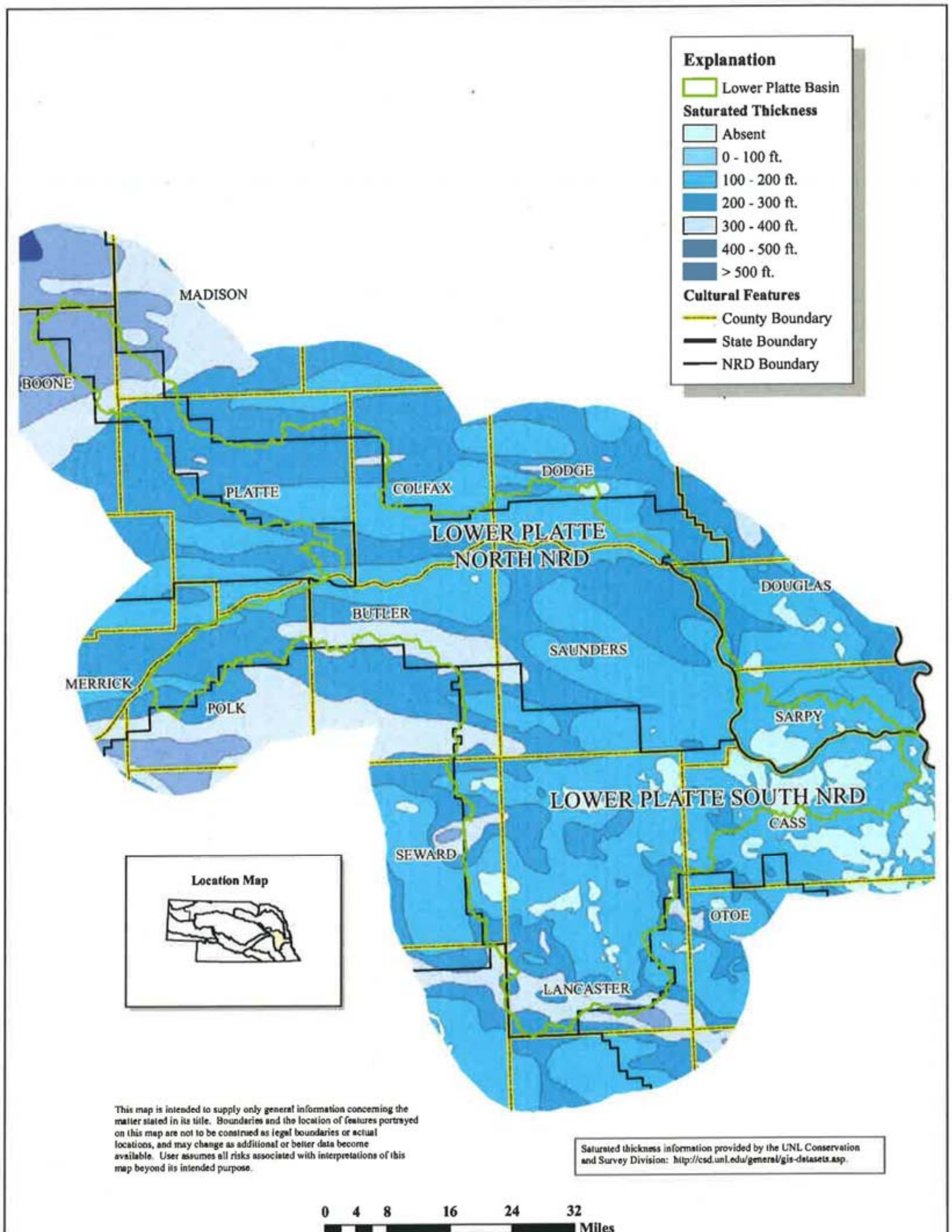


Figure LP-16.

Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Saturated thickness map produced by Kevin J. Schwartman, October 12, 2005

LP-27

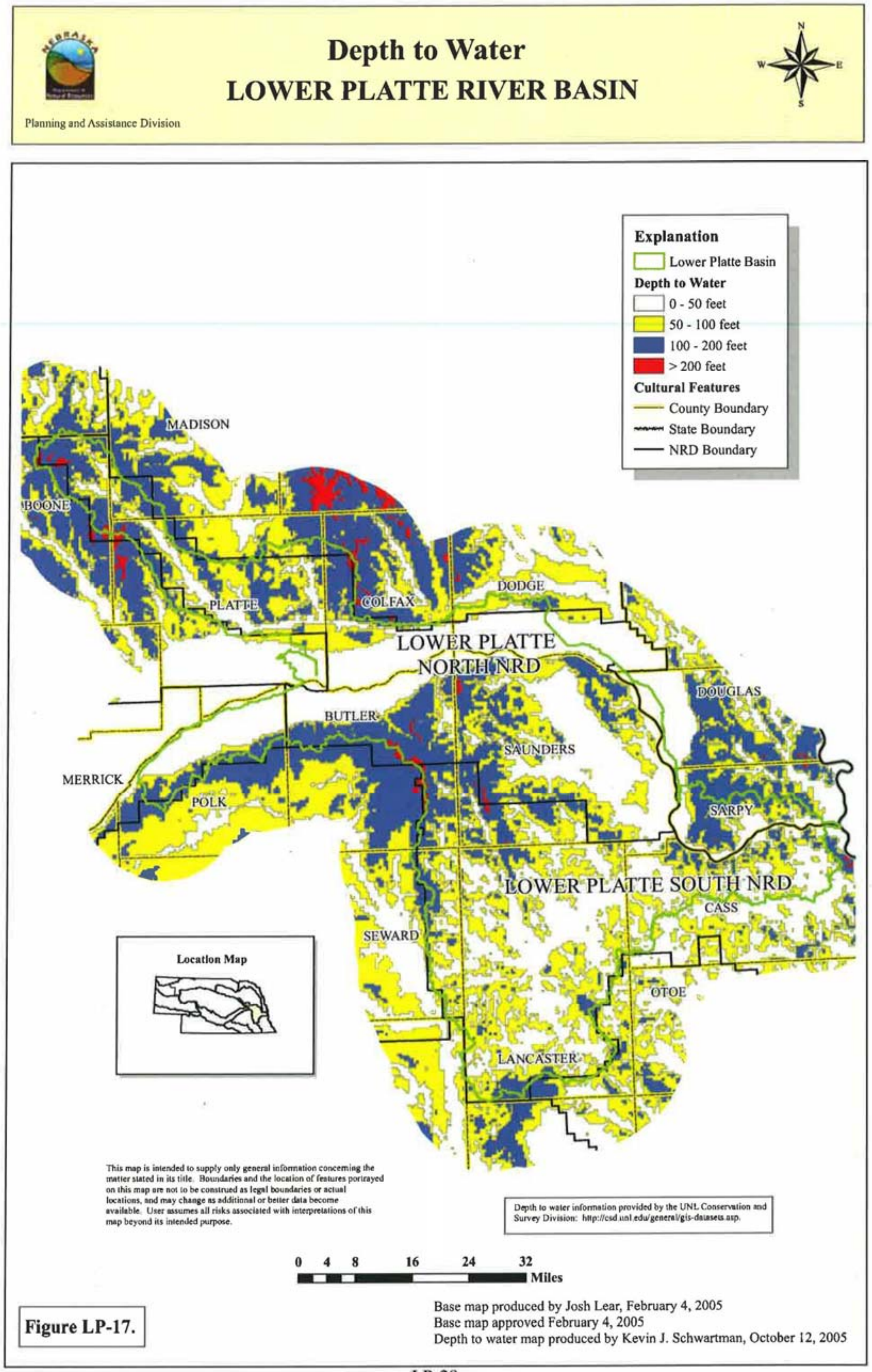
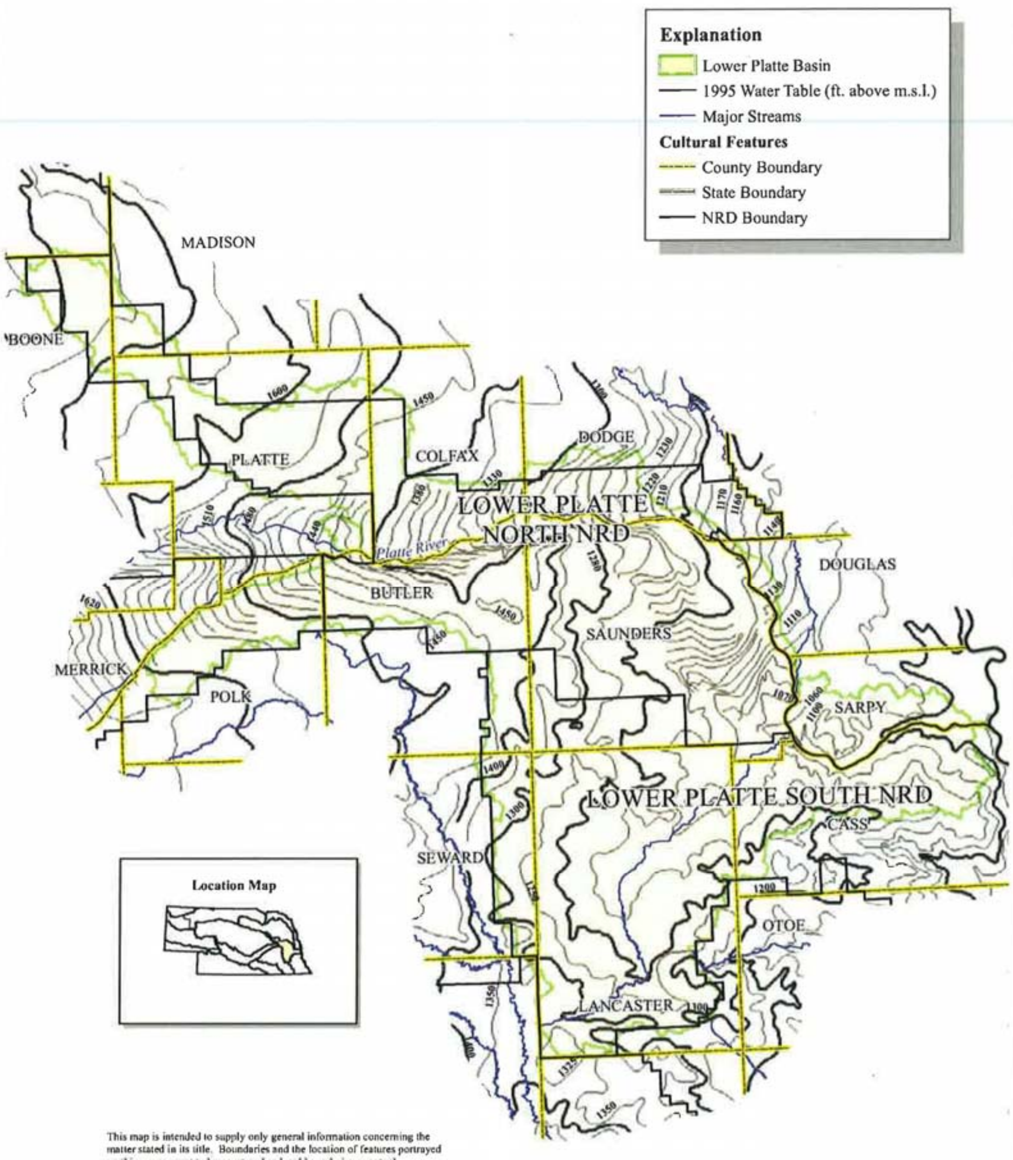


Figure LP-17.

LP-28

1995 Ground Water Table
LOWER PLATTE RIVER BASIN

Planning and Assistance Division



This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

Water table information provided by the UNL Conservation and Survey Division: http://csd.unl.edu/general/gis-datasets.asp

0 4 8 16 24 32 Miles

Figure LP-20.

Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Water table map produced by Kevin J. Schwartman, October 12, 2005

LP-31

References

Gutentag, E.D., Heimes, F.J., Krothe, N.C., Luckey, R.R., Weeks, J.B. 1984. Geohydrology of the High Plains Aquifer in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. U.S. Geological Survey Professional Paper 1400-B.

Nebraska Department of Natural Resources (NDNR). 2005. 2006 Annual Evaluation of Availability of Hydrologically Connected Water Supplies. December 2005.

Appendix E.4

Surface Water Technical Memorandum

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APPENDIX E.4

SURFACE WATER TECHNICAL MEMORANDUM

All waters in Nebraska are regulated, and the State Legislature has recognized the importance of water resources to the state. Although the proposed Nebraska Reroute would use water during construction, is not expected to significantly affect the quantity of water available for use. The use of water could, however, adversely affect water quality and would need to comply with applicable regulations regarding water quality and quantity.

Two agencies have regulatory authority over the state's surface water: Nebraska Department of Natural Resources (NDNR) and Nebraska Department of Environmental Quality (NDEQ). NDNR has jurisdiction over all matters pertaining to surface water rights for storage, irrigation, power, manufacturing, instream flows, and other beneficial uses. NDEQ is responsible for protecting Nebraska's air, land, and water resources. The information contained in this section is based on data obtained from publicly available sources associated with these two agencies and with TransCanada Keystone Pipeline, LP (Keystone).

> Surface waters in Nebraska include all streams, lakes, ponds, impounding reservoirs, marshes, wetlands, watercourses, waterways, springs, canal systems, drainage systems, and all other bodies or accumulations of water, natural or artificial, public or private, situated wholly or partly within or bordering upon the state.

E.4.1 EXISTING CONDITIONS

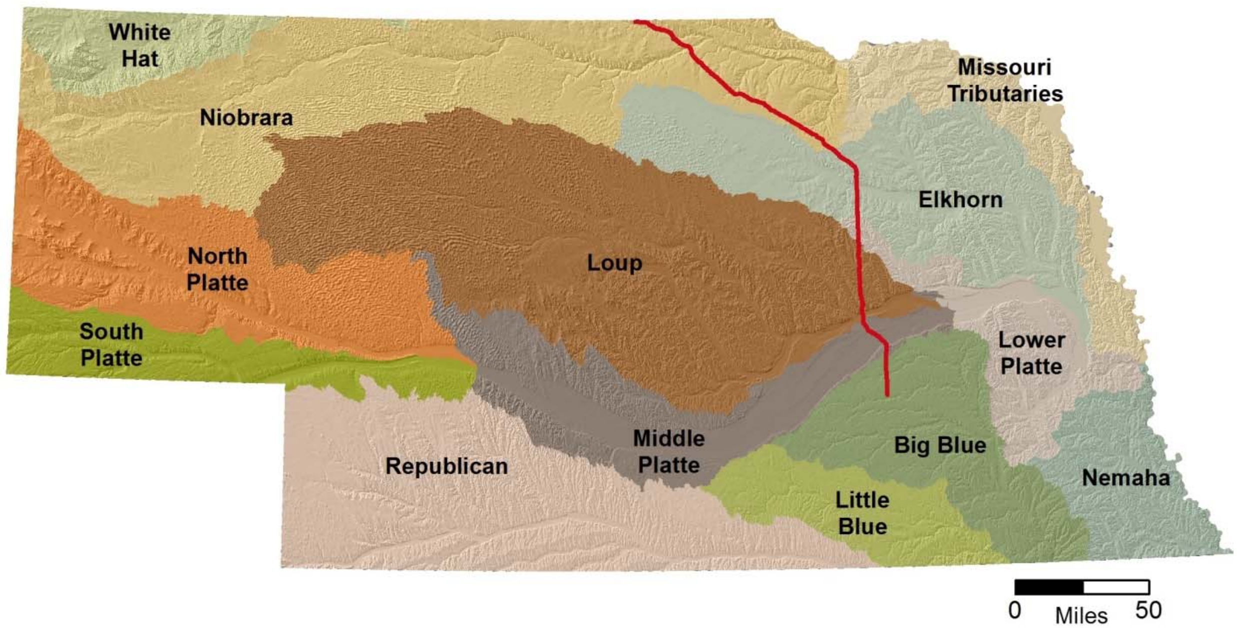
The proposed Nebraska Reroute would cross six major river basins (listed from north to south):

- Niobrara
- Elkhorn
- Lower Platte
- Loup
- Middle Platte
- Big Blue

A river basin (also known as a watershed) is an area that contributes surface water from precipitation to a river. Figure E.4-1 shows Nebraska's major river basins (NDEQ, 2012a).

Surface waters in Nebraska include "all streams, lakes, ponds, impounding reservoirs, marshes, wetlands, watercourses, waterways, springs, canal systems, drainage systems, and all other bodies or accumulations of water, natural or artificial, public or private, situated wholly or partly within or bordering upon the State. Impounded waters in this definition do not include areas designated by [NDEQ] as wastewater treatment or wastewater retention facilities or irrigation reuse pits" (Nebraska Administrative Code, Title 117, Chapter 1).

Figure E.4-1. Nebraska's Major River Basins



Note: The red line shows the proposed Nebraska Reroute.

Attachment B contains a map book showing surface waters that would be crossed by the Nebraska Reroute. Streams or rivers listed in Title 117 of the Nebraska Administrative Code are shown in the map book as solid lines, while dashed lines denote all other streams.

Surface waters identified in Title 117 are categorized as "designated" stream segments. Designated stream segments are categorized and have assigned beneficial uses based on their classification. A beneficial use is "[a]ny productive use of surface water for which water quality is protected. Beneficial uses include, but are not limited to, agricultural, industrial, and public water supplies; support and propagation of fish, and other aquatic life; recreation in and on the water; and aesthetics" (Nebraska Administrative Code, Title 117, Chapter 1).

Title 117 standards apply at all times to all surface waters of Nebraska, with some exceptions. Beneficial uses are assigned to surface waters within or bordering the state of Nebraska. (Title 117 excerpts are included in Attachment C).

E.4.1.1 Regulations

Stream Segments

Title 117 of the Nebraska Administrative Code lists 1,558 designated stream segments and 522 designated lakes. The proposed Nebraska Reroute would cross 163 stream segments, of which 30 are designated stream segments (leaving 133 stream segments that are not listed in Title 117 and, therefore, are undesignated stream segments). Generally, streams that are not listed in Title 117 flow only in response to precipitation; they are protected for aquatic life and aesthetics beneficial uses. Aquatic life beneficial use for undesignated streams is evaluated for general aquatic life criteria and toxicity.

The beneficial uses of designated streams are:

- Primary contact recreation
- Aquatic life – coldwater Classes A and B, warm water Classes A and B
- Water supply – public drinking water, agricultural, and industrial
- Aesthetics

Primary Contact Recreation

This beneficial use applies to surface waters that are used, or have a high potential to be used, for primary contact recreational activities, which are activities where the body may be in prolonged or intimate contact with water such that water may be accidentally ingested and eyes, ears, and nose may be exposed.

Aquatic Life – Coldwater

These are waters that provide, or could provide, a habitat with sufficient water volume or flow, water quality, and other characteristics such as substrate composition that could maintain year-round populations of coldwater fish (typically trout). They are rated as one of two classes:

- Class A – provide a habitat supporting natural reproduction of a coldwater fish population, primarily a trout population
- Class B – provide, or could provide, a habitat capable of maintaining year-round populations of a variety of coldwater fish and associated vertebrate and invertebrate organisms and plants, or that support the seasonal migration of salmonids, but do not support natural reproduction of trout populations because of limitations related to flow, substrate composition, or other habitat conditions (salmonid populations may be maintained year-round if periodically stocked)

Aquatic Life – Warm Water

These are waters that provide, or could provide, a habitat with sufficient water volume or flow, water quality, and other characteristics such as substrate composition that could maintain year-round populations of warm water biota. They are rated as one of two classes:

- Class A – waters that provide, or could provide, a habitat suitable for maintaining one or more identified key species on a year-round basis
- Class B – waters in which the variety of warm water biota is presently limited by water volume or flow, water quality, substrate composition, or other habitat conditions

Surface waters shall be free of toxic substances in concentrations that result in acute or chronic toxicity. Petroleum oil is listed as a toxic substance and shall not exceed 10 milligrams per liter.

Water Supply

Public drinking water describes surface waters that serve as a public drinking water supply.

Agricultural describes surface waters that serve as a general agricultural water supply and fall into one of two classes:

- Class A – waters used for general agricultural purposes (for example, irrigation and livestock watering) without treatment

- Class B – waters where the natural background water quality limits their use for agricultural purposes (no water quality criteria are assigned to protect this use)

Industrial describes waters used for commercial or industrial purposes such as cooling water, hydroelectric power generation, or nonfood processing—with or without treatment.

Aesthetics

This beneficial use applies to all surface waters of the state. To be aesthetically acceptable, waters shall be free from human-induced pollution that results in:

- Noxious odors
- Floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits
- Occurrence of undesirable or nuisance aquatic life—for example, algal blooms

Surface waters shall also be free of junk, refuse, and discarded dead animals.

Undesignated stream segments, including drainageways above coldwater streams, are subject to certain aquatic life and aesthetics beneficial uses. Aquatic life beneficial use for undesignated streams is evaluated for general aquatic life and acute toxicity.

Table E4.C-A in Attachment C summarizes beneficial uses of stream segments along the Nebraska Reroute, as listed in Title 117.

Title 117 of the Nebraska Administrative Code also includes criteria for streams listed as State Resource Waters, which is not a beneficial use but a classification. These are waters that have special significance because they are of very high quality or have unique features that have been recognized by society. They are rated as:

- Class A – waters given special designations because they are included in state or national parks, wildlife refuges, or wild and scenic river systems
- Class B – waters with exceptionally high water quality—much higher than needed to support designated uses

No State Resource Waters are crossed by the Nebraska Reroute.

As previously discussed, the Nebraska Reroute would cross 30 designated streams and 133 undesignated streams (163 streams altogether).

The Elkhorn River has a site-specific water quality criterion for ammonia assigned for a reach just upstream of the proposed Nebraska Reroute crossing. The Platte River also has a site-specific water quality criterion for ammonia assigned for the reach at the proposed Nebraska Reroute crossing. The Niobrara River is listed as a State Resource Water for the reach from Rock Creek to the State Highway 137 bridge just upstream of the proposed Nebraska Reroute. Fifteen streams are listed as containing sensitive species. No segments are identified as a public drinking water supply. No segments are identified as having industrial beneficial uses. The aesthetics beneficial use applies to all stream segments.

Stream Condition

NDEQ evaluates designated stream segments to determine whether the uses are being met. Designated waterbodies are classified by NDEQ using five categories:

- Category 1 – all designated uses are being met
- Category 2 – some beneficial uses are being met
- Category 3 – insufficient information to determine whether uses are being met
- Category 4 – impaired, but a total maximum daily load is not needed (this category has subcategories that are explained in Attachment C)
- Category 5 – one or more beneficial uses determined to be impaired by one or more pollutants, and all of the total maximum daily loads have not been developed (also known as the Section 303[d] list)

A summary of beneficial uses and the NDEQ classification is provided for each designated stream segment in Table E4.C-B in Attachment C; the table also lists the nature of the impairment, parameters of concern, and comments or actions. Undesignated waterbodies are not assigned categories. Overall assessment categories are provided for 9 of the 30 designated stream segments in the list below:

- Category 1 segments – 1
- Category 2 segments – 1
- Category 4a segments – 3
- Category 5 segments – 4

The remaining 21 designated stream segments were not assigned an overall assessment value (thus falling into Category 3). No other categories (for example, Category 4b) were assigned to designated stream segments along the proposed Nebraska Reroute corridor.

E.4.1.2 Watersheds

The ground surface that conveys runoff from precipitation to streams is called a watershed. Generally, if pollutants are present on the watershed surface, they may be carried to streams by runoff. The map book in Attachment B shows watersheds along the proposed Nebraska Reroute. Sensitive areas near the proposed Nebraska Reroute are discussed below.

The Nebraska Land Trust holds a conservation easement near St. Edward referred to as the "Hosford Easement."[1] The northern parcel of the easement is bisected by Beaver Creek and is downstream of the confluence of an unnamed tributary that would be crossed by the proposed Nebraska Reroute. The southeastern corner southern parcel would be near but not crossed by the proposed Nebraska Reroute.

Prior to operation, Keystone would need to identify High Consequence Areas and Unusually Sensitive Areas, as defined by the Pipeline and Hazardous Materials Safety Administration

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1 The Hosford Easement encompasses approximately 546 acres in two parcels in Section 31 (Township 20 North, Range 05 West) and in Section 08 (Township 19 North, Range 05 West) near St. Edward. The proposed Nebraska Reroute corridor includes the watershed of an unnamed tributary to Beaver Creek that crosses the Hosford Easement in the extreme southeastern corner of Section 31. The other portion of the Hosford Easement is in Section 08.

(PHMSA) along the proposed Nebraska Reroute. PHMSA regulations specify required measures to prevent and mitigate the consequences of a pipeline failure that could affect High Consequence Areas (see Chapter 6, Pipeline Safety and Potential Spills).

The U.S. Department of the Interior National Park Service adopted the Niobrara Scenic River Designation Act of 1991 and amended the Wild and Scenic Rivers Act by designating 76 miles of the Niobrara River between the Borman Bridge (southeast of Valentine) to the State Highway 137 bridge north of Newport (U.S. Department of the Interior, National Park Service, 2012). The Nebraska Reroute would not cross the Niobrara River within the designated Wild and Scenic Rivers reach—it would cross the river at a point approximately 12 miles downstream of State Highway 137.

Runoff within a watershed is conveyed to streams via road ditches, swales, and other drainage ways. Open-cut construction methods would be used to install the pipeline along most of the Nebraska Reroute. Exceptions to this method include wide waterbodies and all major paved roads, primary gravel roads, highways, and railroads. Crossings at these locations would be conducted by boring beneath the waterbody, road, or railroad using a process called horizontal boring. The Nebraska Reroute would not adversely affect the operation of road ditches, swales, and other drainage ways.

E.4.1.3 Canyon Crossings and Steep Terrain

Building the Nebraska Reroute in steep terrain would necessitate use of special construction techniques to create a work platform that would facilitate excavating the trench, staging pipe material, welding pipe, lowering pipe into the trench, and backfilling the trench. The Final Environmental Impact Statement (EIS) describes (in Section 2.3.3.3) the special construction techniques proposed for steep terrain (U.S. Department of State [DOS], 2011). The restoration description in the Final EIS addresses “areas where the pipeline route crosses side-slopes” but does not address restoration where the pipeline route would cross down steep slopes at locations such as canyon crossings.

The proposed Nebraska Reroute would cross ground with slopes ranging from 20 to 40 percent and four locations with slopes greater than 40 percent (that is, a vertical change of 40 feet over a horizontal distance of 100 feet). Three locations with slopes greater than 40 percent are at stream crossings. Although steep terrain locations are at isolated locations along the Nebraska Reroute, the majority of locations with steep terrain tend to be located in the Keya River watershed. The surface slope was determined using the slope of a 10-meter-square grid based on ArcGIS data.

The surface slope information was generated using the National Elevation Database developed by the U.S. Geological Survey. It is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the lower 48 states are the primary initial source of data.

The above-described information was used to identify stream segments with valley slope ranges of 20 to 40 percent and 40 to 80 percent. The steepest locations are shown in Table E.4-1 below. There are no ground surface areas along the proposed Nebraska Reroute with slopes greater than 80 percent.

Table E.4-1. Ground Surface Areas with Steep Slopes (between 40 and 80 Percent)

Name	Subbasin	Segment Number
Upland site (not at a stream crossing) Section 25, Township 35N, Range 19W	NI3	Not applicable
Dry Creek	NI3	10200
Beaver Creek	NI3	10400
Big Sandy Creek: Spring Creek to Niobrara River	NI2	12300

E.4.1.4 Streambed Stability

Streams typically exist in one of three conditions: aggrading, degrading, or stable. Aggradation is the deposition of material on top of the streambed, while degradation is the erosion of streambed material. Scour and erosion occur in a natural stable channel; however, if this leads to degradation or aggradation, the stream becomes unstable. "A stable channel is one whose most probable river shape over time, transports the water and sediment produced by its watershed maintaining its shape without aggrading nor degrading" (Rosgen, 1996). Keystone's Supplemental Environmental Report states that increased burial depth will be used where the potential exists for significant stream scour from flooding. The locations and values of these areas are not provided nor is information provided regarding long-term aggradation or degradation of the streambed (Keystone, 2012a).

E.4.1.5 Irrigation Canals

No canals would be crossed by the proposed Nebraska Reroute. This statement is based on the National Hydrographic Data used to determine the stream crossings identified at the beginning of this section.

E.4.1.6 Floodplains

All streams have a water surface profile (flood) with a 1 percent probability of occurring annually, often called the 100-year flood (Federal Emergency Management Agency [FEMA], 2012). Some streams along the Nebraska Reroute have delineated 100-year flood limits, which are used as a planning tool and to determine rates for flood insurance. FEMA defines a Flood Insurance Rate Map as the official map of a community where FEMA has delineated both the special flood hazard area and the risk premium zones applicable to the community. Development such as pipelines can use the 100-year floodplain information to avoid locating facilities that may be susceptible to flood damage or become inaccessible during a flood. Table E.4-2 lists counties participating in the National Flood Insurance Program along the proposed Nebraska Reroute, including those with approved Flood Insurance Rate Maps (FEMA, 2012).

Table E.4-2. County Participation in National Flood Insurance Program

County	Participates in National Flood Insurance Program?
Keya Paha	No
Boyd	Yes
Holt	No
Antelope	Yes
Boone	Yes
Nance	Yes
Merrick	Yes
Polk	Yes
York	Yes

NDNR estimates the limits of the 100-year flood for some streams along the Nebraska Reroute. NDNR has used a geographic information system to map the 100-year floodplains of large, rural, unmapped areas in Nebraska. The Large Area Mapping Initiative has been coordinated with FEMA and NDNR—it is receiving funding from FEMA under the Cooperating Technical Partners program. The Large Area Mapping Initiative process and the Cooperating Technical Partners program have resulted in floodplain mapping of Nebraska counties. NDNR used digital elevation models to create cross-section information and calculated the 100-year flood elevation for the floodplain. Attachment B contains the map book of floodplains along the proposed Nebraska Reroute.

There are 12 waterbody crossings of designated streams with delineated floodplains and 36 crossings of undesignated streams with delineated floodplains.

The proposed Nebraska Reroute would cross the Niobrara River along the boundary between Boyd and Holt counties. The floodplain has been delineated for the Niobrara River at this location, but only Boyd County has adopted the delineation.

Notably wide floodplain crossings are found in the following segments of the proposed Nebraska Reroute (note that values are approximate).

- Loup River (1.2 mile)
- Prairie Creek (3.3 miles)
- Silver Creek (3.8 miles)
- Platte River (1.1 mile)

Most local jurisdictions adopt language similar to that from 44 CFR Part 59 Definitions: "Development means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, excavation, or drilling operations or storage of equipment or materials." The regulations do not distinguish between temporary and permanent development.

Table E4.C-E and Table E4.C-F in Attachment C list designated and undesignated stream segments and whether the 100-year floodplain has been delineated by FEMA or through the Large Area Mapping Initiative.

There are no levees identified on the FEMA floodplain maps along the Nebraska Reroute; however, the Nebraska Reroute may cross private levees.

E.4.2 POTENTIAL IMPACTS

The proposed Nebraska Reroute may affect surface water resources during construction, operation, and spills (see Chapter 6, Pipeline Safety, for a discussion of spills).

E.4.2.1 Construction

The construction phase is described in Chapter 2 of this Draft Evaluation Report. The following general and special techniques, described in Chapter 2, have the potential to affect surface waters:

- Construction camp
- Temporary access roads
- Clearing and grading
- Trenching
- Lowering in pipe and backfilling
- Hydrostatic testing
- Cleanup and revegetation
- Waterbody crossings
  - Horizontal directional drilling (HDD)
  - Open cut – wet
  - Open cut – dry
- Steep terrain
- Water for construction

Construction Camp

Rural Nebraska may not have sufficient temporary housing near the Nebraska Reroute to house all construction personnel. A temporary work camp may be built in Holt County to accommodate the construction workforce.

Although the need for a construction camp is not certain, this document conservatively assumes that it would be built so that potential impacts are addressed. It is assumed the construction camp site may be established on an approximately 100-acre site. Part of that area may be used as a contractor yard, while the majority would be used for housing and administration facilities. The camp would require infrastructure (including parking) and systems needed for up to 900 workers (Keystone, 2012a).

Potable water would be obtained by drilling a well where feasible. If an adequate supply could not be obtained from a well, water would be obtained from municipal sources or would be trucked to the camp. Public drinking water supply must comply with the Nebraska Safe Drinking Water Act and would require a permit from the Nebraska Department of Health and Human Services, which would also need to approve construction plans and specifications. The drinking water system must be operated by a certified operator.

Either a self-contained wastewater treatment facility would be included at the camp (if practicable) or the effluent would be sent (via pipe or truck) to a licensed and permitted publicly owned treatment works. Wastewater treated on-site would undergo primary, secondary, and tertiary treatment consisting of solids removal, bioreactor treatment, membrane filtration, and ultraviolet exposure. A site-specific National Pollutant Discharge Elimination System (NPDES) permit would be required for discharges of wastewater from a camp facility to surface waters of Nebraska. Treated sanitary wastewater would be subject to secondary treatment standards found in Title 119, Chapter 21, of the Nebraska Administrative Code. An NPDES permit application must be filed for a facility discharging domestic wastewater (NDEQ's *NPDES Combined Form 1 & 2A*).

Improvements to local roadways may be necessary to handle the higher vehicle load weight and increased traffic.

If Keystone determines that a work camp is necessary, potential arrangements would be discussed with the landowner(s) and potential local water/wastewater providers. Permits would be obtained, as necessary, based on local jurisdiction/authority. Potential water-related permits necessary for the work camp—and authorizing agencies—are listed below:

- Water supply – Nebraska Department of Health and Human Services permit
- Wastewater treatment facility – NDEQ's NPDES permit for discharge of domestic wastewater
- Stormwater – NDEQ's NPDES permit #NER110000

Access Roads

New access roads (both permanent and temporary) would be needed for entering and exiting the pipeline right-of-way (ROW) if access were not practical or feasible from adjacent public roads or railroad ROW. Prior to pipeline installation, Keystone would obtain environmental approvals from applicable agencies, and reach mutually acceptable agreements with affected landowners regarding the access route that would be used by the contractor. All construction vehicles and equipment would be confined to access roads, public roads, private roads acquired for use by Keystone, and construction ROW.

If temporary private access roads were constructed, they would be designed to maintain proper drainage and would be built to minimize soil erosion. Table E4.C-C in Attachment C summarizes beneficial uses of stream segments along the Nebraska Reroute—as listed in Title 117 of the Nebraska Administrative Code—that would be crossed by temporary access roads.

Keystone would need to include access roads as part of its U.S. Army Corps of Engineers Section 404 Permit and NPDES permit #NER110000 applications and would need to address measures to reduce potential impacts on surface waters crossed by access roads.

Watersheds

Land disturbance activities associated with construction would need to comply with requirements of NPDES permit #NER110000—General NPDES Permit Authorizing Storm Water Discharges Associated with Construction Sites, Entire State of Nebraska. This permit authorizes discharge of certain pollutants associated with construction activity into waters of the state (NDEQ, 2008a).

Construction activity that disturbs more than 1 acre must obtain coverage under NPDES permit #NER110000. A key component is a site-specific stormwater pollution prevention plan (SWPPP) which has two major requirements:

- Identify potential sources of pollution attributable to stormwater discharges associated with on-site construction activity.
- Implement appropriate measures to prevent or reduce stormwater discharges to ensure compliance with the terms and conditions of the NPDES permit.

A SWPPP must be developed in accordance with sound engineering practices, must be developed specific to the site, and must identify allowable sources of nonstormwater discharges (NDEQ, 2008b).

Land disturbance activities on linear construction projects pose challenges when selecting and installing erosion and sediment control best management practices (BMPs). The long and narrow project alignment often transects slopes, such that surface water from undisturbed surfaces beyond the project limits would run onto the project site at multiple locations (called run-on). Run-on should be diverted so that it does not mix with silt-laden runoff and increase the volume of on-site runoff that must be handled by BMPs. BMPs would need to be located and properly installed to ensure maximum effectiveness. Keystone has committed to avoid or reduce impacts by implementing a Construction, Mitigation, and Reclamation Plan (CMRP). The CMRP prescribes construction, operation, and maintenance procedures that are designed to reduce the likelihood and severity of impacts along the Nebraska Reroute.

Potential impacts from project activities may include transferring waterborne invasive species and vectors (for example, purple loose strife, zebra mussels, viral hemorrhagic septicemia, Eurasian milfoil) from watershed to watershed by construction equipment such as pumps, hoses, piping, intake baskets, splash pups, test manifolds, and other equipment that might come into contact with surface waters.

Stream Segments

Construction activities associated with the proposed Nebraska Reroute would not be allowed to adversely affect beneficial uses of surface waters. Each proposed surface water crossing along the proposed Nebraska Reroute corridor must be evaluated, and a plan would be prepared to avoid adversely affecting beneficial uses.

Construction activities might temporarily interrupt downstream water flow. Doing so might interfere with existing water rights, or adversely affect beneficial uses. Existing water rights are regulated, and records are maintained by NDNR. Keystone would identify water rights that may be affected by temporary interruptions of water flow and demonstrate that temporary interruptions to surface water flows would not adversely affect designated beneficial uses.

Construction Techniques for Waterbody Crossings

Specialized construction techniques are typically used at waterbody crossings. The following descriptions of special construction techniques were provided in Appendix L, Waterbody Crossings, of the *Keystone XL Project: Construction, Mitigation, and Reclamation Plan* (Keystone, 2012b):

- **Open cut – dry** (nonflowing open cut): This crossing method would be used for all crossings (for example, ditches, gullies, drains, and swales) with no perceptible flow at the time of construction. An optional temporary vehicle crossing would be constructed, if needed. If conditions change and water is flowing at the time of construction, one of the other stream crossing methods would be used. BMPs applicable to this crossing method would need to be included in the SWPPP submitted with NPDES permit #NER110000.
- **Open cut – wet** (flowing open cut): This crossing method would be used for waterbody crossings if water is flowing at the time of construction. BMPs applicable to this crossing method would need to be included in the SWPPP submitted with NPDES permit #NER110000.
- **Flume – dry**: This crossing method would include a flume that extends from upstream of the pipe trench to downstream of the temporary equipment bridge that is sized to pass 1.5 times the flow measured at the time of construction to allow for sudden precipitation and associated runoff. Impervious dams would be placed at each end of the flume, and the upstream dam (installed first) would seal the stream channel upstream of the pipe trench. The flume would convey flow over the pipe trench, and flow would return to the stream channel downstream of the vehicle crossing.
- **Dam and pump – dry**: This crossing method is very similar to the dry flume method except that a dam upstream and a dam downstream of the crossing would be used to isolate the excavation area from surface waters. A pump would be used to convey waterbody flow around the open trench. A sump might be excavated upstream of the upstream dam to facilitate intake, and an energy dissipater would be installed downstream of the downstream dam to provide scour protection at the discharge point. BMPs such as flume and dry-pump methods used to reduce discharge of sediment into surface waters would need to be included in the SWPPP.

Keystone would utilize a 10-foot setback from the water's edge at stream crossings. Temporary to long-term decreases in bank stability and resultant increases in total suspended solid concentrations would likely result from bank erosion as vegetation removed from banks during construction is reestablished and vehicles and equipment drive across streams without bridging.

The stream crossing details referenced above state that sediment-laden water from trench dewatering should be directed to well-vegetated upland areas with a straw bale dewatering structure or to a geotextile filter bag. Discharges to the stream may need NPDES permit (NEG671000) authorization for dewatering discharges. The primary focus of this permit is to control pollutant discharges from dewatering activities at construction excavation sites and from dewatering wells used to depress groundwater levels. NDEQ notes: "Many discharges from excavated pits and trenches have a much higher potential for containing suspended solids" (NDEQ, 2011). The NPDES permit #NER110000 application requires identification of potential nonstormwater discharges and states that nonstormwater discharges should be eliminated or reduced to the extent feasible. Each stream crossing is a location for potential nonstormwater discharges into waters of the state, and the NPDES permit #NER110000 application must include information describing the plan to eliminate or reduce nonstormwater discharges to the extent feasible for the crossing method utilized at each waterbody up to the jurisdictional limits of U.S. Army Corps of Engineers (USACE) Section 404 authorizations.

Of the 163 stream crossings identified, the Nebraska Reroute would cross 30 designated stream segments. Each designated stream segment has aquatic life listed as a beneficial use. The stream segments are classified as coldwater Class B (15), warm water Class A (6), and warm water Class B (9).

The remaining 133 stream crossings would occur on undesignated stream segments. All surface waters, however, are considered to be waters of the state, and construction activities associated with the Nebraska Reroute must not adversely affect the assigned beneficial uses.

Horizontal Directional Drilling

A brief definition of HDD is: "a trenchless construction technique, which uses guided drilling for creating an arc profile. This technique is used for long distances such as under rivers, lagoons, or highly urbanized areas. The process involves three main stages: drilling of a pilot hole, pilot hole enlargement, and pullback installation of the carrier pipe. The technique can be used in soft soils. The bore hole is supported by a bentonite drilling fluid, which avoids collapsing of the hole" (Webster's Online Dictionary, 2012).

Based on information from Keystone's Supplemental Environmental Report for the proposed Nebraska Reroute (in Section 2.1.11.1, Non-Standard Construction Procedures), HDD would be used for the Nebraska Reroute at the stream crossings listed in Table E.4-3.

Table E.4-3. Stream Segments to be Crossed using HDD Method

Stream Segment	Stream Segment Number	Perennial?	Overall Assessment	2012 Stream Classification Category	Key Species
Keya Paha River	NI3-10100	Yes	Impaired beneficial use	5	Channel catfish, largemouth bass
Niobrara River	NI3-10000	Yes	Impaired beneficial use	4a	Channel catfish, rock bass, largemouth bass, bluegill
Elkhorn River	EL4-10000	Yes	Impaired beneficial use	4a	Northern pike, channel catfish, flathead catfish, largemouth bass
Loup River	LO1-30000	Yes	Impaired beneficial use	4a	Channel catfish, flathead catfish
Platte River	MP1-20000	Yes	Impaired beneficial use	1	Channel catfish, flathead catfish

Many of these streams are identified as having key species (see Table E.4-4). Key species are identified as endangered, threatened, sensitive, or recreationally-important aquatic species.

Table E.4-4 lists additional stream segments with key species. The disturbances associated with open cut stream crossing methods (including HDD, dry flume, or dam and pump) may necessitate special pipeline construction techniques to avoid adverse impacts on beneficial uses assigned to the stream segment.

Although use of HDD techniques would avoid direct disturbance to the stream bed and bank associated with open-cut techniques, there is the potential for an accidental release of drilling fluids (also called frac-out). Release of drilling fluid in waterbodies may result in turbidity issues but not toxicity, based on this excerpt from the *Keystone XL Project, Construction, Mitigation, and Reclamation Plan*: "[d]rilling fluids and additives utilized during implementation of a directional drill [referred to as HDD in this report] shall be non-toxic to the aquatic environment" (Keystone, 2012b).

The primary ingredient in most drilling fluids is bentonite clay. Clays are defined as soil particles less than 0.005 millimeter in size (Lindeburg, 1986). Clay particles tend to stay suspended when released into flowing water. The HDD mitigation plan must outline steps Keystone would implement if an HDD crossing were to fail during construction.

Clearing would be necessary at crossings to provide a path on each edge of the ROW to facilitate placement of telemetry wires used to monitor the location of the drill head while boring the pilot hole for HDD.

Table E.4-4. Additional Stream Segments with Key Species

Stream Segment	Stream Segment Number	Perennial?	Overall Assessment	2012 Stream Classification Category	Key Species
Spotted Tail Creek	NI3-10160	No	Not assigned	3	Blacknose dace
Beaver Creek	NI3-10400	Yes	Not assigned	3	Grass pickerel, largemouth bass
Brush Creek: Headwaters to Unnamed Creek (Section 24, 32 North, 14 West)	NI2-12100	No	Not assigned	3	Blacknose dace, largemouth bass
North Branch Eagle Creek	NI2-11781	Yes	Not assigned	3	Blacknose dace
Middle Branch Eagle Creek	NI2-11780	Yes	Supported beneficial use	2	Blacknose dace, channel catfish
Redbird Creek: Headwaters to Blackbird Creek	NI2-11500	Yes	Not assigned	3	Blacknose dace

Stream Segment	Stream Segment Number	Perennial?	Overall Assessment	2012 Stream Classification Category	Key Species
South Branch Verdigre Creek: Headwaters to East Branch Verdigre Creek (Section 33, 29 North, 7 West)	NI2-10300	Yes	Not assigned	3	Blacknose dace
Big Springs Creek	NI2-10350	Yes	Not assigned	3	Blacknose dace
Beaver Creek: Rae Creek (Section 11, 21 North, 7 West) to Bogus Creek	LO1-10700	Yes	Impaired beneficial use	5	Channel catfish, flathead catfish
Prairie Creek	MP-120100	Yes	Impaired beneficial use	5	Channel catfish, largemouth bass

Canyon Crossings and Steep Terrain

Standard construction methods for installing Nebraska Reroute components on rugged terrain (such as steep slopes) would be used if the pipeline trench can be oriented perpendicular to the contour. This would allow stringing of the pipe prior to installation to be perpendicular to the slope, eliminating the need for special measures (such as cabling the welded pipe string to the slope) to prevent the pipe from rolling down the slope. If the valley slope orientation prevents this approach at a stream crossing within the Nebraska Reroute, an alternative crossing location would be selected or an alternative crossing method would be used.

Steep slopes could necessitate the use of winch lines to help vehicles and equipment ascend and descend slopes.

Where stream crossings would use the HDD technique, special considerations must be taken into account. If the adjacent valley slopes were close to the stream banks, and there is not enough room to prepare an HDD entry or exit site in the valley bottom, it may be necessary to begin and end the HDD crossing at the top of the canyon.

Construction of the Nebraska Reroute on steep valley slopes would necessitate site-specific erosion and sediment control measures to address stormwater discharge and revegetation on steep slopes, use of techniques appropriate for construction activities on steep slopes, and restoration of slopes that are stable and conform to the adjacent undisturbed steep terrain and vegetation to avoid creating discontinuities.

Streambed and Bank Stability

Trenching across the waterbody bed and banks with open cut techniques would disturb the alluvial deposits or introduce upland soils that may adversely affect stream stability. Backfill would consist of spoil excavated from the trench; slurried muck or debris would not be used because it is more susceptible to scour. At locations where excavated material would not be acceptable for use as trench backfill, imported granular material would be used. Rock riprap or biostabilization materials could be used to armor the stream banks upon completion of backfill, but no protocol for determining when armor would be used or a process to select armor is provided.

Temporary road crossings and bridges would generally remain in place until hydrostatic testing and cleanup were complete. Temporary crossings on waterbodies that are dry at the time of construction would not have flumes (Keystone CMRP, Appendix C). If flow were to occur in those waterbodies, water would accumulate upstream until the crossing were overtopped, potentially eroding all or part of the temporary crossing and resulting in streambed erosion at the downstream toe of the temporary crossing. This would increase turbidity in the stream and could adversely affect the waterbody. The SWPPP would need to include BMPs for preventing adverse affects.

Construction activities in the bed and bank of flowing streams would disturb the bed and bank soil, creating suspended sediment. Release of sediment-laden trench dewatering discharges could affect the waterbody and would need an NPDES permit (NEG671000). Sediment-laden water released when backfilling trenches through stream beds and banks may be considered a nonstormwater discharge in NPDES permit #NER110000. Nonstormwater discharges must be identified in the application and would be eliminated or reduced to the extent feasible. Additionally, pollution prevention measures for nonstormwater components of the discharge must be identified. It will be important to address sediment generation and control associated with construction activities that would disturb the beds and banks of flowing streams. With the exception of HDD crossings, the actual crossing method that would be used at a given waterbody would depend on the conditions in the U.S. Army Corps of Engineers' potential authorization under Section 404 of the Clean Water Act and conditions of the Section 401 Water Quality Certification issued by NDEQ. NPDES permit requirements apply to all disturbed areas outside the jurisdictional limits of USACE Section 404 authorizations (see Chapter 2).

Keystone has noted that "[d]esign for lateral migration will accommodate lateral movement of stream beds by installation of the pipeline at design crossing depth to at least 15 feet beyond the design lateral migration zone bed" (Keystone, 2012a). The extent of meanders bisected by the Nebraska Reroute crossing at the Elkhorn River is 5,000 feet; the minimum 15-foot setback may not be sufficient to cover a lateral migration zone of that magnitude.

Floodplains

The low-lying portions of a stream on either side of the channel are subject to flooding from seasonal storms or sudden precipitation. Construction elements such as staging areas, stream spoil stockpiles, temporary stream flow pumping facilities, temporary travel crossing flumes, temporary travel crossing bridges, and HDD entry and exit sites would be subject to flooding from sudden precipitation if located too close to streams or situated in a low-lying area. Some construction elements (such as temporary stream pumping facilities and temporary crossings) must be located in or over the channel to facilitate construction. Some construction elements (such as staging areas, spoil stockpiles, and HDD entry and exit sites), if allowed by design, can be located on higher ground to reduce potential flood hazards.

Development in floodways is required to meet more rigorous standards compared with development in floodplains. Review of the Flood Insurance Rate Maps available on the FEMA Map Service Center website indicated that no floodways are identified for the streams with delineated floodplains.

Floodplain Development Permits would be needed to construct the pipeline and any ancillary facilities within delineated floodplains. Floodplain Development Permit applications are made to the local government agency. Counties with delineated floodplains for the stream segments are identified in Table E4.C-E in Appendix E.4, Attachment C.

No permanent aboveground pipeline structures would be located in floodplains.

Water for Construction

The Nebraska Reroute would use a large amount of water during construction for dust control, for hydrostatic testing of the pipeline, and for preparation of drilling mud for HDD operations. Potential additional water uses include water application during placement of backfill or embankment and water for hydromulching operations. Additional water may be needed during restoration operations to maintain or re-establish vegetation (which could extend over several years).

The Nebraska Reroute would need to obtain water for construction from sources along the pipeline alignment. Potential sources include surface waters, groundwater, and municipal water. Use of Nebraska's surface water resources necessitates (in most cases) a surface water right from NDNR. The permit or water right is approved for a specific location, purpose, and quantity. Several river basins or segments of river basins in Nebraska have been identified by NDNR as either fully appropriated or over appropriated. For those portions of the Nebraska Reroute in a fully appropriated or over appropriated basin, Keystone would need to comply with the plan implemented to protect existing water uses in the affected basin.

The proposed Nebraska Reroute alignment in Merrick County is in the Middle Platte River basin, and has been identified as a fully appropriated basin according to NDNR (see the map book in Attachment B). Requests for new water uses in basins that have been identified by NDNR as being fully appropriated must comply with requirements of the implementation plan administered by the jurisdictional Natural Resources District (NRD). The Central Platte NRD has jurisdiction over groundwater in its NRD.

Use of Nebraska's surface water resources necessitates (in most cases) a surface water right from NDNR. Keystone would need to obtain a Permit to Appropriate Water for each proposed location, identifying the source of water, location, quantity, and when the water withdrawal is proposed. If the proposed withdrawal is in a fully or over-appropriated area, a petition must also be submitted for an application to appropriate water within a moratorium or stay area. There may be additional requirements for use of surface water and groundwater administered by NRDs in areas where NDNR has determined that the surface water resources are fully appropriated or over-appropriated. The NRDs' boundaries are generally delineated to follow watershed boundaries.

The proposed Nebraska Reroute would pass through the following NRD jurisdictions:

- Lower Niobrara
- Upper Elkhorn
- Lower Platte North
- Lower Loup
- Central Platte
- Upper Big Blue
- Lower Big Blue (for the Western Alternative)

Dust Control

Airborne dust levels would be controlled during construction with water truck applications, water sprinklers, or calcium chloride application. Use of calcium chloride application is generally limited to roadways. Sources of water used for dust control may include surface water or groundwater sources and existing municipal or industrial supplies along the Nebraska Reroute corridor. Use of water would comply with the implementation plan of the respective NRD.

Hydrostatic Testing

Hydrostatic testing involves filling a segment of pipe (approximately 30 miles—with a maximum of 50 miles—in length) with water and pressurizing the pipe to a prescribed value. Hydrostatic testing would need to comply with requirements of the NPDES permit (NEG672000) authorizing hydrostatic testing discharges to land application or to surface waters within the same drainage basin as from which it was withdrawn. NDEQ provides the following description of the discharges in its fact sheet for the NPDES permit (NEG672000):

> The primary focus of this permit is to control the pollutant discharges from hydrostatic testing activities. These discharges originate from the testing of existing and new tanks and pipelines for leakage. The primary pollutant is suspended solids. Water from a variety of sources (municipal, stream, or groundwater) is used in hydrostatic testing and will be discharged to a land application or to waters of state and excluding tribal lands within the State of Nebraska. Other pollutants that may be present in hydrostatic testing flows may be dissolved iron, total residual chlorine and total recoverable hydrocarbons. (NDEQ, 2012b)

Written authorization is also needed for hydrostatic testing when effluent discharge is within 2,500 feet of any waters of the state listed in Appendix B of the NPDES permit (NEG672000). A review of stream segments that would be crossed by the proposed Nebraska Reroute indicated that none of the stream segments are identified in Appendix B; however, during final design, Keystone would need to determine whether any stream segments listed in Appendix B of the NPDES permit (NEG672000) would be crossed.

Nebraska and Kansas have entered into an agreement to maintain minimum flows in the Big Blue River at the state line. The Big Blue River Basin Compact requires minimum mean daily flows during the period of May 1 through September 30. Nebraska is required to regulate diversion from natural flows of the Big Blue River basin by water appropriators designated since

November 1, 1968 (described as "junior") (Nebraska Revised Statute 1-115). Any water appropriation for construction activities associated with the Nebraska Reroute would be considered junior, so they must comply with the Big Blue River Basin Compact.

Horizontal Directional Drilling

Water is needed to hydrostatically test the pipe string, and prepare drilling mud used in the HDD technique. Drilling mud is disposed of following completion of the crossing operation. Entry and exit sites for HDD are often some distance from the surface water being crossed, so paths would be needed to provide access for water collection. For paths at each stream crossing using the HDD technique, Keystone would define the following:

- Corridor width and length of access path to the waterbody
- Dimensions of any workspace needed at the waterbody
- Location of workspace relative to water's edge
- Clearing and grading that might be needed to establish the routes and riparian workspace
- Size and criteria (for example, double-walled) of any fuel tanks that would be positioned at the river and how long they would be deployed
- Methods to avoid or minimize clearing and spoil disturbance
- Impacts and acreage of disturbance

The permit application for Appropriation of Water must include an estimate of the amount of water that would be used for pre-testing the HDD pipe string and mixing drilling mud.

E.4.2.2 Operation

Operation of the proposed Nebraska Reroute may affect surface waters.

Manuals and written procedures would be prepared for conducting operation, maintenance, inspection, and monitoring activities as required by Pipeline and Hazardous Materials Safety Administration regulations. This would include development and implementation of an annual Pipeline Maintenance Program to ensure integrity of the pipeline. The Pipeline Maintenance Program would include valve maintenance, periodic inline inspections, and cathodic protection readings to ensure facilities are reliable, protected, and in service. Data collected during each year of the program would inform how the following year's program is developed (see Section 2.4.1, Normal Operations and Routine Maintenance, of the Final EIS [DOS, 2011]).

The pipeline ROW would be inspected through aerial and ground surveillance to provide prompt identification of possible encroachments or nearby construction activities, ROW erosion, exposed pipe, and other conditions that could damage the pipeline or adversely affect surface waters. Aerial surveillance of the pipeline ROW would be conducted at least 26 times per year. Permanent ROW would provide access for the life of the Nebraska Reroute to support surface and aerial inspections and necessary repairs or maintenance (see Section 2.4.1, Normal Operations and Routine Maintenance, of the Final EIS [DOS, 2011]).

Watersheds

NPDES permit #NER110000 for construction activities requires that vegetation disturbed by maintenance activities would be restored immediately following completion of the maintenance activity.

Stream Segments

Removing temporary crossings may create portions of the pipeline ROW that would no longer be directly accessible from public ROW for ground surveillance.

Canyon Crossings and Steep Terrain

Removing temporary crossings may create portions of the pipeline ROW that would no longer be directly accessible for ground surveillance. Aerial surveillance would be the primary method used in canyon crossing segments.

Streambed Stability

The effects of short-term degradation include migration of existing upstream or downstream headcuts (also known as nick points), local scour during high flows, and long-term streambed degradation. The potential for development and movement of short-term and long-term stream degradation should be addressed at each stream crossing to determine whether the proposed 5-foot depth of cover for open-cut stream crossing locations is sufficient to protect the pipeline from exposure or damage.

In some cases, streams that may not be actively degrading or aggrading could be prone to lateral migration within the valley floor. The potential for lateral channel migration would be evaluated to determine the starting and ending point of greater depth of cover at stream crossings.

Stream meanders can also lead to bank undercutting and sloughing, which is problematic if a pipeline is buried in the bank.

Floodplains

Any components of the proposed Nebraska Reroute that are located in a floodplain would be subject to damage during a flood from scour, floating debris, or submergence or may be inaccessible for operation, maintenance, or monitoring during the flood. Therefore, pipeline facilities would be situated to prevent damage during flooding and to ensure accessibility during a flood.

The 100-year flood is widely used as a planning tool to reduce the hazard attributable to flooding for development in the floodplain. Those crossings shown on FEMA Flood Insurance Rate Maps have water surface elevations of the 100-year flood available for determining the location of aboveground features. NDNR has additional information on water surface elevations for the 100-year flood from its Large Area Mapping Initiative.

Pump stations and valves are aboveground features of the Nebraska Reroute that may require operation, maintenance, or monitoring during a flood. Three of the five pump station locations would be along the Nebraska Reroute, as shown in Figure 1.1-1 in Keystone's Supplemental Environmental Report (Keystone, 2012a). Potential valve locations are based on description provided in Section 2.2.2, Mainline Valves, of the Final EIS (DOS, 2011).

- No floodplain information is available for pump station 22 and nearby local roadways, located in Holt County. The site appears to be near the top of the watershed and accessible from U.S. Highway 281 by one of several routes using local roadways.
- Pump station 23 and nearby local roadways, in Antelope County, are not located in delineated floodplains if approached from the west, north, or east. Access from the south, however, would be adversely affected by flooding of the Elkhorn River.
- Pump station 24 is located between the Loup River and Prairie Creek floodplains in Nance County. While the pump station site is not shown to be in either stream's floodplain, accessibility may be limited due to widespread flooding of local roadways and highways surrounding the pump station. Access from the north and west would be adversely affected by flooding of the Loup River, which may flood Highways 14 and 22. Access from the east and south would be adversely affected by flooding of Prairie Creek or Silver Creek, which may flood Highways 14 and 92.

Keystone redesigned the Nebraska Reroute to increase the number of valves to take "into consideration elevation, population, and environmentally sensitive locations, to minimize the consequences of a release" (see Section 2.2.2, Mainline Valves, of the Final EIS [DOS, 2011]). Seven river crossings (at Keya Paha, Niobrara, Elkhorn, Loup, and Platte Rivers and at Beaver and Prairie Creeks) and all but one of the coldwater Class B stream segments are anticipated to be considered environmentally sensitive. Coldwater Class B segments, the Keya Paha River, and the southern side of the Niobrara River crossings are located in Keya Paha and Holt counties, which do not participate in the National Flood Insurance Program and do not have floodplains delineated by NDNR. These waterbody crossing locations would have intermediate valves located near the waterbody (see Section 2.2.2, Mainline Valves, of the Final EIS [DOS, 2011]). The limits of the 100-year flood would need to be determined at those stream crossings so that pipeline facilities could be properly located to avoid damage by flooding and to ensure accessibility during a flood. The floodplains of the Loup River, Prairie Creek, Silver Creek, and Platte River are more than 1 mile wide and extend to nearly 4 miles wide.

E.4.3 MITIGATION

Pipeline construction must comply with Nebraska Administrative Code Title 117, NPDES permit #NER110000, permit NEG671000, permit NEG672000, and surface water appropriation permits.

E.4.3.1 Construction Mitigation

Construction Camp

Section 4.10, Cleanup, of the *Keystone XL Project: Construction, Mitigation, and Reclamation Plan* (CMRP) (see Appendix C) addresses general procedures to restore the ROW and other disturbed areas to approximate preconstruction ground contours and to replace spoil and stockpiled material in a manner that preserves soil capability and quality to a degree reasonably equivalent to the original condition or to the condition of undisturbed land. Section 4.11, Reclamation and Revegetation, of the CMRP addresses the return of disturbed areas to approximate preconstruction uses and capabilities.

Restoration of temporary ROW will comply with NPDES permit requirements and other applicable federal, State, local, and landowners requirements. The Final EIS discusses decommissioning of the construction camp in Section 2.2.7.4, describing a two-stage process in which all infrastructure will be removed and reused, recycled, or disposed of in accordance with regulatory requirements (DOS, 2011). In addition, each site will be restored and reclaimed in accordance with permit requirements and the applicable procedures described in the CMRP.

Construction Activities

Mitigation measures for temporary surface water impacts from construction activities will be implemented in accordance with NPDES permit requirements. Many mitigation practices are listed in Appendix C of this Draft Evaluation Report; for example:

- Use of filter bags or straw bale dewatering structures for dewatering activities
- Use of dry flume and dam and pump crossing methods for certain stream crossings
- Installation of imported rock riprap, timber cribbing, and live staking reclamation methods for stream beds and banks
- Practices to ensure attainment of water quality standards for hydrostatic testing discharges entering receiving waters, in accordance with permit requirements
- Erosion and sediment control practices for areas disturbed by construction activities
- Practices to reduce erosion and sedimentation by construction quickly to reduce the duration of stream bed and bank disruption

Additional information about waterbody construction and mitigation procedures is provided in Appendix C of this Draft Evaluation Report.

E.4.3.2 Operation Mitigation

Mitigation measures for potential surface water impacts resulting from pipeline operation will be implemented in accordance with NPDES permit requirements. Many practices are listed in Appendix C of this Draft Evaluation Report; for example, use of imported rock riprap, timber cribbing, and live staking reclamation methods for stream beds and banks.

Keystone is required by PHMSA regulations to prepare manuals and written procedures for conducting operation, maintenance, inspection, and monitoring activities. As stated in Chapter 2, the pipeline ROW would be inspected through aerial and ground surveillance to provide prompt identification of possible encroachments or nearby construction activities, ROW erosion, exposed pipe, and other conditions that could damage the pipeline or adversely affect surface waters. Aerial surveillance of the pipeline ROW would be carried out at least 26 times per year. Permanent ROW would provide access for the life of the Nebraska Reroute to support surface and aerial inspections and necessary repairs or maintenance.

E.4.3.3 Spills Mitigation

Keystone's CMRP and other commitments (see Appendix C of this Draft Evaluation Report) will avoid or reduce many impacts on surface waters that occur along the Nebraska Reroute.

The potential impacts of an accidental release of crude oil from the pipeline are a major concern to Nebraskans. Keystone would be liable for all costs associated with cleanup and restoration as well as other compensations, up to a maximum of $350 million, for any release that could affect surface water, no matter what the reason.

Mitigation for surface waters affected by a potential spill will include deployment of emergency response equipment, clearing the affected riparian vegetation, removing the spill material from water and soils, replacing removed soils, replanting or reseeding the affected area, and monitoring surface water (see Chapter 6, Pipeline Safety, for a discussion of spills).

Construction impacts on surface water resources associated with hazardous liquid spills and leaks are addressed by the procedures in Keystone's Spill Prevention, Containment, and Countermeasure Plan, which would be prepared specifically for the Nebraska Reroute.

E.4.4 WESTERN ALTERNATIVE

The Western Alternative would be located within the Lower Big Blue NRD and would cross 13 waterbodies. The overall impacts to the waterbodies would be similar to those that would have occurred if the pipeline were built in the previous location.

E.4.5 REFERENCES

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Attachment A

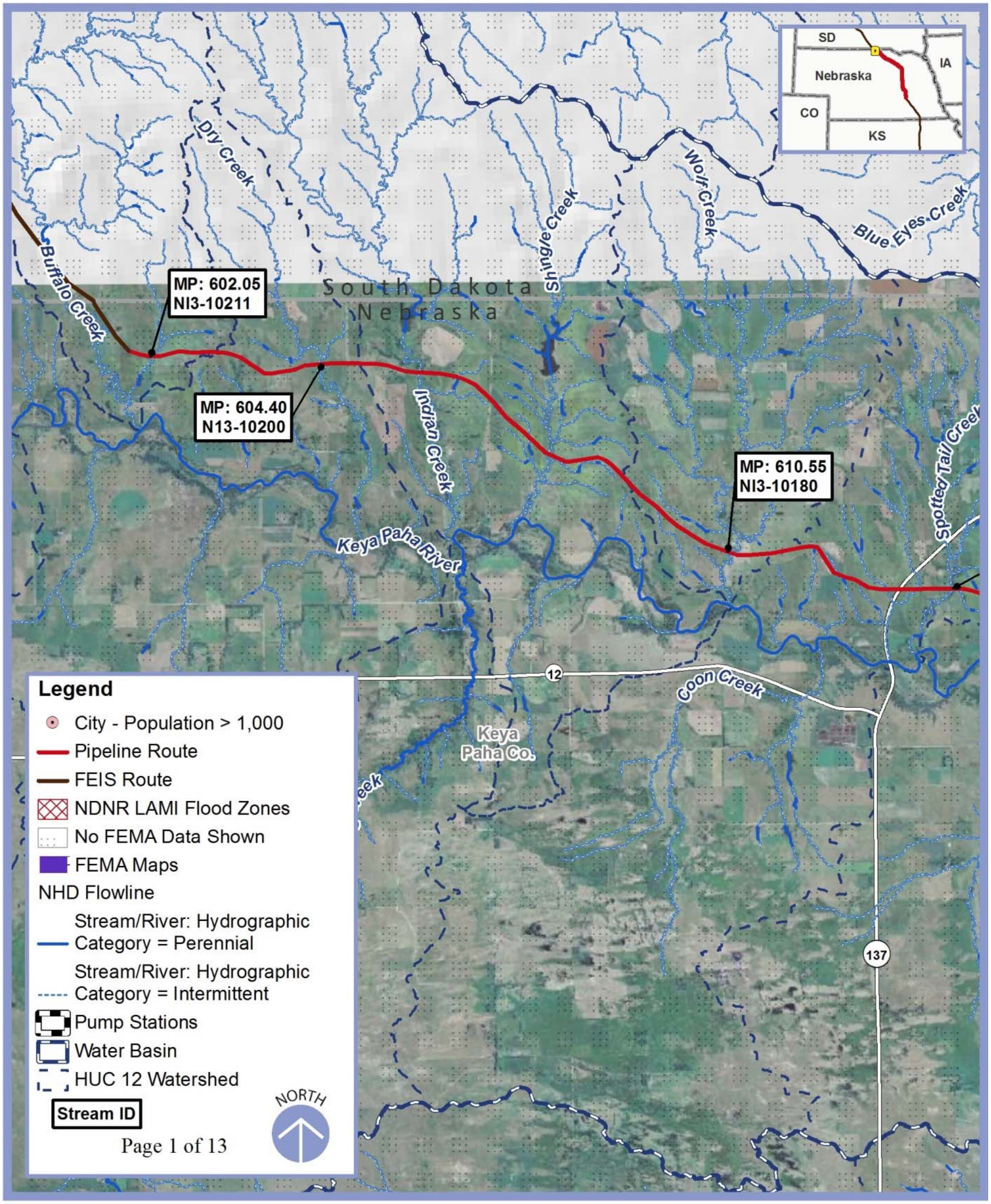
Abbreviations and Acronyms

Abbreviation or Acronym	Definition
BMP	best management practice
CMRP	Construction, Mitigation, and Reclamation Plan
DOS	U.S. Department of State
EIS	environmental impact statement
FEMA	Federal Emergency Management Agency
HDD	horizontal directional drilling
Keystone	TransCanada Keystone Pipeline, LP
NDEQ	Nebraska Department of Environmental Quality
NDNR	Nebraska Department of Natural Resources
NPDES	National Pollutant Discharge Elimination System
NRD	Natural Resources District
ROW	right-of-way
SWPPP	stormwater pollution prevention plan

Attachment B

Surface Water Map Book[2]

[2] Federal Emergency Management Agency (FEMA). 2012. "FEMA Community Status Book Report." Updated June 15, 2012, retrieved August 3, 2012. <http://www.fema.gov /cis/NE.html>."



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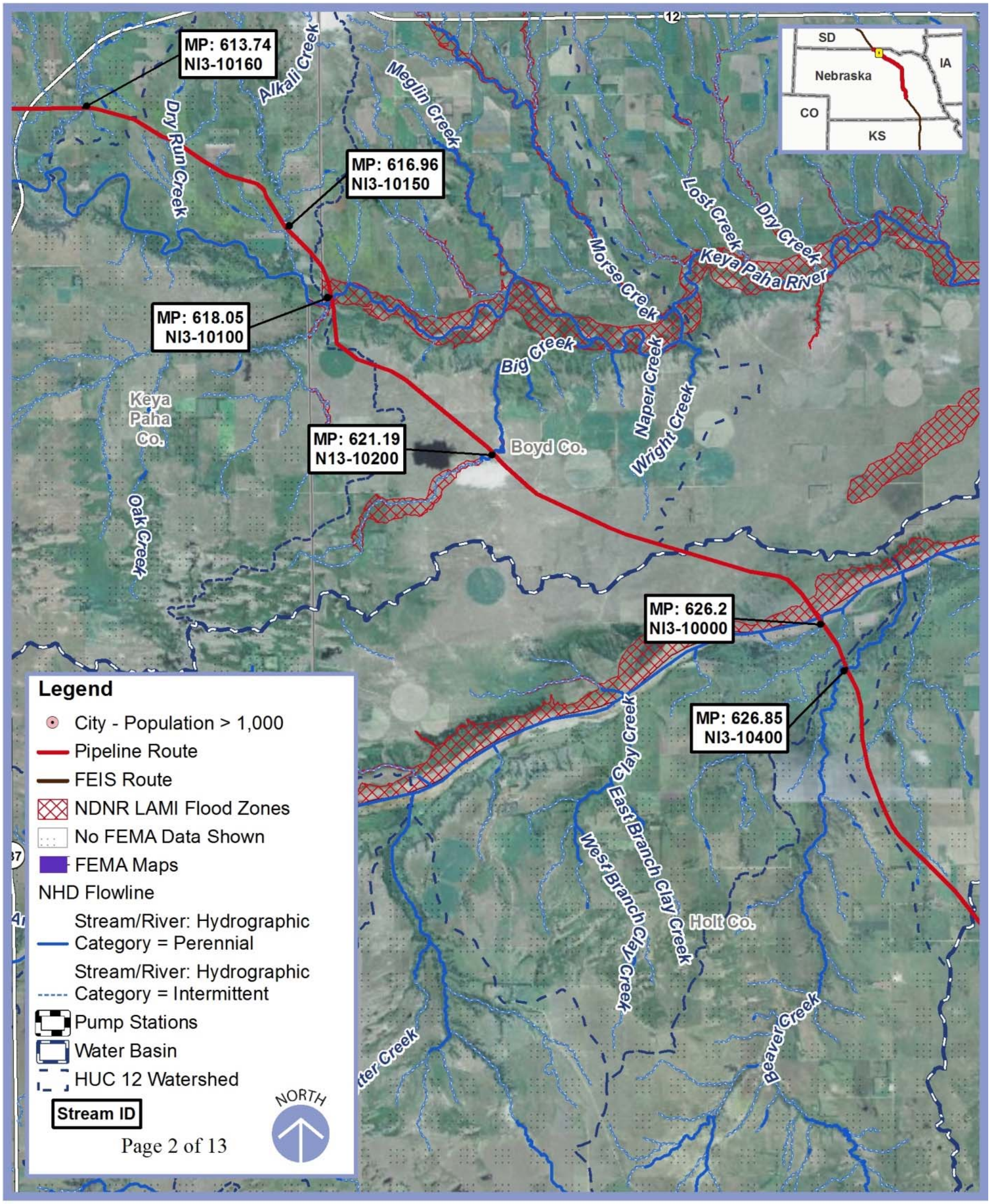

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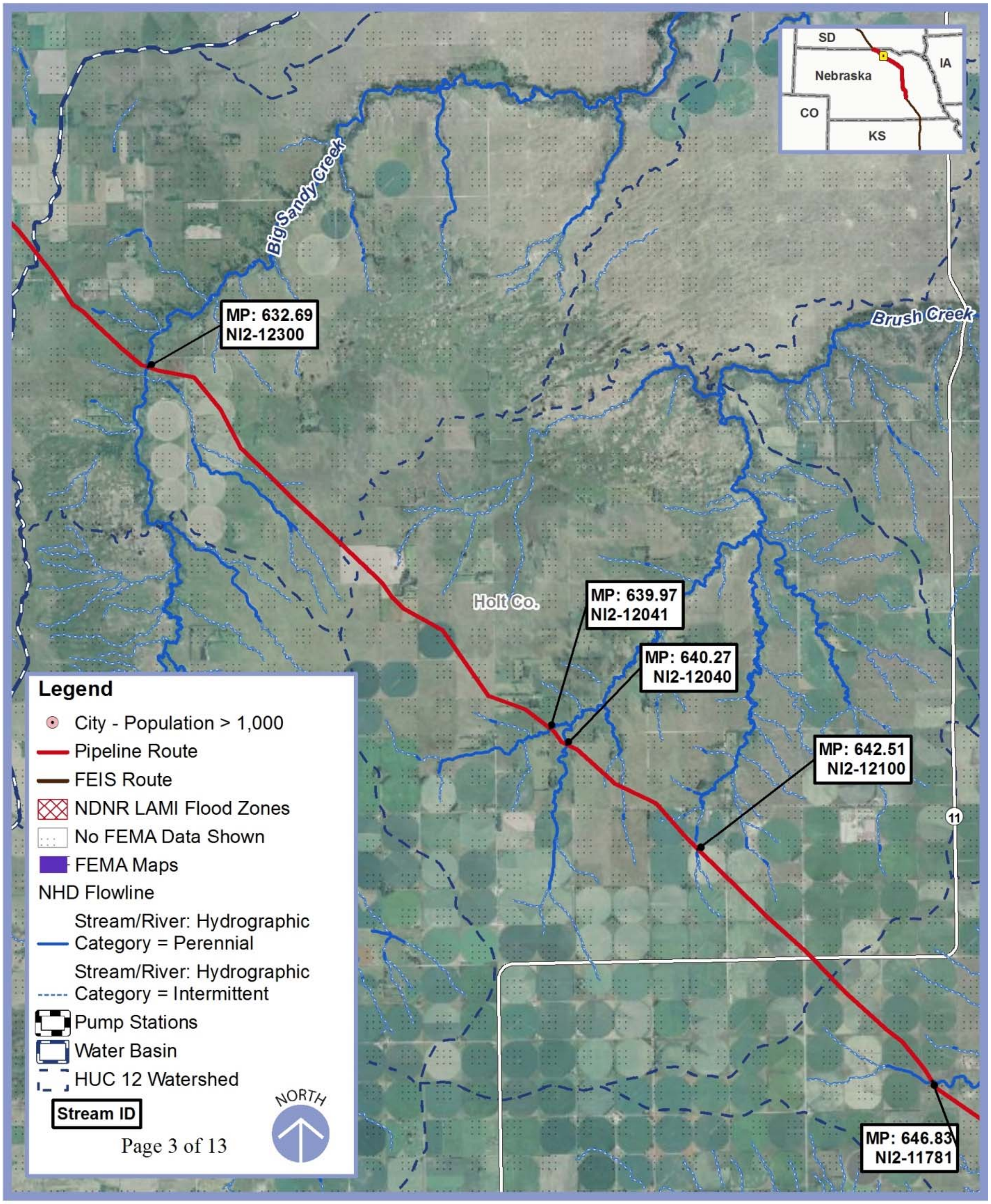

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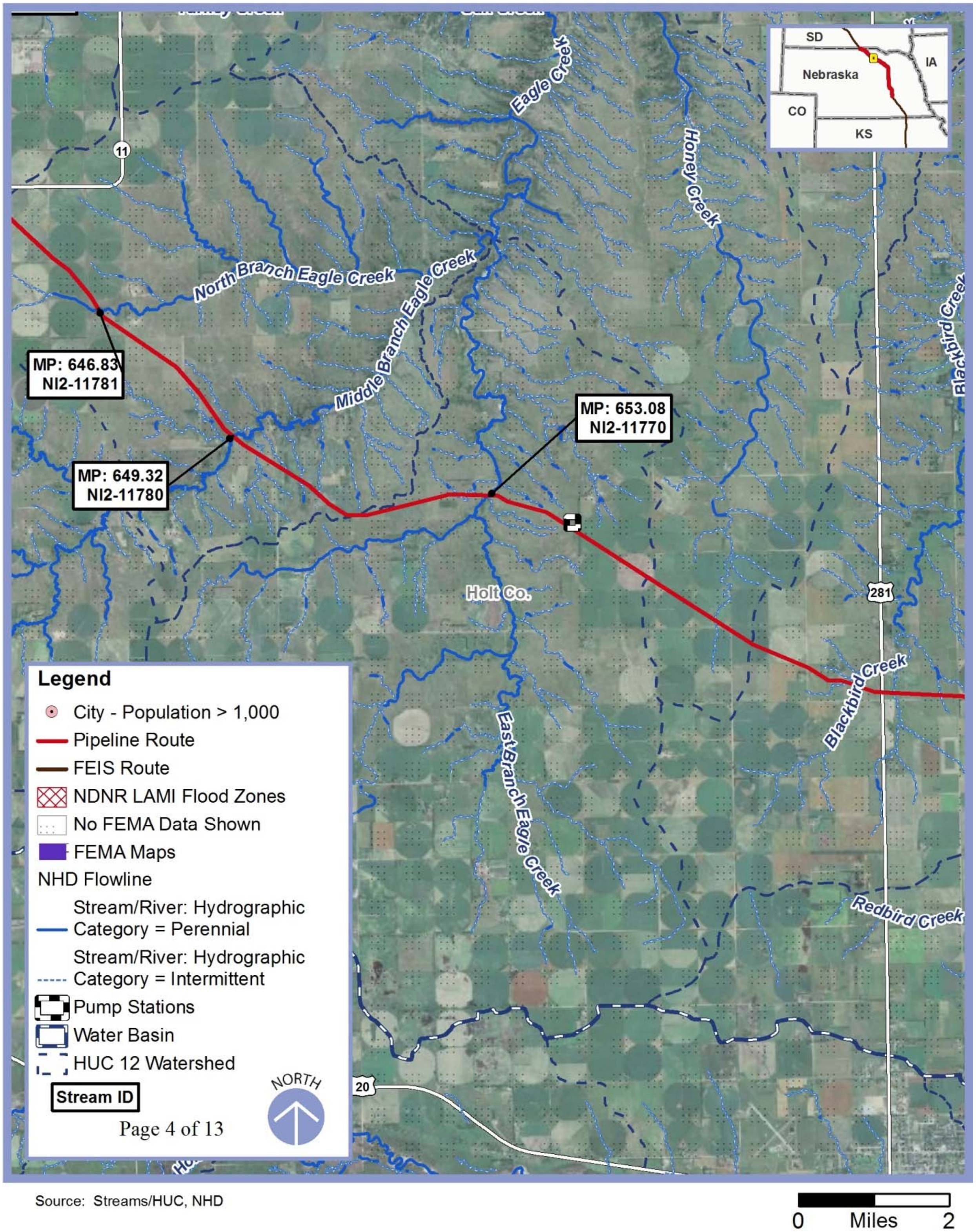

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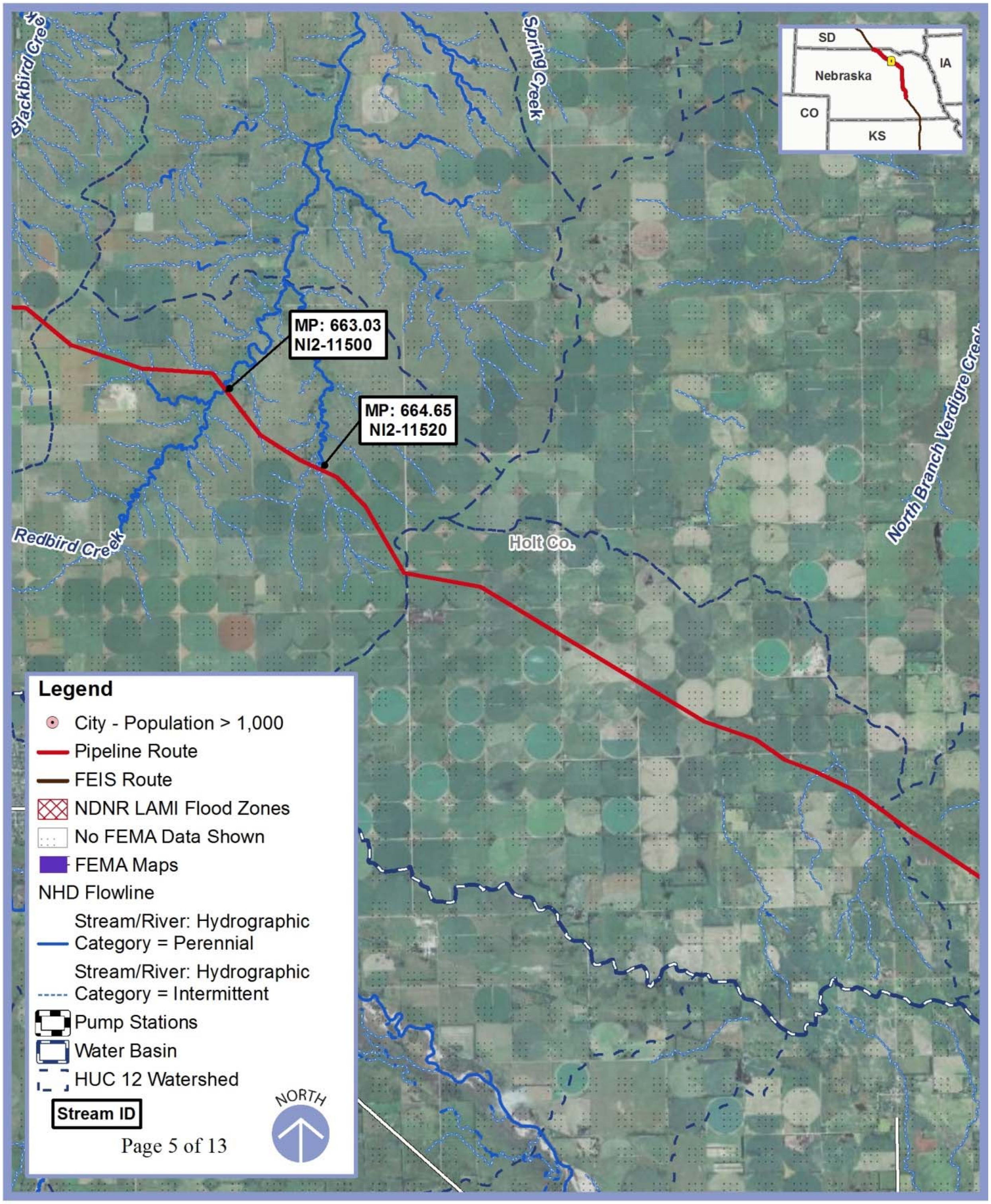

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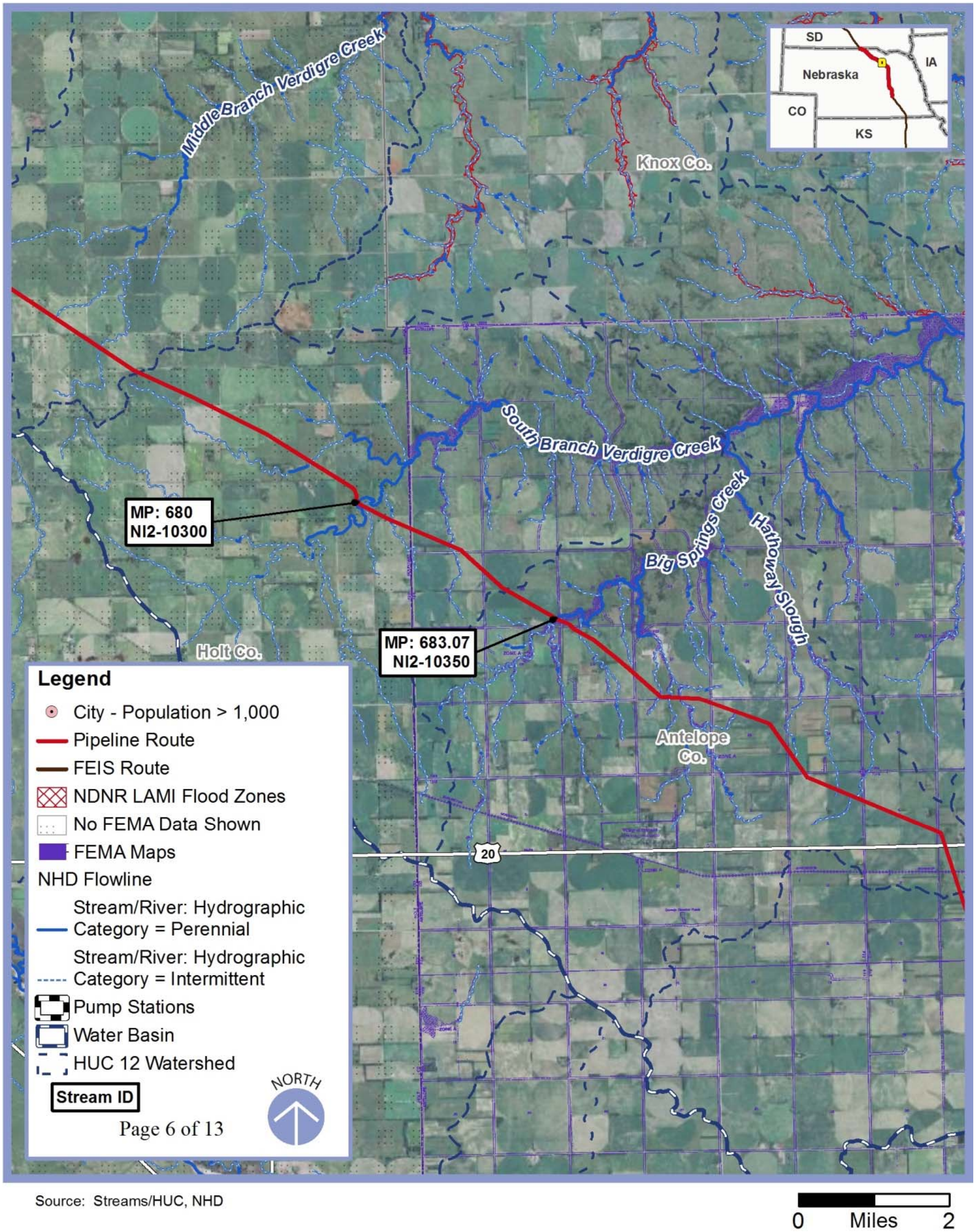

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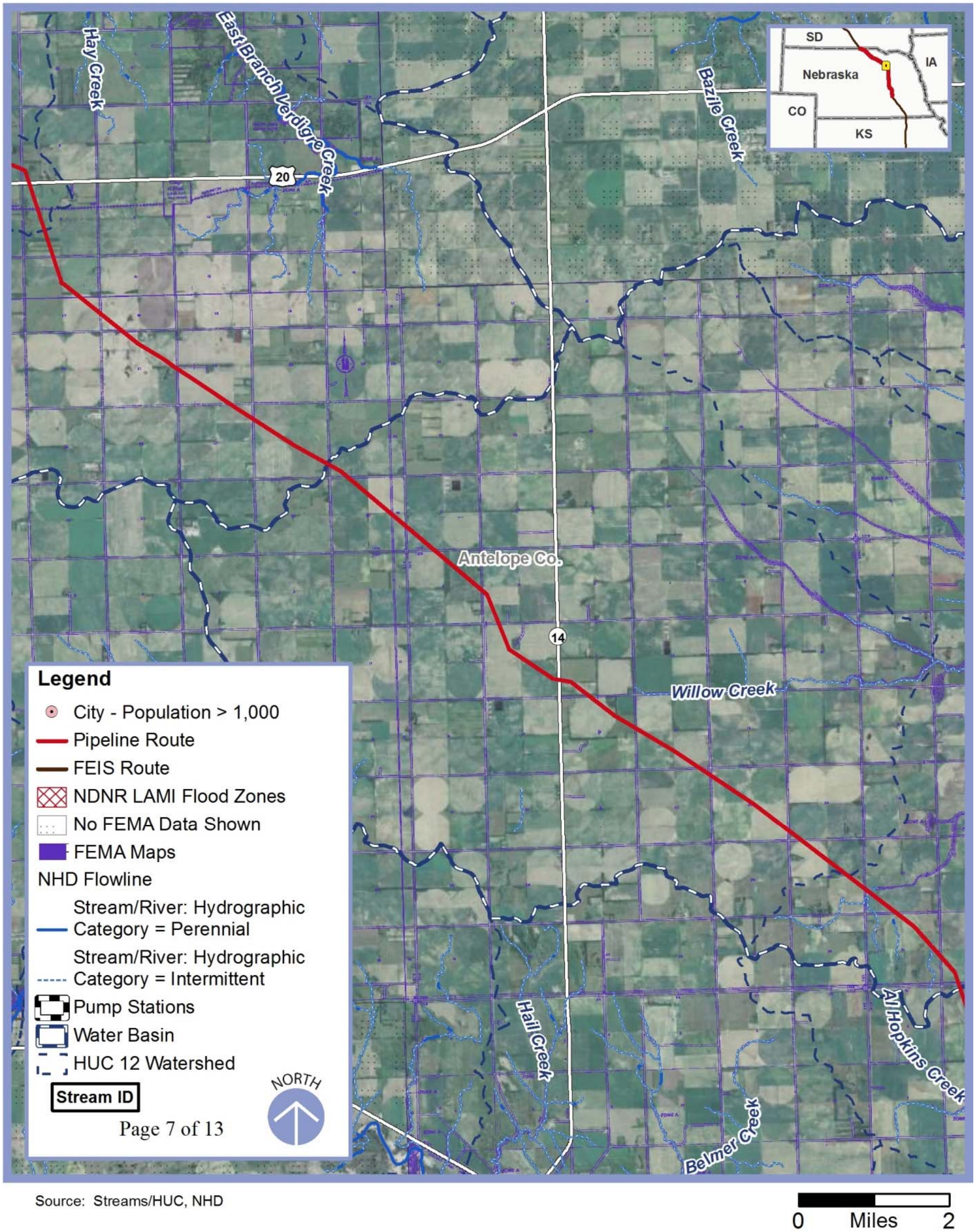

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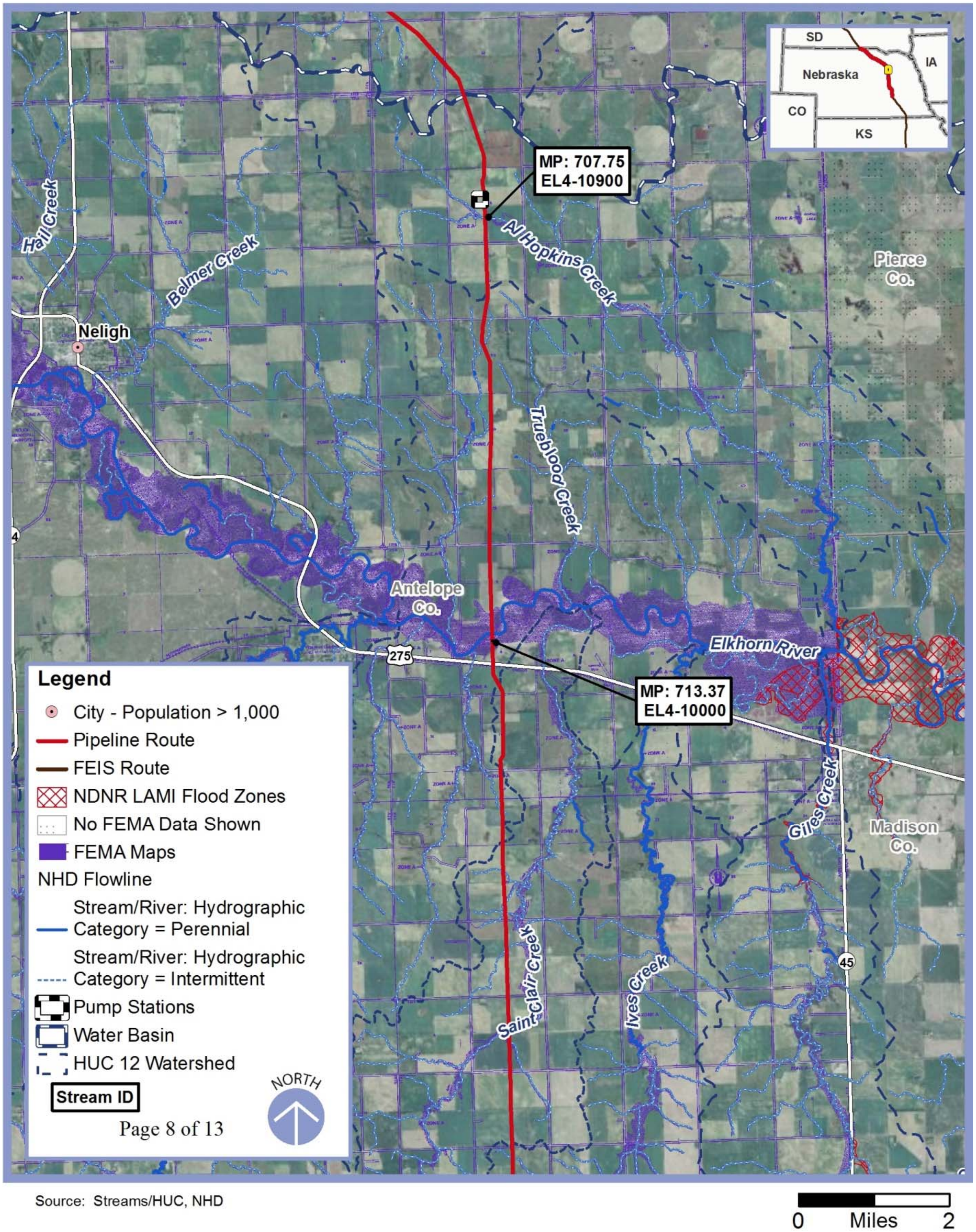

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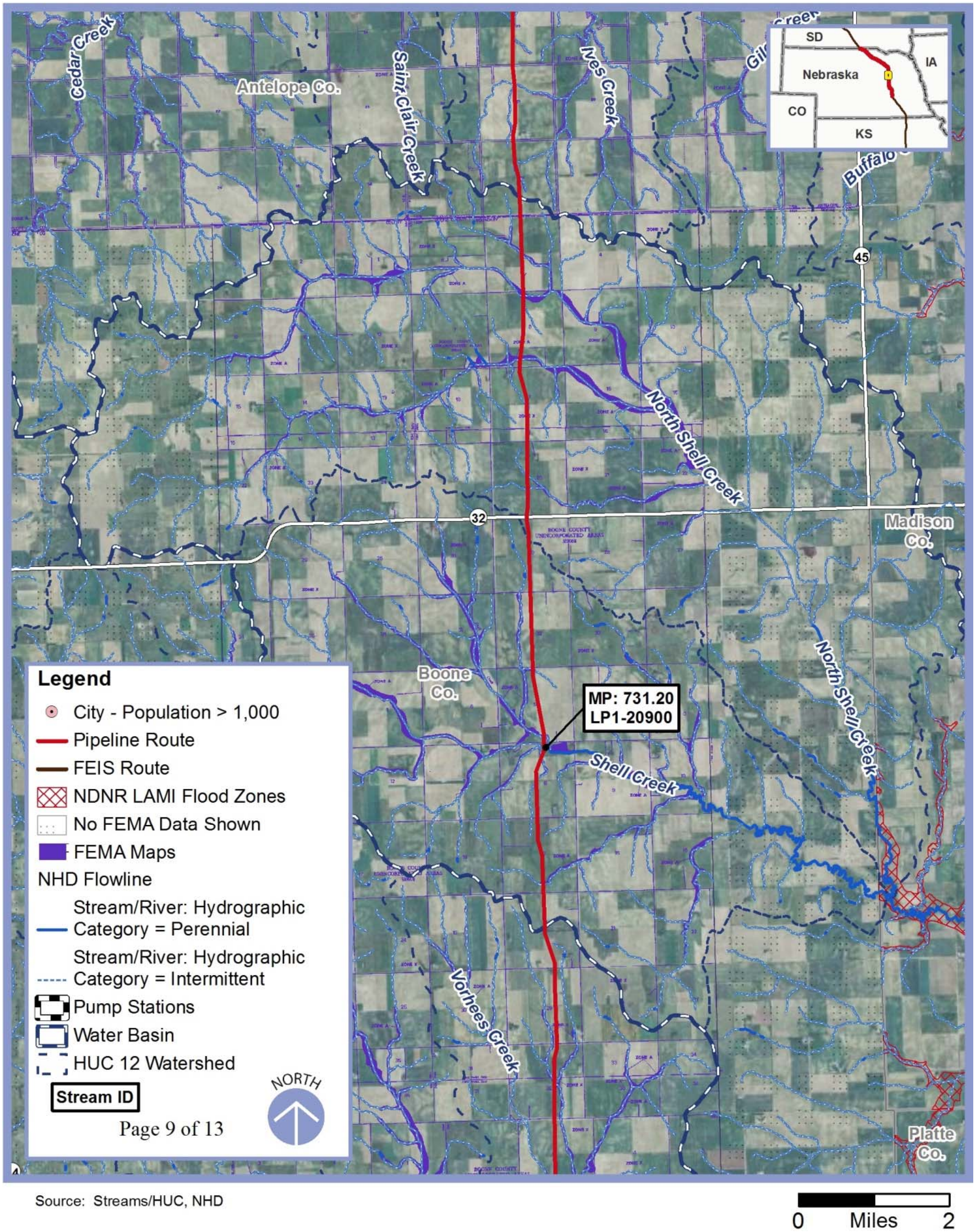

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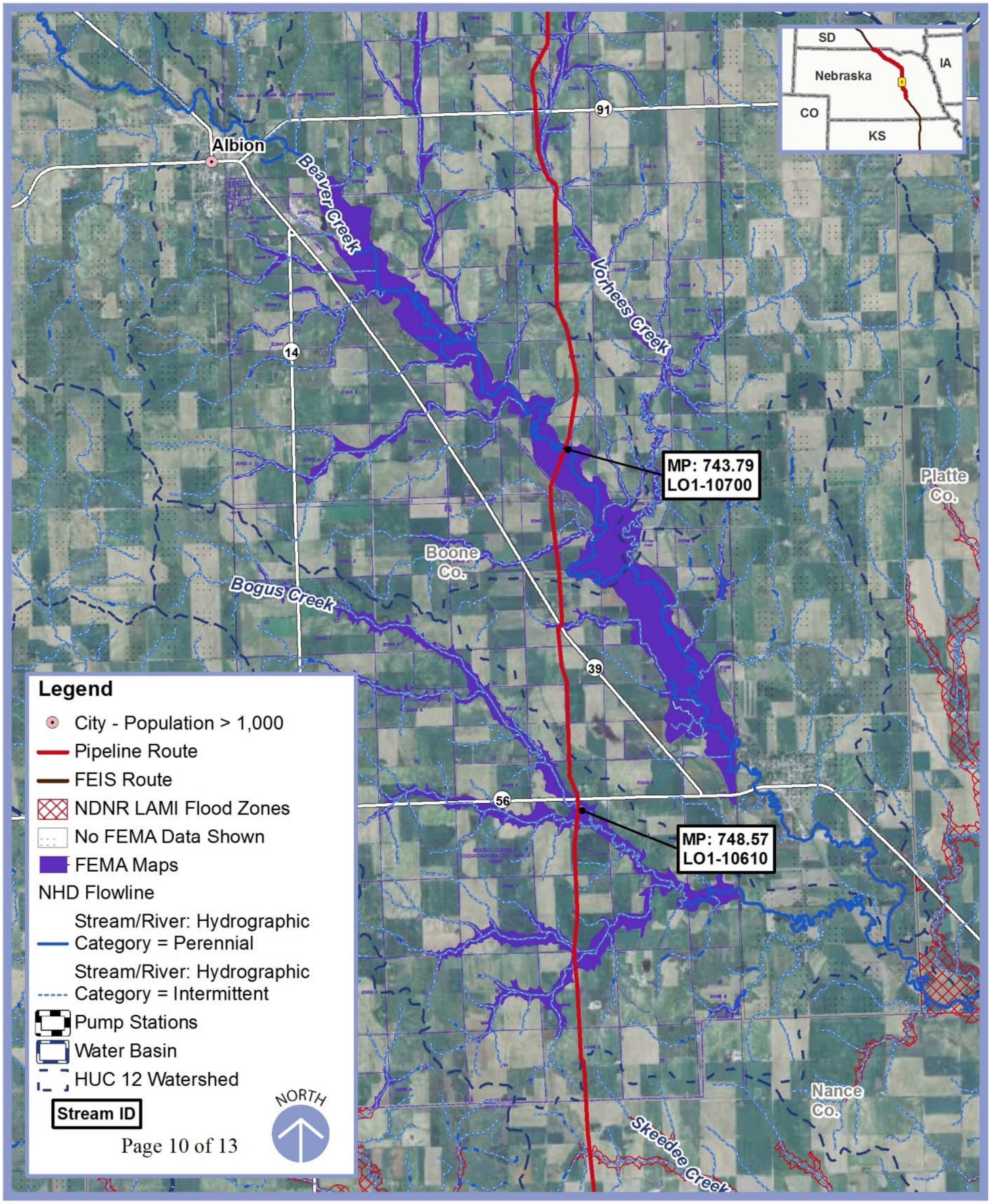

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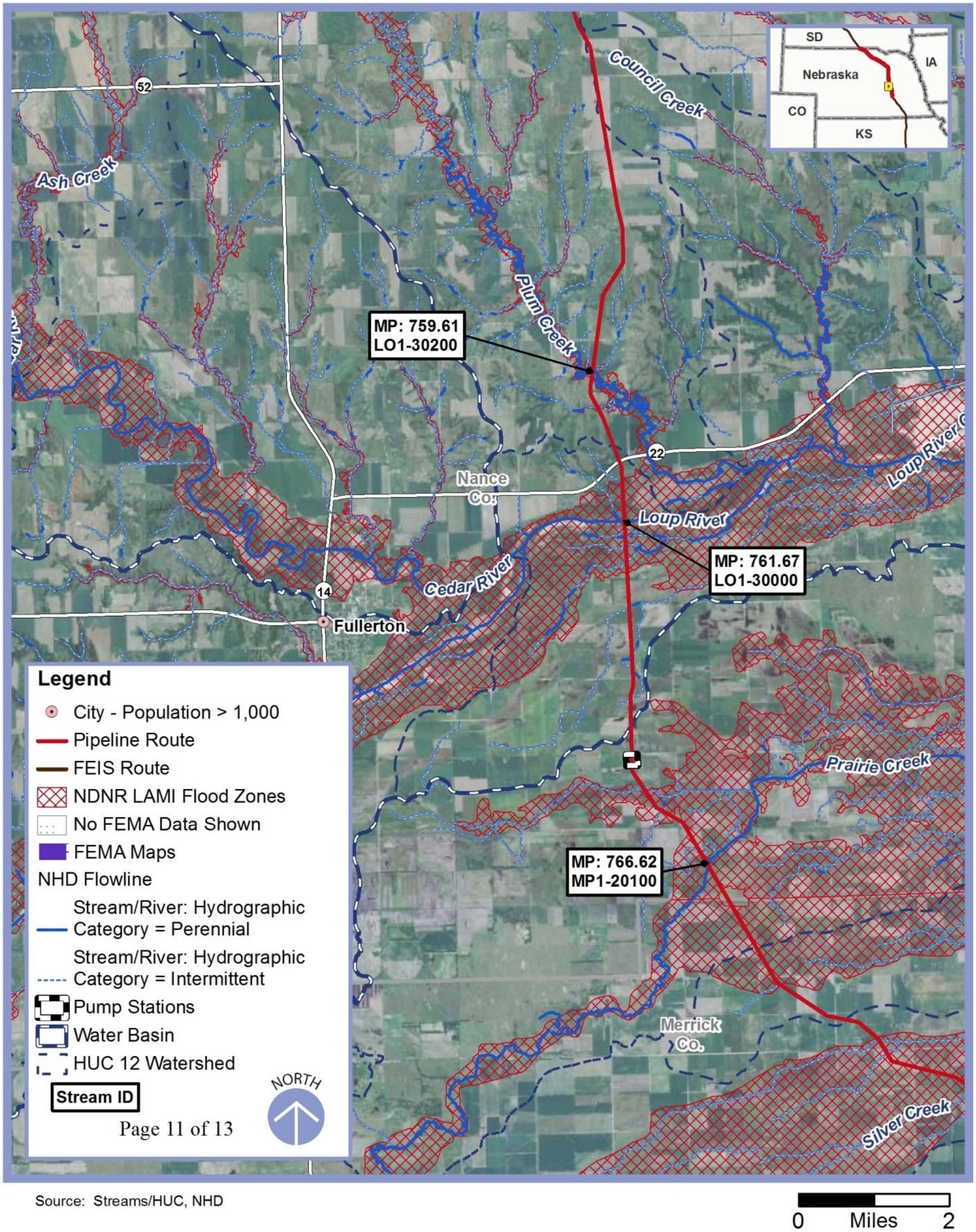
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Nebraska
IA
CO
KS
Council Creek
Ash Creek
Plum Creek
MP: 759.61
LO1-30200
Nance Co.
Loup River
Cedar River
MP: 761.67
LO1-30000
Fullerton
Prairie Creek
MP: 766.62
MP1-20100
Merrick Co.
Silver Creek
Legend
City - Population > 1,000
Pipeline Route
FEIS Route
NDNR LAMI Flood Zones
No FEMA Data Shown
FEMA Maps
NHD Flowline
Stream/River: Hydrographic Category = Perennial
Stream/River: Hydrographic Category = Intermittent
Pump Stations
Water Basin
HUC 12 Watershed
Stream ID
Page 11 of 13
NORTH
Source: Streams/HUC, NHD
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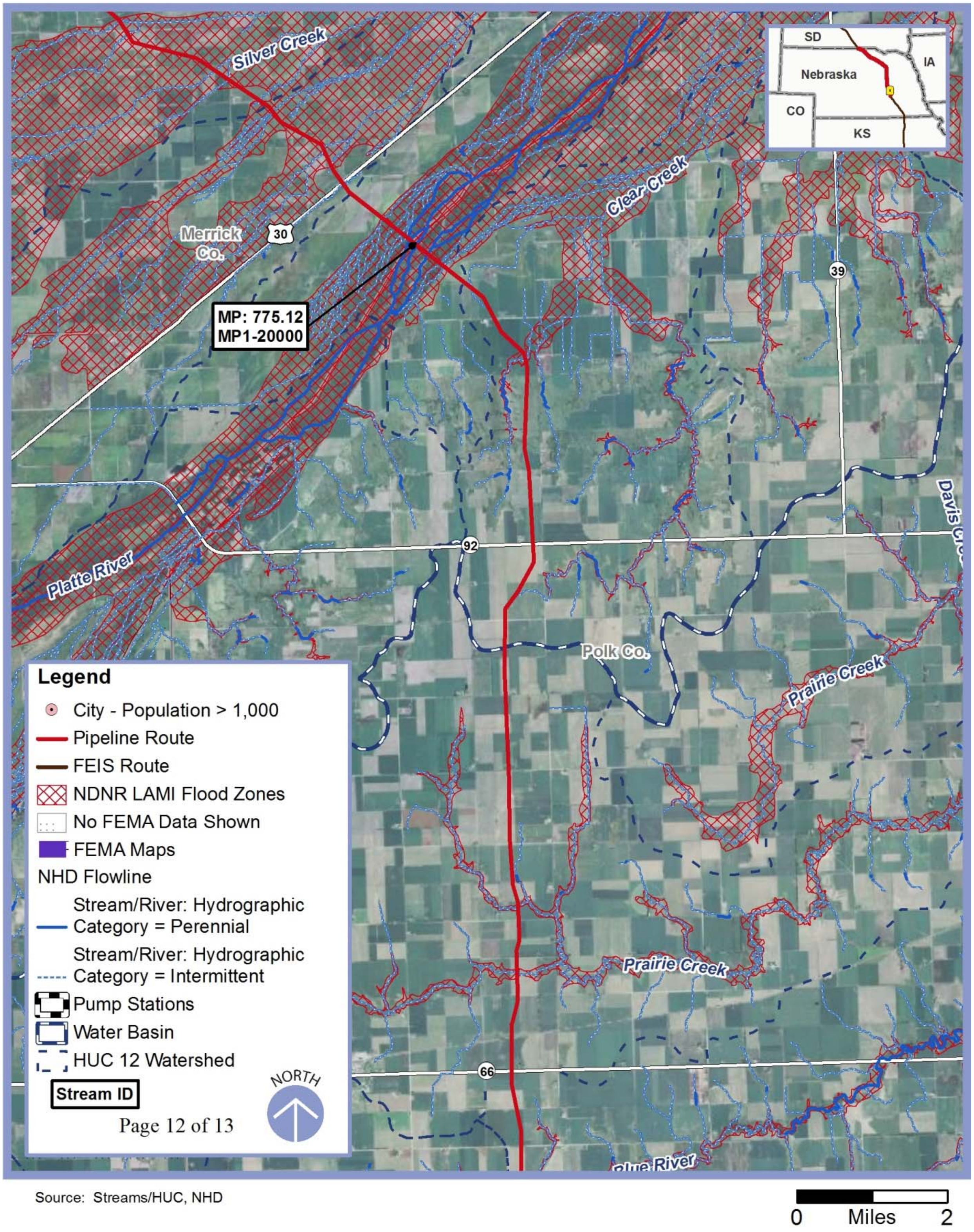

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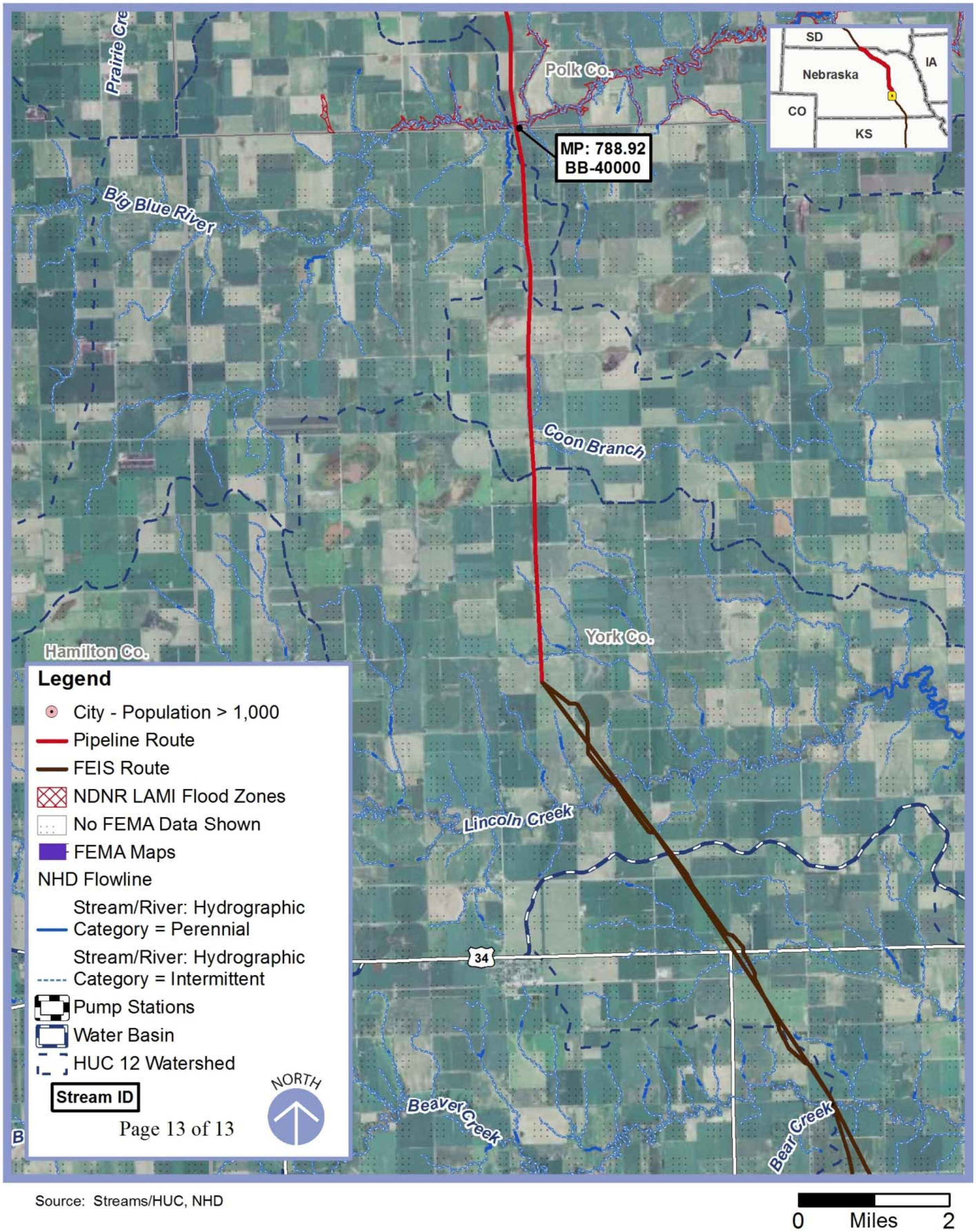

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Attachment C

Surface Water Data

TITLE 117 OF THE NEBRASKA ADMINISTRATIVE CODE

Title 117 standards apply at all times to all surface waters of Nebraska with some exceptions described therein. Beneficial uses are assigned to surface waters within or bordering the state of Nebraska. (Nebraska Administrative Code, Nebraska Department of Environmental Quality, Title 117 – Nebraska Surface Water Quality Standards, Revised Effective Date April 1, 2012.)

The beneficial uses are:

- Primary contact recreation
- Aquatic life – coldwater A, coldwater B, warm water A, and warm water B
- Water supply – public drinking water, agriculture, and industrial
- Aesthetics

Title 117 states that State Resource Waters not a beneficial use but a classification. These are waters that have special significance by being either of very high quality or having unique features that have been recognized by society.

- Class A: These waters have been given special designations by being included in State or National Parks, wildlife refuges, or wild and scenic river systems. Their existing water quality characteristics may not be degraded (NDEQ, 2005).
- Class B: These waters have exceptionally high water quality—much higher than needed to support the designated uses. Their existing high water quality is to be protected and can only be lowered after a very involved public process and a finding that the lowered water quality would be in the public's interest.

The following beneficial use definitions are found in Title 117:

Primary Contact Recreation

This use applies to surface waters which are used, or have a high potential to be used, for primary contact recreational activities. Primary contact recreation includes activities where the body may come into prolonged or intimate contact with the water, such that water may be accidentally ingested and sensitive body organs (e.g. [for example], eyes, ears, nose, etc.) may be exposed. Although the water may be accidentally ingested, it is not intended to be used as a potable water supply unless acceptable treatment is applied. These waters may be used for swimming, water skiing, canoeing, and similar activities. These criteria apply during the recreational period of May 1 through September 30.

These waters shall be free from toxic substances, alone or in combination with other substances, in concentrations that result in adverse health impacts to humans participating in primary contact recreation.

Aquatic Life

Coldwater – These are waters which provide, or could provide, a habitat consisting of sufficient water volume or flow, water quality, and other characteristics such as substrate composition which are capable of maintaining year-round populations of coldwater biota. Coldwater biota are considered to be life forms in waters where temperatures seldom exceed 25°Celsius (C) (77°F).

Class A – These waters provide a habitat which supports natural reproduction of a salmonid (trout) population. These waters also are capable of maintaining year-round populations of a variety of other coldwater fish and associated vertebrate and invertebrate organisms and plants.

Class B – These are waters which provide, or could provide, a habitat capable of maintaining year-round populations of a variety of coldwater fish and associated vertebrate and invertebrate organisms and plants or which support the seasonal migration of salmonids. These waters do not support natural reproduction of salmonid populations due to limitations of flow, substrate composition, or other habitat conditions, but salmonid populations may be maintained year-round if periodically stocked.

Warm water – These are waters which provide, or could provide, a habitat consisting of sufficient water volume or flow, water quality, and other characteristics such as substrate composition which are capable of maintaining year-round populations of warm water biota. Warm water biota are considered to be life forms in waters where temperatures frequently exceed 25°C (77°F).

Class A – These waters provide, or could provide, a habitat suitable for maintaining one or more identified key species on a year-round basis. These waters also are capable of maintaining year-round populations of a variety of other warm water fish and associated vertebrate and invertebrate organisms and plants.

Class B – These are waters where the variety of warm water biota is presently limited by water volume or flow, water quality (natural or irretrievable human-induced conditions), substrate composition, or other habitat conditions. These waters are only capable of maintaining year-round populations of tolerant warm water fish and associated vertebrate and invertebrate organisms and plants. Key species may be supported on a seasonal or intermittent basis (e.g. [for example], during high flows) but year-round populations cannot be maintained.

Surface waters shall be free of toxic substances in concentrations that result in acute or chronic toxicity to aquatic life or present in concentrations that result in objectionable tastes of significant bioaccumulation in organisms that renders them unsuitable or unsafe for consumption. Petroleum oil is listed as a toxic substance and shall not exceed 10 mg/l.

Water Supply

Public Drinking Water – These are surface waters which serve as a public drinking water supply. These waters must be treated (e.g. [for example], coagulation, sedimentation, filtration, chlorination) before the water is suitable for human consumption. After treatment, these waters are suitable for drinking water, food processing, and similar uses. Wastes or toxic substances introduced directly or indirectly by human activity in concentrations that would degrade the use (i.e. [that is], would produce undesirable physiological effects in humans) shall not be allowed.

Agricultural – Wastes or toxic substances introduced directly or indirectly by human activity in concentrations that would degrade the use (would produce undesirable physiological effects in crops or livestock) shall not be allowed.

Class A – These are waters used for general agricultural purposes (such as irrigation and livestock watering) without treatment.

Class B – These are waters where the natural background water quality limits its use for agricultural purposes. No water quality criteria are assigned to protect this use.

Industrial – These are waters used for commercial or industrial purposes such as cooling water, hydroelectric power generation, or nonfood processing water; with or without treatment. Water quality criteria to protect this use will vary with the type of industry involved. Where water quality criteria are necessary to protect this use, site-specific criteria will be developed.

Aesthetics

This use applies to all surface waters of the state. To be aesthetically acceptable, waters shall be free from human-induced pollution which causes: 1) noxious odors; 2) floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits; and 3) the occurrence of undesirable or nuisance aquatic life (such as algal blooms). Surface waters shall also be free of junk, refuse, and discarded dead animals.

Table E4.C-A summarizes beneficial uses of the 30 stream segments along the Nebraska Reroute listed in Title 117 (Nebraska Administrative Code, Nebraska Department of Environmental Quality, Title 117 – Nebraska Surface Water Quality Standards, Revised Effective Date April 1, 2012.) The Nebraska Reroute would cross the following types of designated stream segments:

- 10 categorized with primary contact recreation beneficial uses
- 15 with coldwater B beneficial uses
- 6 with warm water A beneficial uses
- 9 with warm water B beneficial uses

One stream (Elkhorn River) has a site-specific water quality criteria for ammonia (NH_3) assigned for a reach just upstream of the proposed Nebraska Reroute crossing. The Platte River also has a site-specific water quality criterion for ammonia, it is assigned for the reach at the proposed Nebraska Reroute crossing. The Niobrara River is listed as a State Resource Water for the reach from Rock Creek to the State Highway 137 Bridge just upstream of the proposed Nebraska Reroute. Sixteen streams are listed as containing sensitive species. None of the designated streams along the proposed Nebraska Reroute are listed as containing threatened species in Title 117. No segments are identified has providing a public drinking water use. All designated stream segments are identified as Class A, agricultural use. No segments are identified as having commercial or industrial uses.

Undesignated stream segments, including drainageways above coldwater streams, are considered warm water Class B and are subject to aquatic life and aesthetics beneficial uses. Aquatic life beneficial use for undesignated streams is evaluated solely for acute ammonia.

Aesthetics use applies to all surface waters of the state. (Nebraska Administrative Code, Nebraska Department of Environmental Quality, Title 117 – Nebraska Surface Water Quality Standards, Revised Effective Date April 1, 2012.)

Identification of perennial and intermittent flow regime is not a beneficial use listed in Title 117 but is included to provide additional information on the stream segments.

Table E4.C-A. Beneficial Uses of Stream Segments

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed Creek: Nebraska-South Dakota border to Buffalo Creek (Section 26, 35 North, 19 West)	NI3	10211	I	—	—	WB	—	A	—	■		
Dry Creek (Section 30, 35 North, 18 West)	NI3	10200	I	—	—	WB	—	A	—	■		
Indian Creek: Tributary to the Keya Paha River (Section 29, 35 North, 18 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Indian Creek (Section 28, 35 North, 18 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Shingle Creek (Section 34, 35 North, 18 West)	NI3		I			WB				■		
Shingle Creek: Tributary to Keya Paha River (Section 34, 35 North, 18 West)	NI3		I			WB				■		
Wolf Creek	NI3	10180	I	—	—	CB	—	A	—	■		
Unnamed creek: Tributary to Keya Paha River (Section 05, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Keya Paha River (Section 08, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Keya Paha River (Section 09, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Keya Paha River (Section 09, 34 North, 17 West)	NI3		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Spotted Tail Creek	NI3	10160	I	—	—	CB	—	A	—	■	blacknose dace	sensitive species
Unnamed creek: Tributary to Spotted Tail Creek (Section 09, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Spotted Tail Creek (Section 09, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Spotted Tail Creek (Section 09, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Spotted Tail Creek (Section 10, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Dry Run Creek (Section 10, 34 North, 17 West)	NI3		I			WB				■		
Dry Run Creek: Tributary to Keya Paha River (Section 11, 34 North, 17 West)	NI3		I			WB				■		
Unnamed creek: Tributary to Alkali Creek (Section 11, 34 North, 17 West)	NI3		I			WB				■		
Alkali Creek	NI3	10150	I	—	—	WB	—	A	—	■		
Keya Paha River: Nebraska-South Dakota border (Section 23, 35 North, 20 West) to Niobrara River	NI3	10100	P	—	PCR	WA	—	A	—	■	channel catfish, largemouth bass	
Big Creek	NI3	10120	P	—	—	CB	—	A	—	■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification									Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species		
							Public Drinking Water	Agriculture	Industrial				
Niobrara River: Plum Creek to Keya Paha River	NI3	10000	P	—	PCR	WA	—	A	—	■	channel catfish, rock bass, largemouth bass, bluegill		State Resource Water designation applies from Rock Creek (NI3-12900) (Section 12, 32 North, 22 West) to State Hwy. 137 bridge (Section 5, 32 North, 17 West) (*not at pipeline crossing*)
Unnamed creek: Tributary to Niobrara River (Section 07, 33 North, 15 West)	NI3		I			WB				■			
Unnamed creek: Tributary to Niobrara River (Section 18, 33 North, 15 West)	NI3		I			WB				■			
Beaver Creek	NI3	10400	P	—	—	CB	—	A	—	■	grass pickeral, largemouth bass		sensitive species
Unnamed creek: Tributary to Niobrara River (Section 20, 33 North, 15 West)	NI3		I			WB				■			

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Niobrara River (Section 29, 33 North, 15 West)	NI3		I			WB				■		
Big Sandy Creek: Spring Creek to Niobrara River	NI2	12300	P	—	PCR	WB	—	A	—	■		
Unnamed creek: Tributary to Big Sandy Creek	NI2		I			WB				■		
Unnamed Creek (Section 33, 32 North, 14 West)	NI2	12041	P	—	—	CB	—	A	—	■		
Unnamed Creek (Section 24, 32 North, 14 West)	NI2	12040	P	—	—	CB	—	A	—	■		
Unnamed creek: Tributary to unnamed creek NI2-12041 (Section 03, 31 North, 14 West)	NI2		I			WB				■		
Unnamed creek: Tributary to unnamed creek NI2-12041 (Section 03, 31 North, 14 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Brush Creek (Section 11, 31 North, 14 West)	NI2		I			WB				■		
Brush Creek: Headwaters to unnamed creek (Section 24, 32 North, 14 West)	NI2	12100	I	—	—	CB	—	A	—	■	blacknose dace, largemouth bass	sensitive species
North Branch Eagle Creek	NI2	11781	P	—	PCR	CB	—	A	—	■	blacknose dace	sensitive species

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification									Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species		
							Public Drinking Water	Agriculture	Industrial				
Middle Branch Eagle Creek	NI2	11780	P	—	PCR	CB	—	A	—	■	blacknose dace, channel catfish		sensitive species
Unnamed creek: Tributary to Middle Branch Eagle Creek (Section 03, 30 North, 13 West)	NI2		I			WB				■			
Unnamed creek: Tributary to Middle Branch Eagle Creek (Section 02, 30 North, 13 West)	NI2		I			WB				■			
Unnamed creek: Tributary to Middle Branch Eagle Creek (Section 11, 30 North, 13 West)	NI2		I			WB				■			
Unnamed creek: Tributary to East Branch Eagle Creek (Section 07, 30 North, 12 West)	NI2		I			WB				■			
Unnamed creek: Tributary to East Branch Eagle Creek (Section 07, 30 North, 12 West)	NI2		I			WB				■			
East Branch Eagle Creek	NI2	11770	P	—	—	CB	—	A	—	■			
Unnamed creek: Tributary to Honey Creek	NI2		I			WB		A		■			
Unnamed creek: Tributary to Blackbird Creek (Section 24, 30 North, 12 West)	NI2		I			WB				■			
Unnamed creek: Tributary to Blackbird Creek (Section 24, 30 North, 12 West)	NI2		I			WB				■			

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Blackbird Creek (Section 19, 30 North, 11 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Blackbird Creek (Section 19, 30 North, 11 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Redbird Creek (Section 28, 30 North, 11 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Redbird Creek (Section 28, 30 North, 11 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Redbird Creek (Section 28, 30 North, 11 West)	NI2		I			WB				■		
Redbird Creek: Headwaters to Blackbird Creek	NI2	11500	P	—	—	CB	—	A	—	■	blacknose dace	sensitive species
Unnamed creek: Tributary to Redbird Creek (Section 35, 30 North, 11 West)	NI2		I			WB				■		
Unnamed creek: Tributary to unnamed creek NI2-11520 (Section 02, 29 North, 11 West)	NI2		I			WB				■		
Unnamed Creek (Section 23, 30 North, 11 West)	NI2	11520	P	—	—	CB	—	A	—	■		
Unnamed creek (Section 25, 29 North, 10 West)	NI2		I			WB				■		
Unnamed creek (Section 25, 29 North, 10 West)	NI2		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Middle Branch Verdigre Creek (Section 32, 29 North, 09 West)	NI2		I			CB				■		
Unnamed creek: Tributary to Middle Branch Verdigre Creek (Section 05, 28 North, 09 West)	NI2		I			WB				■		
Unnamed creek: Tributary to South Branch Verdigre Creek (Section 11, 28 North, 09 West)	NI2		I			WB				■		
South Branch Verdigre Creek: Headwaters to East Branch Verdigre Creek (Section 33, 29 North, 7 West)	NI2	10300	P	—	PCR	CB	—	A	—	■	blacknose dace	sensitive species
Unnamed creek: Tributary to South Branch Verdigre Creek (Section 13, 28 North, 09 West)	NI2		I			WB				■		
Unnamed creek: Tributary to South Branch Verdigre Creek (Section 13, 28 North, 09 West)	NI2		I			WB				■		
Unnamed creek: Tributary to South Branch Verdigre Creek (Section 18, 28 North, 08 West)	NI2		I			WB				■		
Big Springs Creek	NI2	10350	P	—	—	CB	—	A	—	■	blacknose dace	sensitive species

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Big Springs Creek (Section 28, 28 North, 08 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Big Springs Creek (Section 27, 28 North, 08 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Big Springs Creek (Section 27, 28 North, 08 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Big Springs Creek (Section 27, 28 North, 08 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Hathoway Slough (Section 36, 28 North, 08 West)	NI2		I			WB				■		
Unnamed creek: Tributary to Hathoway Slough (Section 01, 27 North, 06 West)	NI2		I			WB				■		
Unnamed creek (Section 30, 26 North, 05 West)	EL3		I			WB				■		
Unnamed creek (Section 31, 26 North, 05 West)	EL3		I			WB				■		
Al Hopkins Creek	EL4	10900	I	—	—	WB	—	A	—	■		
Unnamed creek: Tributary to Elkhorn River (Section 20, 25 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Elkhorn River (Section 32, 25 North, 05 West)	EL4		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply: Public Drinking Water	Water Supply: Agriculture	Water Supply: Industrial	Aesthetics	Key Species	
Elkhorn River: Cedar Creek to North Fork Elkhorn River	EL4	10000	P	—	PCR	WA	—	A	—	■	northern pike, channel catfish, flathead catfish, largemouth bass	site-specific NH3
Unnamed creek: Tributary to Elkhorn River (Section 20, 24 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 29, 24 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 29, 24 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 29, 24 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 32, 24 North, 05 West)	EL4		I			WB				■		
Saint Clair Creek - Tributary to the Elkhorn River (Section 05, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 05, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Saint Clair Creek (Section 05, 23 North, 05 West) (Second crossing)	EL4		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Ives Creek (Section 17, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 17, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 20, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 20, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 20, 23 North, 05 West) (Second crossing)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 29, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 29, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 32, 23 North, 05 West)	EL4		I			WB				■		
Unnamed creek: Tributary to Ives Creek (Section 32, 23 North, 05 West) (Second crossing)	EL4		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 05, 22 North, 05 West)	LP1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
							Water Supply					
				State Resource Water	Recreation	Aquatic Life	Public Drinking Water	Agriculture	Industrial	Aesthetics	Key Species	
North Shell Creek: Tributary to Shell Creek (Section 08, 22 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 08, 22 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 17, 22 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 17, 22 North, 05 West) (Second Crossing)	LP1		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 20, 22 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to North Shell Creek (Section 20, 22 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to Shell Creek (Section 05, 21 North, 05 West)	LP1		I			WB				■		
Shell Creek: Headwaters to North Shell Creek	LP1	20900	P	—	—	WB	—	A	—	■		
Unnamed creek: Tributary to Shell Creek (Section 08, 21 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to Shell Creek (Section 08, 21 North, 05 West)	LP1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Shell Creek (Section 08, 21 North, 05 West) (Second crossing)	LP1		I			WB				■		
Unnamed creek: Tributary to Shell Creek (Section 17, 21 North, 05 West)	LP1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 32, 21 North, 05 West)	LO1		I			WB				■		
Vorhees Creek: Tributary to Beaver Creek (Section 08, 20 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 17, 20 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 17, 20 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 17, 20 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 20, 20 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 20, 20 North, 05 West)	LO1		I			WB				■		
Vorhees Creek: Tributary to Beaver Creek (Section 20, 20 North, 05 West)	LO1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Vorhees Creek: Tributary to Beaver Creek (Section 29, 20 North, 05 West) (Second crossing)	LO1		I			WB				■		
Unnamed creek: Tributary to Vorhees Creek (Section 29, 20 North, 05 West)	LO1		I			WB				■		
Beaver Creek: Rae Creek (Section 11, 21 North, 7 West) to Bogus Creek	LO1	10700	P	—	PCR	WA	—	A	—	■	channel catfish, flathead catfish	
Unnamed creek: Tributary to Beaver Creek (Section 17, 19 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Beaver Creek (Section 17, 19 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Beaver Creek (Section 17, 19 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Beaver Creek (Section 20, 19 North, 05 West)	LO1		I			WB				■		
Bogus Creek	LO1	10610	I	—	—	WB	—	A	—	■		
Unnamed creek: Tributary to Bogus Creek (Section 05, 18 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Bogus Creek (Section 05, 18 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Bogus Creek (Section 08, 18 North, 05 West)	LO1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Bogus Creek (Section 08, 18 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Bogus Creek (Section 08, 18 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Bogus Creek (Section 17, 18 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Skeedee Creek (Section 29, 18 North, 05 West)	LO1		I			WB				■		
Plum Creek	LO1	30200	P	—	—	WB	—	A	—	■		
Unnamed creek: Tributary to Plum Creek (Section 33, 17 North, 05 West)	LO1		I			WB				■		
Loup River: Confluence of North and Middle Loup Rivers to Loup River Canal Division (Section 06, 16 North, 04 West)	LO1	30000	P	—	PCR	WA	—	A	—	■	channel catfish, flathead catfish	
Unnamed creek: Tributary to Loup River (Section 09, 16 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Loup River (Section 09, 16 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Loup River (Section 16, 16 North, 05 West)	LO1		I			WB				■		
Unnamed creek: Tributary to Loup River (Section 16, 16 North, 05 West)	LO1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Loup River (Section 16, 16 North, 05 West) (Second crossing)	LO1		I			WB				■		
Unnamed creek: Tributary to Loup River (Section 21, 16 North, 05 West) (Third crossing)	LO1		I			WB				■		
Unnamed creek: Tributary to Prairie Creek (Section 28, 16 North, 05 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Prairie Creek (Section 28, 16 North, 05 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Prairie Creek (Section 34, 16 North, 05 West)	MP1		I			WB				■		
Prairie Creek	MP1	20100	P	—	—	WB	—	A	—	■	channel catfish, largemouth bass	
Unnamed creek: Tributary to Silver Creek (Section 12, 15 North, 05 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 13, 15 North, 05 West)	MP1		I			WB				■		
Silver Creek: Headwaters to identified segment of Silver Creek (Section 18, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 18, 15 North, 04 West)	MP1		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Unnamed creek: Tributary to Silver Creek (Section 17, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 20, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 20, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 21, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Silver Creek (Section 28, 15 North, 04 West)	MP1		I			WB				■		
Platte River: Wood River to Loup Power Canal (Section 35, 17 North, 01 East)	MP1	20000	P	—	PCR	WA	—	A	—	■	channel catfish, flathead catfish	site-specific NH3
Unnamed creek: Tributary to Platte River (Section 35, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Clear Creek (Section 35, 15 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Clear Creek (Section 02, 14 North, 04 West)	MP1		I			WB				■		
Unnamed creek: Tributary to Prairie Creek (Section 11, 13 North, 04 West)	BB4		I			WB				■		
Prairie Creek: Tributary to Big Blue River (Section 14, 13 North, 04 West)	BB4		I			WB				■		

Stream Segment	Subbasin	Segment Number	Flow Regime	Beneficial Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Big Blue River: Headwaters to North Fork Big Blue River	BB4	40000	P	—	—	WB	—	A	—	■		
Coon Branch: Tributary to Lincoln Creek (Section 23, 12 North, 04 West)	BB4		I			WB				■		
Unnamed creek: Tributary to Lincoln Creek (Section 02, 11 North, 04 West)	BB4		I			WB				■		
Unnamed creek: Tributary to Lincoln Creek (Section 11, 11 North, 04 West)	BB4		I			WB				■		

Notes:

P = perennial flow, I = intermittent flow, PCR = primary contact recreation, CB = coldwater B, WA = warm water A, WB = warm water B, A = agriculture water supply, ■ = beneficial use assigned to stream segment, NH_3 = ammonia

2012 WATER QUALITY INTEGRATED REPORT

NDEQ prepares an integrated water quality report every 2 years to identify and establish a priority ranking for all waterbodies where technology-based effluent limitations are not stringent enough to attain and maintain applicable water quality standards. This information is provided for the general public but also for water quality management planning purposes such as future monitoring, total mean daily loading (TMDL) development, and best management practice implementation. The following classification descriptions and data in Table E4.C-B are from the 2012 Water Quality Integrated Report.

Classification

NDEQ evaluates designated stream segments to determine whether the uses are being met. Waterbodies are defined by NDEQ in one of the following five categories:

- **Category 1** – Waterbodies where all designated uses are met.
- **Category 2** –Waterbodies where some of the designated uses are met but there is insufficient information to determine if all uses are being met.
- **Category 3** –Waterbodies where there is insufficient data to determine if any beneficial uses are being met.
- **Category 4** – Waterbody is impaired, but a TMDL is not needed. Subcategories 4A, 4B, 4C, and 4R outline the rationale for the waters not needing a TMDL:
  - **Category 4A** – Waterbody assessment indicates the waterbody is impaired, but all of the required TMDLs have been completed.
  - **Category 4B** – Waterbody is impaired, but "other pollution control requirements" are expected to address the water quality impairment(s) within a reasonable period of time. Other pollution control requirements include but are not limited to, National Pollutant Discharge Elimination System (NPDES) permits and best management practices.
  - **Category 4C** – Water body is impaired but the impairment is not caused by a pollutant. This category also includes waters where natural cause/sources shall refer to those pollutants that originate from landscape geology and climatic conditions. It should be noted that the general description does not exclude parameters and can be used when appropriate justification is provided.
  - **Category 4R** – Waterbody data exceed the impairment threshold; however, a TMDL may not be needed. The category will be used only for nutrient assessments in new or renovated lakes and reservoirs. Newly filled reservoirs usually go through a period of trophic instability—a trophic upsurge followed by trophic decline (Holdren et al., 2001). Erroneous or nonrepresentative water quality assessments are likely to occur during this period. To account for this, all new or renovated reservoirs will be placed in this category for a period not to exceed 8 years following the fill or re-fill process. After the 8^{th} year, monitoring data will be assessed and the water body will be appropriately placed in category 1, 2, or 5.
- **Category 5** – Waterbodies where one or more beneficial uses are determined to be impaired by one or more pollutants and all of the TMDLs have not been developed. In Nebraska, Category 5 waters constitute the Section 303(d) list subject to

U.S. Environmental Protection Agency approval/disapproval (NDEQ, 2012). A waterbody beneficial use assessment can have one of four outcomes:

- S = supported beneficial use
- I = impaired beneficial use
- NA = not assessed

A blank cell indicates the beneficial use is not assigned to this waterbody in Title 117.

Table E4.C-B. Stream Segment Water Quality Summary

Stream Segment	Subbasin	Segment Number	Recreation	Aquatic Life	Public Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2012 IR	Impairment	Parameters of Concern	Comments/Actions
Unnamed Creek - Nebraska-South Dakota border to Buffalo Creek (Section 26, 35 North, 19 West)	NI3	10211		NA		NA		NA		3			
Dry Creek (Section 30, 35 North, 18 West)	NI3	10200		NA		NA		NA		3			
Wolf Creek	NI3	10180		NA		NA		NA		3			
Spotted Tail Creek	NI3	10160		NA		NA		NA		3			
Alkali Creek	NI3	10150		NA		NA		NA		3			
Keya Paha River: Nebraska-South Dakota border (Section 23, 35 North, 20 West) to Niobrara River	NI3	10100	I	S		S		S	I	5	Recreation – bacteria	E. coli	Fish consumption assessment
Big Creek	NI3	10120		NA		NA		NA		3			
Niobrara River: Plum Creek to Keya Paha River	NI3	10000	I	S		S		S	I	4a	Recreation – bacteria	E. coli	E. coli TMDL approved 1/06
Beaver Creek	NI3	10400		NA		NA		NA		3			
Big Sandy Creek: Spring Creek to Niobrara River	NI2	12300	NA	NA		NA		NA		3			

Stream Segment	Subbasin	Segment Number	Recreation	Aquatic Life	Public Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2012 IR	Impairment	Parameters of Concern	Comments/Actions
Unnamed Creek (Section 33, 32 North, 14 West)	NI2	12041		NA		NA		NA		3			
Unnamed Creek (Section 24, 32 North, 14 West)	NI2	12040		NA		NA		NA		3			
Brush Creek: Headwaters to Unnamed Creek (Section 24, 32 North, 14 West)	NI2	12100		NA		NA		NA		3			
North Branch Eagle Creek	NI2	11781	NA	NA		NA		NA		3			
Middle Branch Eagle Creek	NI2	11780	NA	S		NA		NA	S	2			
East Branch Eagle Creek	NI2	11770		NA		NA		NA		3			
Redbird Creek: Headwaters to Blackbird Creek	NI2	11500		NA		NA		NA		3			
Unnamed Creek (Section 23, 30 North, 11 West)	NI2	11520		NA		NA		NA		3			
South Branch Verdigre Creek: Headwaters to East Branch Verdigre Creek (Section 33, 29 North, 7 West)	NI2	10300	NA	NA		NA		NA		3			

Stream Segment	Subbasin	Segment Number	Recreation	Aquatic Life	Public Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2012 IR	Impairment	Parameters of Concern	Comments/Actions
Big Springs Creek	NI2	10350		NA		NA		NA		3			
Al Hopkins Creek	EL4	10900		NA		NA		NA		3			
Elkhorn River: Cedar Creek to North Fork Elkhorn River	EL4	10000	I	S		S		S	I	4a	Recreation – bacteria	E. coli	E. coli TMDL approved 9/09, Aquatic community and fish consumption assessment
Shell Creek: Headwaters to North Shell Creek	LP1	20900		NA		NA		NA		3			
Beaver Creek: Rae Creek (Section 11, 21 North, 7 West) to Bogus Creek	LO1	10700	I	I		S		S	I	5	Recreation – bacteria, aquatic life – impaired aquatic community	E. coli	Aquatic community and fish consumption assessment
Bogus Creek	LO1	10610		NA		NA		NA		3			
Plum Creek	LO1	30200		NA		NA		NA		3			
Loup River: Confluence of North and Middle Loup Rivers to Loup River Canal Division (Section 6, 16 North, 4 West)	LO1	30000	I	S		S		S	I	4a	Recreation – bacteria	E. coli	E. coli TMDL approved 1/06

Stream Segment	Subbasin	Segment Number	Recreation	Aquatic Life	Public Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2012 IR	Impairment	Parameters of Concern	Comments/Actions
Prairie Creek	MP1	20100		I		S		S	I	5	Aquatic life – DO	Unknown	Aquatic community assessment
Platte River: Wood River to Loup Power Canal (Section 35, 17 North, 1 East)	MP1	20000	S	S		S		S	S	1			Fecal coliform TMDL approved 5/03
Big Blue River: Headwaters to North Fork Big Blue River	BB4	40000		I		S		S	I	5	Aquatic life – DO, atrazine	Unknown atrazine	Aquatic community assessment

Notes:
S = supported beneficial use, I = impaired beneficial use, NA = not assessed, blank cell = beneficial use not assigned to this waterbody in Title 117

TEMPORARY ACCESS ROADS

The following waterbodies are crossed by temporary access roads as shown on the Nebraska Reroute provided on September 4, 2012 (see Table E4.C-C and Table E4.C-D). Keystone will need to include temporary access roads as part of its NPDES permit application and address measures used to reduce the potential for adverse impacts to surface waters crossed by the access roads.

Table E4.C-C. Beneficial Use Classifications for Streams Crossed by Temporary Access Roads

Stream Segment	Subbasin	Segment Number	Flow Regime	Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Shingle Creek: Tributary to Keya Paha River (Section 34, 35 North, 18 West)	NI3		I			WB				Aesth		
Meglin Creek	NI3	10130	P	—	—	CB	—	—	A	Aesth		
Unnamed creek: Tributary to Keya Paha River (Section 21, 34 North, 16 West)	NI3		I			WB				Aesth		
Unnamed creek: Tributary to Keya Paha River (Section 20, 34 North, 16 West)	NI3		I			WB				Aesth		
Unnamed creek: Tributary to Keya Paha River (Section 19, 34 North, 16 West)	NI3		I			WB				Aesth		
Unnamed creek:	NI2		I			WB				Aesth		

Stream Segment	Subbasin	Segment Number	Flow Regime	Use Classification								Comments
				State Resource Water	Recreation	Aquatic Life	Water Supply			Aesthetics	Key Species	
							Public Drinking Water	Agriculture	Industrial			
Tributary to Blackbird Creek (Section 24, 30 North, 12 West)												
Unnamed creek: Tributary to Elkhorn River (Section 20, 25 North, 05 West)	EL		I			WB				Aesth		
Unnamed creek: Tributary to Elkhorn River (Section 20, 25 North, 05 West)	EL		I			WB				Aesth		
Unnamed creek: Tributary to Elkhorn River (Section 20, 24 North, 05 West)	EL		I			WB				Aesth		
Unnamed creek: Tributary to Beaver Creek (Section 08, 19 North, 05 West)	EL		I			WB				Aesth		

Notes:
P = perennial flow, I = intermittent flow, CB = coldwater B, WB = warm water B, A = industrial water supply, Aesth = aesthetics

Table E4.C-D. Stream Segment Crossed by Temporary Access Roads

Stream Segment	Subbasin	Segment Number	Recreation	Aquatic Life	Public Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2012 IR	Impairment	Parameters of Concern	Comments/ Actions
Meglin Creek	NI3	10130	—	NA	—	NA	—	NA	—	3	—	—	—

Notes:
NA = not assessed

FLOODPLAINS

Table E4.C-E lists designated stream segments and Table E4.C-F lists nondesignated stream segments where the 100-year floodplain has been delineated. The Nebraska Reroute would cross the Niobrara River along the boundary between Boyd and Holt Counties. The floodplain has been delineated for the Niobrara River at this location, but Boyd County has adopted the delineation and Holt County has not.

Table E4.C-E. Designated Stream Segments and Associated Floodplains

Stream Segment	Subbasin	Segment Number	County	Delineated Floodplain Source
Keya Paha River: Nebraska-South Dakota border (Section 23, 35 North, 20 West) to Niobrara River	NI3	10100	Boyd	FEMA[a]
Niobrara River: Plum Creek to Keya Paha River	NI3	10000	Boyd/Holt	FEMA/No
Big Springs Creek	NI2	10350	Antelope	FEMA
Elkhorn River: Cedar Creek to North Fork Elkhorn River	EL4	10000	Antelope	FEMA
Shell Creek: Headwaters to North Shell Creek	LP1	20900	Boone	FEMA
Beaver Creek: Rae Creek (Section 11, 21 North, 7 West) to Bogus Creek	LO1	10700	Boone	FEMA
Bogus Creek	LO1	10610	Boone	FEMA
Plum Creek	LO1	30200	Nance	FEMA
Loup River: Confluence of North and Middle Loup Rivers to Loup River Canal Division (Section 6, 16 North, 4 West)	LO1	30000	Nance	FEMA
Prairie Creek	MP1	20100	Merrick	FEMA
Platte River	MP1	20000	Merrick/Polk	FEMA
Big Blue River	BB4	40000	Polk	FEMA

Note:
[a] *Federal Emergency Management Agency*

Table E4.C-F. Undesignated Streams and Associated Floodplains

Stream Segment	Subbasin	County	Delineated Floodplain Source
Big Creek	NI3	Boyd	FEMA[a]
Unnamed creek: Tributary to South Branch Verdigre Creek (Section 18, 28 North, 08 West)	NI2	Antelope	FEMA
Unnamed creek: Tributary to Big Springs Creek (Section 28, 28 North, 08 West)	NI2	Antelope	FEMA
Unnamed creek: Tributary to Big Springs Creek (Section 27, 28 North, 08 West)	NI2	Antelope	FEMA
Unnamed creek: Tributary to Big Springs Creek (Section 27, 28 North, 08 West)	NI2	Antelope	FEMA
Saint Clair Creek: Tributary to the Elkhorn River (Section 05, 23 North, 05 West)	EL4	Antelope	FEMA
Unnamed creek: Tributary to North Shell Creek (Section 05, 22 North, 05 West)	LP1	Boone	FEMA
North Shell Creek: Tributary to Shell Creek (Section 08, 22 North, 05 West)	LP1	Boone	FEMA
Unnamed creek: Tributary to North Shell Creek (Section 08, 22 North, 05 West)	LP1	Boone	FEMA
Unnamed creek: Tributary to Shell Creek (Section 08, 21 North, 05 West)	LP1	Boone	FEMA
Unnamed creek: Tributary to Shell Creek (Section 17, 21 North, 05 West)	LP1	Boone	FEMA
Unnamed creek: Tributary to Vorhees Creek (Section 32, 21 North, 05 West)	LO1	Boone	FEMA
Vorhees Creek: Tributary to Beaver Creek (Section 08, 20 North, 05 West)	LO1	Boone	FEMA
Vorhees Creek: Tributary to Beaver Creek (Section 08, 20 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Vorhees Creek (Section 17, 20 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Vorhees Creek (Section 20, 20 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Vorhees Creek (Section 20, 20 North, 05 West)	LO1	Boone	FEMA
Vorhees Creek: Tributary to Beaver Creek (Section 20, 20 North, 05 West)	LO1	Boone	FEMA
Vorhees Creek: Tributary to Beaver Creek (Section 29, 20 North, 05 West) (Second crossing)	LO1	Boone	FEMA
Unnamed creek: Tributary to Beaver Creek (Section 17, 19 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Beaver Creek (Section 20, 19 North, 05 West)	LO1	Boone	FEMA

Stream Segment	Subbasin	County	Delineated Floodplain Source
Unnamed creek: Tributary to Bogus Creek (Section 05, 18 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Bogus Creek (Section 08, 18 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Bogus Creek (Section 08, 18 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Bogus Creek (Section 17, 18 North, 05 West)	LO1	Boone	FEMA
Unnamed creek: Tributary to Skeedee Creek (Section 29, 18 North, 05 West)	LO1	Nance	FEMA
Unnamed creek: Tributary to Plum Creek (Section 33, 17 North, 05 West)	LO1	Nance	FEMA
Unnamed creek: Tributary to Plum Creek (Section 04, 16 North, 05 West)	LO1	Nance	FEMA
Unnamed creek: Tributary to Prairie Creek	MP1	Merrick	FEMA
Silver Creek	MP1	Merrick	FEMA
Unnamed creek: Tributary to Clear Creek (Section 02, 14 North, 04 West)	MP1	Polk	FEMA
Unnamed creek: Tributary to Prairie Creek (Section 11, 13 North, 04 West)	BB4	Polk	FEMA
Prairie Creek	BB4	Polk	FEMA
Coon Branch: Tributary to Lincoln Creek	BB4	York	FEMA/Work[b]
Unnamed creek: Tributary to Lincoln Creek	BB4	York	FEMA/Work
Unnamed creek: Tributary to Lincoln Creek	BB4	York	FEMA/Work

Notes:
[a] *Federal Emergency Management Agency*
[b] *York County participates in the National Flood Insurance Program; NDNR Floodplain Work Maps may be best available information for streams crossed by the proposed Nebraska Reroute.*

References

Nebraska Department of Environmental Quality (NDEQ). 2005. *Nebraska Surface Water Quality Report*. Appendix A, Definitions.

———. 2012. Water Quality Integrated Report. Water Quality Division. April 1.

Appendix E.5

Wetlands Technical Memorandum

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APPENDIX E.5

WETLANDS TECHNICAL MEMORANDUM

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of wetland vegetation typically adapted for life in saturated soil conditions. Wetlands are essential breeding, rearing, and feeding grounds for many species of fish and wildlife. They also perform flood protection and pollution control functions (Cowardin et al., 1979).

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of wetland vegetation typically adapted for life in saturated soil conditions.

Wetlands in the Nebraska Reroute corridor fall under the jurisdiction of the U.S. Army Corps of Engineers (USACE) Omaha District, the U.S. Environmental Protection Agency (EPA), and the Nebraska Department of Environmental Quality (NDEQ). Under the authority of Section 404 of the Clean Water Act (CWA), permits are required for the discharge of fill material into waters of the United States. Waters of the United States protected by the CWA include surface waters such as streams, lakes, impoundments, and wetlands. Waters of the United States include the area below the ordinary high water mark of stream channels and lakes or ponds connected to the tributary system and wetlands adjacent to these waters. Nonwetland surface water features are addressed in Appendix E.4 of this Draft Evaluation Report.

As part of federal regulatory requirements under the CWA, inventories involving field surveys of wetlands and other waters of the United States are required along the proposed pipeline right-of-way (ROW) and other associated areas of disturbance related to the Nebraska Reroute to evaluate the potential for adverse effects to waters of the United States. Information gathered during these inventories would be used to complete notification and permitting requirements under Sections 401 and 404 of the CWA (by USACE) and applicable State agencies under the review of EPA. EPA dictates federal jurisdiction and can veto permit decisions for discharge activities with unacceptable impacts on wetlands.

In addition to following USACE regulations, the State of Nebraska regulates impacts on wetlands in accordance with the CWA and the Nebraska Environmental Protection Act (Nebraska Revised Statutes §§ 81-1501 to 81-1533). NDEQ serves as administrator for regulatory review under Section 401 of the CWA and the aforementioned state laws. NDEQ considers wetlands to be waters of the State and protects them from degradation (NDEQ, 2012). The State applies an antidegradation policy to all wetlands and has adopted regulations for the administration of Section 401 (Title 120) and water quality standards (Title 117) for all surface waters and natural wetlands, whether waters of the United States or not. For Section 401 water quality certification, NDEQ requires mitigation for wetland impacts through creation of new wetlands or through restoration or enhancement of existing wetlands (Association of State Wetland Managers, 2011).

E.5.1 EXISTING CONDITIONS

The designated Study Area for reviewing wetland impacts for the proposed Nebraska Reroute consists of a 300- to 500-foot-wide corridor centered on the route. In addition to the 300- to 500-foot-wide route, the Study Area includes proposed ancillary facility locations.

Wetlands, whether they are isolated or are connected (hydrologically) to riverine systems, perform functions that have ecological, economic, and societal value (EPA, 2001). Table E.5-1 summarizes the functions and corresponding values commonly attributed to wetlands.

Table E.5-1. Wetland Functions and Related Values

Function	Value
Surface water storage	Flood control, aquatic habitat
Shoreline stabilization	Wave damage protection, shoreline erosion control
Groundwater recharge	Replenish water supplies
Sediment removal and nutrient cycling	Water quality protection
Supporting aquatic productivity	Fishing, shell fishing, waterfowl hunting
Production of trees (bottomland forests)	Timber harvest, forest habitat
Herbaceous vegetation growth	Livestock grazing and haying, wildlife habitat
Development of peat	Peat harvest
Provision of plant and wildlife habitat	Hunting and trapping, nature observation, aesthetics, plant/wildlife/nature photography

Source: EPA, 2001

According to data provided by TransCanada Keystone Pipeline, LP (Keystone) on September 20, 2012; U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps; National Land Cover Dataset (NLCD); and the U.S. Geological Survey (USGS) National Gap Analysis Program (GAP), wetlands within the Study Area include freshwater emergent (palustrine emergent wetland), freshwater forested/shrub (palustrine forested and palustrine scrub/shrub wetlands), riverine (perennial, intermittent, and ephemeral waterways), freshwater pond (open waterbody), and other types (man-made waterbody and ditch) (see Attachment B).

Section 4.6 discusses Biologically Unique Landscapes (BULs) crossed by the Study Area. Some wetlands found within these BULs are considered sensitive wetland habitats by the Nebraska Game and Parks Commission (NGPC). A discussion of these sensitive wetland habitats is included in Section 4.6.4.

To identify the types and acreage of wetlands that would be crossed by the Nebraska Reroute, field delineations and aerial photography interpretations were performed in the spring and summer of 2012 by Keystone. These data were used to calculate potential impacts to wetland resources in this analysis in combination with USFWS NWI, NLCD, and USGS GAP data. NDEQ monitored Keystone's field delineations and verified the wetland mapping.

E.5.1.1 Freshwater Emergent Wetlands

Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes (nonwoody herbs that thrive in wet environments), excluding mosses and lichens. Hydrophytic vegetation is present for most of the growing season in most years and contains predominantly perennial plants. In areas with relatively stable climatic conditions, emergent wetlands maintain the same appearance year after year. In other areas, such as the prairies of the central United States, substantial seasonal and annual climatic fluctuations can result in a range of conditions in the same wetland, such as vegetated to open water ponded habitats. Emergent wetlands are known by many names based on the regional and landscape position, including marsh, meadow, fen, prairie pothole, and slough (Cowardin et al., 1979). Freshwater emergent wetlands within the Study Area are shown in Attachment B.

E.5.1.2 Freshwater Forested/Shrub Wetlands

Forested wetlands are characterized by woody vegetation with a height above 6 meters. Forested wetlands are most common in areas where moisture is relatively abundant, particularly along rivers and in the mountains. Forested wetlands normally have an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer (Cowardin et al., 1979). Shrub wetlands include areas dominated by woody vegetation less than 6 meters tall. Vegetation forms found in this type of wetland include shrubs, young trees, and trees or shrubs that are small or have experienced stunted growth because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or could be relatively stable communities (Cowardin et al., 1979). Forested /shrub wetlands within the Study Area are shown in Attachment B.

Additional information about plant communities associated with each wetland type is included in Section 4.6, Terrestrial Vegetation, of this Draft Evaluation Report.

E.5.1.3 Riverine Wetlands

Riverine wetlands are closely associated with the riparian zones and floodplains of all of Nebraska's rivers and streams. These riparian areas are complex systems with numerous inter-related wetland and non-wetland components (e.g., wetlands, organic matter, sandbars, tree falls, side channels, etc.). Wetlands are an important component of this system by producing invertebrates and other organic matter that provide nutrients to the streams and rivers. Additionally riverine wetlands provide spawning and nursery areas for many different types of fish, amphibians, and reptiles, and a home for numerous wildlife species. Based on NGPC maps, the Study Area crosses the riverine wetland complex area in Antelope County at the Elkhorn River.

E.5.1.4 Freshwater Pond Wetlands

Freshwater ponds included as wetlands in the NWI dataset are often shallow to deep depressions with open water surrounded by a wetland fringe. During dry seasons or years the water can recede, these areas become mud flats.

E.5.1.5 Other Wetlands

Wetlands included as "other" in the NWI dataset are areas that likely support wetland vegetation, soils, and hydrology but do not occur along a stream, river, lake, or pond. They may occur in irrigated crop land or along other man made water features such as ditches.

E.5.2 POTENTIAL IMPACTS

Potential impacts on wetlands within the Study Area were calculated using the data provided by Keystone on September 20, 2012; USFWS NWI maps; NLCD; and the USGS GAP data. The proposed construction width within wetlands is 85 feet; however impacts were calculated based on the typical construction width of 110 feet. Ancillary facilities outside of the pipeline ROW may also affect wetlands. The temporary construction camp in Nebraska should be located to avoid impacts on wetlands. Preliminary estimates of the surface area of emergent and forested/shrub wetlands affected by construction and operation of the ROW as well as ancillary facilities (access roads, pump stations, pipe yards, and contractor yards outside the pipeline construction ROW) are summarized in Table E.5-2. Each type of wetland supports unique flora, fauna, and hydrology; consequently, impacts from construction, operation, and potential spills could affect each wetland type differently.

Table E.5-2. Wetlands Within Temporary and Permanent Right-of-Way

Wetland Classification	Wetlands within Temporary Right-of-way (acres)[a]	Wetlands within Permanent Right-of-way (acres)[a]	Total Wetlands within Right-of-way (acres)[a]	Number of Wetland Crossings
Freshwater emergent	18.28	14.30	32.58	44
Freshwater forested/Shrub	5.78	10.21	15.99	36
Riverine	4.42	7.99	12.40	131
Freshwater Pond	0.63	0.72	1.35	4
Other	0.03	0.01	0.05	1
Total	29.14	33.23	62.37	216

Sources: TransCanada Keystone Pipeline, LP, geographic information system data from September 21, 2012; USFWS, 2012; NLCD (Fry et al., 2011); USGS GAP data (USGS, 2012).

[a] *Temporary and permanent disturbance areas include forested areas within the 85-foot-wide right-of-way, around pole structures, and crossed by operational access roads. Discussion of temporary and permanent land needs can be found in Sections 2.2 and 2.3.*

Construction of the pipeline would affect wetlands and their functionality primarily during and immediately following construction activities. However, wetland recovery may take 3 to 5 years, and permanent changes are also possible (Federal Energy Regulatory Commission [FERC], 2004). Potential construction- and operation-related impacts to wetlands could result from backfilling or draining, modifying surface and subsurface flow patterns that could affect wetland productivity, and altering wetland vegetation composition and structure through clearing and operational maintenance. Noxious and invasive weeds could be spread to wetlands along the Nebraska Reroute corridor during construction and operational maintenance. Invasive noxious weeds could hinder the return of native and preconstruction vegetation. The federal, State, and county lists of noxious weeds that could potentially occur along the Nebraska Reroute—and information about efforts to control the spread of noxious weeds within the Nebraska Reroute—are presented in Appendix C.7. Within the portion of the Nebraska Reroute that has been surveyed, musk thistle (*Carduus nutans*) and Canada thistle (*Cirsium arvense*) were the two noxious species identified. The remainder of the Nebraska Reroute would be surveyed prior to construction to prepare noxious weed plans (Keystone, 2012).

Wetland soils, hydrology, and vegetation would also be affected within the Nebraska Reroute through increased soil temperatures near the pipeline. According to temperature profile data published in Appendix L of the FEIS (August 2011), operation of the proposed pipeline could increase soil temperatures above ambient surrounding soil temperatures. The estimates, which are listed below, are based on a flow of 900,000 barrels per day. At Keystone's estimated maximum flow of 830,000 barrels per day, the temperature would be expected to be less than these values:

- At the soil surface – by 4 degrees Fahrenheit (°F) to 8°F
- At 6 inches below the soil surface – by 10°F to 15°F
- At pipeline burial depth – by as much as 40°F

The largest increases are anticipated to occur from January to May within the Nebraska Reroute (U.S. Department of State [DOS], 2011). Native prairie grasses, trees, and shrubs have root systems penetrating below 6 inches and would be affected by the increased soil temperature. Operation of the proposed pipeline could also cause slight increases in water temperatures because the pipeline would be buried 4 to 5 feet below the ground surface or waterbody. Small ponds and wetlands may remain unfrozen later than surrounding wetlands and may thaw sooner than surrounding wetlands. Increased soil and water temperatures during early spring could cause early germination and increased productivity in wetland plant species. Early and late migrant waterfowl may be attracted to and concentrated within these areas during spring and fall migrations (DOS, 2011). Although positive effects on vegetation would likely result from elevated soil temperatures in early to mid-spring, potentially negative effects could occur later in the summer if pipeline-influenced soil temperatures promoted soil drying in concert with higher air temperatures. Negative effects could occur to vegetation in early to mid-spring if the vegetation is germinating earlier than normal and is then subject to frost-kill. In addition migratory species and plant pollinators may be affected by the potential early germination and early thaw near the centerline of the pipeline.

E.5.2.1 Freshwater Emergent Wetlands

Herbaceous species within emergent wetlands typically regenerate within 3 to 5 years (FERC, 2004). The affects to wetlands would be short-term (end of construction to 3 years) to long-term impact (3 years or more). Emergent wetlands would be affected during construction by the removal of vegetation, loss and degradation of topsoil, soil compaction and rutting from construction equipment, introduction and dispersal of invasive weeds, and alteration of ground elevation and water flow. Generally, following construction, wetland communities eventually undergo a transition back into a community that is functionally similar to preconstruction conditions, provided conditions such as elevation, grade, and soil structure are successfully restored (FERC, 2004). If mitigation measures discussed in Section E.5.3 are followed, the Nebraska Reroute would result in 3 to 5 year impacts on emergent wetlands

E.5.2.2 Freshwater Forested/Shrub Wetlands

Clearing trees within riparian forest communities would result in long-term impacts on these vegetation communities, given the length of time needed for the trees and understory to mature and return to preconstruction conditions. Permanent impacts on forested/shrub wetlands would occur within the 50-foot-wide permanent easement centered on the pipeline by conversion of forested wetland to emergent wetland. In this 50-foot-wide area, trees would be removed during construction and would be prevented from reestablishing because of periodic mowing and brush clearing during pipeline operation. It is likely that herbaceous emergent wetland vegetation would grow within the permanent ROW in previously forested/shrub wetlands.

E.5.2.3 Riverine Wetlands

Riverine wetlands within the Study Area are shown in Appendix E.5. The two most common causes of impacts on surface water during construction are trenching through waterbodies and erosion from uncontrolled runoff. Additional information about potential impacts on rivers and streams in the Study Area are discussed in Section 4.4.2.

E.5.2.4 Freshwater Pond Wetlands

Freshwater pond wetlands within the Study Area are shown in Appendix E.5. The two most common causes of impacts on surface water during construction are trenching through waterbodies and erosion from uncontrolled runoff. Additional information about potential impacts on freshwater ponds in the Study Area are discussed in Section 4.4.2.

E.5.2.5 Other Wetlands

Other wetlands within the Study Area are shown in Appendix E.5. The two most common causes of impacts on surface water during construction are trenching through waterbodies and erosion from uncontrolled runoff. Generally, following construction, wetland communities eventually undergo a transition back into a community that is functionally similar to preconstruction conditions, provided conditions such as elevation, grade, and soil structure are successfully restored (FERC, 2004).

E.5.3 MITIGATION

Pipeline construction through wetlands must comply with USACE Section 404 permit conditions, as well as the State of Nebraska's antidegradation policy for waters of the state. The requirements for compensatory mitigation under the CWA would depend on USACE decisions on jurisdictional determinations within the Nebraska Reroute. Compensatory mitigation, where required by USACE, would be provided for losses of aquatic resources within the Nebraska Reroute corridor. Compensatory Mitigation Plans would be developed and implemented in accordance with 33 Code of Federal Regulations Part 332 (Compensatory Mitigation for Losses of Aquatic Resources).

E.5.3.1 Construction Mitigation

Mitigation measures for temporary wetland impacts from construction activities would be implemented in accordance with the Construction Mitigation and Reclamation Plan in Appendix B of the Final EIS (DOS, 2011). Mitigation of impacts on natural, isolated wetlands that may not be subject to regulatory oversight by USACE under the CWA may be required by NDEQ in accordance with the Nebraska Environmental Protection Act (Nebraska Revised Statutes §§ 81-1501 to 81-153).

Wetland impacts would be avoided or minimized along the Nebraska Reroute to the extent practicable. If equipment must operate within a wetland or sensitive area containing standing water or saturated soils, the contractor would use timber mats, timber riprap, or other methods to stabilize surface conditions and reduce impacts during construction. Keystone would reduce impacts on forest/shrub wetlands by limiting the removal of tree stumps and restricting grading activities to the area directly over the trench line. Other methods used to avoid and/or minimize permanent impacts on wetlands include:

- Reducing the construction corridor width to 85 feet in wetlands
- Situating the Nebraska Reroute next to previously affected areas along existing linear utilities
- Crossing riparian wetland features perpendicularly wherever possible
- Selecting route variations to reduce the total length of wetland crossings
- Cleaning all construction equipment before it is mobilized to the construction job or after it passes through areas having noxious species
- Controlling sedimentation with best management practices
- Locating additional temporary workspace outside of wetlands
- Limiting the duration of construction in wetlands
- Limiting construction equipment crossings of wetlands
- Avoiding placing ancillary facilities (including temporary roads) in wetlands

As discussed in Section 2.3 of Appendix C, Weed Control, the spread of noxious and invasive weeds into wetlands would be minimized and avoided. Erosion-control measures would be used when constructing on slopes or where the potential for erosion or sedimentation is high. Additional information about wetland and water body construction and mitigation procedures is provided in Chapter 5, Mitigation, of this Draft Evaluation Report and in Appendix C.2, Wetland and Water Body Construction and Mitigation Procedures.

E.5.3.2 Operation Mitigation

Keystone would develop compensation for impacts on wetlands in the Nebraska Reroute corridor in conjunction with NDEQ staff under the State Water Quality Certification Program. Generally, following construction, emergent wetland communities eventually undergo a transition back into a community that is functionally similar to preconstruction conditions provided conditions such as elevation, grade, and soil structure are successfully restored (FERC, 2004). Herbaceous species in emergent wetlands typically regenerate quickly (within 3 to 5 years) (FERC, 2004). Mitigation for impacts on forested wetlands attributable to the conversion of forested wetlands to emergent wetlands within the 50-foot-wide permanent ROW would also be developed. Detailed mitigation information for wetland impacts is discussed in Chapter 5.

E.5.3.3 Spills (Emergency Response) Mitigation

Mitigation for wetlands affected by a potential spill could include clearing the affected wetland vegetation, removing the spill from water and soils, replacing removed soils, replanting or reseeding the affected area, and monitoring groundwater. Additional information about impacts on wetlands from potential spills is provided in Chapter 6, Potential Pipeline Spills.

E.5.4 WESTERN ALTERNATIVE

Forested/shrub, emergent, riverine, open water, and other wetlands are found within the Western Alternative. The Western Alternative would fall within the Rainwater Basin (U.S. Department of Agriculture, Natural Resources Conservation Service, 2012). The USFWS Rainwater Basin Wetland Management Area in the Rainwater Basin includes Waterfowl Production Areas, which are managed for the conservation of migrating and nesting waterfowl habitat. The nearest such area to the Western Alternative is the Fillmore County Waterfowl Production Area, approximately 22 miles north-northwest of the Western Alternative. The Final EIS route and Nebraska Reroute would also cross the Rainwater Basin. In addition, the amount of wetlands within the Western Alternative is similar to the amount of wetlands within the Final EIS route and within the Nebraska Reroute. Therefore, impacts on wetland resources within the Western Alternative would be similar to those within the Final EIS route and Nebraska Reroute.

E.5.5 REFERENCES

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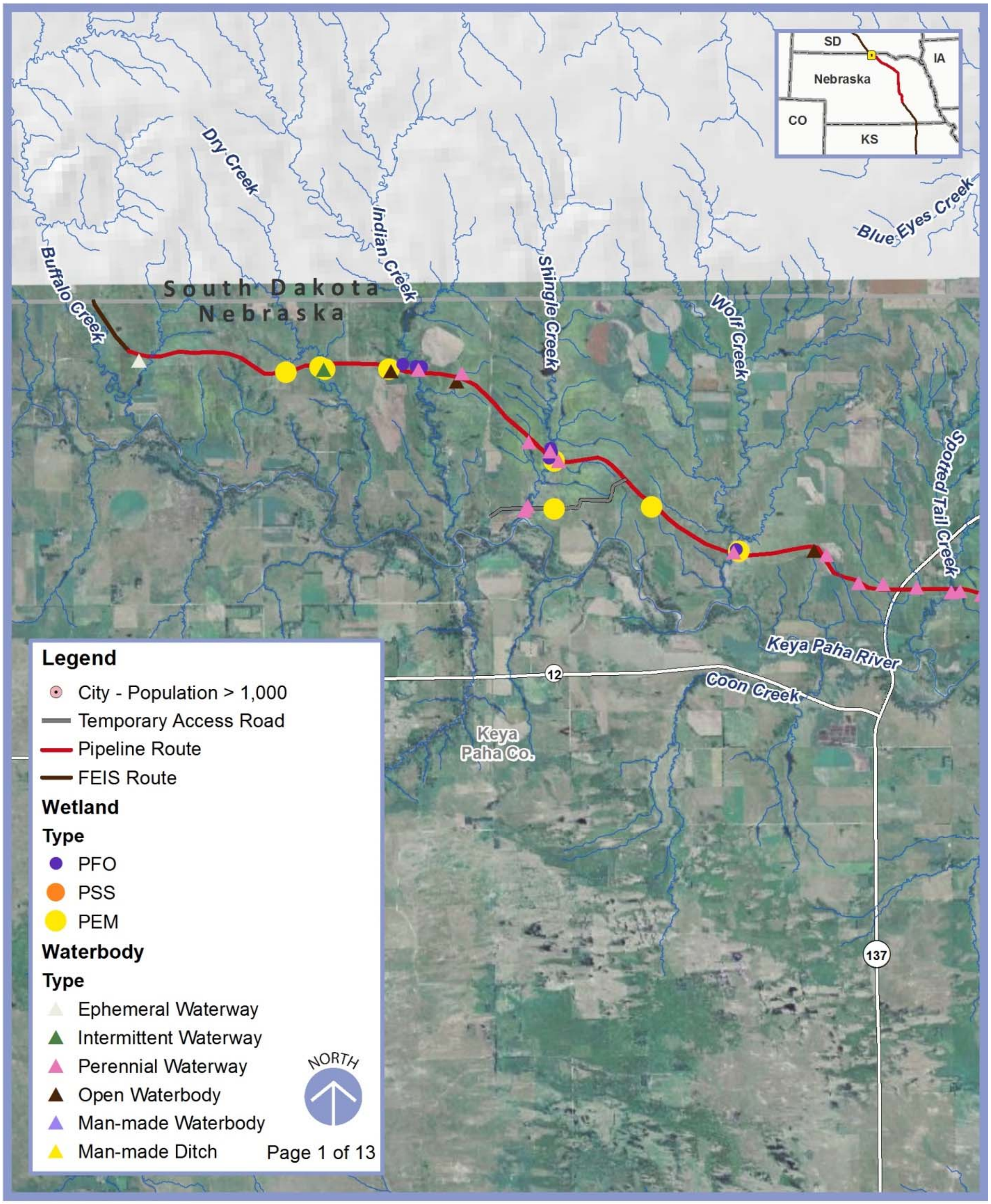
Attachment A

Abbreviations and Acronyms

Abbreviation or Acronym	Description
BUL	biologically unique landscape
CWA	Clean Water Act
DOS	U.S. Department of State
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GAP	National Gap Analysis Program
Keystone	TransCanada Keystone Pipeline, LP
NDEQ	Nebraska Department of Environmental Quality
NGPC	Nebraska Game and Parks Commission
NLCD	National Land Cover Data
NWI	National Wetland Inventory
ROW	right-of-way
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Department of the Interior, U.S. Fish and Wildlife Service
USGS	U.S. Department of the Interior, U.S. Geological Survey

Attachment B

Wetlands Map Book



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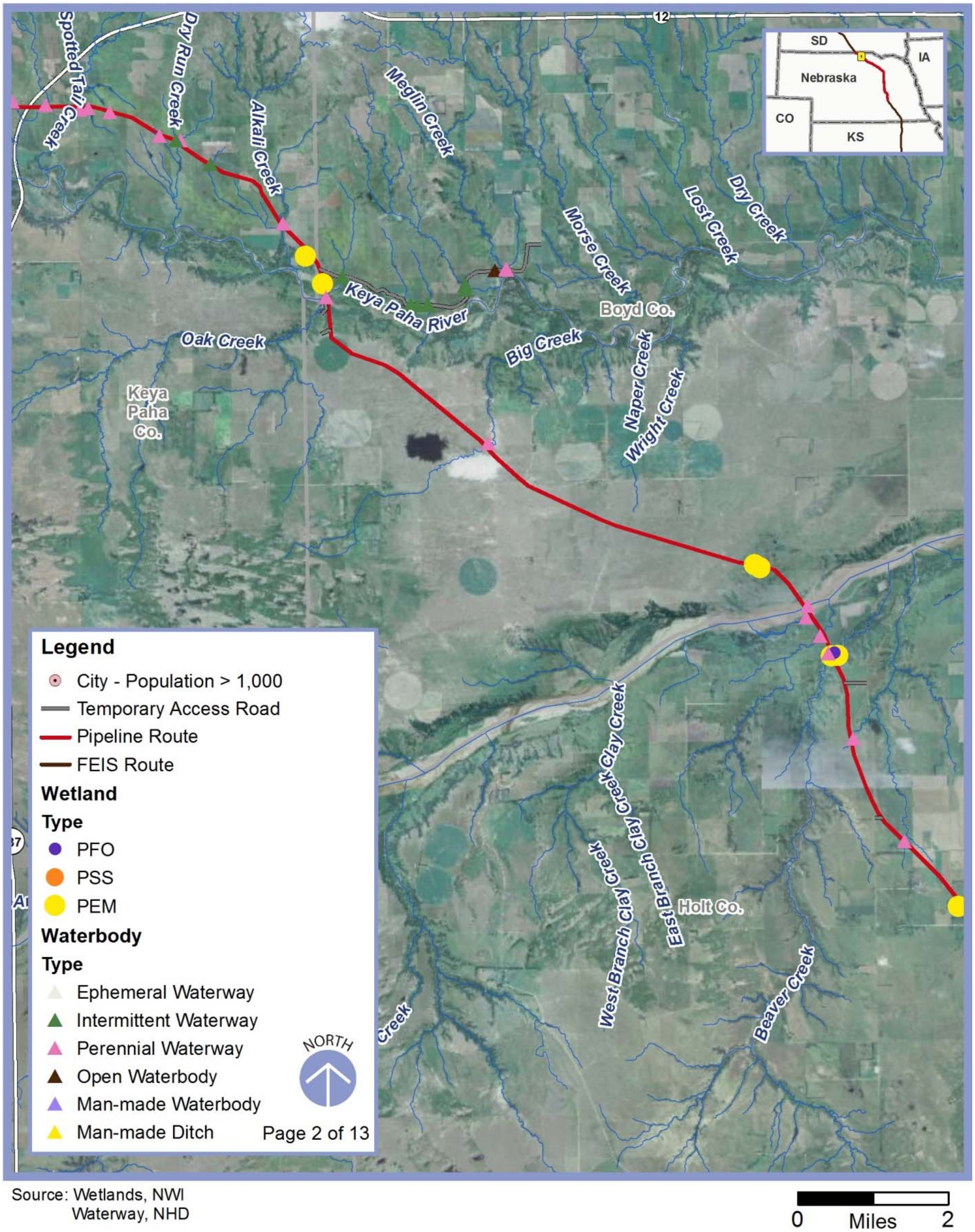
Waterway, NHD



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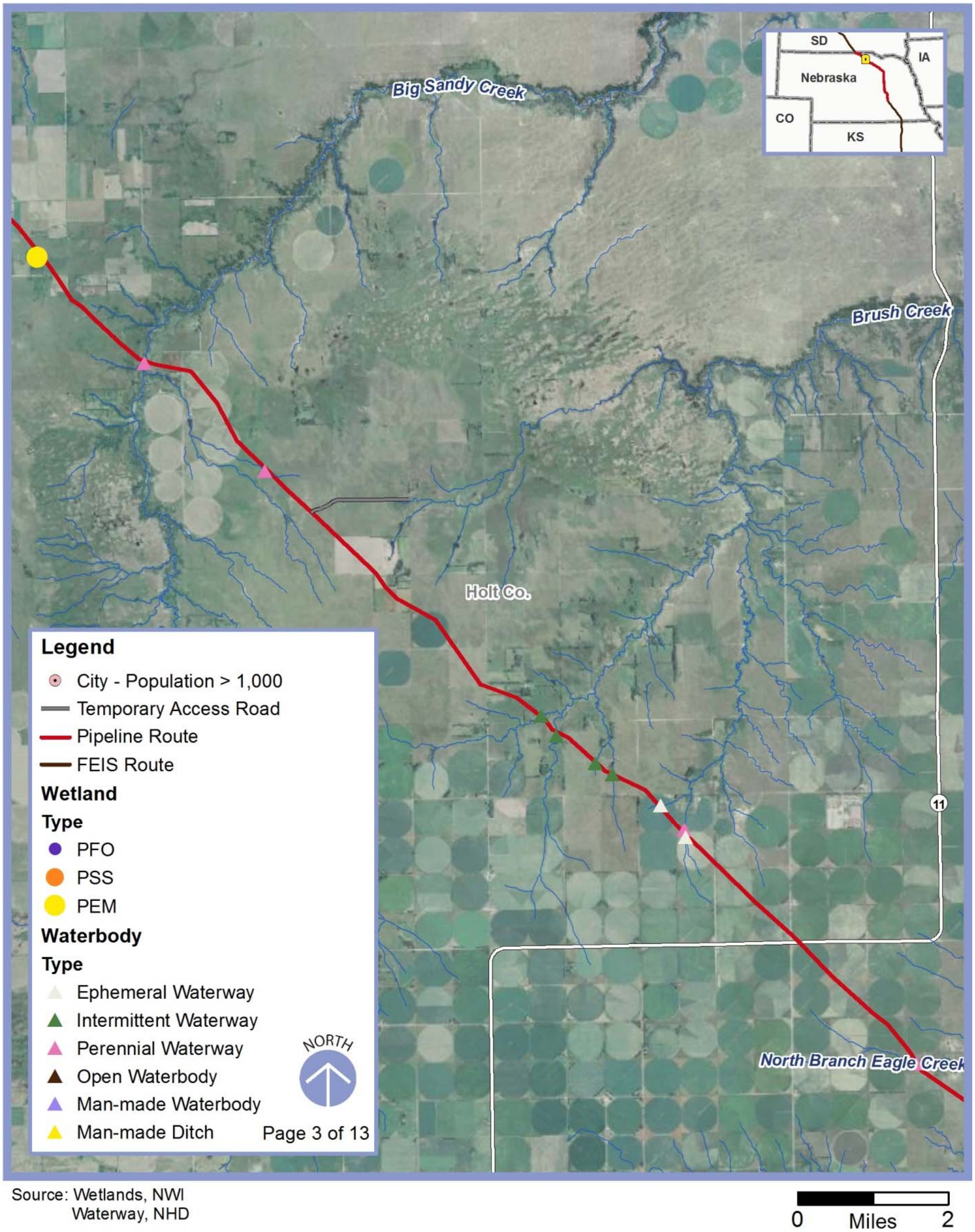

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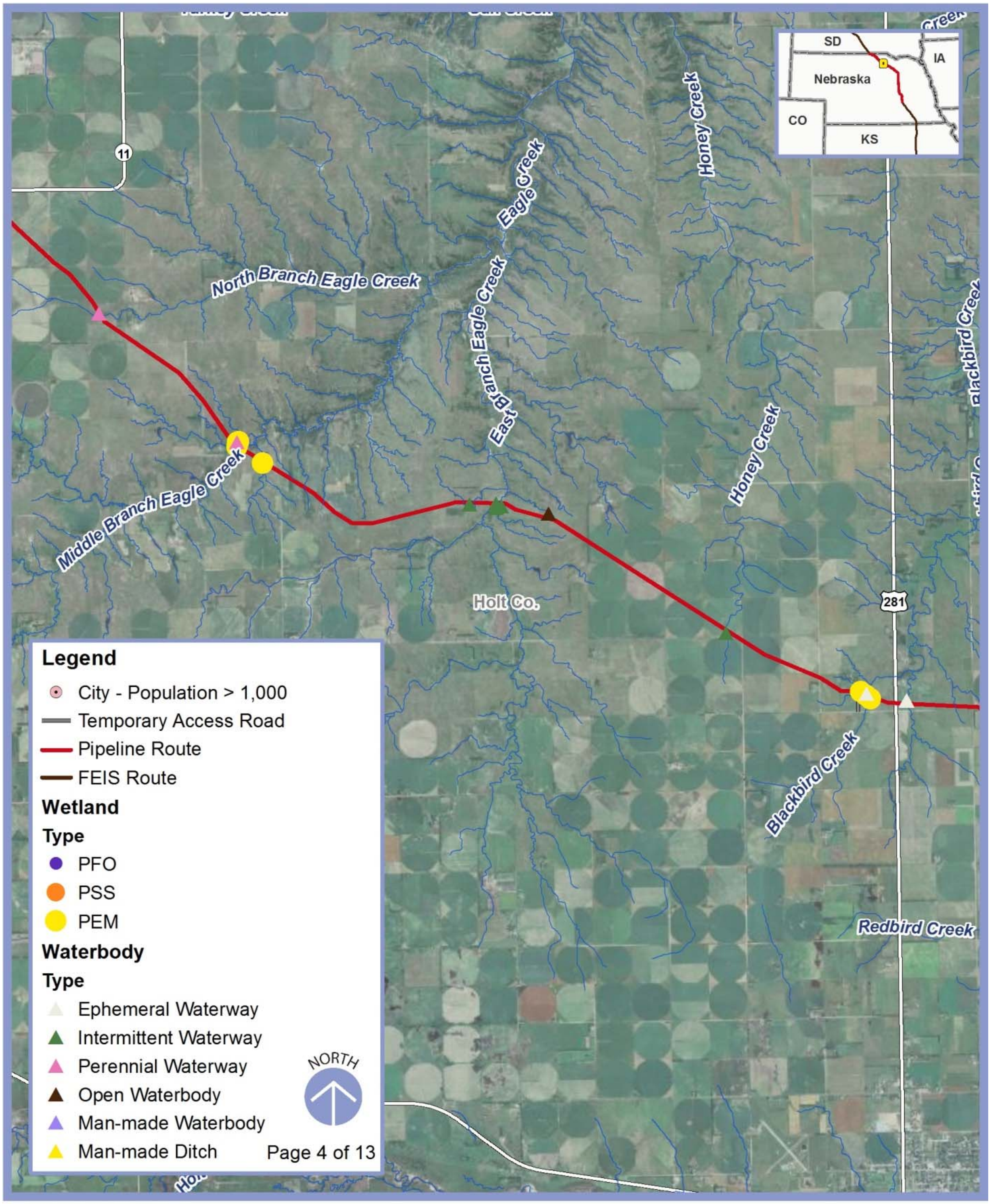

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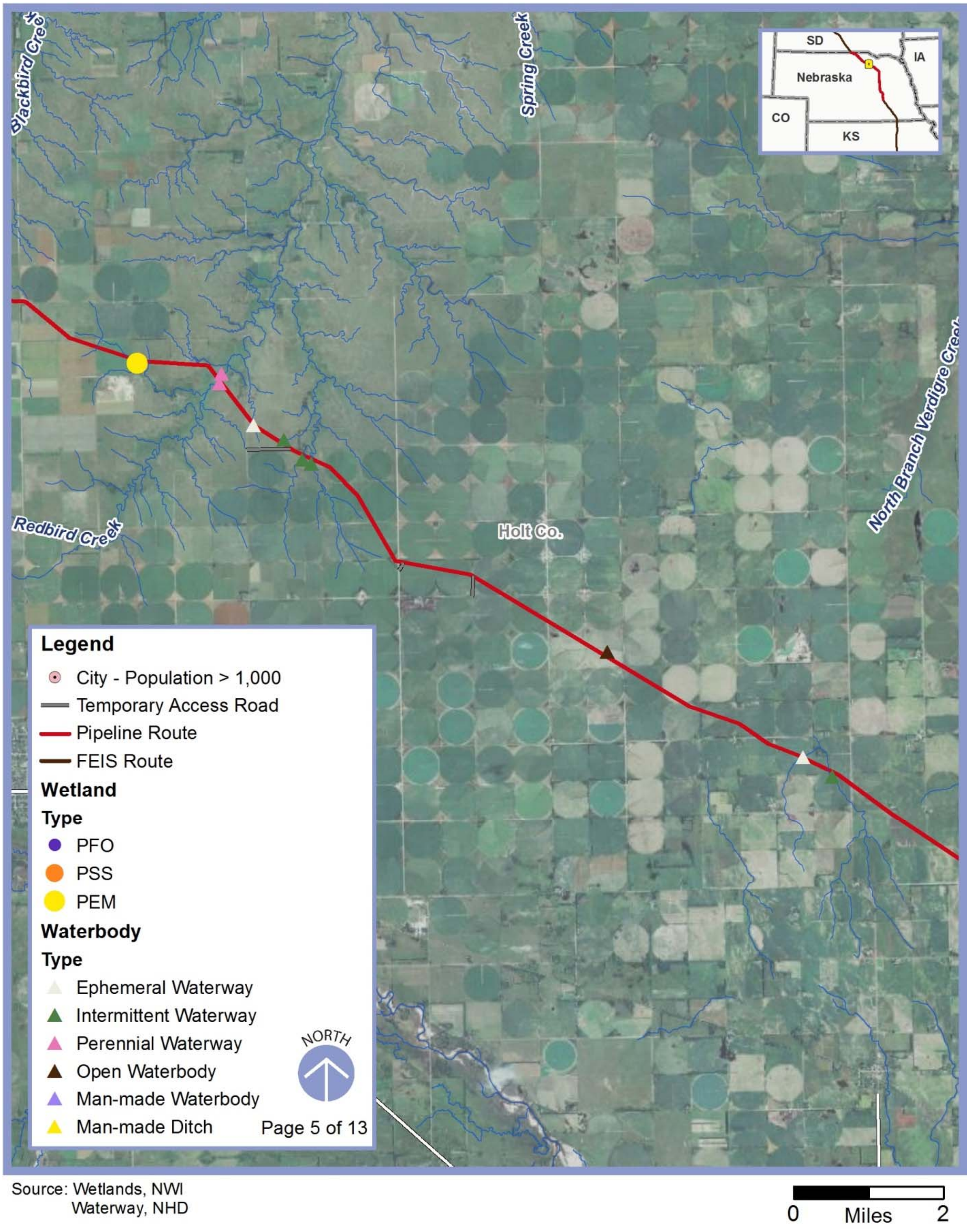

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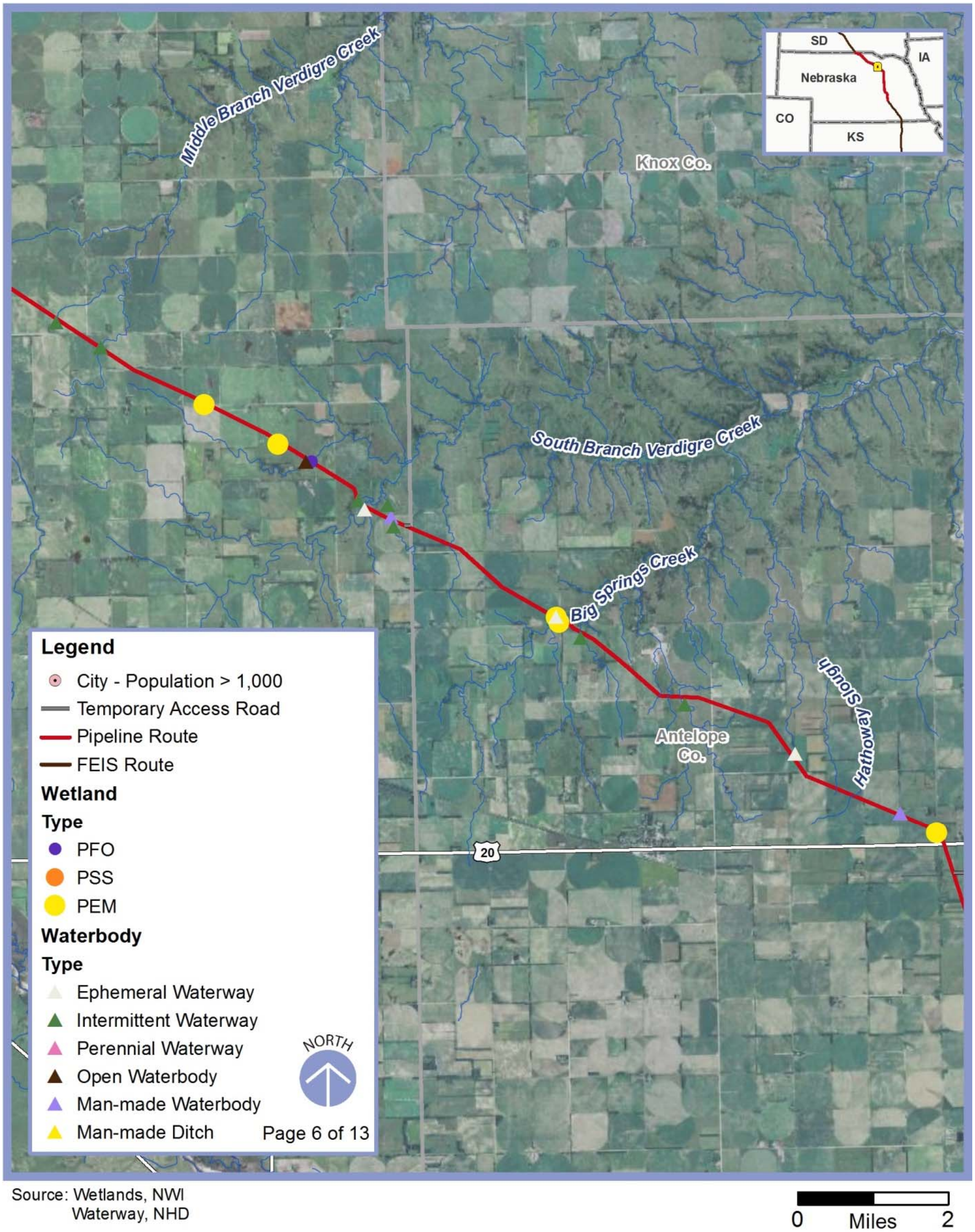

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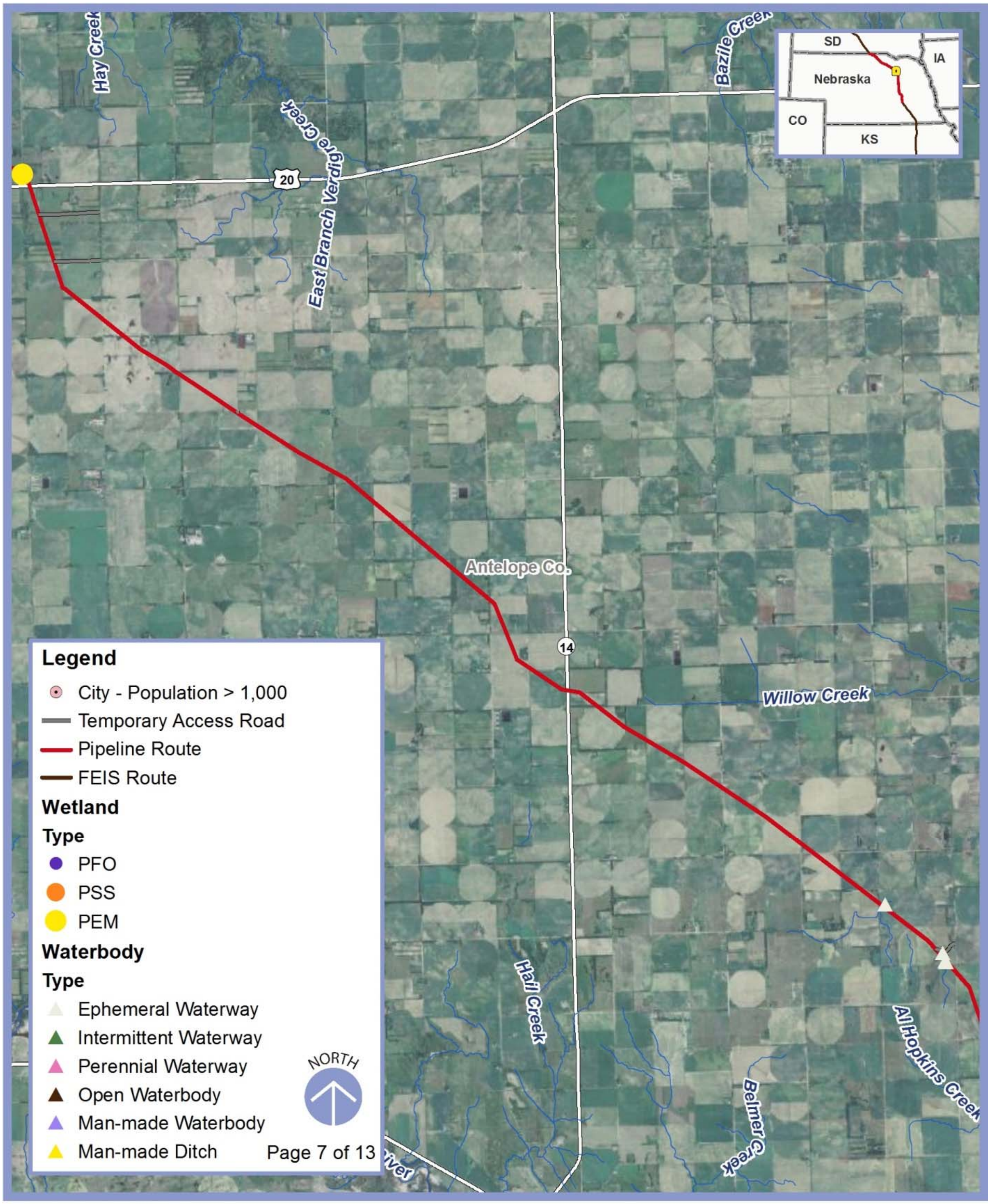

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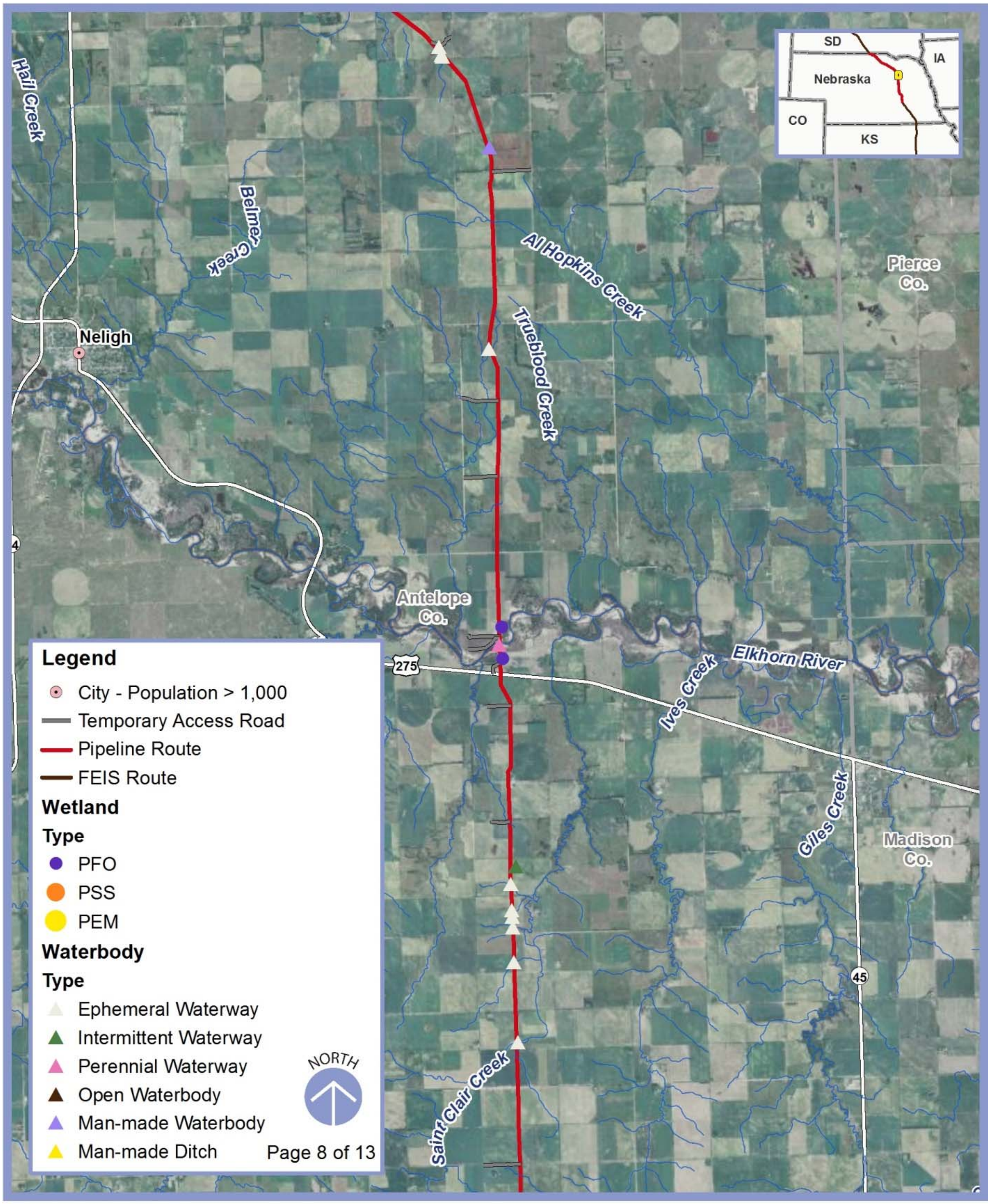

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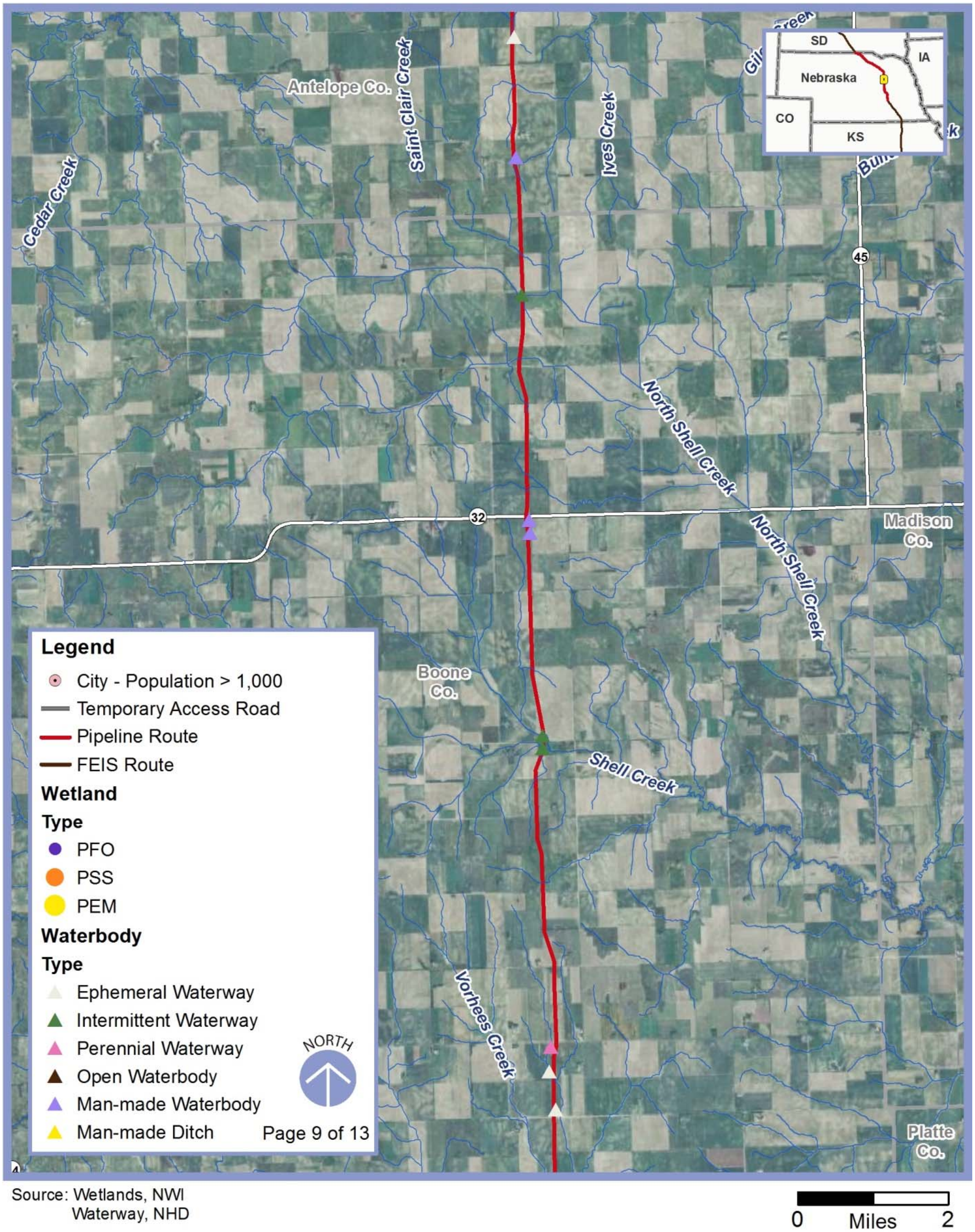

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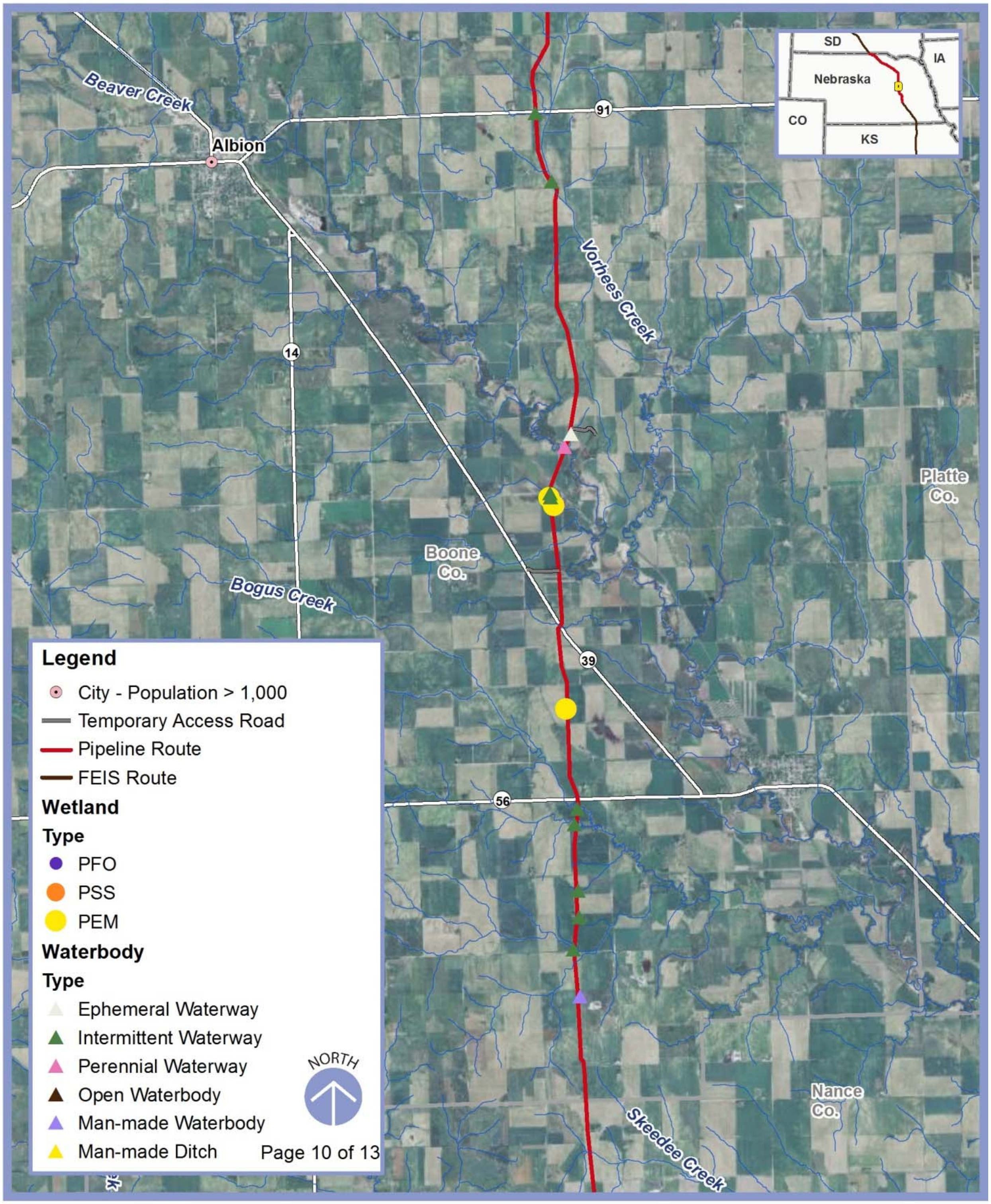

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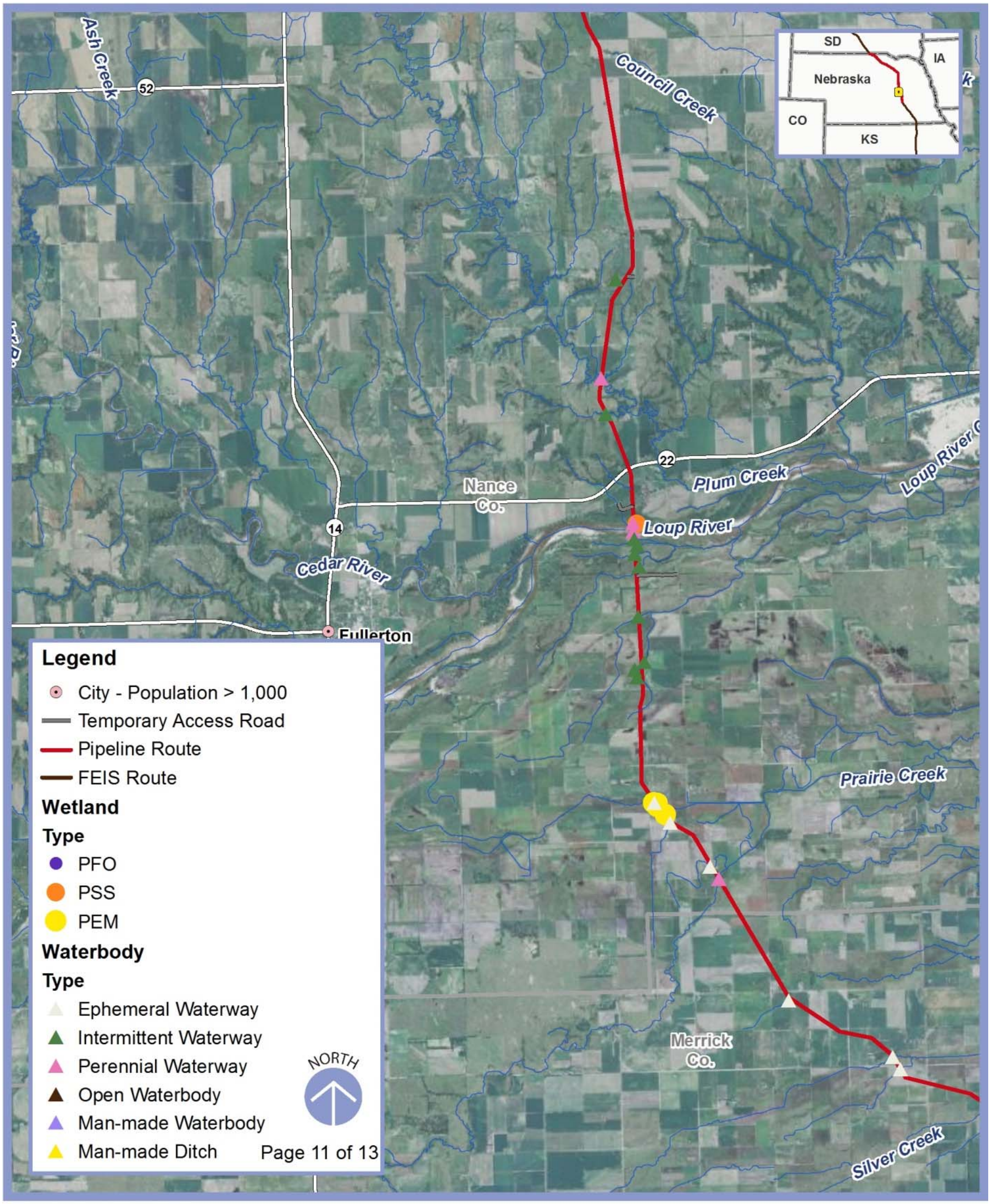

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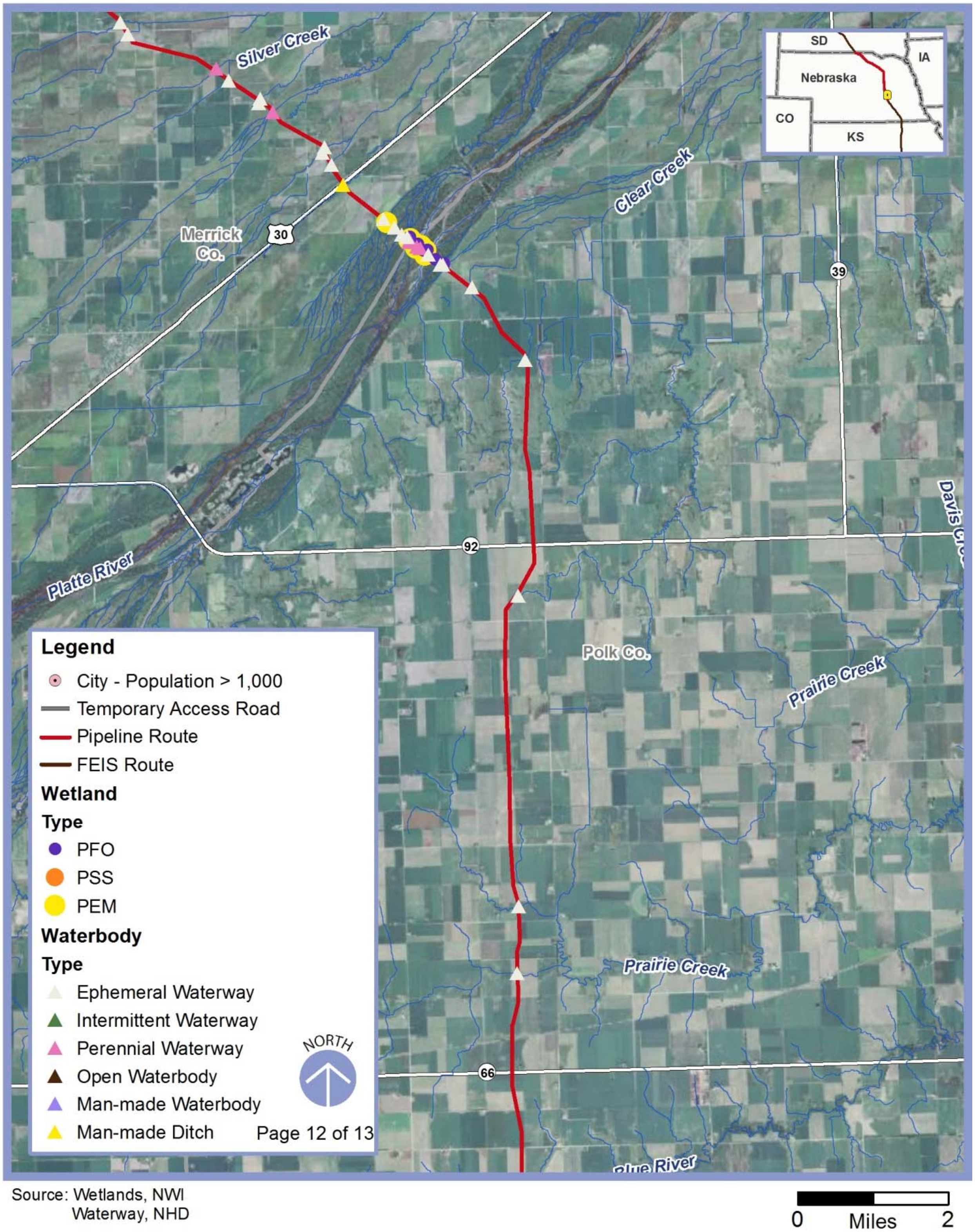

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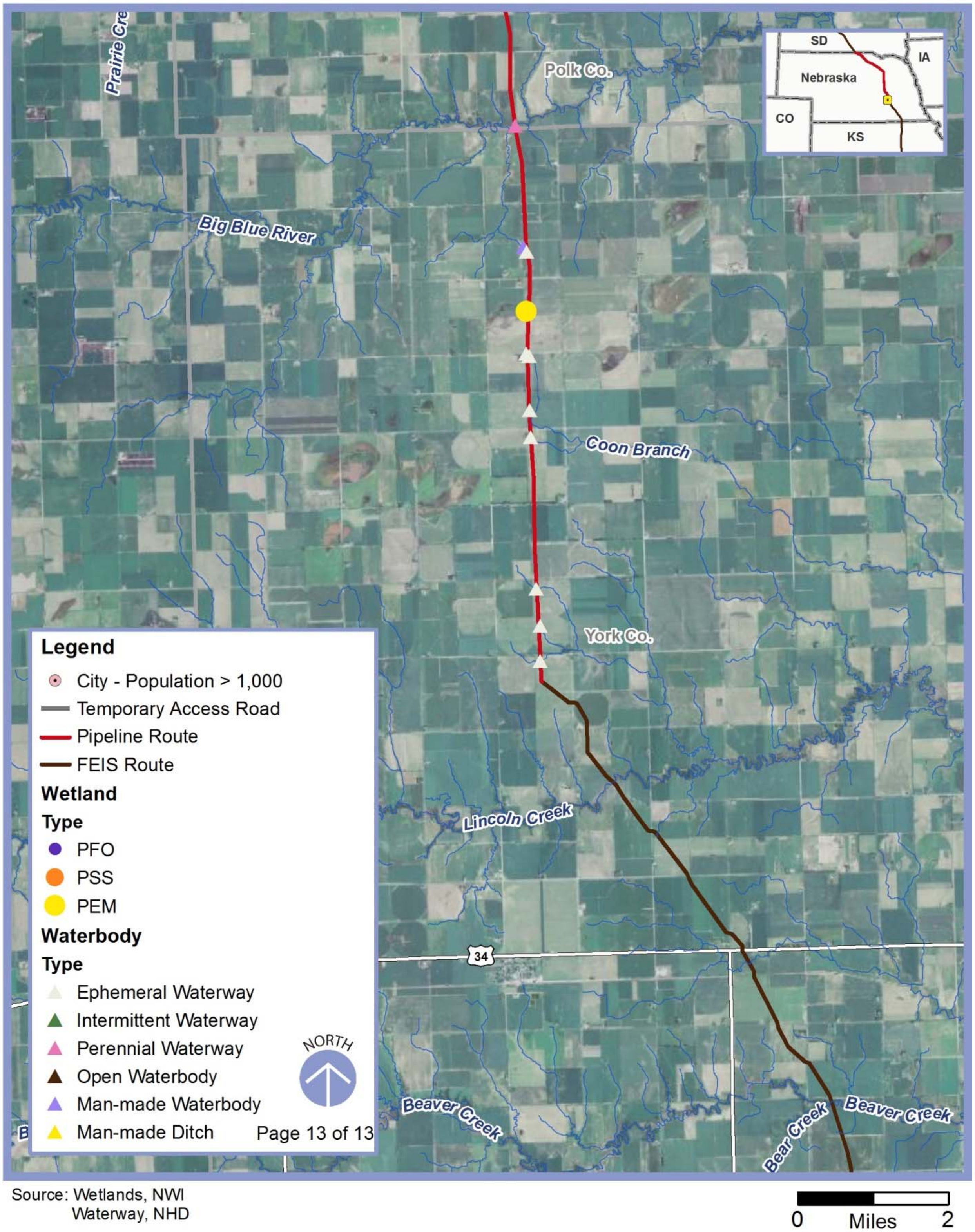

Source: Wetlands, NWI
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Appendix E.6

Terrestrial Vegetation

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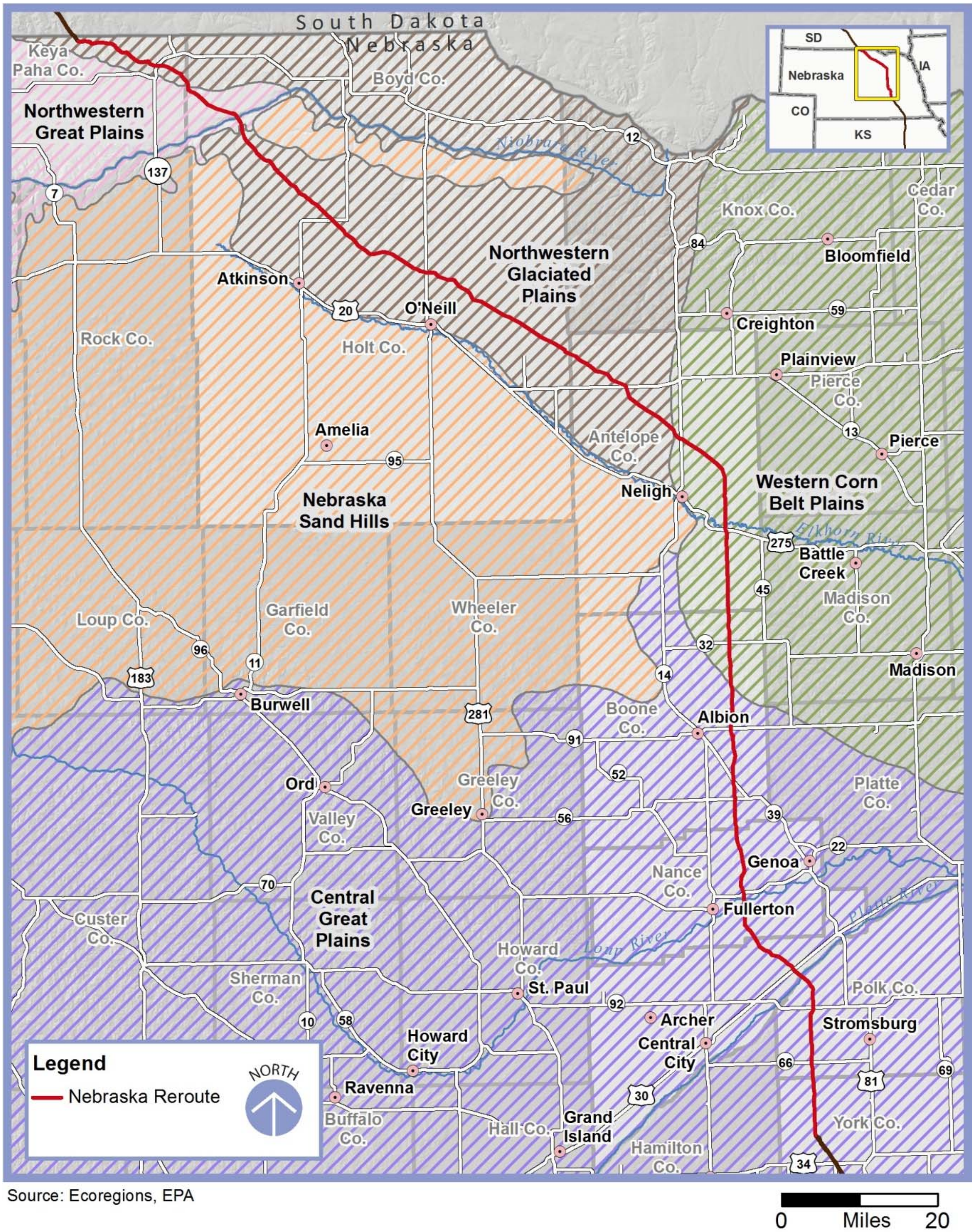
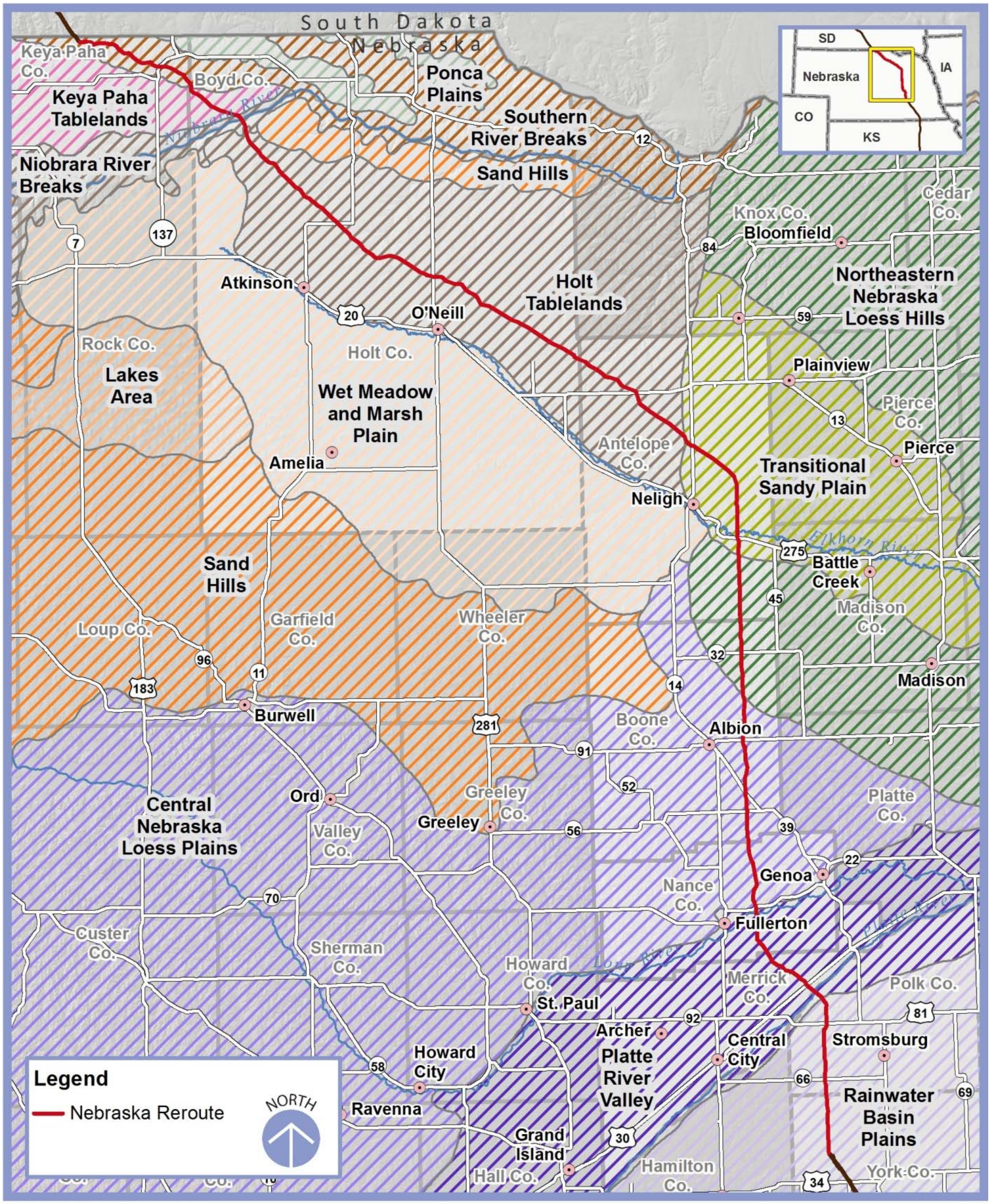
TERRESTRIAL VEGETATION

Figure E.6-1. Level III Ecoregions



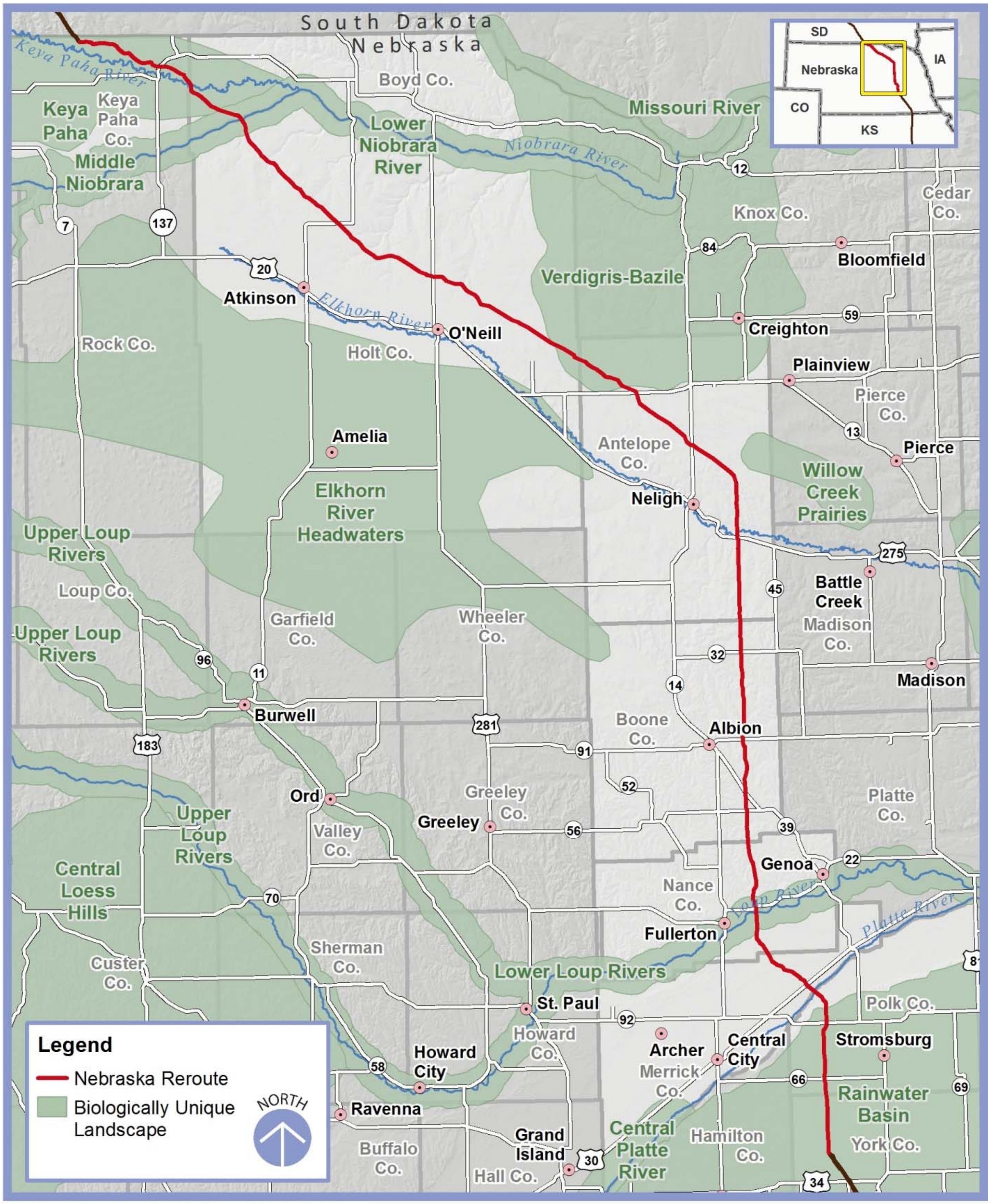
Source: Ecoregions, EPA

Figure E.6-2. Level IV Ecoregions



Source: Ecoregions, EPA

Figure E.6-3. Biologically Unique Landscapes



Source: Biologically Unique Landscapes, NNHP

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Appendix E.7

Wildlife

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APPENDIX E.7

WILDLIFE

Table E.7-1. Representative Game Wildlife and Furbearers Potentially Occurring in the Study Area

Wildlife Species	Habitat Type[a] Association						
	Cultivated Crops[b]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Mammals							
White-tailed deer *Odocoileus virginianus*	X	X	X	X	X	X	
Mule deer *Odocoileus hemionus*		X	X	X			
Pronghorn *Antilocapra americana*		X	X				
Cottontail rabbit *Sylvilagus floridanus*	X	X	X	X	X		
Coyote *Canis latrans*	X	X	X	X	X	X	
Opossum *Didelphis virginiana*		X	X	X	X		
Raccoon *Procyon lotor*	X	X	X	X	X	X	
Red fox *Vulpes vulpes*		X	X	X	X		
Least weasel *Mustela nivalis*	X	X	X	X			
Long-tailed weasel *Mustela frenata*	X	X	X	X	X		
Common muskrat *Ondatra zibethicus*					X	X	X
Nutria *Myocastor coypus*					X	X	X
American badger *Taxidea taxus*		X	X	X			
American beaver *Castor canadensis*					X	X	X
Gray squirrel *Sciurus carolinensis*				X	X		

Wildlife Species	Habitat Type[a] Association						
	Cultivated Crops[b]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Fox squirrel *Sciurus niger*		X	X	X			
Birds							
Canada goose *Branta canadensis*		X	X			X	X
Snow goose *Chen caerulescens*		X	X			X	X
Mallard *Anas platyrhynchos*							X
Gadwall *Anas strepera*							X
Green-winged teal *Anas crecca*							X
American wigeon *Anas americana*							X
Northern pintail *Anas acuta*							X
Redhead *Aythya americana*							X
Lesser scaup *Aythya affinis*							X
Canvasback *Aythya valisineria*							X
Mourning dove *Zenaida macroura*	X	X	X	X	X		
Wild turkey *Meleagris gallopavo*		X	X	X			
Ring-necked pheasant *Phasianus colchicus*	X	X	X	X			
Northern bobwhite *Colinus virginianus*	X	X	X				

Sources: American Society of Mammologists (ASM), 2012; Cornell University, 2011; Ehrlich et al., 1988; Fry et al., 2011; Sibley, 2000; DOS, 2011.

[a] *Evergreen Forest is not included due to its very small area within the corridor.*

[b] *Wildlife included in this category are species that may be associated with rural residential or agricultural development as well as with crop habitats.*

[c] *Wildlife included in this category may not be strictly aquatic (e.g., soft-shell turtle) but are associated with habitats (rangeland, wetland or forest) immediately adjacent to bodies of open water.*

Table E.7-2. Representative Nongame Wildlife Potentially Occurring in the Study Area

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Mammals							
Northern pocket gopher *Thomomys talpoides*	X	X	X				
Woodchuck *Marmota monax*	X	X	X				
Ord's kangaroo rat *Dipodomys ordii*		X	X				
Plains pocket mouse *Perognathus flavescens*		X	X				
Prairie vole *Microtus ochrogaster*	X	X	X				
Meadow vole *Microtus pennsylvanicus*	X	X	X			X	
Deer mouse *Peromyscus maniculatus*	X	X	X	X	X	X	
Northern short-tailed shrew *Blarina brevicauda*	X	X	X	X	X	X	
Least shrew *Cryptotis parva*	X	X	X			X	
Hayden's shrew *Sorex haydeni*			X				
Black-tailed prairie dog *Cynomys ludovicianus*		X	X				
Thirteen-lined ground squirrel *Spermophilus tridecemlineatus*	X	X	X				
Least chipmunk *Tamias minimus*				X	X		
Big brown bat[d] *Eptesicus fuscus*	X	X	X				
Eastern red bat[d] *Lasiurus borealis*				X	X		
Hoary bat[d] *Lasirus cinereus*				X	X		
Little brown myotis[d] *Myotis lucifugus*	X			X	X		
Northern myotis[d] *Myotis septentrionalis*	X			X	X		

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Tri-colored bat[d] *Perimyotis subflavus*				X	X		
Reptiles							
Northern prairie lizard *Sceloporus undulatus*	X		X	X			
Six-lined racerunner *Cnemidophorus sexlineatus*			X	X			
Many-lined skink *Eumeces multivirgatus*			X	X			
Prairie skink *Eumeces septentrionalis*			X	X			
Lesser earless lizard *Holbrookia maculata*			X	X			
Northern prairie lizard *Sceloporus undulatus*	X		X	X	X		
Bullsnake *Pituophis catenifer sayi*	X		X	X	X		
Plains garter snake *Thamnophis radix*	X		X	X	X	X	
Fox snake *Elaphe vulpina*	X		X	X	X	X	
Northern water snake *Nerodia sipedon*						X	X
Green racer *Coluber constrictor*			X	X	X		
Red-sided garter snake *Thamnophis sirtalis parietalis*	X		X	X		X	
Western hognose snake *Heterodon nasicus*			X	X			
Eastern hognose snake *Heterodon platirhinos*				X	X		
Prairie rattlesnake *Crotalus viridis*			X	X			
Western milk snake *Lampropeltis triangulum*	X		X	X	X		
Spiny softshell *Apalone spinifera*							X
Blanding's turtle *Emydoidea blandingii*							X

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Snapping turtle *Chelydra serpentina*							X
Ornate box turtle *Terrapene ornata*			X	X			
Amphibians[e]							
Bull frog *Rana catesbeiana*	X					X	X
Northern cricket frog *Acris crepitans*	X					X	X
Northern leopard frog *Rana pipiens*	X					X	X
Plains leopard frog *Rana blairi*	X					X	X
Great Plains toad *Bufo cognatus*			X	X			
Great Plains narrowmouth toad *Gastrophryne olivacea*			X	X	X		
Woodhouse's toad *Bufo woodhousei*	X		X	X		X	
Western gray treefrog *Hyla chrysoscelis*				X	X		
Western striped chorus frog *Pseudacris triseriata*				X	X		
Tiger salamander *Ambystoma tigrinum*	X					X	X
Birds							
American crow *Corvus brachyrhynchos*	X		X	X	X		
Common grackle *Quiscalus quiscula*	X	X	X				
Great blue heron *Ardea herodias*						X	X
Little blue heron[f] *Egretta caerulea*						X	X
Long-billed curlew[f] *Numenius americanus*			X				
American bittern[f] *Botaurus lentiginosus*						X	

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Least bittern[f] *Ixobrychus exilis*						X	
Sora *Porzana carolina*						X	
Black tern[f] *Chlidonas niger*							X
Red-tailed hawk *Buteo jamaicensis*	X		X	X	X		
Swainson's Hawk[f] *Buteo swainsonii*	X		X	X	X		
Ferruginous hawk[f] *Buteo regalis*		X	X				
Turkey vulture *Cathartes aura*	X		X	X	X		
Burrowing owl[f] *Athene cunicularia*		X	X				
Short-eared owl[f] *Asio flammeus*	X	X	X				
Eastern screech owl *Megascops asio*				X	X		
Great-horned owl *Bubo virginianus*	X		X	X	X		
Upland sandpiper[f] *Bartramia longicauda*	X	X	X				
Western meadowlark *Sturnella neglecta*	X	X	X	X		X	
Loggerhead shrike[f] *Lanius ludovicianus*	X	X	X	X	X		
Bell's vireo[f] *Vireo bellii*			X	X	X		
Dickcissel[f] *Spiza americana*	X	X	X	X		X	
Field sparrow *Spizella pusilla*			X	X	X		
Grasshopper sparrow[f] *Ammodramus savannarum*		X	X				
Baird's sparrow *Ammodramus bairdii*		X	X				

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Lark sparrow *Chondestes grammacus*	X	X	X	X	X		
Song sparrow *Melospiza melodia*	X		X	X		X	
Lark bunting[f] *Calamospiza melanocorys*	X	X	X				
Bobolink *Dolichonyx oryzivorus*	X	X	X			X	
Brown-headed cowbird *Molothrus ater*	X	X	X	X	X	X	
Baltimore oriole *Icterus galbula*			X	X	X		
Red-winged blackbird *Agelaius phoeniceus*	X	X	X	X		X	X
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	X		X	X		X	X
Eastern phoebe *Sayornis phoebe*	X		X	X	X		
Eastern kingbird *Tyrannus tyrannus*	X		X	X	X	X	
Scissor-tailed flycatcher[f] *Tyrranus forficatus*	X	X	X				
Scarlet tanager *Piranga olivacea*				X	X		
Blue grosbeak *Guiraca caerulea*				X	X		
Indigo bunting *Passerina cyanea*				X	X		
Red-headed woodpecker[f] *Melanerpes erythrocephalus*	X			X	X		
Northern flicker *Colaptes auratus*				X	X		
House wren *Troglodytes aedon*	X			X	X		
Marsh wren *Cistothorus palustris*						X	
Yellow warbler *Dendroica petechia*				X	X		

Wildlife Species	Habitat Type Association						
	Cultivated Crops[a]	Hay/ Pastureland	Herbaceous Rangeland	Deciduous Forest[b]	Forested Wetland	Emergent Herbaceous Wetland	Open Water[c]
Black-and-white warbler *Mniotilta varia*				X	X		
Yellow-billed cuckoo *Coccyzus americanus*				X	X		
Black-billed cuckoo[f] *Coccyzus erythropthalmus*				X	X		
American kestrel *Falco sparverius*	X	X	X	X			
Killdeer *Charadrius vociferus*	X		X			X	X
Sprague's Pipit *Anthus spargueii*			X				

Sources: Ehrlich et al., 1988; Fry et al., 2011; Harvey et al., 1999; Lynch., 1985; Schmidly, 2004; Sibley, 2000; Cornell University 2012; University of Nebraska, Lincoln 2012; DOS, 2011.

[a] *Wildlife included in this category are species that may be associated with rural residential or agricultural development, as well as with crop habitats.*

[b] *Species potentially occurring in wooded shelterbelts are included in this habitat type.*

[c] *Wildlife included in this category may not be strictly aquatic (e.g., soft-shell turtle), but require open water in association with habitats (rangeland, wetland, or forest) immediately adjacent to bodies of open water.*

[d] *Habitat association refers to roosting or hibernating habitat.*

[e] *Association with cultivated crop and rangeland/pasture habitats where irrigation or rain creates ponding during the breeding season.*

[f] *Migratory Bird Treaty Act bird species of conservation concern potentially breeding in the Study Area.*

Table E.7-3. Tier I At-Risk Species Potentially Occurring in Biologically Unique Landscapes Crossed By the Nebraska Reroute

Species Name[a]	Lower Loup Rivers	Verdigris-Bazile	Lower Niobrara	Keya Paha
Birds				
Baird's sparrow *Ammodramus bairdii*	X	X	X	X
Bell's vireo	X		X	X
Burrowing owl		X		X
Buff-breasted sandpiper *Tryngites subruficollis*		X		
Greater prairie chicken *Tympanuchus cupido*		X		X
Long-billed curlew			X	
Wood thrush *Hylocichla mustelina*		X	X	
Mammals				
Northern river otter *Lontra canadensis*	X		X	
Plains pocket mouse	X	X		
Bailey's eastern woodrat *Neotoma floridana baileyi*				X
Reptiles				
Blanding's turtle *Emydoidea blandingii*	X			
Insects				
Regal frittilary *Speyeria idalia*	X	X	X	X
Iowa skipper *Atrytone arogos iowa*		X	X	X
Ottoe skipper *Hesperia ottoe*	X		X	

Source: Schneider et al. 2011
Notes:
[a] *Scientific names of some species are already included in previous tables.*

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Attachment A

Tier II At-Risk Species

Appendix 9: Tier II at-risk species.

Tier II species include those that did not meet the Tier I criteria but were ranked by the Nebraska Natural Heritage Program as either State Critically Imperiled (S1), State Imperiled (S2) or State Vulnerable (S3) (see appendix 4 for explanation of ranks). Because of the large number of at-risk plant species, only those species listed as S1 or S2 are included in the following list. The Tier II list is used to help prioritize conservation planning/actions and does not have legal or regulatory ramifications. Tier II species are typically those that are not at-risk from a global or national perspective but are rare or imperiled within Nebraska. Conservation of these species is needed to ensure they remain a part of Nebraska's flora and fauna.

During the development of the Nebraska Natural Legacy Project, the "S-Ranks" were reviewed and revised for amphibians, birds, mammals, fish, reptiles, mollusks, plants and a limited number of insects.

The Tier II at-risk species lists will be periodically reviewed and revised by taxon experts. This revision will occur on an on-going basis as new information on the abundance, distribution, and population trends becomes available, with an overall review at least every five years. The Tier II list was reviewed and revised with input from taxon experts in workshops held in 2010.

Common Name	Scientific Name	Grank	Srank
Amphibians			
American Toad	*Anaxyrus americanus*	G5	S1
Great Plains Narrowmouth Toad	*Gastrophryne olivacea*	G5	S2
Smallmouth Salamander	*Ambystoma texanum*	G5	S1
Birds			
Acadian Flycatcher	*Empidonax virescens*	G5	S2?
American Wigeon	*Anas americana*	G5	S2
American Woodcock	*Scolopax minor*	G5	S3
Bald Eagle	*Haliaeetus leucocephalus*	G5	S3
Barn Owl	*Tyto alba*	G5	S3
Black-and-white Warbler	*Mniotilta varia*	G5	S3
Black-billed Magpie	*Pica hudsonia*	G5	S3
Black-crowned Night-Heron	*Nycticorax nycticorax*	G5	S3
Black-necked Stilt	*Himantopus mexicanus*	G5	S3
Black Tern	*Chlidonias niger*	G4	S3
Brewer's Blackbird	*Euphagus cyanocephalus*	G5	S2
Brown Creeper	*Certhia americana*	G5	S2
Canvasback	*Aythya valisineria*	G5	S3
Carolina Wren	*Thryothorus ludovicianus*	G5	S2
Cassin's Kingbird	*Tyrannus vociferans*	G5	S3
Cassin's Sparrow	*Aimophila cassinii*	G5	S3
Chuck-will's-widow	*Caprimulgus carolinensis*	G5	S1
Cinnamon Teal	*Anas cyanoptera*	G5	S1S2
Clark's Grebe	*Aechmophorus clarkii*	G5	S2
Clark's Nutcracker	*Nucifraga columbiana*	G5	S1

Common Name	Scientific Name	Grank	Srank
Cordilleran Flycatcher	*Empidonax occidentalis*	G5	S1
Dark-eyed Junco	*Junco hyemalis*	G5	S1
Forster's Tern	*Sterna forsteri*	G5	S3
Golden Eagle	*Aquila chrysaetos*	G5	S3
Kentucky Warbler	*Geothlypis formosa*	G5	S3
King Rail	*Rallus elegans*	G4	S1
Lesser Scaup	*Aythya affinis*	G5	S3
Lewis’s Woodpecker	*Melanerpes lewis*	G4	S1
Louisiana Waterthrush	*Parkesia motacilla*	G5	S1
Merlin	*Falco columbarius*	G5	S1
Mississippi Kite	*Ictinia mississippiensis*	G5	S1
Northern Saw-whet Owl	Aegolius acadicus	G5	SNR
Peregrine Falcon	*Falco peregrinus*	G4	S3
Pileated Woodpecker	*Dryocopus pileatus*	G5	S1
Pine Siskin	*Spinus pinus*	G5	S3
Plumbeous Vireo	*Vireo plumbeus*	G5	S2
Prairie Falcon	*Falco mexicanus*	G5	S1
Prothonotary Warbler	*Protonotaria citrea*	G5	S2
Pygmy Nuthatch	*Sitta pygmaea*	G5	S3
Red-shouldered Hawk	*Buteo lineatus*	G5	S1
Ruby-throated Hummingbird	*Archilochus colubris*	G5	S3
Savannah Sparrow	*Passerculus sandwichensis*	G5	S3
Sandhill Crane	*Grus canadensis*	G5	S3
Scissor-tailed Flycatcher	*Tyrannus forficatus*	G5	S3
Sedge Wren	*Cistothorus platensis*	G5	S3
Sharp-shinned Hawk	*Accipiter striatus*	G5	S1
Snowy Plover	*Charadrius nivosus*	G4	S1
Summer Tanager	*Piranga rubra*	G5	S4
Swainson's Hawk	*Buteo swainsoni*	G5	S3
Swamp Sparrow	*Melospiza georgiana*	G5	S3
Townsend's Solitaire	*Myadestes townsendi*	G5	S2
Tufted Titmouse	*Baeolophus bicolor*	G5	S3
Violet-green Swallow	*Tachycineta thalassina*	G5	S3
Western Grebe	*Aechmophorus occidentalis*	G5	S3
Whip-poor-will	*Caprimulgus vociferus*	G5	S3
White-eyed Vireo	*Vireo griseus*	G5	S2
White-faced Ibis	*Plegadis chihi*	G5	S3
White-throated Swift	*Aeronautes saxatalis*	G5	S3
Wilson’s Snipe	*Gallinago delicata*	G5	S2
Yellow-throated Vireo	*Vireo flavifrons*	G5	S3
Yellow-throated Warbler	*Setophaga dominica*	G5	S1

Fish

American Eel	*Anguilla rostrata*	G4	SNR
Black Buffalo	*Ictiobus niger*	G5	S2
Blacknose Dace	*Rhinichthys atratulus*	G5	S2
Blackside Darter	*Percina maculata*	G5	S1
Bluntnose Minnow	*Pimephales notatus*	G5	S3
Bowfin	*Amia calva*	G5	S1

Common Name	Scientific Name	Grank	Srank
Burbot	*Lota lota*	G5	S1
Chestnut Lamprey	*Ichthyomyzon castaneus*	G4	S1
Common Shiner	*Luxilus cornutus*	G5	S2
Flathead Chub	*Platygobio gracilis*	G5	S5
Lake Chub	*Couesius plumbeus*	G5	S1
Paddlefish	*Polyodon spathula*	G4	S2
Pearl Dace	*Margariscus margarita*	G5	S3
Plains Minnow	*Hybognathus placitus*	G4	S4
Silver Lamprey	*Ichthyomyzon unicuspis*	G5	S1
Tadpole Madtom	*Noturus gyrinus*	G5	S3
Trout-Perch	*Percopsis omiscomaycus*	G5	S1
Western Silvery Minnow	*Hybognathus argyritis*	G4	S?

Mammals

Black-tailed Jackrabbit	*Lepus californicus*	G5	S?
Bushy-tailed Woodrat	*Neotoma cinerea*	G5	S3
Dwarf Shrew	*Sorex nanus*	G4	S1
Eastern Chipmunk	*Tamias striatus*	G5	S1
Eastern Gray Squirrel	*Sciurus carolinensis*	G5	S3
Eastern Pipistrelle	*Pipistrellus subflavus*	G5	S1
Eastern Spotted Skunk	*Spilogale putorius*	G5	S1
Eastern Woodrat	*Neotoma floridana*	G5	S3
Evening Bat	*Nycticeius humeralis*	G5	S3
Hispid Cotton Rat	*Sigmodon hispidus*	G5	S3
Least Chipmunk	*Tamias minimus*	G5	S3
Long-legged Myotis	*Myotis volans*	G5	S1
Long-tailed Weasel	*Mustela frenata*	G5	S2
Merriam's Shrew	*Sorex merriami*	G5	S1
Mountain Lion	*Felis concolor*	G5	S1
Northern Myotis	*Myotis septentrionalis*	G4	S3
Olive-backed Pocket Mouse	*Perognathus fasciatus*	G5	S3
Silky Pocket Mouse	*Perognathus flavus*	G5	S?
Townsend’s Big-eared Bat	*Corynorhinus townsendii*	G4	S1
White-tailed Jackrabbit	*Lepus townsendii*	G5	S?
Woodland Vole	*Microtus pinetorum*	G5	S3

Reptiles

Copperhead	*Agkistrodon contortrix*	G5	S2
Eastern Glossy Snake	*Arizona elegans*	G5	S1
Eastern Hognose Snake	*Heterodon platirhinos*	G5	S2?
Five-lined Skink	*Eumeces fasciatus*	G5	S1
Graham's Crayfish Snake	*Regina grahamii*	G5	S2
Mountain Short-horned Lizard	*Phrynosoma hernandesi*	G5	S3
Plains Blackhead Snake	*Tantilla nigriceps*	G5	S1
Prairie Kingsnake	*Lampropeltis calligaster*	G5	S2
Redbelly Snake	*Storeria occipitomaculata*	G5	S2
Red-eared Slider	*Trachemys scripta elegans*	G5T5	S?

Common Name	Scientific Name	Grank	Srank
Slender Glass Lizard	*Ophisaurus attenuatus*	G5	S1
Smooth Green Snake	*Liochlorophis vernalis*	G5	S1
Smooth Soft-shelled Turtle	*Apalone mutica*	G5	S3?
Speckled Kingsnake	*Lampropeltis holbrooki*	G5	S1
Terrestrial Garter Snake	*Thamnophis elegans*	G5	S2?
Western Ribbon Snake	*Thamnophis proximus*	G5	S2
Western Worm Snake	*Carphophis vermis*	G5	S2

Insects

Common Name	Scientific Name	Grank	Srank
A Grasshopper	*Encoptolophus subgracilis*	G5	S1
A Mayfly	*Apobaetis lakota*	G2G3	SNR
A Mayfly	*Paraleptophlebia gregalis*	G3G4	SNR
A Mayfly	*Brachycercus nasutus*	G3G4	SNR
A Mayfly	*Cercobrachys fox*	G3G4	SNR
A Scarab Beetle	*Rhyssemus neglectus*	GNR	S1
A Stonefly	*Perlesta golconda*	G2G3	SNR
Acadian Hairstreak	*Satyrium acadicum*	G5	S3
Acastus Checkerspot	*Chlosyne acastus*	G4G5	S1
Afranius Duskywing	*Erynnis afranius*	G5	S2
American Copper	*Lycaena phlaeas*	G5	S1S2
Anicia Checkerspot	*Euphydryas anicia*	G5	S3
Anise Swallowtail	*Papilio zelicaon*	G5	S3
Aphrodite Fritillary	*Speyeria aphrodite*	G5	S3
Arachne Checkerspot	*Poladryas arachne arachne*	G5TNR	S1
Arogos Skipper	*Atrytone arogos*	G3	S1S2
Arrowhead Blue	*Glaucopsyche piasus*	G5	S1
Badlands Tiger Beetle	*Cicindela decemnotata*	G4	SNR
Banded Hairstreak	*Satyrium calanus*	G5	S2S3
Beautiful Tiger Beetle	*Cicindela pulchra*	G4	S1
Broad-winged Skipper	*Poanes viator viator*	G5T4	S2
Byssus Skipper	*Problema byssus kumskaka*	G3G4	S1
Callippe Fritillary	*Speyeria callippe*	G5	S1
Cobweb Skipper	*Hesperia metea*	G4G5	S1
Common Branded Skipper	*Hesperia colorado*	G5	S3
Coral Hairstreak	*Satyrium titus*	G5	S3
Coronis Fritillary	*Speyeria coronis*	G5	S3
Creamy Marblewing	*Euchloe ausonides palaeoreios*	G5TNR	S1
Creeping Water Bug	*Ambrysus mormon*	GNR	S2
Crossline Skipper	*Polites origenes*	G5	S3
Delaware Skipper	*Atrytone logan*	G5	S3
Delilah Underwing	*Catocala delilah*	G3G4	SNR
Desert Forktail	*Ischnura barberi*	G4	S1
Dion Skipper	*Euphyes dion*	G4	S2
Dogface	*Colias cesonia*	G5	S3
Dotted Blue	*Euphilotes ancilla*	G5	S1S2
Dun Skipper	*Euphyes vestris*	G5	S3
Dusted Skipper	*Atrytonopsis hianna*	G4G5	S3
Elusive Clubtail	*Gomphus notatus*	G3	SNR

Common Name	Scientific Name	Grank	Srank
Field Crescentspot	*Phyciodes pratensis*	G5	S1
Fiery Skipper	*Hylephila phyleus*	G5	S3
Fulvia Checkerspot	*Thessalia fulvia*	G5	S2S3
Garita Skipperling	*Oarisma garita*	G5	S2
Gray Comma	*Polygonia progne*	G4G5	S3
Great Plains Giant Tiger Beetle	*Amblycheila cylindriformis*	G4G5	S1
Green Skipper	*Hesperia viridis*	G5	S1
Greenish Blue	*Plebejus saepiolus*	G5	S1
Grizzly Spur-throat Grasshopper	*Melanoplus punctulatus*	G4	S1
Habilis Underwing	*Catocala habilis*	G5	S1
Hairy Duskywing	*Erynnis persius fredericki*	G5TNR	S2
Harvester	*Feniseca tarquinius*	G4	S2
Henry's Elfin	*Incisalia henrici*	G5	S2
Hickory Hairstreak	*Satyrium caryaevorum*	G4	S1S2
Hoary Edge	*Achalarus lyciades*	G5	S1
Hobomok Skipper	*Poanes hobomok*	G5	S3S4
Horace's Duskywing	*Erynnis horatius*	G5	S3
Indra Swallowtail	*Papilio indra*	G5	S1S2
Juvenal's Duskywing	*Erynnis juvenalis*	G5	S2S3
Large Heath	*Coenonympha tullia*	G5	S2
Little Glassywing	*Pompeius verna*	G5	S3
Long Dash	*Polites mystic*	G5	S3
Mead's Wood Nymph	*Cercyonis meadii*	G5	S1
Milbert's Tortoiseshell	*Nymphalis milberti*	G5	S3
Mormon Fritillary	*Speyeria mormonia kimemela*	G5	S1
Mulberry Wing	*Poanes massasoit*	G4	S?
Mylitta Crescent	*Phyciodes mylitta*	G5	S1
Northern Broken Dash	*Wallengrenia egeremet*	G5	S3
Northern Crescent	*Phyciodes cocyta*	G5	S1S2
Northern Pearlyeye	*Enodia anthedon*	G5	S3
Olive Hairstreak	*Mitoura grynea*	G5	S3
Orange Roadside Skipper	*Amblyscirtes simius*	G4	S1
Oslar's Roadside Skipper	*Amblyscirtes oslari*	G4	S2
Pahaska Skipper	*Hesperia pahaska*	G5	S2
Painted Crescentspot	*Phyciodes pictus*	G5	S2
Pallid Crescentspot	*Phyciodes pallidus*	G5	S1
Pawnee Stone	*Perlesta xube*	G2	S2?
Phoebus' Parnassian	*Parnassius smintheus*	G5	S1
Plains Gray Skipper	*Polites rhesus*	G4	S2
Prairie Long-lipped Tiger Beetle	*Cicindela nebraskana*	G4	S1
Purplish Copper	*Lycaena helloides*	G5	S3
Queen Alexandra's Sulphur	*Colias alexandra*	G5	S3
Residua Underwing	*Catocala residua*	G5	S1
Riding's Satyr	*Neominois ridingsii*	G5	S2
Robinson's Underwing	*Catocala robinsoni*	G4	S1
Ruddy Copper	*Lycaena rubida*	G5	S3
Salt Creek Grasshopper	*Trimerotropis salina*	G5	S2?
Scalloped Sootywing	*Staphylus hayhurstii*	G5	S3
Serene Underwing	*Catocala serena*	G5	S1

Common Name	Scientific Name	Grank	Srank
Shasta Blue	*Icaricia shasta*	G5	S2
Silver-bordered Fritillary	*Boloria selene*	G5	S2
Silvery Blue	*Glaucopsyche lygdamus*	G5	S3
Silvery Checkerspot	*Chlosyne nycteis*	G5	S3
Sleepy Duskywing	*Erynnis brizo*	G5	S2
Sleepy Orange	*Eurema nicippe*	G5	S2N
Small Wood Nymph	*Cercyonis oetus*	G5	S1
Smoky-eyed Brown	*Satyrodes eurydice fumosa*	G5T3T4	S3
Southern Cloudywing	*Thorybes bathyllus*	G5	S2
Strecker's Giant Skipper	*Megathymus streckeri*	G5	S3
Striped Hairstreak	*Satyrium liparops*	G5	S2
Tawny Emperor	*Asterocampa clyton*	G5	S2S3
Taxiles Skipper	*Poanes taxiles*	G5	S2S3
Uhler's Arctic	*Oeneis uhleri*	G5	S3
Uncas Skipper	*Hesperia uncas*	G5	S2
Weidemeyer's Admiral	*Limenitis weidemeyerii*	G5	S3
Western Black Swallowtail	*Papilio bairdii*	G5T5	S3
Western Green Hairstreak	*Callophrys affinis homoperplexa*	G5TNR	S1S2
Western Tailed Blue	*Everes amyntula*	G5	S1
Western White	*Pontia occidentalis*	G5	S2
White-cloaked Tiger Beetle	*Cicindela togata*	G5	S1
Widow Underwing	*Catocala vidua*	G5	S1
Wild Indigo Duskywing	*Erynnis baptisiae*	G5	S3
Yellow-grey Underwing	*Catocala luctuosa*	G4	S1
Yucca Skipper	*Megathymus yuccae coloradensis*	G5T5	S3S4
Zabulon Skipper	*Poanes zabulon*	G5	S2
Zebra Swallowtail	*Eurytides marcellus*	G5	S3
Zerene Fritillary	*Speyeria zerene*	G5	S1S2

Mollusks

Common Name	Scientific Name	Grank	Srank
A Freshwater Snail	*Fossaria techella*	G3G4	SNR
Black Sandshell	*Ligumia recta*	G5	SNR
Fatmucket	*Lampsilis siliquoidea*	G5	SNR
Niobrara Ambersnail	*Oxyloma haydeni*	G3	SNR
Pondmussel	*Ligumia subrostrata*	G5	S1
Threeridge	*Amblema plicata*	G5	SNR
Wabash Pigtoe	*Fusconaia flava*	G5	SNR
Yellow Sandshell	*Lampsilis teres*	G5	SNR

Plants

Common Name	Scientific Name	Grank	Srank
Alkali Blite	*Chenopodium rubrum* var. *humile*	G5T5	S1
Alyssum-leaf Phlox	*Phlox alyssifolia*	G5	S1
American Dragon's-head	*Dracocephalum parviflorum*	G5	S1
American Eelgrass	*Vallisneria americana*	G5	S1
American False-pennyroyal	*Hedeoma pulegioides*	G5	S1
American Lotus	*Nelumbo lutea*	G4	S1S3
American Pillwort	*Pilularia americana*	G5	S1

Common Name	Scientific Name	Grank	Srank
American Sweetflag	*Acorus americanus*	G5	S2
Antelope-Horns	*Asclepias asperula* var. *decumbens*	G5TNR	S1
Arrowfeather Three-awn	*Aristida purpurascens* var. *purpurascens*	G5T5	S1
Ashy Sunflower	*Helianthus mollis*	G4G5	S1
Autumn Coral-root	*Corallorhiza odontorhiza* var. *odontorhiza*	G5	S1S3
Awned Slender Wheatgrass	*Elymus trachycaulus* var. *andinus*	G5T5	S1
Bay Forget-me-not	*Myosotis laxa*	G5	S1
Beaked Spikerush	*Eleocharis rostellata*	G5	S1
Bearberry	*Arctostaphylos uva-ursi*	G5	S1
Bearded Short-husk	*Brachyelytrum erectum*	G5	S2
Bebb's Sedge	*Carex bebbii*	G5	S1S3
Berlandier's Flax	*Linum berlandieri* var. *berlandieri*	G5T5?	S1
Big-fruit Dodder	*Cuscuta umbrosa*	G5	S1S3
Bigroot Morning-glory	*Ipomoea pandurata*	G5	S1
Birdfoot Violet	*Viola pedata* var. *pedata*	G5TNR	S1
Black-foot Quillwort	*Isoetes melanopoda* ssp. *melanopoda*	G5TNR	S1
Blackjack Oak	*Quercus marilandica* var. *marilandica*	G5T4T5	S1
Black-seed Ricegrass	*Piptatherum racemosum*	G5	S2
Blue Cohosh	*Caulophyllum thalictroides*	G4G5	S1
Blue Larkspur	*Delphinium nuttallianum*	G5	S1
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	G5	S1
Bodin's Milk-vetch	*Astragalus bodinii*	G4	S1
Bog Rush	*Juncus biflorus*	G5	S1
Bog White Violet	*Viola lanceolata* var. *lanceolata*	G5T5	S2
Bouquet Mud-plantain	*Heteranthera multiflora*	G4	S1
Branched Noseburn	*Tragia ramosa*	G5	S1
Brazilian Watermeal	*Wolffia brasiliensis*	G5	S1
Britton's Skullcap	*Scutellaria brittonii*	G4G5	S2
Broad-leaf Milkweed	*Asclepias latifolia*	G5	S1S3
Broad-leaf Spring-Panicum	*Dichanthelium latifolium*	G5	S1
Broom Groundsel	*Senecio spartioides*	G5	S1
Brown Bog Sedge	*Carex buxbaumii*	G5	S2
Buckley's Penstemon	*Penstemon buckleyi*	G4G5	S1
Buff Fleabane	*Erigeron ochroleucus*	G5	S2
Buffalo Clover	*Trifolium reflexum*	G3G4	S1
Bulblet Bladder Fern	*Cystopteris bulbifera*	G5	S1
Bush's Sedge	*Carex bushii*	G4	S1S2
Bushy Seedbox	*Ludwigia alternifolia*	G5	S1?
Butterweed	*Packera glabella*	G5	S1
Buttonbush	*Cephalanthus occidentalis*	G5	S1S3
Button-snakeroot	*Eryngium yuccifolium* var. *yuccifolium*	G5T5	S1
California Amaranth	*Amaranthus californicus*	G4	S2
Camphor-weed	*Heterotheca latifolia*	GNR	S1S2
Canada Hawkweed	*Hieracium kalmii* var. *canadense*	G5T5	S1
Canada Lousewort	*Pedicularis canadensis* var. *canadensis*	G5T5	S1
Canada Nailwort	*Paronychia canadensis*	G5	S1
Capitate Spikerush	*Eleocharis geniculata*	G5	S1
Cardinal Flower	*Lobelia cardinalis*	G5	S1
Carolina False Dandelion	*Pyrrhopappus carolinianus*	G5	S1

Common Name	**Scientific Name**	**Grank**	**Srank**
Carruth's Sagewort	*Artemisia carruthii*	G4?	S1
Chaffweed	*Lysimachia minima*	G5	S1
Chapman's Bluegrass	*Poa chapmaniana*	G5	S1
Chickasaw Plum	*Prunus angustifolia*	G5	S1
Clammy Hedge-hyssop	*Gratiola neglecta*	G5	S1
Clasping-leaf Milkweed	*Asclepias amplexicaulis*	G5	S1
Coreopsis Beggar-ticks	*Bidens polylepis*	GNR	S2
Creeping Juniper	*Juniperus horizontalis*	G5	S1
Creeping Lovegrass	*Eragrostis reptans*	G5	S1
Creeping Polemonium	*Polemonium reptans*	G5	S1
Crested Wood Fern	*Dryopteris cristata*	G5	S1
Culver's Root	*Veronicastrum virginicum*	G4	S1
Curly Three-awn	*Aristida desmantha*	G5	S1
Cursed Crowfoot	*Ranunculus sceleratus* var. *multifidus*	G5T5	S1S3
Cut-leaf Cyclanthera	*Cyclanthera dissecta*	G5	S1
Cut-leaf Toothwort	*Cardamine concatenata*	G5	S1
Cut-leaf Water-milfoil	*Myriophyllum pinnatum*	G5	S1
Desert Centaury	*Zeltnera exaltata*	G5	S1
Douglas' Knotweed	*Polygonum douglasii*	G5	S2
Downy Ground-cherry	*Physalis missouriensis*	G5?	S1
Drummond's Wild Onion	*Allium drummondii*	G5	S1
Dusty-maiden	*Chaenactis douglasii* var. *douglasii*	G5T5	S1
Dwarf Ground-cherry	*Physalis pumila*	G5	S1
Dwarf Indigo-bush	*Amorpha nana*	G5	S1
Dwarf Larkrspur	*Delphinium tricorne*	G5	S1S3
Dwarf Locoweed	*Oxytropis multiceps*	G5	S2
Dwarf Skullcap	*Scutellaria parvula*	G4	S1
Dwarf Spikerush	*Eleocharis coloradoensis*	GNR	S1
Dwarf St. John's-wort	*Hypericum mutilum* var. *mutilum*	G5TNR	S1
Dwarf Swamp Raspberry	*Rubus pubescens*	G5	S1
Dwarf-dandelion	*Krigia cespitosa*	G5	S1
Ear-leaf Toothcup	*Ammannia auriculata*	G5	S1
Early Blue-top Fleabane	*Erigeron vetensis*	G4	S1
Early Buttercup	*Ranunculus fascicularis*	G5	S1
Eastern Star Sedge	*Carex radiata*	G4	S1
Eastern Toothed Spurge	*Euphorbia dentata*	G5	S1
Ebony Spleenwort	*Asplenium platyneuron*	G5	S1
Engelmann's Flatsedge	*Cyperus engelmannii*	GNR	S2
Erect Knotweed	*Polygonum erectum*	G5	S1S3
False Dragon's-head	*Physostegia parviflora*	G4G5	S1
False Lily-of-the-valley	*Maianthemum canadense* var. *interius*	G5	S1
False-garlic	*Nothoscordum bivalve*	G4	S1
Fendler's Aster	*Symphyotrichum fendleri*	G4?	S1
Few-flower Spikerush	*Eleocharis quinqueflora*	G5	S1
Field Milk-vetch	*Astragalus agrestis*	G5	S1
Field Thistle	*Cirsium discolor*	G5	S1S2
Finger Coreopsis	*Coreopsis palmata*	G5	S1S3
Fireweed	*Chamerion angustifolium* var. *canescens*	G5T5	S1?
Flat-top Aster	*Doellingeria umbellata* var. *pubens*	G5T5	S2

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Floating Primrose-willow	*Ludwigia peploides* var. *glabrescens*	G5T5	S1
Forest Muhly	*Muhlenbergia sylvatica*	G5	S1S3
Foxglove Penstemon	*Penstemon digitalis*	G5	S1
Frank's Sedge	*Carex frankii*	G5	S1S2
Fraser's Wild Onion	*Allium canadense* var. *fraseri*	G5T4T5	S2
Fremont's Evening-primrose	*Oenothera macrocarpa* ssp. *fremontii*	G5T3	S1
Fremont's Leather-flower	*Clematis fremontii*	G5	S1
Fries' Pondweed	*Potamogeton friesii*	G4	S2
Frost Grape	*Vitis vulpina*	G5	S1
Gardner's Saltbush	*Atriplex gardneri* var. *gardneri*	G5TNR	S1
Georgia Bulrush	*Scirpus georgianus*	G5	S1S3
Geyer's Larkspur	*Delphinium geyeri*	G5	S1
Giant St. John's-wort	*Hypericum pyramidatum*	G4	S1S3
Gilia Beardtongue	*Penstemon ambiguus* var. *ambiguus*	G4G5T4T5	S1
Glade Blue Curls	*Trichostema brachiatum*	G5	S1
Golden Fumewort	*Corydalis aurea*	G5	S1
Golden-fruit Sedge	*Carex aureolensis*	GNR	S1
Golden-glow	*Rudbeckia laciniata* var. *ampla*	G5T3T5	S1
Goldenweed	*Grindelia ciliata*	G4G5	S1
Graceful Buttercup	*Ranunculus inamoenus* var. *inamoenus*	G5T5	S1
Graham's Rock Cress	*Boechera grahamii*	GNR	S1S3
Grass-leaf Arrowhead	*Sagittaria graminea* var. *graminea*	G5T5	S2
Graybark Grape	*Vitis cinerea* var. *cinerea*	G4G5TNR	S1
Great Basin Wild-rye	*Leymus cinereus*	G5	S1
Great Plains Flatsedge	*Cyperus lupulinus* ssp. *macilentus*	G5T5?	S1
Great Plains Twin-pod	*Physaria brassicoides*	G5	S1
Greater Straw Sedge	*Carex normalis*	G5	S1
Green Dragon	*Arisaema dracontium*	G5	S2
Green-flower Hedgehog Cactus	*Echinocereus viridiflorus*	G5	S2
Green-flower Wintergreen	*Pyrola chlorantha*	G5	S1
Green-fruit Bur-reed	*Sparganium emersum*	G5	S2
Gronovius' Dodder	*Cuscuta gronovii*	G5	S1S3
Gunnison's Mariposa-lily	*Calochortus gunnisonii* var. *gunnisonii*	G5TNR	S1
Hairy Bugseed	*Corispermum villosum*	G4?	S1
Hairy Gayfeather	*Liatris hirsuta*	G4?	S1S3
Hairy Goldenaster	*Heterotheca villosa* var. *minor*	G5T4T5	S1
Hairy Mountain-mint	*Pycnanthemum verticillatum* var. *pilosum*	G5T5	S1
Hairy Pinweed	*Lechea mucronata*	G5	S1?
Hairy Wood Sedge	*Carex hirtifolia*	G5	S1
Hairy-stem Gooseberry	*Ribes hirtellum*	G5	S1
Hispid Hedge-nettle	*Stachys hispida*	GNR	S1
Hoary-aster	*Dieteria canescens* var. *glabra*	G5T4T5	S1
Hoary-pea	*Tephrosia virginiana*	G5	S1
Hooded Ladies'-tresses	*Spiranthes romanzoffiana*	G5	S1
Hooked Buttercup	*Ranunculus recurvatus* var. *recurvatus*	G5TNR	S2
Hooker's Townsendia	*Townsendia hookeri*	G5	S1
Hook-spur Violet	*Viola adunca* var. *adunca*	G5T5	S1?
Hop Sedge	*Carex lupulina*	G5	S1
Hudson Bay Anemone	*Anemone multifida* var. *multifida*	G5TNR	S1

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Indian Blanket-flower	*Gaillardia pulchella* var. *pulchella*	G4G5T4T5	S1S3
Indian-pipe	*Monotropa uniflora*	G5	S1
Indian-tobacco	*Lobelia inflata*	G5	S1
Inflated Duckweed	*Lemna gibba*	G4G5	S2
Inflated Sedge	*Carex vesicaria* var. *monile*	G5T4	S1
Inland Serviceberry	*Amelanchier interior*	G5	S1
Intermountain Aster	*Symphyotrichum ascendens*	G5	S1
Iowa Crab Apple	*Malus ioensis* var. *ioensis*	G4G5T4T5	S1S3
James' Nailwort	*Paronychia jamesii* var. *jamesii*	G4T4	S1S3
James' Rush-pea	*Pomaria jamesii*	G5	S1
Joint-leaf Rush	*Juncus articulatus*	G5	S1
Kiss-me-quick	*Portulaca pilosa*	G5	S1
Lace Grass	*Eragrostis capillaris*	G5	S1
Lance-leaf Cottonwood	*Populus ×acuminata*	GNA	S1?
Large-leaf Pondweed	*Potamogeton amplifolius*	G5	S1
Lavender Giant-hyssop	*Agastache foeniculum*	G4G5	S1
Least Duckweed	*Lemna minuta*	G4	S1
Least Muhly	*Muhlenbergia minutissima*	G5	S1
Leopard-lily	*Fritillaria atropurpurea*	G5	S2
Lesser Bladderwort	*Utricularia minor*	G5	S1
Limber Pine	*Pinus flexilis*	G4	S1
Limestone Adder's-tongue	*Ophioglossum engelmannii*	G5	S1
Limestone Wild-petunia	*Ruellia strepens*	G4G5	S2
Loesel's Twayblade	*Liparis loeselii*	G5	S1
Long-barb Arrowhead	*Sagittaria longiloba*	G5	S1
Long-beak Willow	*Salix bebbiana*	G5	S1
Long-bract Green Orchid	*Dactylorhiza viridis*	G5	S1
Long-leaf Tick-clover	*Desmodium cuspidatum* var. *longifolium*	G5T5?	S1S3
Low Pussytoes	*Antennaria dimorpha*	G5	S1
Low Sedge	*Carex umbellata*	G5	S1
Mare's-tail	*Hippuris vulgaris*	G5	S1
Marsh Arrow-grass	*Triglochin palustris*	G5	S1
Marsh Vetchling	*Lathyrus palustris*	G5	S1S3
Marsh-St. John's-wort	*Triadenum fraseri*	G5	S2
Mat Muhly	*Muhlenbergia richardsonis*	G5	S1
May-apple	*Podophyllum peltatum*	G5	S2
Menzies' Catchfly	*Silene menziesii*	G5	S1
Midwestern Summer Bluets	*Houstonia purpurea* var. *calycosa*	G5T5	S1
Missouri Spurge	*Euphorbia missurica* var. *missurica*	G5TNR	S1S3
Montana Wild-rye	*Elymus albicans*	G5?	S1
Moss Phlox	*Phlox bryoides*	GNR	S2
Mountain White-camas	*Anticlea elegans* var. *elegans*	G5T5	S1
Mountain Birch	*Betula occidentalis*	G4G5	S1
Mountain Bladder-pod	*Physaria montana*	G5	S2
Mountain Brome	*Bromus marginatus*	G5	S1S3
Mud Sedge	*Carex limosa*	G5	S1
Mullein-foxglove	*Dasistoma macrophylla*	G4	S1
Muttongrass	*Poa fendleriana* ssp. *fendleriana*	G5T5	S1
Nannyberry	*Viburnum lentago*	G5	S1

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Narrow-leaf Cottonwood	*Populus angustifolia*	G5	S1
Narrow-leaf False Foxglove	*Agalinis tenuifolia* var. *macrophylla*	G5T4T5	S1S3
Narrow-leaf Hawkweed	*Hieracium umbellatum*	G5	S1?
Narrow-leaf Mountain-mint	*Pycnanthemum tenuifolium*	G5	S1
Narrow-leaf Paleseed	*Leucospora multifida*	G5	S1
Narrow-leaf Pinweed	*Lechea tenuifolia*	G5	S1
Narrow-leaf Vervain	*Verbena simplex*	G5	S1
Nevada Bulrush	*Amphiscirpus nevadensis*	G4	S2
New Mexico Checker-mallow	*Sidalcea neomexicana* var. *neomexicana*	G4?TNR	S1
Nodding Brome	*Bromus porteri*	G5	S2?
Nodding Mouse-ear Chickweed	*Cerastium nutans* var. *nutans*	G5T5?	S1
Nodding Wild Onion	*Allium cernuum*	G5	S2
Nodding Wild-buckwheat	*Eriogonum cernuum*	G5	S1
Northern Adder's-tongue	*Ophioglossum pusillum*	G5	S2
Northern Dewberry	*Rubus flagellaris*	G5	S1
Northern Manna Grass	*Glyceria borealis*	G5	S2
Northern Marsh Buttercup	*Ranunculus caricetorum*	G5	S1
Northern Shooting-star	*Primula pauciflora* var. *pauciflora*	G5TNR	S1
Northern Water-starwort	*Callitriche hermaphroditica*	G5	S2
Northwest Territory Sedge	*Carex utriculata*	G5	S1
Northwestern Lady Fern	*Athyrium filix-femina* var. *cyclosorum*	G5T5	S1
Notch-bract Waterleaf	*Hydrophyllum appendiculatum*	G5	S1
Ohio Buckeye	*Aesculus glabra* var. *arguta*	G5T4?Q	S1S2
Old-field Cinquefoil	*Potentilla simplex*	G5	S1
One-flower Broomrape	*Orobanche uniflora*	G5TNR	S1
One-sided Wintergreen	*Orthilia secunda*	G5	S1
Ostrich Fern	*Matteuccia struthiopteris* var. *pensylvanica*	G5TNR	S1
Pale False-dandelion	*Agoseris glauca* var. *glauca*	G5T5	S1
Pale Fumewort	*Corydalis flavula*	G5	S1
Pale Gentian	*Gentiana alba*	G4	S1
Pale Goosefoot	*Chenopodium pallescens*	G5	S1
Pale Indian-plantain	*Arnoglossum atriplicifolium*	G4G5	S2
Pale Purple Coneflower	*Echinacea pallida*	G4	S1
Panicled Bulrush	*Scirpus microcarpus*	G5	S1
Pearly Everlasting	*Anaphalis margaritacea*	G5	S1
Pennslyvania Bitter Cress	*Cardamine pensylvanica*	G5	S1
Perennial Bursage	*Ambrosia tomentosa*	G4	S1
Perennial Gumweed	*Grindelia perennis*	G5	S1
Persimmon	*Diospyros virginiana*	G5	S1
Pine-drops	*Pterospora andromedea*	G5	S2
Pinesap	*Monotropa hypopitys*	G5	S1
Pinnate Tansy Mustard	*Descurainia pinnata* var. *osmiarum*	G5T5?	S1
Pitcher's Leather-flower	*Clematis pitcheri* var. *pitcheri*	G4G5TNR	S1
Plains Blackberry	*Rubus laudatus*	G5	S1
Plains Cutleaf Violet	*Viola viarum*	G5	S1
Plains Frostweed	*Crocanthemum bicknellii*	G5	S1S2
Platte River Cinquefoil	*Potentilla plattensis*	G4	S1
Playa Lovegrass	*Eragrostis pilosa* var. *perplexa*	G4TNR	S1
Poison Suckleya	*Suckleya suckleyana*	G5	S1

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Poverty Oatgrass	*Danthonia spicata*	G5	S1
Poverty Sumpweed	*Iva axillaris* var. *axillaris*	G5TNR	S1S3
Powdery Cloak Fern	*Argyrochosma dealbata*	G4G5	S1
Powell's Saltbush	*Atriplex powellii* var. *powellii*	G4TNR	S1
Prairie Bluebells	*Mertensia lanceolata* var. *lanceolata*	G5T5	S2
Prairie Broomweed	*Amphiachyris dracunculoides*	G4G5	S1S2
Prairie Buttercup	*Ranunculus rhomboideus*	G5	S1
Prairie Fawn-lily	*Erythronium mesochoreum*	G4G5	S2
Prairie Ninebark	*Physocarpus intermedius*	G3G5	S2
Prairie Pinweed	*Lechea stricta*	G4?	S1
Prairie White Aster	*Symphyotrichum falcatum* var. *falcatum*	G5T4T5	S1
Prickly Naiad	*Najas marina*	G5	S1
Prince's-plume	*Stanleya pinnata* var. *pinnata*	G5T4T5	S1
Pull-up Muhly	*Muhlenbergia filiformis*	G5	S1
Purple Cudweed	*Gamochaeta purpurea*	G5	S1
Purple Giant-hyssop	*Agastache scrophulariifolia*	G4	S1
Purple Milkweed	*Asclepias purpurascens*	G5?	S1
Purple Rattlesnake-root	*Prenanthes racemosa* var. *multiflora*	G5T4?	S1
Purple Spikerush	*Eleocharis atropurpurea*	G4G5	S1
Purple-stem Cliff-brake	*Pellaea atropurpurea*	G5	S2
Quaking Aspen	*Populus tremuloides*	G5	S1S3
Ramp	*Allium tricoccum* var. *burdickii*	G5T4T5	S2
Raven-foot Sedge	*Carex crus-corvi*	G5	S1
Red Lovegrass	*Eragrostis secundiflora* var. *capitata*	G5TNR	S1
Red Raspberry	*Rubus strigosus*	G5	S1
Red-seed Plantain	*Plantago rhodosperma*	GNR	S1
Rillscale	*Stutzia dioica*	G4?	S1
River Grass	*Scolochloa festucacea*	G5	S1
Rockpink Fame-flower	*Phemeranthus calycinus*	G5	S1S2
Rocky Mountain Fescue	*Festuca saximontana* var. *saximontana*	G5T5	S1
Rocky Mountain Gayfeather	*Liatris ligulistylis*	G5?	S1
Rocky Mountain Iris	*Iris missouriensis*	G5	S1
Rocky Mountain Knotweed	*Polygonum sawatchense* ssp. *sawatchense*	G4G5TNR	S1S3
Rocky Mountain Maple	*Acer glabrum*	G5	S1?
Rocky Mountain Navarretia	*Navarretia saximontana*	GNR	S1
Rose Heath Daisy	*Chaetopappa ericoides*	G5	S2
Rose Highbush Blackberry	*Rubus rosa*	G5	S1
Rosinweed	*Silphium integrifolium* var. *integrifolium*	G5T5	S1
Ross' Sedge	*Carex rossii*	G5	S2
Rough Buttonweed	*Diodia teres* var. *teres*	G5T5	S1
Rough-fruit Fairybells	*Prosartes trachycarpa*	G5	S1
Rough-pod Copperleaf	*Acalypha ostryifolia*	G5	S1S3
Round-head Prairie-clover	*Dalea multiflora*	G5	S1
Round-leaf Bladder-pod	*Physaria ovalifolia* var. *ovalifolia*	G5?T5?	S1
Round-pod St. John's-wort	*Hypericum sphaerocarpum*	G5	S1
Round-stem False Foxglove	*Agalinis gattingeri*	G4	S1S3
Rydberg's Wild-rye	*Elymus vulpinus*	G1G3Q	S1
Sagebrush Buttercup	*Ranunculus glaberrimus* var. *ellipticus*	G5T5	S1
Saltmarsh Aster	*Symphyotrichum subulatum*	G5	S1S3

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Saltmarsh Sand-spurry	*Spergularia salina*	G5	S1
Sandbar Lovegrass	*Eragrostis frankii*	G5	S1
Sandberg's Beggar-ticks	*Bidens connata* var. *pinnata*	G5TNR	S1
Saskatchewan Cinquefoil	*Potentilla effusa* var. *effusa*	G5?TNR	S2?
Scribner's Groundsel	*Senecio scribneri*	G1G3	S1
Sea Milkwort	*Lysimachia maritima*	G5	S1
Seaside Heliotrope	*Heliotropium curassavicum* var. *curassavicum*	G5T5	S1
Seaside Heliotrope	*Heliotropium curassavicum* var. *obovatum*	G5T5	S1
Secund Bladder-Pod	*Physaria arenosa* var. *arenosa*	G5T5	S1
Seep Monkey-Flower	*Mimulus guttatus*	G5	S1
Seneca Snakeroot	*Polygala senega*	G4G5	S1
Sessile-leaf Tick-clover	*Desmodium sessilifolium*	G5	S1
Sharpwing Monkey-flower	*Mimulus alatus*	G5	S1S2
Shining Sumac	*Rhus copallinum* var. *latifolia*	G5T5	S1
Short-pod Draba	*Draba brachycarpa*	G4G5	S1
Short-ray Fleabane	*Erigeron lonchophyllus*	G5	S1
Short-ray Prairie-coneflower	*Ratibida tagetes*	G4G5	S1
Short's Rock Cress	*Boechera dentata*	G5	S2
Short-seed Waterwort	*Elatine brachysperma*	G5	S1
Short-stem Wild-buckwheat	*Eriogonum brevicaule* var. *brevicaule*	G4T4?	S1
Showy Orchid	*Galearis spectabilis*	G5	S1
Showy-wand Goldenrod	*Solidago speciosa* var. *pallida*	G5T4	S1
Silverweed	*Potentilla anserina*	G5	S1
Slender Cotton-grass	*Eriophorum gracile*	G5	S2
Slender Fimbry	*Fimbristylis autumnalis*	G5	S2
Slender Ladies'-tresses	*Spiranthes lacera* var. *gracilis*	G5T4T5	S1
Slender Lip Fern	*Cheilanthes feei*	G5	S2
Slender Yellow Cress	*Rorippa tenerrima*	G5	S1
Slender-leaf Spring-panicum	*Dichanthelium linearifolium*	GNR	S1
Slim-flower Muhly	*Muhlenbergia tenuiflora*	G5	S1
Slim-leaf Scurf-pea	*Pediomelum linearifolium*	G4?	S1
Small Bluets	*Houstonia pusilla*	G5	S1
Small Sundrops	*Oenothera perennis*	G5	S2
Small Venus'-looking-glass	*Triodanis biflora*	G5	S1
Small-flower Bitter Cress	*Cardamine parviflora*	G5	S1
Small-flower Prairie-star	*Lithophragma parviflora*	G5	S1
Small-flower Sandpuffs	*Tripterocalyx micranthus*	G5	S1
Small-flower Wallflower	*Erysimum inconspicuum*	G5	S2
Smith's Hybrid Aspen	*Populus* × *smithii*	GNA	S1
Smooth Cliff-brake	*Pellaea glabella* var. *glabella*	G5T5	S1
Smooth False Foxglove	*Agalinis purpurea*	G5	S1S3
Snowberry	*Symphoricarpos albus* var. *albus*	G5T5	S1?
Soft Rush	*Juncus effusus* var. *solutus*	G5T5	S1
Sooth Four-o'clock	*Mirabilis glabra*	G5	S2
Southern Chervil	*Chaerophyllum tainturieri* var. *tainturieri*	G5T4T5	S1
Southern Wild Senna	*Senna marilandica*	G5	S1S2
Spike Hawthorn	*Crataegus macracantha* var. *occidentalis*	GNRTNR	S1S3
Spikebent	*Agrostis exarata* var. *minor*	G5TNR	S1
Spiked Muhly	*Muhlenbergia glomerata*	G5	S2

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Spike-fescue	*Leucopoa kingii*	G5	S1?
Spikenard	*Aralia racemosa*	G4G5	S1
Spinulose Wood Fern	*Dryopteris carthusiana*	G5	S2
Spotted Evening-primrose	*Oenothera canescens*	G4G5	S2
Spotted St. John's-wort	*Hypericum punctatum*	G5	S1
Spotted Water-hemlock	*Cicuta maculata* var. *bolanderi*	G5T3T4	S1
Spreading Fleabane	*Erigeron divergens*	G5	S2
Spreading Pygmyleaf	*Loeflingia squarrosa* var. *texana*	G5TNR	S1
Spring Avens	*Geum vernum*	G5	S1
Spring Bitter Cress	*Cardamine bulbosa*	G5	S1S3
Spring Coral-root	*Corallorhiza wisteriana*	G5	S1
Spring Forget-me-not	*Myosotis verna*	G5	S1
Spring Ladies'-tresses	*Spiranthes vernalis*	G5	S1S3
Starved Spring-panicum	*Dichanthelium depauperatum*	G5	S1
Stickleaf	*Mentzelia oligosperma*	G4	S1
Sticky Crane's-bill	*Geranium viscosissimum*	G5	S1
Sticky Gilia	*Aliciella pinnatifida*	G4G5	S1
Straight-leaf Pondweed	*Potamogeton strictifolius*	G5	S1
Streambank Ragwort	*Packera pseudaurea* var. *semicordata*	G5T3T5Q	S1
Striped Coral-Root	*Corallorhiza striata* var. *vreelandii*	G5TNR	S1
Sugarbowls	*Clematis hirsutissima* var. *scottii*	G4T4?	S1
Summer Coral-root	*Corallorhiza maculata* var. *occidentalis*	G5T3T5	S1
Summer Grape	*Vitis aestivalis* var. *aestivalis*	G5T5	S1
Summer Orophaca	*Astragalus hyalinus*	G4	S2
Tall Cotton-grass	*Eriophorum angustifolium* var. *angustifolium*	G5TNR	S2
Taper-tip Rush	*Juncus acuminatus*	G5	S1
Texas Bergia	*Bergia texana*	G5	S1
Texas Dropseed	*Sporobolus texanus*	G5	S1
Texas Sandwort	*Minuartia michauxii* var. *texana*	G5T3T5	S2
Texas Sedge	*Carex texensis*	G5	S1
Texas Toadflax	*Nuttallanthus texanus*	G4G5	S2
Thick-spike Gayfeather	*Liatris pycnostachya* var. *pycnostachya*	G5T5	S1S3
Thread-leaf Pondweed	*Stuckenia filiformis* var. *occidentalis*	G5T5	S1
Three-flower Melic Grass	*Melica nitens*	G5	S1
Three-nerve Fleabane	*Erigeron subtrinervis*	G5	S2
Tine-leaf Milk-vetch	*Astragalus pectinatus*	G5	S1
Tube Penstemon	*Penstemon tubiflorus* var. *tubiflorus*	G5T4T5	S1
Tuberous False Dandelion	*Pyrrhopappus grandiflorus*	G5	S1
Tufted Fleabane	*Erigeron caespitosus*	G5	S2
Twisted Yellow-eyed-grass	*Xyris torta*	G5	S2
Two-leaf Waterweed	*Elodea bifoliata*	G4G5	S1
Vahl's Fimbry	*Fimbristylis vahlii*	G5	S1
Veiny Pepper-grass	*Lepidium oblongum*	G5	S1
Vernal Water-starwort	*Callitriche palustris*	G5	S2
Violet Lespedeza	*Lespedeza violacea*	G5	S1
Virginia Spring-beauty	*Claytonia virginica*	G5	S1
Virginia Wild-rye	*Elymus virginicus* var. *intermedius*	G5TNR	S1S3
Water Dock	*Rumex verticillatus*	G5	S1
Water Horsetail	*Equisetum fluviatile*	G5	S1

Common Name	Scientific Name	Grank	Srank
Water Sedge	*Carex aquatilis* var. *substricta*	G5TNR	S2
Watershield	*Brasenia schreberi*	G5	S2
Water-thread Pondweed	*Potamogeton diversifolius*	G5	S2
Wax-flower Shinleaf	*Pyrola elliptica*	G5	S1
Wedge-leaf Draba	*Draba cuneifolia* var. *cuneifolia*	G5T5	S1
Welsh's Bugseed	*Corispermum welshii*	G2G4	S1
Western Marsh Cudweed	*Gnaphalium palustre*	G5	S1S3
Western Prairie Flax	*Linum lewisii* var. *lewisii*	G5T5	S1
Western Rattlesnake-plantain	*Goodyera oblongifolia*	G5?	S1
Whip Nut-Rush	*Scleria triglomerata*	G5	S1S2
White Arrow-leaf Aster	*Symphyotrichum urophyllum*	G4G5	S1
White Baneberry	*Actaea pachypoda*	G5	S1
White Bear Sedge	*Carex albursina*	G5	S1
White Boltonia	*Boltonia asteroides* var. *latisquama*	G5TNR	S1S3
White Oak	*Quercus alba*	G5	S1
White Water-lily	*Nymphaea odorata* ssp. *tuberosa*	G5T5	S1S3
White Woodland Aster	*Symphyotrichum lateriflorum*	G5	S1
White-scale Sedge	*Carex xerantica*	G5	S2
White-stem Blazing-star	*Mentzelia albicaulis*	G5	S1
White-stem Pondweed	*Potamogeton praelongus*	G5	S1
Whorled Water-milfoil	*Myriophyllum verticillatum*	G5	S1
Wild Geranium	*Geranium maculatum*	G5	S1
Wild Yam	*Dioscorea villosa*	G5	S1
Wild-goose Plum	*Prunus hortulana*	G4?	S1
Wire-lettuce	*Stephanomeria runcinata*	G5	S2
Wood Mint	*Blephilia hirsuta*	G5?	S1
Wool-grass	*Scirpus cyperinus*	G5	S1
Woolly-fruit Sedge	*Carex lasiocarpa* var. *americana*	G5T5	S1
Yellow Lady's-slipper	*Cypripedium parviflorum*	G5	S1
Yellow Marsh-marigold	*Caltha palustris*	G5	S2
Yellow Pond-lily	*Nuphar variegata*	G5	S2
Yellow Stonecrop	*Sedum lanceolatum* var. *lanceolatum*	G5T3T5	S2
Yellow Valley Violet	*Viola vallicola*	G5?	S2
Yellow Vetchling	*Lathyrus ochroleucus*	G4G5	S2
Yellow-fruit Sedge	*Carex brachyglossa*	GNR	S1S3
Zigzag Goldenrod	*Solidago flexicaulis*	G5	S1

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Fisheries

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FISHERIES

Table E.8-1. Stream Value Classifications Crossed by Proposed Nebraska Reroute

Stream Name	Value Classification
Shingle Creek	IV
Keya Paha River	II
Niobrara River	II
Beaver Creek	III
Big Sandy Creek	IV
Blackbird Creek	IV
Middle Branch Verdigre Creek	II
South Branch Verdigre Creek	III
Big Springs Creek	II
Elkhorn River	I
Saint Clair Creek	IV
Vorhees Creek	IV
Beaver Creek	II
Plum Creek	IV
Loup River	I
Prairie Creek	III
Silver Creek	III
Platte River	III
Prairie Creek	IV
Big Blue River	III

Source: Nebraska Game and Parks Commission, 1978

Table E.8-2. Fish Species Present in River Basins along Proposed Nebraska Reroute[a]

Common Name	Family	Scientific Name	Niobrara	Elkhorn	Lower Platte	Loup	Middle Platte
Goldeye	*Hiodontidae*	*Hiodon alosoides*			X	X	X
Brown trout	*Salmonidae*	*Salmo trutta*	X	X		X	
Rainbow trout		*Oncorhynchus mykiss*	X	X			
Bigmouth shiner	*Cyprinidae*	*Notropis dorsalis*			X	X	X
Brassy minnow		*Hybognathus hankinsoni*			X	X	X
Common carp		*Cyprinus carpio*	X	X	X	X	X
Common shiner		*Notropis cornutus*				X	X
Creek chub		*Semotilus atromaculatus*	X	X	X	X	X
Emerald shiner		*Notropis atherinoides*			X	X	X
Fathead minnow		*Pimephales promelas*			X	X	X
Finescale dace		*Phoxinus neogaeus*	X			X	
Flathead chub		*Platygobio gracilis*			X	X	
Golden shiner		*Notemigonus crysoleucas*	X	X	X	X	
Longnose dace		*Rhinichthys cataractae*				X	
Northern redbelly dace		*Phoxinus eos*	X				
Pearl dace		*Margariscus margarita*	X			X	
Plains minnow		*Hybognathus placitus*			X	X	X
Red shiner		*Cyprinella lutrensis*			X	X	
Sands shiner		*Notropis stramineus*				X	X
Silver carp		*Hypophthalmichthyes molitrix*				X	
Silver chub		*Macrhybopsis storeriana*			X	X	
Silvery minnow		*Hybognathus nuchalis*			X	X	X
Speckled chub		*Macrhybopsis aestivalis*			X	X	X
Stoneroller		*Campostoma anomalum*				X	X

Common Name	Family	Scientific Name	Niobrara	Elkhorn	Lower Platte	Loup	Middle Platte
Longnose sucker		*Catastomus catastomus*	X				
Quillback		*Carpiodes cyprinus*			X	X	X
River carpsucker	*Catostomidae*	*Carpiodes carpio*	X	X	X	X	X
Shorthead redhorse		*Moxostoma macrolepidotum*	X	X	X	X	X
White sucker		*Catastomus commersoni*	X	X	X	X	X
Black bullhead		*Ameirus melas*	X	X	X	X	X
Channel catfish		*Ictalurus punctatus*	X	X	X	X	X
Flathead catfish	*Ictaluridae*	*Pylodictis olivaris*		X	X	X	X
Stonecat		*Noturus flavus*			X	X	X
Yellow bullhead		*Ameiurus natalis*	X	X	X	X	X
Plains killifish	*Cyprinodontidae*	*Fundulus zebrinus*			X	X	X
Plains topminnow		*Fundulus sciadicus*			X	X	X
Brook stickleback	*Gasterosteidae*	*Culaea inconstans*			X	X	X
Black crappie		*Pomoxis nigromaculatus*	X	X	X	X	X
Bluegill		*Lepomis macrochirus*	X	X	X	X	X
Green sunfish		*Lepomis cyanellus*	X	X	X	X	X
Largemouth bass		*Micropterus salmoides*	X	X	X	X	X
Orangespotted sunfish	*Centrachidae*	*Lepomis humilis*	X	X	X	X	
Pumpkinseed		*Lepomis gibbosus*	X	X			
Rock bass		*Ambloplites rupestris*	X				X
Smallmouth bass		*Micropterus dolomieu*			X	X	X
White crappie		*Pomoxis annularis*	X	X	X	X	X
Iowa darter		*Etheostoma exile*	X	X		X	
Johnny darter		*Etheostoma nigrum*	X	X	X	X	
Sauger	*Percidae*	*Sander canadensis*	X	X	X	X	
Walleye		*Sander vitreus*	X	X	X	X	X
Yellow perch		*Perca flavescens*	X				

Common Name	Family	Scientific Name	Niobrara	Elkhorn	Lower Platte	Loup	Middle Platte
Northern pike	*Esocidae*	*Esox lucius*	X	X		X	X
Grass pickerel		*Esox americanus vermiculatus*	X	X		X	
Freshwater drum	*Sciaenidae*	*Aplodinotus grunniens*	X	X	X	X	X
Gizzard shad	*Clupeidae*	*Dorosoma cepedianum*	X	X	X	X	X

Sources: Bliss and Schainost, 1973a, 1973b, 1973c; Nebraska Game and Parks Commission, 2012

[a] *Table E.8-2reflects fish species sampled and fish species known to be present in the Study Area's river basins and is not exhaustive. Since fish can be highly mobile, additional state species (not listed here) may also be found within the river basins.*

Table E.8-3. Stream Segments to be Crossed Using HDD Method

Stream Segment	Perennial?	Key Species
Keya Paha River	Yes	Channel catfish, largemouth bass
Niobrara River	Yes	Channel catfish, rock bass, largemouth bass, bluegill
Elkhorn River	Yes	Northern pike, channel catfish, flathead catfish, largemouth bass
Loup River	Yes	Channel catfish, flathead catfish
Platte River	Yes	Channel catfish, flathead catfish

E.8.1 REFERENCES

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Nebraska Game and Parks Commission. 1978. *Stream Resource Map.*

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Appendix E.9

Threatened and Endangered Species and Species of Conservation Concern Technical Memorandum

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APPENDIX E.9

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONSERVATION CONCERN TECHNICAL MEMORANDUM

E9.1 EXISTING CONDITIONS

Numerous State- or federally listed threatened or endangered species are listed within the counties crossed by the Nebraska Reroute.

This technical memorandum describes the existing conditions, impacts, and potential mitigation of impacts on threatened and endangered wildlife from the construction of the proposed pipeline, operation of the pipeline, the ancillary facilities, and the construction camp. The Nebraska Reroute would begin at milepost (MP) 601.76 and end at MP 796.31, for a total length of 195 miles, and lies in Keya Paha, Boyd, Holt, Antelope, Boone, Nance, Merrick, Polk, and York Counties.

Based on information from the U.S. Department of the Interior's U.S. Fish and Wildlife Service (USFWS) Information, Planning, and Conservation Services (USFWS, 2012a), six federally listed threatened or endangered species may exist within the Study Area. Through coordination with the Nebraska Game and Parks Commission (NGPC) (NGPC, 2012a), 11 State-listed threatened or endangered species (and one candidate species) are known to exist within the vicinity of the Study Area. Consultation with USFWS is required under Section 7 of the Endangered Species Act to ensure that actions authorized, funded, or carried out by a federal agency do not adversely impact federally listed species. Similarly, consultation with the NGPC is required under Neb. Rev. Stat. § 37-807(3) of Nongame and Endangered Species Conservation Act (NESCA) to ensure that actions authorized, funded, or carried out by a state agency do not adversely impact State-listed species.

The Sprague's pipit (*Anthus spragueii)* has undergone a review by the USFWS for its conservation status. The USFWS determined that although listing the Sprague's pipit as endangered or threatened is warranted, proposal of a regulation implementing this action is precluded by higher priority listing actions (USFWS, 2010). This species is discussed in this technical memorandum because its listing status could change. All federally listed species automatically become State-listed species. The northern long-eared bat (*Myotis septentrionalis*) is currently undergoing a review by the USFWS to determine its conservation status. Although its status has not yet been determined, a discussion of this species is included because it could be protected under the Endangered Species Act.

The Nebraska Reroute would avoid the current range of the blowout penstemon (*Penstemon haydenii*); therefore, this species was not evaluated. In addition, the USFWS's comprehensive status review for the Platte River caddisfly determined it did not warrant protection under the Endangered Species Act. Therefore, this species is not discussed in this technical memorandum. A 12-month review was completed by the USFWS regarding the conservation status of the Platte River caddisfly (*Ironoquia plattensis*). The USFWS determined that there is sufficient scientific and commercial data to demonstrate that the Platte River caddisfly is secure throughout its range and is not warranted for listing at this time (USFWS, 2012d).

The bald eagle (*Haliaeetus leucocephalus*) has been removed from the USFWS federally threatened or endangered species list and from the State of Nebraska threatened or endangered species list. The bald eagle is protected under the Bald and Gold Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA) and is therefore discussed further in this technical memorandum.

Table E.9-1 lists the species identified by USFWS and NGPC, their status, their typical habitat, and their occurrence. Subsequent sections provide detailed information regarding each species listed.

Table E.9-1. Protected Species Potentially Occurring in the Study Area

Common Name *(Scientific Name)*	Federal Status	State Status	Typical Habitat	Occurrence
Interior least tern *Sternula antillarum athalassos*	Endangered	Endangered	Sparsely vegetated sandbars, sand and gravel shorelines of rivers, and alkali wetlands	Migration, summer breeding, and nesting on sandbars in the Niobrara, Elkhorn, and Loup Rivers; may use wetlands within the Study Area for foraging
Piping plover *Charadrius melodus*	Threatened	Threatened	Sparsely vegetated sandbars, sand and gravel shorelines of rivers, and alkali wetlands	Migration, summer breeding, and nesting on sandbars in the Niobrara, Elkhorn, and Loup Rivers
Whooping crane *Grus americana*	Endangered	Endangered	Spring and fall migration through central flyway, along Missouri and Niobrara Rivers, cropland and pastures, wet meadows, shallow marshes, and shallow areas in rivers, lakes, reservoirs, and stock ponds	Within the tributaries and wetlands located in the Study Area during spring and fall migration
Sprague's pipit *Anthus spragueii*	Candidate	—	Prefer large patches of native grassland throughout life cycle; may be found in grazed areas and rarely found in cultivated areas	Uncommon spring and fall migrant in Nebraska; could occur statewide, but most observations from central Nebraska; breeding range not currently in Nebraska
Pallid sturgeon *Scaphirhynchus albus*	Endangered	Endangered	Main channel of turbid, free flowing rivers, backwaters, chutes, and edges of sandbars	Not within the Study Area, but tributaries into lower Platte River may influence flow and water quality in the lower Platte River

Common Name (Scientific Name)	Federal Status	State Status	Typical Habitat	Occurrence
American burying beetle *Nicrophorus americanus*	Endangered	Endangered	Riparian zone, mixed agricultural land (pastures and mowed land), grasslands, and woodland edge habitat	Keya Paha, Holt, and Antelope Counties
Western prairie fringed orchid *Platanthera praeclara*	Threatened	Threatened	Wet-mesic to mesic tallgrass prairie; unplowed sedge meadows	Sandhills region extending east
Northern long-eared bat *Myotis septentriaonalis*	Federal status pending	—	Forested habitats, especially around wetlands, and use different sites for day and night roosts	Typically found in the eastern half of the United States, including eastern Nebraska
Blacknose shiner *Notropis heterolepis*		Endangered	Cool, clean, well oxygenated streams with abundant aquatic vegetation	Keya Paha and Holt Counties
Finescale dace *Phoxinus neogaeus*	—	Threatened	Headwaters of clear, cool, high quality streams	Keya Paha, Nance, Holt, and Merrick Counties
Northern redbelly dace *Phoxinus eos*	—	Threatened	Headwaters of clear, cool, high quality streams	Keya Paha and Holt Counties
Northern river otter *Lontra canadensis*	—	Threatened	Wooded rivers and streams with sloughs and backwaters, ponded water areas, and year-round open water with rock, brush, and log piles	Niobrara, Elkhorn, Loup, and Platte Rivers
Small white lady's slipper *Cypripedium candidum*	—	Threatened	Moist-to-wet sedge-meadows, wet prairies, and wet-mesic tallgrass prairie	Along the Niobrara, Elkhorn, and Loup Rivers
Bald eagle[a] *Haliaeetus leucocephalus*	Protected under BGEPA[b] and MBTA[c]		Mature riparian areas along streams, rivers, and permanent bodies of water	Winter roosting and nesting along the Niobrara, Elkhorn, and Loup Rivers

Sources: NatureServe, 2009; Nebraska Bird Library, 2012; NGPC, 2011; NGPC, 2012a; USFWS, 2007; USFWS, 2009; USFWS, 2011a; USFWS 2011b; USFWS 2011c; USFWS, 2012

[a] *This species is not federally listed as threatened or endangered under Section 7 of the Endangered Species Act; however, this species is federally protected under the Bald and Golden Eagle Protection Act (16 USC §§ 668a–d).*

[b] *Bald and Golden Eagle Protection Act*

[c] *Migratory Bird Treaty Act*

For each of the species listed in Table E.9-1, the species occurrence, history, and habitat requirements were reviewed from current or recent research reports, management and recovery plans, and conservation assessments. The following summarizes the biology and occurrence of each species.

E.9.1.1 Interior Least Tern

The population of the interior least tern (*Sternula antillarum athalassos*) was federally listed as endangered in 1985.[1] All federally listed species automatically become State-listed species. In 2008, USFWS initiated a 5-year review of this species.[2] No critical habitat has been designated for the interior least tern.

The interior least tern occurs on the rivers in the vicinity of the Study Area. These species nest from mid-May to early August. Interior least terns nest in colonies on sand islands and sandbars in rivers as well as on gravel pits and beaches. A key factor for nest site selection is continuous above water exposure of the site for at least 100 days during the nesting period (Smith and Renken, 1993). Suitable nesting locations contain little vegetation (less than 10 percent), and the existing vegetation is less than 4 inches tall (Dirks et al., 1993).

Nesting interior least terns are commonly found within or near nesting colonies of piping plovers; therefore, this species is considered a breeding associate of the piping plover in the Missouri River and Niobrara River systems.

Interior least tern. Photo by U.S. Fish and Wildlife Service

Interior least terns may occur near the Study Area at the crossing of the Loup, Elkhorn, and Niobrara Rivers only during the breeding and nesting season (from late April through early August). Several interior least tern and piping plover nesting colonies are known to occur on the Niobrara, Elkhorn, and Loup Rivers (NGPC, 2011a). Interior least terns and piping plovers nest along the Niobrara River, between Spencer Dam and the confluence with the Missouri River (Lott, 2006). Bare sand or gravel areas that exist along the Niobrara, Elkhorn, and Loup Rivers within the Study Area may provide nesting habitat for either interior least terns or piping plovers. In addition, the wetlands that exist along the floodplains are known to be used by interior least terns for feeding. These wetlands provide habitat for small fish that interior least terns use for forage.

E.9.1.2 Piping Plover

The Northern Great Plains population of piping plovers (*Charadrius melodus*) was federally listed as threatened in 1985.[3] All federally listed species automatically become State-listed species. In 2008, USFWS initiated a 5-year review of this species,[4] which was completed and

[1] 50 Federal Register (FR) 21784–92. May 28, 1985. Endangered and Threatened Wildlife and Plants; Interior Population of the Least Tern Determined to be Endangered; Final Rule.

[2] 73 FR 21643–45. April 22, 2008. Endangered and Threatened Wildlife and Plants; 5 Year Reviews; Notice of initiation of review; request for information on seven listed Midwestern species.

[3] 50 FR 50726–34. December 11, 1985. Endangered and Threatened Wildlife and Plants; Determination of Endangered and Threatened Status for the Piping Plover; Final Rule.

[4] 73 FR 56860–62. September 30, 2008. Endangered and Threatened Wildlife and Plants; 5-Year Review; Notice of initiation of review; request for information on the piping plover (*Charadrius melodus*).

summarized on September 29, 2009 (USFWS, 2009). There is currently no federally designated critical habitat for the piping plover within Nebraska or in the Study Area.

Piping plover. Photo by U.S. Fish and Wildlife Service

Piping plovers arrive on breeding grounds between mid-April and mid-May (Prindiville-Gaines et al., 1988; Haig and Oring, 1985). Departure from nesting sites is usually completed by early August. Piping plovers in the Midwest, similar to interior least terns, nest on the Niobrara, Elkhorn, and Loup Rivers and other Great Plains rivers and use dry, barren sandbars, beaches, and gravel pits for nesting. Suitable nesting areas often contain minimal vegetative cover of less than 25 percent (Ziewitz et al., 1992). The optimal range for vegetative cover on nesting habitat has been estimated to be from 0 to 10 percent (Armbruster, 1986). Piping plovers often prefer nests to be initiated near objects such as driftwood, stones, or plant debris (Haig and Elliot-Smith, 2004). Warnock et al., (2002) hypothesize that such objects may serve as windbreaks or nest markers for the birds. Sandbar area and height are also important factors in nesting habitat selection for both piping plovers and interior least terns. Nesting piping plovers are commonly found within or near nesting interior least tern colonies; therefore, this species is considered a breeding associate of the interior least tern in the Missouri River and Niobrara River systems.

Piping plovers may occur near the Study Area at the crossing of the Loup, Elkhorn, and Niobrara Rivers only during the breeding and nesting season (from late April through early August). Several interior least tern and piping plover nesting colonies are known to occur on the Niobrara, Elkhorn, and Loup Rivers (NGPC, 2011a). Interior least terns and piping plovers nest along the Niobrara River, between Spencer Dam and the confluence with the Missouri River (Lott, 2006). Bare sand or gravel areas that exist along the Niobrara, Elkhorn, and Loup Rivers within the Study Area may provide nesting habitat for either interior least terns or piping plovers. In addition, the wetlands that exist along the floodplains are known to be used by piping plover for feeding. These wetlands provide habitat for macroinvertebrates that piping plover use for forage.

E.9.1.3 Whooping Crane

Whooping crane. Photo by U.S. Fish and Wildlife Service

The whooping crane (*Grus americana*) was federally listed as endangered in 1967,[5] and critical habitat was designated for this species in 1978.[6] All federally listed species automatically become State-listed species. The critical habitat for this species is located along a 56-mile-long, 3-mile-wide stretch of the Platte River between Lexington and Denman, Nebraska. This location is approximately 55 miles from the southernmost limits of the Study Area.

Whooping cranes can be found in South Dakota and Nebraska during fall and spring migrations. Whooping cranes' fall migration through South Dakota and Nebraska is between early October and late November and their spring migration is between mid-March and late May. Figure E.9-1 shows the whooping crane migration corridor in Nebraska. The percentages represent the geographic area in which all whooping crane sitings have been reported. For example, the 75 percent corridor represents that 75 percent of the sitings occurred in this geographic area. The USFWS estimates that only 4 percent of whooping cranes that stop over in Nebraska are observed and reported. A variety of habitats are used during migration such as croplands and wetlands for feeding and shallow portions of rivers, lakes, and streams for roosting sites (Austin and Richert, 2005). Overnight roosting requires shallow water over submerged sandbars on which the cranes stand and rest. This species has shown a preference for unobstructed channels that are isolated from human disturbance (Canadian Wildlife Service and USFWS, 2007). Large palustrine wetlands are used for roosting and feeding during migration.

Today, most whooping cranes migrate from Wood Buffalo National Park in Canada to Aransas National Wildlife Refuge on the Texas coast. This route passes southeast through northeastern Alberta, southcentral Saskatchewan, northeastern Montana, western North Dakota, western South Dakota, central Nebraska and Kansas, westcentral Oklahoma, and eastcentral Texas.

Scattered occurrences have been reported in adjacent states and provinces (Canadian Wildlife Service and USFWS, 2007). No critical habitat for this species exists within or near the Study Area; however, the whooping crane migration route encompasses the entire Study Area. During migration, this species may be present in suitable habitat within the Study Area.

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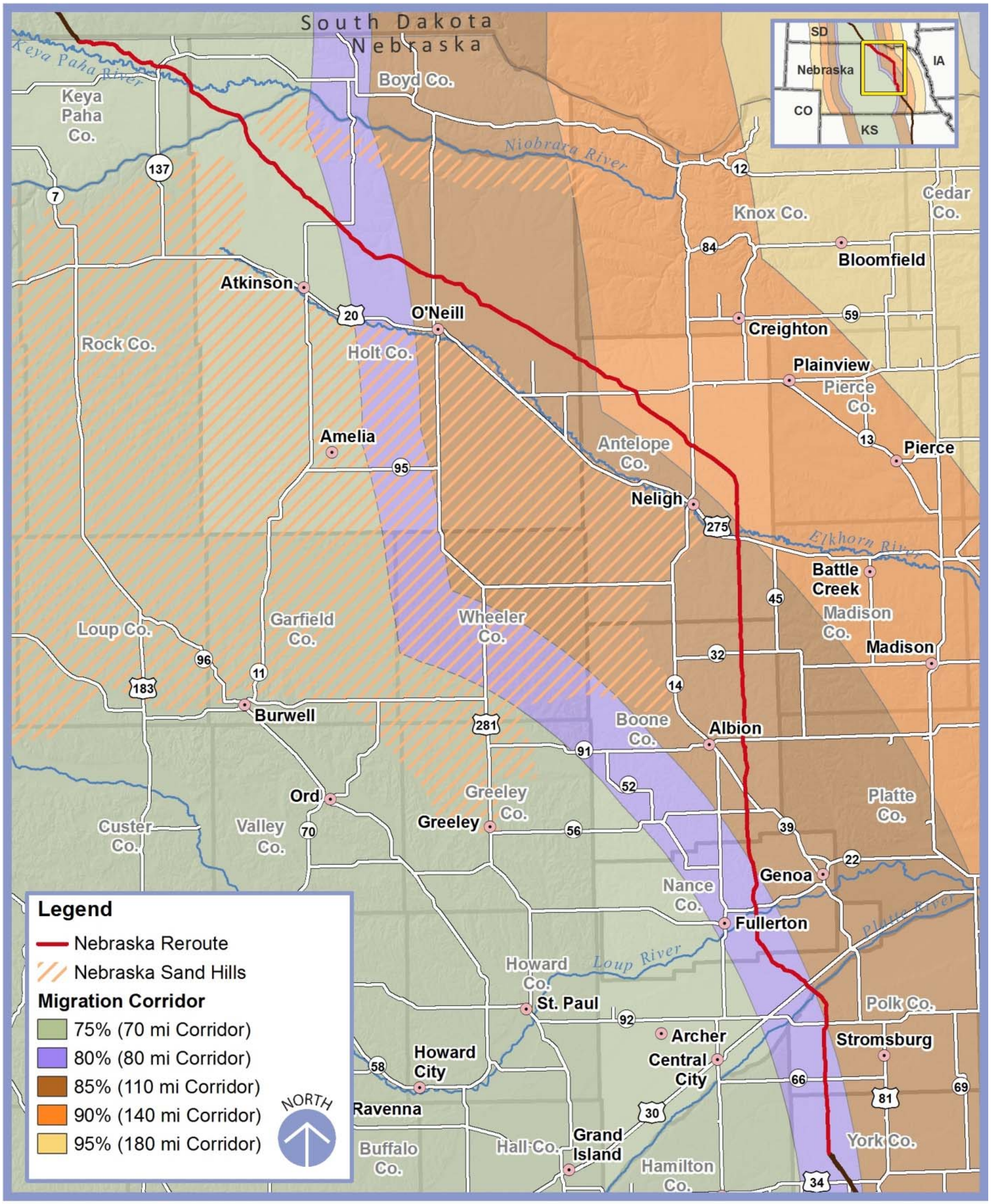
5 32 FR 4001. March 11, 1967. Native Fish and Wildlife; Endangered Species.

6 43 FR 20938–42. May 15, 1978. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Whooping Crane; Final Rule.

Figure E.9-1. Whooping Crane Migration



Source: Migration Corridor, U.S. FWS

E.9.1.4 Sprague's Pipit

Sprague's pipit. Photo by Phil Swanson.

In 2011, USFWS initiated review of candidate species,[7] including the Sprague's pipit, which was completed and summarized on October 26, 2011 (USFWS, 2011a). The USFWS determined that listing the Sprague's pipit (*Anthus spragueii*) as endangered or threatened is warranted; however, proposal of a regulation implementing this action is precluded by higher priority listing actions. As a result, the Sprague's pipit was added to the candidate species list.[8] In the event that it becomes a federally listed species, it will automatically become a State-listed species. The Sprague's pipit is listed on the Nebraska Natural Legacy Project State Wildlife Action Plan's Tier I At-Risk Species List (NGPC, 2012b).

Sprague's pipits are found in large patches of native grassland vegetation of the plains and prairies; they are not common in bare areas near water. Suitable grasslands are typically of intermediate height with sparse to moderate vegetation density. Studies have shown they are sensitive to areas less than 190 hectares in size, as smaller patches are at risk of brood parasitism from brown-headed cowbirds (*Molothrus ater*) during the breeding season (Dechant et al., 2003). They prefer to breed in well-drained, open grasslands and avoid grasslands with excessive shrubs (USFWS, 2011b). While Sprague's pipits prefer native grasslands, they have been observed in nonnative vegetation if the vegetative structure is suitable. They may also be found in areas of light to heavy grazing, though it is not preferred (Dechant et al., 2003). They are rarely found in cultivated areas.

In the United States, the Sprague's pipit's breeding range extends from northern South Dakota through North Dakota and central Montana to northwestern Minnesota, in large patches of native grassland (USFWS 2011b). They arrive on the breeding grounds in April and depart for the wintering grounds in September and October. Two breeding periods have been reported in North Dakota: late April to early June, and mid-July to early September (Dechant et al., 2003). There are no records of breeding within the Study Area. Sprague's pipits are not likely to breed in or near the Study Area because it is outside of the current breeding range for the species.

Sprague's pipits are not known to winter in Nebraska but are uncommon spring and fall migrants. Sprague's pipits may stop over in the Study Area during the spring and fall migration. Areas most likely to attract migrants are patches of native grassland and pasture land or nonnative vegetation with vegetative structures similar to their preferred habitat.

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[7] 50 FR 66370–66439, October 26, 2011. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions.

[8] 50 FR 56028–50, September 15, 2010. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List Sprague's Pipit as Endangered or Threatened Throughout Its Range.

E.9.1.5 Pallid Sturgeon

Pallid sturgeon. Photo by Ken Bouc. Copyright © Nebraska Game and Parks Commission. All rights reserved.

The pallid sturgeon (*Scaphirhynchus albus)* was federally listed as endangered in 1990.[9] All federally listed species automatically become State-listed species. The published range of this species includes the states of Arkansas, Illinois, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Tennessee. In 1993, USFWS issued a recovery plan for the pallid sturgeon (USFWS, 1993).

No critical habitat has been designated for the pallid sturgeon; however, the recovery plan outlined species recovery objectives and criteria and divided the species' range into six Recovery-Priority Management Areas (RPMA) (USFWS, 1993). One of these areas, RPMA 4, consists of the Missouri River from Gavins Point Dam downstream to the confluence with the Mississippi River and includes the lower Platte River, from the confluence with the Missouri River upstream, to the Elkhorn River confluence (National Research Council [NRC], 2005). Recent studies have found pallid sturgeon in the Platte River below Columbus, NE (Hamel and Pegg, 2010).

Pallid sturgeons are considered to be well adapted for life on the bottoms of large, swift moving rivers that are turbid and free flowing (USFWS, 1993). Pallid sturgeons evolved in the diverse and ephemeral environments of the Missouri and Mississippi Rivers. The historic floodplain habitat of the Missouri and Mississippi Rivers provided important functions for native fish found in large rivers, such as the pallid sturgeon. Floodplains were considered the major source of organic matter, sediment, and woody debris for these rivers when flood flows crested the riverbanks. The transition zone between the vegetated floodplain and the main channel included habitats with variable depths described as chutes, sloughs, and side channels. The still waters in this transition zone allowed organic material, important to macroinvertebrate production, to accumulate. At different stages in their lives, pallid sturgeons have a high incidence of feeding on aquatic macroinvertebrates, making these chutes and backwaters inviting places for feeding. Flood flows connect these important habitats and allow fish from the main channel to utilize these areas for feeding (USFWS, 1993). While most habitat descriptions are based on fish in the juvenile or adult life stage, the habitat used by pallid sturgeons during all life stages varies widely (Wildhaber et al., 2007).

Historically, the range of the pallid sturgeon consisted of large rivers with shallow braided channels and shifting sand bars (Peters and Parham, 2008). The lower Platte River still retains this type of habitat. Pallid sturgeon in the lower Platte River use areas associated with the downstream ends of sand bars and in deeper channels along the edges of sand bars (Peters and Parham, 2008; Swigle, 2003). The lower Platte River includes shallow sand bars and swift deeper channel habitats, which have been described as preferred conditions for adult and juvenile pallid sturgeon (Peters and Parham, 2008). In the channelized sections of the lower Missouri River (RPMA 4), pallid sturgeons have been documented in areas near wing dikes (Jacobson et al., 2007; Laustrup et al., 2007). Studies in the upper Missouri and Yellowstone Rivers reveal that pallid sturgeons were commonly located in areas with sand bars and sandy substrates (Bramblett and White, 2001).

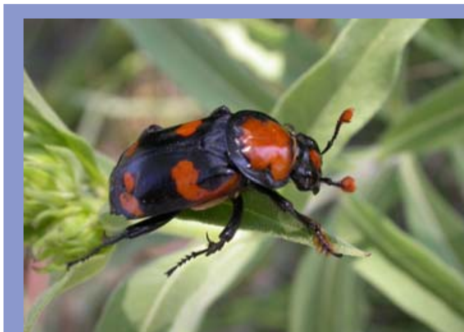
[9] 55 FR 36641–47. September 6, 1990. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Pallid Sturgeon; Final Rule.

Pallid sturgeons are not likely to occur at the crossings of the Loup or Elkhorn Rivers within the Study Area. There are no recorded observations of the species in the Loup River.

E.9.1.6 American Burying Beetle

The American burying beetle (*Nicrophorus americanus*) (ABB) was federally listed as endangered in 1989.[10] In 2007, USFWS initiated a 5-year species review,[11] which was completed and summarized in 2008 (USFWS, 2008). No critical habitat has been designated for this species. All federally listed species are automatically State-listed species.

ABBs are active from late April through September. This species is nocturnal, generally active only when temperatures exceed 60°F for several consecutive nights. In South Dakota and Nebraska, the ABB is attracted to areas that have significant topsoil suitable for burial of carrion, which it depends on for food and reproduction. Optimal carrion size has been found to range from 3.5 to 7.0 ounces (USFWS, 1991). The ABB is one of the largest carrion beetles and is a strong flier, traveling great distances.



American burying beetle. Photo by Doug Backlund, <www.wildphotosphotography.com>

Although the ABB's habitat is not clearly defined, capture data suggest the possibility of riparian woodlands, mixed agricultural lands (including pastures and mowed fields), and grasslands (Ratcliffe and Jameson, 1992). Habitats where ABBs currently occur in Nebraska consist of grassland prairie, forest edges, open woodlands with grasslands, and scrubland (USFWS, 2008). Recent research suggests that the ABB is more of a generalist species, using a wider range of habitats than other burying beetles, and that the presence of appropriate soil for carrion burial is more important than habitat type. Adequate soil moisture levels appear to be a critical element of suitable habitat (Bishop et al., 2002; Jurzenski, 2011).

Historically, ABBs have been found in the Sand Hills of northcentral Nebraska, where there is sufficient carrion, even though sandy soils may make carrion burial difficult (Ratcliffe and Jameson, 1992). Given the documented occurrence of the species in Keya Paha and Antelope Counties, and the ABB's ability to fly long distances in search of carrion, this species might be present in suitable habitats within the Study Area (USFWS, 1991).

Wyatt Hoback, who has studied the ABB for over 10 years, completed a driving survey to assess the availability of suitable ABB habitat along the Final EIS portion of the preferred alternative route. Surveys for ABBs were completed in the best possible habitat in areas that were accessible. Hoback used the "American Burying Beetle Nebraska Trapping Protocol" (2008), which is more stringent than the USFWS-required "American Burying Beetle *Nicrophorus americanus* Rangewide Survey Guidance." Where habitat was inaccessible, Hoback assumed that the habitat between traps would be suitable based on surveys on either end of the

[10] 54 FR 29652-55. July 13, 1989. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the American Burying Beetle; Final Rule.

[11] 72 FR 4018–19. January 29, 2007. Endangered and Threatened Wildlife and Plants; Initiation of a 5-Year Review of Ten Listed Northeastern Species; Notice.

inaccessible stretch. Capture rates (beetles per trap night) were used to determine ABB concentrations between 2009 and 2011.

Based on the 2009 surveys, Hoback concluded that the pipeline route in areas dominated by row crops in Jefferson, Saline, Fillmore, York, Hamilton, Merrick, Nance, Boone Counties did not appear to support populations of ABBs. Surveys in 2010 found that the majority of the pipeline route in northern Holt and Keya Paha Counties supported ABB populations. The highest concentrations were found in prime habitat in southern Holt County. In September 2012, Hoback surveyed new locations along the reroute portion of the preferred alternative route in Keya Paha, Boyd, Holt, and Antelope Counties. No ABBs were found along the preferred alternative route in Antelope and Boyd Counties. ABBs were found in Keya Paha and Holt Counties in lower concentrations than that of the prime habitat in southern Holt County. The lower concentrations could be due to the presence of reduced habitat quality in these areas or the current drought, which anecdotally has resulted in lower ABB trap success.

E.9.1.7 Western Prairie Fringed Orchid

The western prairie fringed orchid (*Platanthera praeclara*) was federally listed as threatened on September 28, 1989.[12] All federally listed species automatically become State-listed species. In February 2009, USFWS completed and summarized a 5-year review of this species[13] (USFWS, 2009). No critical habitat has been designated for this species.

Western prairie fringed orchid. Photo by U.S. Fish and Wildlife Service

In Nebraska, the western prairie fringed orchid is found in the eastern two-thirds of the state, from Cherry and Keith Counties in the west to the Missouri River in the east. This species is a perennial orchid found in wet-mesic–to–mesic tallgrass prairie, specifically in unplowed, calcareous prairies and sedge meadows. The soils in this region are usually Udolls or Udic Ustolls (humid to intermittently dry mollisols, or prairie soils) on gentle to moderate slopes. In tallgrass prairies, the western prairie fringed orchid is typically associated with big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indiangrass (*Sorghastrum nutans*). This species is commonly associated with tufted hairgrass (*Deschampsia caespitosa*) and switchgrass (*Panicum virgatum*) in wetter growth sites. In sedge meadows, this species is often dominated by sedges (*Carex* spp.) and spikerushes (*Eleocharis* spp.) (USFWS, 1996). There is evidence that orchid ecology is tied to mycorrhizal associations (that is, a symbiotic relationship between soil fungi and plant roots) (USWFS, 2009). In Nebraska, this orchid blooms almost exclusively from the last week of June through the first 2 weeks of July. Flowering may be suppressed by litter accumulation and stimulated by fire

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[12] 54 FR 39857–63. September 28, 1989. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Eastern and Western Prairie Fringed Orchids; Final Rule.

[13] 71 FR 16176–77. March 30, 2006. Endangered and Threatened Wildlife and Plants; 5-Year Review of Five Midwestern Species; Notice of Review.

(USFWS, 1996). Within the Study Area, the western prairie fringed orchid can be found in Holt, Antelope, and Boone Counties where there is suitable habitat.

E.9.1.8 Northern Long-Eared Bat

The USFWS issued a 90 day finding on a petition to list the northern long-eared bat (*Myotis septentrionalis*) as endangered or threatened on June 27, 2011 (USFWS, 2011c). It was determined that there is substantial scientific or commercial information indicating that listing of the northern long-eared bat may be warranted. A review of the status of the species was initiated, and a 12-month finding will be issued to address whether listing is warranted. All federally listed species automatically become State-listed species.

The northern long-eared bat is a common and widespread bat; however, much remains to be studied regarding their life cycle. They are widely distributed from British Colombia, Canada east to the Atlantic Ocean and southward into Arkansas and Florida. This species is typically found in the eastern half of the United States, but occurs in North Dakota, South Dakota, eastern Wyoming, eastern Nebraska, Kansas, and eastern Oklahoma (Western Bat Working Group, 2012).

Northern long-eared myotis. Copyright © The Smithsonian Book of North American Mammals. All rights reserved.

The northern long-eared bat generally is associated with old-growth forests composed of trees 100 years old or older. It relies on intact interior forest habitat, with low edge-to-interior ratios (NatureServe 2012). They roost singly or in small groups in buildings, under shingles of buildings, under exfoliating tree bark, and in caves and mines (Western Bat Working Group, 2012).

In summer, this species is often associated with forested habitats, especially around wetlands, and use different sites for day and night roosts (Minnesota Department of Natural Resources, 2012). Daytime roosts are often found in crevices or hollows or under the loose bark of trees and in a variety of small spaces associated with buildings and other structures. Night roosts may include caves, mines, and quarry tunnels (NatureServe, 2012).

Maternity roosts are warm sites that maximize the growth rate of young while providing protection from weather and predation (NatureServe, 2012). Females form small maternity colonies behind exfoliating bark, in tree snags, and in stumps, as well as in bat houses and behind building shutters (USFWS, 2011). Females bear a single offspring in June or July. Nursery colonies disband in July, once offspring are able to fly, at which time the bats join roost sites in caves, mines, and tunnels (Minnesota Department of Natural Resources, 2012).

Hibernation occurs in caves, mines, and tunnels from late fall through early spring. Within these areas, hibernators frequently roost in small sites such as crevices and drill holes, but roosting in the open is not uncommon (NatureServe, 2012). They will hang individually or in small clusters.

Although there is a lack of old-growth forested habitat, caves, and tunnels in the Study Area (which is located on the western limits of their range), northern long-eared bats could occur in the Study Area in patches of oak woodland and scattered structures.

E.9.1.9 Blacknose Shiner

Blacknose shiner. Photo by Konrad Schmidt; <fishbase.sinica.edu.tw >.

The State-listed endangered blacknose shiner (*Notropis heterolepis*) is a minnow, commonly 3 to 5 inches in length. Historically, the species was widely distributed across the northeastern and north-central United States. The current distribution is in clear prairie streams in quite pools with considerable vegetation, muck, and organic debris, often overlaying sand, gravel, or rock bottoms (Pflieger, 1997). In Nebraska, the blacknose shiner is found in clean, cool, well oxygenated streams with abundant aquatic vegetation. The minnow's preferred habitat is areas swept by currents, island heads, and sand bars. Blacknose shiners are intolerant of turbid water and pollution. Their diet consists of small aquatic invertebrates, insects, crustaceans, and algae. Spawning usually occurs in the last week of June. Because the blacknose shiner is not a federally listed threatened or endangered species, its presence or absence is not subject to federal Section 7 requirements for consultation with USFWS. However, consultation with the NGPC during the Nebraska Department of Natural Resources review of an application for a water use permit and with NDEQ during review of an NPDES permit is required under Neb. Rev. Stat. § 37-807(3) of NESCA.

E.9.1.10 Finescale Dace

The State-listed threatened finescale dace (*Phoxinus neogaus*) is a minnow, commonly 3 to 5 inches in length. Historically, this species was found throughout much of the central portion of Nebraska as well as in the Nebraska panhandle. Current distribution has been reduced primarily to the Sand Hills and several small tributaries of the North Platte and South Loup Rivers. The finescale dace is usually found at sites near stream headwaters. Inhabited streams are usually relatively narrow (1 to several yards wide) and shallow (several inches to a foot deep), with deeper pools. During the late summer or during dry periods, if flows are greatly reduced or stopped, the fish find refuge in remaining pools. High water quality, fine sand substrate, some in-stream floating vegetation, and bank vegetation consisting of grasses, forbs, some willows, and shrubs characterize these streams. Because the finescale dace is not a federally listed threatened or endangered species, its presence or absence is not subject to federal Section 7 requirements for consultation with USFWS. However, consultation with the NGPC is required during the Nebraska Department of Natural Resources review of an application for a water use permit and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. § 37-807(3) of NESCA.

Finescale dace. Photo by Konrad Schmidt; U.S. Geological Survey, 2012. Nonindigenous Aquatic Species Database. Gainesville, Florida. Retrieved December 16, 2012; <http://nas.er.usgs.gov /queries/FactSheet.aspx?speciesID =2556>.

E.9.1.11 Northern Redbelly Dace

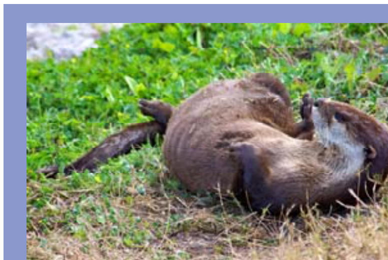
The northern redbelly dace (*Phoxinus eos*) is State listed as a threatened species in Nebraska; however, it is not a federally listed species. Therefore, its presence or absence is not subject to federal Section 7 requirements for consultation with USFWS. However, consultation with the NGPC is required during the Nebraska Department of Natural Resources review of an application for a water use permit and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. § 37-807(3) of NESCA.

Northern redbelly dace. Photo by Konrad Schmidt; <http://hatch.cehd.umn.edu/research/fish/fishes/northern_red.html>.

The northern redbelly dace is a small minnow, approximately 2–3 inches in length. Historically, individuals were found throughout much of the central portion of Nebraska as well as in the panhandle. Current distribution has been reduced primarily to the Sand Hills and several small tributaries of the North Platte and South Loup Rivers. Survey work in Sand Hill streams in Cherry, Brown, and Keya Paha Counties from 1995 through 1997 recorded the species from streams in the drainages of the Niobrara, North Loup, and Snake Rivers. This species is usually found at sites near the headwaters of the stream. Inhabited streams are usually relatively narrow (1 to several yards wide) and shallow (several inches to a foot deep), with deeper pools. During the late summer or during dry periods, if flows are greatly reduced or stopped, the fish find refuge in remaining pools. High water quality, fine sand substrate, some in-stream floating vegetation, and bank vegetation consisting of grasses, forbs, some willows, and shrubs characterize these streams.

E.9.1.12 Northern River Otter

The northern river otter (*Lontra canadensis*), also known as the North American river otter, is a long, slender, partially aquatic mammal. This species was State listed as endangered in 1980 and was down-listed to threatened status in 2005 after a series of successful reintroductions (Boyle, 2006). Because the northern river otter is not a federally listed threatened or endangered species, its presence or absence is not subject to federal Section 7 requirements for consultation with USFWS. However, consultation with the NGPC is required during the Nebraska Department of Natural Resources review of an application for a water use permit and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. § 37-807(3) of NESCA.



Northern river otter. Photo by U.S. Fish and Wildlife Service

NGPC released northern river otters at seven sites between 1986 and 1991, including sections of the Niobrara River in Sheridan County, the Elkhorn River in Antelope County, and the South Loup River in Custer County. Recent observations suggest that northern river otters have become established in several Nebraska watersheds. Northern river otters are highly mobile, and relocate in response to food availability or environmental conditions, resulting in a large and extremely dynamic home range. This species needs a large amount of space to meet its annual requirements. At any given time, northern river otters may occupy only a few miles of stream but will often move from one area to another.

Northern river otters are social animals that hunt and travel together, using the same resting sites, latrines, and dens. This species is active year-round and does not migrate. Breeding can occur in March and April, but is extremely variable. Breeding may take place on land or in water and may occur anywhere within the female's home range. Females give birth and rear young in abandoned dens of other aquatic mammals. Natal dens may occasionally be found up to a few hundred feet from water.

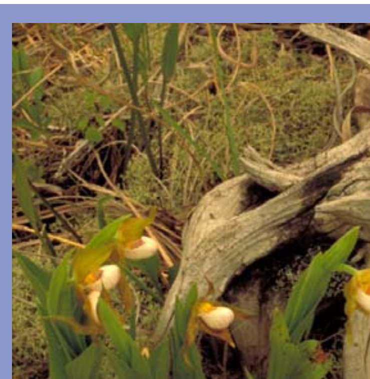
The northern river otter's diet consists primarily of fish, but may also include crustaceans, mollusks, insects, birds, and small mammals. Species that have been reported to prey on northern river otters include the gray wolf (*Canis lupus*), bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), red fox (*Vulpes vulpes*), and bald eagle (*Haliaeetus leucocephalus*). Threats to the northern river otter include destruction and degradation of habitat, water pollution, human settlement, recreational use of riparian areas, incidental trapping, and illegal take, such as trapping or hunting (Boyle, 2006).

Populations of northern river otter exist along the Elkhorn, Loup, and Niobrara Rivers. Occurrences within the Study Area would most likely be in floodplain wetlands along the Elkhorn and Loup Rivers and other tributaries that contain suitable northern river otter habitat. The northern river otter's current estimated range does not extend into the Study Area on the Niobrara River (NGPC, 2011b), although the possible occurrence should not be ruled out, because northern river otters are highly mobile and may be present wherever there is suitable habitat.

E.9.1.13 Small White Lady's Slipper

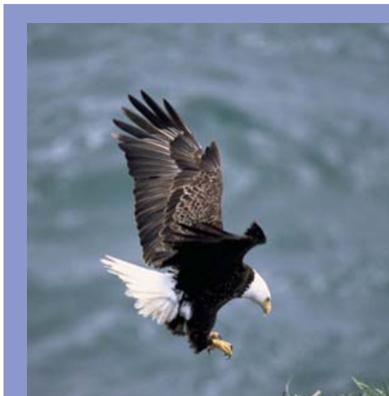
The small white lady's slipper (*Cypripedium candidum*) is State listed as threatened in Nebraska; however, it is not a federally listed species. Because it is not a federally listed threatened or endangered species, the presence or absence of this species is not subject to federal Section 7 requirements for consultation with USFWS. However, consultation with the NGPC is required during the Nebraska Department of Natural Resources review of an application for a water use permit and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. §37-807(3) of NESCA.

The small white lady's slipper grows in clumps, with one flower at the tip of a flowering stem consisting of a white, pouch-shaped "slipper." The small white lady's slipper in Nebraska has been associated with northern sedge fen meadows, northern cordgrass wet prairies, and mesic-to-wet tallgrass prairies (eFloras.org, 2010). In addition, some individual small white lady's slipper plants have been identified in roadside ditches and growing in association with smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*), although this has not been documented as typical habitat. This species blooms from the end of May through early June. Populations exist in Keya Paha, Holt, Antelope, Nance, and Merrick Counties. The distribution of small white lady's slipper follows the Niobrara River, Elkhorn River, and Loup River drainages within these counties (NGPC, 2011a).



Small white lady's slipper. Photo by U.S. Fish and Wildlife Service

E.9.1.14 Bald Eagle



Bald eagle. Photo by U.S. Fish a nd Wildlife Service

The bald eagle (*Haliaeetus leucocephalus*) is a protected species under the BGEPA and the MBTA. USFWS formally removed the bald eagle from the federal list of threatened or endangered species in 2007,[14] and in 2008, the bald eagle was formally removed from the Nebraska threatened or endangered species list. There have been no critical habitat designations for the bald eagle. Consequently, none of the land within the Study Area is considered critical habitat.In North America, bald eagles migrate both north and south seasonally. The distance of migration depends on the severity of the winter climatic conditions and subsequent available habitat for feeding. The bald eagle is often associated with the Missouri River during annual migrations and throughout the winter in areas where open water is present. The southward migration of bald eagles begins as early as October, and the wintering period extends from December to March. Migrating and wintering eagles may be found in Nebraska from early November to early April.

During the winter, the bald eagle feeds on fish in open water areas created by dam tailwaters; in the warm effluents of power plant, municipal, and industrial discharges; or in power plant cooling ponds. The Missouri River floodplain forming Nebraska's border is a major wintering area for the bald eagle because of the presence of large dead or dying cottonwood trees located along the banks of the river and open water at the tailwaters of Gavins Point Dam. The frequency and duration of bald eagle use of these areas depends on weather conditions and the presence of ice.

Suitable breeding habitat for the bald eagle is characterized by riparian areas with large mature trees suitable for nesting and roosting. The bald eagle must have access to lakes, reservoirs, major rivers, and select seacoast habitats with an abundant source of food such as fish, rabbits, turtles, snakes, other small mammals, and carrion (USFWS, 2007). Bald eagles can generally be found statewide in Nebraska but tend to occur most frequently along rivers and other permanent bodies of water.

Bald eagles nest in Nebraska from mid-February through mid-August. They tend to nest in large trees with specific size and structural characteristics. Bald eagles usually nest in the same territories each year, often using the same nest repeatedly. Potential bald eagle habitat in the Study Area would include riparian areas surrounding the Niobrara, Elkhorn, and Loup Rivers. These areas would be attractive to bald eagles because of the presence of large trees with suitable nesting areas.

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14 72 FR 37345–72. July 9, 2007. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife; Final Rule.

E.9.2 POTENTIAL IMPACTS

E.9.2.1 Interior Least Tern

Potential direct impacts to interior least tern habitat may occur because of construction and operation of the Nebraska Reroute. The crossings of the Niobrara, Elkhorn, and Loup Rivers have associated interior least tern habitat. Each of these locations would be crossed using the horizontal directional drilling (HDD) method; however, the effects of construction, such as noise and dust, near these locations could influence nest site selection and/or nesting success if construction were to occur during nesting and breeding season (from early May to mid-August). In addition, impacts on interior least terns could occur if there were an unintended release of drilling fluids (frac-out) during the HDD operation and the impacts from frac-out clean-up response. A frac-out would release drilling mud (bentonite and water) into the river system, which would disperse into flowing water or settle in standing water. While bentonitic drilling mud is nontoxic, the effects can be similar to turbidity and sedimentation. The frac-out and related response may impact nest site selection or nesting in areas downstream of the release. Short-term direct impacts that could occur during construction include construction noise, dust, and artificial lighting (that is, nighttime work with lights).

Short-term indirect impacts to this species might occur during hydrostatic testing of the pipeline because of potential depletions of flow within the Niobrara River and the Platte River basins, including the Elkhorn River and Loup River basins. Reduction in potential forage habitat and increased access to in-river nesting sites from predators might occur because of a reduction in flows. At this time, the amount of water needed from these two river systems is unknown. Activities involved with maintenance or spill cleanup might adversely affect interior least terns if activities were to take place in or near habitat or nest site locations. These issues will need to be addressed during Section 7 of the Endangered Species Act consultation with the USFWS, with the NGPC during the Nebraska Department of Natural Resources review of an application for a water use permit, and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. § 37-807(3) of NESCA.

Because of the potential impacts to roosting and feeding habitats, the Nebraska Reroute may impact migrating interior least terns within the Study Area. See Section E.9.3 for conservation measures.

E.9.2.2 Piping Plover

Potential direct impacts to piping plover habitat might occur because of construction and operation of the Nebraska Reroute. The crossings of the Niobrara, Elkhorn, and Loup Rivers have associated interior least tern and piping plover habitat. Each of these locations would be crossed using HDD; however, the effects of construction, such as noise and dust, near these locations could influence nest site selection and/or nesting success if construction were to occur during nesting and breeding season (from mid-April to early August). In addition, impacts on piping plovers could occur if there were an unintended release of drilling fluids (frac-out) during the HDD operation and the impacts from frac-out clean-up response. A frac-out would release drilling mud (bentonite and water) into the river system, which would disperse into flowing water or settle in standing water. While bentonitic drilling mud is nontoxic, the effects can be similar to turbidity and sedimentation. The frac-out and related response may impact nest site selection or nesting in areas downstream of the release. Short-term direct impacts that could occur during construction include construction noise, dust, and artificial lighting (that is, nighttime work with lights).

Short-term indirect impacts to these species might occur during hydrostatic testing of the pipeline because of potential depletions of flow within the Niobrara River and the Platte River basins, including the Elkhorn River and Loup River basins. Reduction in potential forage habitat and increased access to in-river nesting sites from predators might occur because of a reduction in flows. At this time, the amount of water needed from these two river systems is unknown. Activities involved with maintenance or spill cleanup might adversely affect interior least terns and piping plovers if activities were to take place in or near their habitat or nest site locations. These issues will need to be addressed during Section 7 of the Endangered Species Act consultation with the USFWS, with the NGPC during the Nebraska Department of Natural Resources review of an application for a water use permit, and with NDEQ during review of an NPDES permit under Neb. Rev. Stat. § 37-807(3) of NESCA.

Because of the potential impacts to roosting and feeding habitats, the Nebraska Reroute may impact migrating piping plovers within the Study Area. See Section E.9.3 for conservation measures.

E.9.2.3 Whooping Crane

Migrating whooping cranes roost and feed within the Study Area. Direct impacts on the whooping crane would result from the potential disturbance to whooping crane roosting and feeding habitats during migration because of construction activities; however, these impacts would be temporary and would cease once construction activities stop. Roosting habitats would most likely occur at major river crossings, such as at the Loup, Elkhorn, and Niobrara Rivers. Feeding habitats would include wetland areas, shallow water areas in stream corridors, and row-crop fields.

Short-term indirect impacts to this species might occur during hydrostatic testing of the pipeline because of potential depletions of flow within the Niobrara River and the Platte River basins, including the Elkhorn River and Loup River basins. Reduction in flow could reduce shallow water areas used for roosting and feeding. At this time, the amount of water needed from these two river systems is unknown. This issue will need to be addressed during Section 7 of the Endangered Species Act consultation with USFWS.

Activities involved with maintenance or spill cleanup may impact whooping cranes if activities were to take place in or near their roosting or foraging habitat.

Because of the potential impacts to roosting and feeding habitats during construction the Nebraska Reroute may impact migrating whooping cranes within the Study Area. See Section E.9.3 for conservation measures.

Impacts due to power line placement are outside the purview of NDEQ, but will be addressed through the Nebraska Power Review Board approval process.

E.9.2.4 Sprague's Pipit

The Nebraska Reroute is not within the Sprague's pipit current breeding range (beginning in northern South Dakota), and large, native grasslands do not exist in the Study Area. The Sprague's pipit could stopover in the Study Area during the spring and fall migrations. Direct impacts on the Sprague's pipit may result from the potential disturbance of foraging habitats during migration because of construction activities; however, these impacts would be temporary and would cease once construction activities stop. Construction would decrease the amount of available foraging habitat; however, this is small in comparison to adjacent foraging areas. Additionally, pipeline construction, and associated infrastructure, could fragment suitable habitat. It is not anticipated that the project will impact the Sprague's pipit because this species does not breed within the Study Area and there is sufficient foragaing habitat available adjacent to the Study Area. However, a Migratory Bird Conservation Plan will be developed that may involve surveying for Sprague's pipit during migration period or other appropriate actions as agreed upon by the USFWS and NGPC.

E.9.2.5 Pallid Sturgeon

No direct impacts on the pallid sturgeon are anticipated because the Nebraska Reroute would not cross any waterbodies containing this species. The distance from the Nebraska Reroute to known pallid sturgeon habitat is approximately 65 miles for the Niobrara River, 100 miles for the Elkhorn River, and 40 miles for the Loup River (below the confluence with the Loup Power Canal tailrace return). Short-term indirect impacts to this species might occur during hydrostatic testing of the pipeline because of potential depletions of flow within the Niobrara River and the Platte River basins, including the Elkhorn River and Loup River basins. Decreased flow could reduce longitudinal and lateral migration of this species, potentially impacting spawning locations or contributing to potential fish stranding. At this time, the amount of water needed from these two river systems is unknown. This issue will need to be addressed during Section 7 of the Endangered Species Act consultation with the USFWS. In addition, if the Platte River downstream of the Loup River confluence were used as a source for hydrostatic testing, there would be a potential for entrainment of larval pallid sturgeon.

E.9.2.6 American Burying Beetle

Based on information gathered by Wyatt Hoback, the preferred alternative route would have a reduced impact on ABB by avoiding prime ABB habitat in Holt County and crossing Boyd County, where no ABBs were found during surveys. By shifting the pipeline route east out of the Sand Hills the number of ABB-containing counties (Garfield and Wheeler) would be reduced. Antelope County had a historic ABB occurrence, but 2012 sampling efforts found no ABBs. Antelope County is largely row crops with only islands of suitable ABB habitat. The Counties of Boone, Nance, Merrick, Polk, York, Fillmore, Saline, and Jefferson are largely row crops and lack suitable habitat for ABBs. Trapping efforts in those counties have not resulted in ABBs and no ABBs are expected to occur in those counties.

Construction of the Nebraska Reroute would have the potential to impact the ABB. These impacts might occur during vegetation clearing, site grading, and excavation activities. Work within the right-of-way (ROW) might reduce soil moisture as a result of topsoil removal and grading. Compaction of soil would occur during construction and reclamation activities after construction, including ripping, disking, or chiseling using a disc or harrow. These activities might result in temporary habitat loss, alteration of suitable habitat, habitat fragmentation, and potential mortality to eggs, larvae, and adults through construction and construction-related activities.

During operation of the pipeline, the Nebraska Reroute might increase soil temperature locally by as much as 15°F at 6 inches below the surface. The thermal models indicate that heat dissipation effects would occur primarily within 3.5 feet of the pipeline. Soil heating could increase ABB mortality triggered by early emergence when food sources would be scarce and cold air temperatures could cause emergent adult mortality. In addition, higher soil temperatures could increase metabolic rates such that overwintering beetles could starve prior to emergence, or drying soils could cause beetles to lose water and desiccate (Bedick et al., 1999). ABBs are sensitive to desiccation and altered hydrology may make an area unsuitable even after vegetation has been restored.

The Nebraska Reroute may impact American burying beetles within the Study Area during construction. See Section E.9.3 for conservation measures.

E.9.2.7 Western Prairie Fringed Orchid

Construction of the Nebraska Reroute may impact the Western prairie fringed orchid and its habitat. Construction-related impacts include changing wetland hydrology and consequently disturbing existing habitat, and the potential to introduce or spread competing exotic invasive plant species as a result of revegetation. Permanent project-related facilities (for example, pump stations and access roads) could permanently displace Western prairie fringed orchid populations and their habitat.

The Nebraska Reroute may impact western prairie fringed orchid and its habitat within the Study Area during construction. See Section E.9.3 for conservation measures.

E.9.2.8 Northern Long-Eared Bat

The Nebraska Reroute occurs at the cusp of the northern long-eared bat's range; however, much information is lacking for this species. Old-growth forests, caves, and quarry tunnels have not been identified in the Study Area. If northern long-eared bat were present in patches of oak woodlands, direct impacts could result from the clearing of these trees for the pipeline and associated infrastructure. The removal of any structures they are roosting in would also directly impact the species. This species actively forages at night; therefore, daytime construction would not impact feeding behavior. If the species was observed in the Study Area during surveys, their roosting site could be avoided by construction or individuals relocated as a conservation measure. As a result of the lack of habitat and the implementation of conservation measures if it were present, it is not anticipated the Nebraska Reroute would impact the northern long-eared bat. See Section E.9.3 for conservation measures.

E.9.2.9 Blacknose Shiner

The potential impact of the Nebraska Reroute on fisheries is described in Section 4.8.2 of the Environmental Evaluation.

As recommended by NGPC, surveys for the blacknose shiner were performed in 2009 on the previous alignment. In 2009, no blacknose shiners were found in Nebraska during these surveys, although potential habitat was identified at five waterbody crossings. In 2012, surveys were performed along the proposed Nebraska Reroute corridor and will continue in spring 2013. These surveys will be reviewed in consultation with NGPC. If blacknose shiners are present in any waterbodies crossed by the project, the methods used to cross these would be determined after discussions with NGPC. These discussions would determine which specific method would have the least impact to the species in each waterbody.

E.9.2.10 Finescale Dace

The potential impact of the Nebraska Reroute on fisheries is described in Section 4.8.2 of the Environmental Evaluation.

As recommended by NGPC, surveys for the finescale dace were conducted in 2009 on the previous alignment. In 2009, no finescale dace or habitat for this species was found in Nebraska during these surveys. In 2012, surveys were performed along the proposed Nebraska Reroute corridor and will continue in spring 2013. These surveys will be reviewed in consultation with NGPC. If finescale dace are present in any waterbodies crossed by the project, the methods used to cross these would be determined after discussions with NGPC. These discussions would determine which specific method would have the least impact to the species in each waterbody.

E.9.2.11 Northern Redbelly Dace

The potential impact of the Nebraska Reroute on fisheries is described in Section 4.8.2 of the Environmental Evaluation.

As recommended by NGPC, surveys for the northern redbelly dace were conducted in 2009 on the previous alignment. In 2009 no northern redbelly dace or habitat for this species was found in Nebraska during these surveys. The 2012 survey results will be reviewed in consultation with NGPC for a determination of impacts on this species. In 2012, surveys were performed along the proposed Nebraska Reroute corridor and will continue in spring 2013. These surveys will be reviewed in consultation with NGPC. If northern redbelly dace are present in any waterbodies crossed by the project, the methods used to cross these would be determined after discussions with NGPC. These discussions would determine which specific method would have the least impact to the species in each waterbody.

E.9.2.12 Northern River Otter

Construction of the Nebraska Reroute involves crossings of the Niobrara, Elkhorn, and Loup Rivers where northern river otter habitat is most likely to occur. These rivers would be crossed through use of HDD. Construction-related impacts on the northern river otters could occur, resulting in den disturbance as a result of construction-related noise; however, impacts are anticipated to be temporary and would cease once construction activities stop. See Section E.9.3 for conservation measures.

E.9.2.13 Small White Lady's Slipper

Construction of the Nebraska Reroute may impact the small white lady's slipper and its habitat. Construction-related impacts include changing wetland hydrology, and the potential to introduce or spread competing exotic invasive plant species as a result of revegetation. Construction of the Nebraska Reroute may impact small white lady's slipper species and habitat. Permanent project-related facilities (for example, pump stations and access roads) could permanently displace small white lady's slipper habitat and populations.

The Nebraska Reroute may impact small white lady's slipper and its habitat within the Study Area during construction. See Section E.9.3 for conservation measures.

E.9.2.14 Bald Eagle

The potential for encountering the bald eagle, either wintering or nesting, would occur at the major river crossings (Niobrara, Elkhorn, and Loup), as well as minor crossings, such as the Keya Paha River and Beaver and Shell Creeks. These areas would be attractive to migrating bald eagles because of the presence of large trees, and it is conceivable that a pair would attempt to nest in these areas.

The likelihood of occurrence of wintering bald eagles depends on seasonal weather conditions and the presence of open water on river systems that provide an adequate food source. Because potential bald eagle habitat in the Study Area would include riparian areas surrounding the Niobrara, Elkhorn, and Loup Rivers, nesting pairs might be temporarily disturbed if these areas were near construction activities associated with the Nebraska Reroute. Although wintering or nesting habitat would be most likely to occur at river crossings where HDD would occur, construction activities on the banks could create short-term disturbances to roosting or nesting bald eagles. Long-term impacts associated with HDD are not anticipated because there is ample nesting and roosting habitat available along these river crossings.

The Nebraska Reroute may impact bald eagles during construction if detected within the Study Area. See Section E.9.3 for conservation measures.

Operation of the Nebraska Reroute would have limited potential to impact the bald eagle. No operational disturbances would be anticipated at major river crossings. Activities involved with maintenance or spill cleanup could impact bald eagles in areas near bald eagle habitat, or sites used for roosting or nesting. Once pump stations have been established, noise and human activity in these areas would become a common part of the environment.

E.9.3 MITIGATION

When impacts cannot be avoided and are minimized to the extent possible, residual impacts are mitigated through compensation or restoration by Keystone. Based on future survey results, avoidance, minimization, and mitigation measures, Keystone will coordinate with the USFWS and NGPC to determine if changes to these conservation measures are necessary. The method used to cross environmentally sensitive waterbodies (that is, those with threatened or endangered species or species of concern) would be determined after discussions with NGPC. These discussions would determine which specific method would have the least impact to the species in each waterbody.

E.9.3.1 Interior Least Tern and Piping Plover

The following summarizes the conservation measures identified for the interior least tern and piping plover as provided in the Final EIS, in the applicant-prepared Biological Assessment (BA), and further discussion with NGPC:

- Conduct preconstruction surveys within 0.25 mile of suitable breeding habitat.
- Conduct no construction activities within 0.25 mile of an active nest until fledglings have left the nest.
- NGPC recommends downshield lighting during construction during the nesting season until fledglings have left the nest.

- NGPC recommends Keystone coordinate with NGPC if nesting is initiated within 0.25 mile of construction after construction has begun.
- Cease construction if an interior least tern or a piping plover nest is observed at a construction site and initiate coordination with the appropriate agencies.

E.9.3.2 Whooping Crane

The following summarizes the conservation measures identified for the whooping crane as provided in the Final EIS, in the applicant-prepared BA, and from further discussions with NGPC:

- Perform surveys for whooping cranes during migration season.
- NCPC recommends following the Whooping Crane Survey Protocol (USFWS, 2012e).
- Cease construction if a whooping crane were to land at a construction site; initiate coordination with the appropriate agencies.

E.9.3.3 Sprague's Pipit

The following summarizes the conservation measures identified for the Sprague's pipit as provided in the Final EIS and in the applicant-prepared BA:

- A Migratory Bird Conservation Plan will be developed. This plan may involve surveying for Sprague's pipit during the migration period in Montana, or other appropriate actions as agreed upon by the USFWS and NGPC.

E.9.3.4 Pallid Sturgeon

No conservation measures are proposed for the pallid sturgeon on the Nebraska Reroute because the species occurs downstream of the Nebraska Reroute.

E.9.3.5 American Burying Beetle

The following summarizes the conservation measures identified for the ABB as provided in the Final EIS and in the applicant-prepared BA:

- Implement appropriate conservation measures as recommended and agreed upon by NGPC and USFWS (Nebraska Field Office). These measures may include capture and relocation, removing animal carcasses, and mowing and removing/windrowing vegetation.
- Train workers in identification and avoidance of beetles.
- Downshield lighting at ancillary facilities and use sodium vapor lights.
- Compensate for temporary and permanent construction and operation impacts through establishment of a conservation trust.
- Monitor for compliance on reclaimed areas.
- Implement a reclamation performance bond to insure that funds would be available if reclamation following construction were to fail.

E.9.3.6 Western Prairie Fringed Orchid

The following summarizes the conservation measures identified for the Western prairie fringed orchid as provided in the Final EIS, the applicant-prepared BA, and from further discussions with NGPC:

- Conduct presence/absence surveys prior to construction.
- Consider site-specific route modifications to avoid populations found along the alignment during pre-construction surveys.
- Plants may be transplanted where deemed necessary and appropriate by USFWS and NGPC.
- Reduce construction width in sensitive areas.
- Salvage topsoil.
- Restore habitat using methods approved by USFWS, NGPC, and NRCS.
- Monitor the restoration of selected wetland areas.
- NGPC recommends the establishment of a conservation trust to compensate for temporary and permanent construction and operation impacts.

E.9.3.7 Northern Long-Eared Bat

The following summarizes the conservation measures identified for the northern long-eared bat as provided in the Final EIS and in the applicant-prepared BA:

- Perform surveys for northern long-eared bat in suitable habitat.
- Avoid roosting sites. NGPC and USFWS would be contacted if individuals are observed during construction. It may be necessary to relocate an individual if one is observed during construction.

E.9.3.8 Blacknose Shiner

No conservation measures are proposed at this time because this species is not known to be present in the Study Area. Surveys will be conducted prior to construction. If this species is found, coordination with NGPC would occur to develop appropriate measures to avoid or minimize impacts on the species.

E.9.3.9 Finescale Dace

No conservation measures are proposed at this time because this species is not known to be present in the Study Area. Surveys will be conducted prior to construction. If this species is found, coordination with NGPC would occur to develop appropriate measures to avoid or minimize impacts on the species.

E.9.3.10 Northern Redbelly Dace

No conservation measures are proposed at this time because this species is not known to be present in the Study Area. Surveys will be conducted prior to construction. If this species is found, coordination with NGPC would occur to develop appropriate measures to avoid or minimize impacts on the species.

E.9.3.11 Northern River Otter

The following summarizes the conservation measures identified for the northern river otter as provided in the Final EIS:

- Conduct surveys prior to construction.
- Restrict construction within 0.5 mile of active dens.
- Use the HDD construction method on all rivers potentially supporting river otters.

E.9.3.12 Small White Lady's Slipper

The following summarizes the conservation measures identified for the small white lady's slipper as provided in the Final EIS, the applicant-prepared BA, and from further discussions with NGPC:

- Conduct presence/absence surveys prior to construction.
- Consider site-specific route modifications to avoid populations found along the alignment during pre-construction surveys.
- Plants may be transplanted where deemed necessary and appropriate by USFWS and NGPC.
- Reduce construction width in sensitive areas.
- Salvage topsoil.
- Restore habitat using methods approved by USFWS, NGPC, and NRCS.
- Monitor selected wetland areas.
- NGPC recommends the establishment of a conservation trust to compensate for temporary and permanent construction and operation impacts.

E.9.3.13 Bald Eagle

The following summarizes the conservation measures identified for the bald eagle as provided in the Final EIS:

- Conduct nest/roost surveys within 1 mile of right-of-way (if construction were to occur during the nesting/roosting period).
- Consult with USFWS for buffers and construction activities.

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Attachment A

Abbreviations and Acronyms

Abbreviation or Acronym	Definition
ABB	American burying beetle
BA	Biological Assessment
BGEPA	Bald and Gold Eagle Protection Act
HDD	horizontal directional drilling
MBTA	Migratory Bird Treaty Act
NGPC	Nebraska Game and Parks Commission
NNLP	Nebraska Natural Legacy Program
RENEW	Recovery of Nationally Endangered Wildlife
ROW	right-of-way
RPMA	Recovery-Priority Management Areas
USFWS	U.S. Fish and Wildlife Service

Appendix E.10

Agriculture and Land Use

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APPENDIX E.10

AGRICULTURE AND LAND USE

Table E.10-1. Prime Farmland Crossed by the Nebraska Reroute Alignment and Acreage within the Nebraska Reroute Counties

Type of Prime or Important Farmland	Miles (corridor)	Percentage of Total	Acres (counties)	Percentage of Total
All areas are prime farmland	62.6	32.2	1,143,294	24.7
Prime farmland if drained	3.8	1.9	121,519	2.6
Prime farmland if irrigated	7.3	3.8	97,860	2.1
Farmland of statewide importance	35.1	18.0	443,624	9.6
Not prime farmland	85.7	44.1	2,824,071	61.0
Total	194.5	100.0[a]	4,630,368	100.0

Source: USDA, 2011.
[a] *Percentages have been rounded to the nearest decimal.*

Table E.10-2. Organic Farming in Nebraska Reroute Counties (2007)[a]

	Boyd County	Holt County	Antelope County	Boone County	Merrick County
Organic operations	1	6	0	2	2
Agricultural land, organic acres	(D)[b]	3,716	0	(D)	(D)
Organic cropland operators	1	3	0	2	2
Organic cropland acres harvested	(D)	510	0	(D)	(D)
Organic acres pastureland	(D)	3,206	0	(D)	0
Organic pastureland operators	1	6	0	2	0
Organic transitioning operations	2	7	5	1	1
Organic transitioning acres	(D)	486	125	(D)	(D)

Source: USDA, 2012c.

[a] *This is the latest information available. None of the three remaining Nebraska Reroute counties have any organic operations or operations in transition.*

[b] *(D) Withheld to avoid disclosing data for individual operations.*

Table E.10-3. Prime Farmland within the Construction Easement Corridor by County[a]

Type of Prime or Important Farmland	Keya Paha	Boyd	Holt	Antelope	Boone	Nance	Merrick	Polk	York	Total
All areas are prime farmland	16	3	143	166	156	111	36	158	94	883
Prime farmland if drained	0	1	3	0	7	18	20	1	4	54
Prime farmland if irrigated	40	2	60	0	0	0	0	0	0	102
Farmland of statewide importance	3	4	139	105	180	45	5	6	0	487
Not prime farmland	162	104	417	330	50	32	47	29	5	1,176
Not classified	8	15	26	34	3	18	0	0	0	104
Total	229	129	788	635	396	224	108	194	103	2,806

Source: USDA, 2011.

[a] *Because of rounding, total acreage of farmland of statewide importance and soil categorized as not classified and the total acreage for Boyd, Boone, Nance, and York Counties and for the nine counties in the Nebraska Reroute do not add to exact values.*

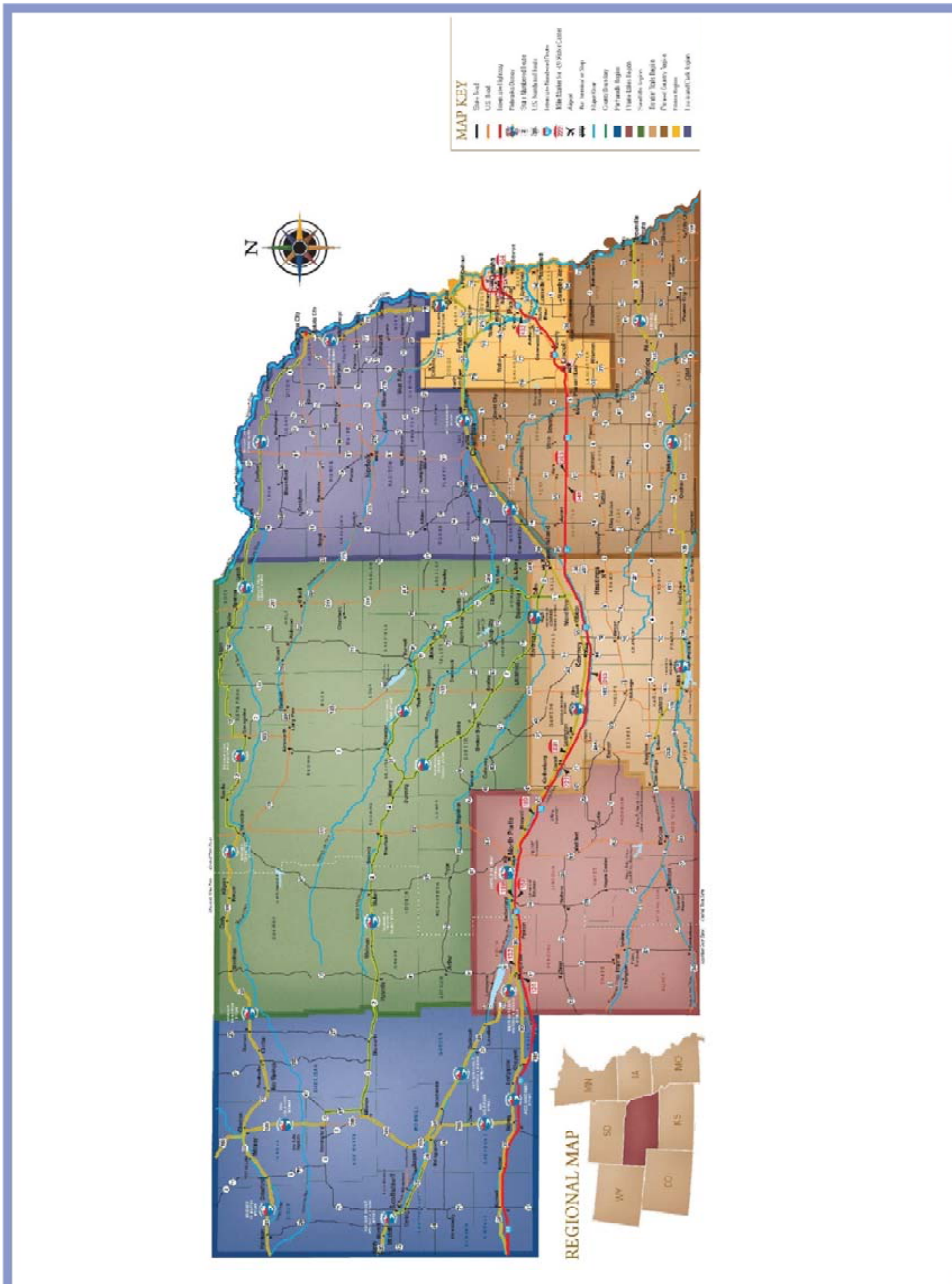
Appendix E.11

Recreation and Visual Resources

Appendix E.11

RECREATION AND VISUAL RESOURCES

Figure E.11-1. Nebraska's Tourism Regions



Appendix E.12

Population and Environmental Justice

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APPENDIX E.12

POPULATION AND ENVIRONMENTAL JUSTICE

Table E.12-1. Population Density in Nebraska Reroute Corridor Counties

County	Area[a]	Population[b]	Population Density[c]
Keya Paha	774	824	1.06
Boyd	545	2,099	3.85
Holt	2,417	10,435	4.32
Antelope	859	6,685	7.79
Boone	687	5,505	8.01
Nance	448	3,735	8.33
Merrick	494	7,845	15.86
Polk	441	5,406	12.27
York	576	13,665	23.73
Total	**7,241**	**56,199**	**7.76**

Sources: U.S. Census Bureau, 2011a, 2012.
[a] *Total square miles in county (land and water).*
[b] *Data taken from the 2010 U.S. Census.*
[c] *People per square mile.*

Table E.12-2. Cities and Villages within 2 miles of the Nebraska Reroute Centerline

City/Village	County[a]	Population[b]	Distance from Centerline[c]
Orchard	Antelope	379	1.9
Royal	Antelope	63	1.6
Oakdale	Antelope	322	1.8
St. Edward	Boone	705	2.4
Polk	Polk	322	1.6

Source: U.S. Census Bureau 2011a.
Notes:
[a] *All towns and villages in Keya Paha and Boyd Counties are more than 5 miles from the centerline of the Nebraska Reroute alignment.*
[b] *2010 U.S. Census population.*
[c] *Distance measured from the centerline of the Nebraska Reroute alignment to the incorporated boundaries of cities and villages as mapped by the 2010 U.S. Census.*

Table E.12-3. Racial Characteristics of the Nine Nebraska Reroute Counties

Group	Keya Paha	Boyd	Holt	Antelope	Boone	Nance	Merrick	Polk	York	Total
Total population	824	2,099	10,435	6,685	5,505	3,735	7,845	5,406	13,665	56,199
White	817	2,035	10,132	6,517	5,422	3,659	7,550	5,292	12,980	54,404
Percentage	99.2	97.0	97.1	97.5	98.5	98.0	96.2	97.9	95.0	96.8
Black or African American	0	1	16	19	23	8	15	6	158	246
Percentage	0.0%	0.0%	0.2%	0.3%	0.4%	0.2%	0.2%	0.1%	1.1%	0.4%
American Indian and Alaska Native	1	12	29	11	12	10	31	11	58	175
Percentage	0.1%	0.6%	0.3%	0.2%	0.2%	0.3%	0.4%	0.2%	0.4%	0.3%
Asian	1	17	18	20	11	2	60	6	60	195
Percentage	0.1%	0.8%	0.2%	0.3%	0.2%	0.1%	0.8%	0.1%	0.4%	0.3%
Native Hawaiian and Other Pacific Islander	0	2	8	0	1	0	6	2	7	26
Percentage	0.0%	0.1%	0.1%	0.0%	0. 0%	0.0%	0.1%	0.0%	0.0%	0.0%
Some Other Race	2	12	182	77	18	19	105	35	263	713
Percentage	0.2%	0.6%	1.7%	1.2%	0.3%	0.5%	1.3%	0.6%	1.9%	1.3%
Two or More Races	3	20	50	41	18	37	78	54	139	440
Percentage	0.4%	1.0%	0.5%	0.6%	0.3	1.0%	1.0%	1.0%	1.0%	0.8%

Source: U.S. Census Bureau 2011a.

Table E.12-4. Racial Characteristics of the Nine Nebraska Reroute Counties and the State of Nebraska

Group	Nebraska Reroute County Subdivisions[a]	Nebraska Reroute Counties	State of Nebraska
Total population	13,893	56,199	1,826,341
White	13,645	54,404	1,572,838
Percentage	98.2%	96.8%	86.1%
Black or African American	34	246	82,885
Percentage	0.3%	0.4%	4.5%
American Indian and Alaska Native	30	175	18,427
Percentage	0.2%	0.3%	1.0%
Asian	31	195	32,293
Percentage	0.2%	0.3%	1.8%
Native Hawaiian and Other Pacific Islander	3	26	1,279
Percentage	0.0%	0.0%	0.1%
Some Other Race	81	713	79,109
Percentage	0.6%	1.3%	4.3%
Two or More Races	69	440	39,510
Percentage	0.5%	0.8%	2.2%

Source: U.S. Census Bureau, 2011a.

Note: County subdivisions are townships or precincts in each county (as defined in the U.S. Census). The Nebraska Reroute county subdivisions are townships and precincts partially within the 4-mile-wide Nebraska Reroute study area.

Table E.12-5. Ethnic Minority Characteristics of the Nine Nebraska Reroute Counties

Group	Keya Paha	Boyd	Holt	Antelope	Boone	Nance	Merrick	Polk	York	Total
Total population	824	2,099	10,435	6,685	5,505	3,735	7,845	5,406	13,665	56,199
Hispanic and Latino	4	33	305	178	65	65	271	156	555	1,632
Percentage	0.5%	1.6%	2.9%	2.7%	1.2%	1.7%	3.5%	2.9%	4.1%	2.9%

Source: U.S. Census Bureau, 2011a.

Table E.12-6. Ethnic Minority Population of the Nebraska Reroute Counties and the State of Nebraska

Group	Nebraska Reroute Corridor County Subdivisions[a]	Nebraska Reroute Counties Total	State of Nebraska
Total population	13,893	56,199	1,826,341
Hispanic or Latino	209	1,632	167,405
Percentage	1.5%	2.9%	9.2%

Source: U.S. Census Bureau, 2011a.
Note: County subdivisions are townships or precincts in each county (as defined in the U.S. Census). The Nebraska Reroute county subdivisions are townships and precincts partially within the Nebraska Reroute Study Area.

Table E.12-7. Low-Income Characteristics of the Nine Nebraska Reroute Counties

Group	Keya Paha	Boyd	Holt	Antelope	Boone	Nance	Merrick	Polk	York	Total
Total population	824	2,099	10,435	6,685	5,505	3,735	7,845	5403	12,699	54,344
Poverty	168	170	794	745	360	346	832	375	890	4,680
Percentage	22.7	8.3	7.8	11.4	6.6	9.8	10.7	6.9	7.0	8.6

Source: U.S. Census Bureau, 2011b.

Table E.12-8. Low-Income Population of the Nebraska Reroute and the State of Nebraska

Group	Nebraska Reroute Corridor County Subdivisions	Nebraska Reroute Counties Total	State of Nebraska
Total population	12,176	54,344	1,826,341
Low-Income Population	943	4680	206,227
Percentage	7.7%	8.6%	11.8%

Source: U.S. Census Bureau, 2011b.

Table E.12-9. Limited English Proficiency (Households) in the Nebraska Reroute Corridor

Group	Keya Paha	Boyd	Holt	Antelope	Boone	Nance	Merrick	Polk	York	Total
Total households	346	932	4,244	2,792	2,382	1,528	3,145	2,230	5,771	23,370
Limited English Proficiency	0	0	12	27	0	0	0	5	43	87
Percentage	0.0%	0.0%	0.3%	1.0%	0.0%	0.0%	0.0%	0.2%	0.7%	0.4%

Source: U.S. Census Bureau, 2011b.

Table E.12-10. Limited English Proficiency Population of the Nebraska Reroute Corridor and the State of Nebraska

Group	Nebraska Reroute Corridor County Subdivisions	Nebraska Reroute Counties Total	State of Nebraska
Total households	5,933	23,370	771,771
Limited English Proficiency	6	87	16,971
Percentage	0.1%	0.4%	2.4%

Source: U.S. Census Bureau, 2011b.

Table E.12-11. Housing Units and Vacancy Status in Counties within 50 Miles of the Nebraska Reroute

County	Total Units	Occupied Units	Vacant Units	Units for Rent
Keya Paha	549	381	168	22
Rock	912	685	227	32
Boyd	1,390	942	448	22
Holt	5,215	4,447	768	107
Knox	4,788	3,647	1,141	102
Pierce	3,222	2,911	311	36
Wayne	3,776	3,507	269	104
Antelope	3,284	2,841	443	67
Madison	15,014	13,939	1,075	435
Boone	2,649	2,336	313	68
Platte	13,378	12,658	720	223
Nance	1,801	1,525	276	41
Howard	2,951	2,625	326	71
Merrick	3,698	3,151	547	128
Hamilton	3,968	3,563	405	75
Hall	23,549	22,196	1,353	448
Adams	13,350	12,466	884	354
Polk	2,731	2,212	519	51
Butler	4,053	3,391	662	57
York	6,231	5,564	667	261
Fillmore	2,913	2,483	430	69
Seward	6,875	6,266	609	245
Total	**126,297**	**113,736**	**12,561**	**3,018**

Source: U.S. Census Bureau 2011a.

Table E.12-12. Campgrounds, RV Parks, Hotels, and Motels in Counties within 50 miles of the Nebraska Reroute[a]

County	Campgrounds/ RV Parks[b]	Hotels/Motels/Inns in County[c]	Hotels/Motels/Inns in City/Village[d]	Rooms[e]	Distance from Center line[f]
Keya Paha	1	3	Springview – 3	8[g]	15
Boyd	1	2	Spencer – 1 Butte – 1	N/A N/A	15 21
Rock	1	1	Bassett – 1	43	26
Holt	3	11	Atkinson – 5 O'Neill – 6	25[g] 184[g]	8 5
Knox	3	4	Niobrara – 1 Verdigre – 2 Creighton – 1	3 7[g] 12	27 18 15
Pierce	4	0	0	0	N/A
Wayne	1	2	Wayne – 2	85	46
Antelope	3	4	Elgin – 1 Neligh – 3	4 31[g]	8 5
Madison	7	9	Norfolk – 9	586	23
Boone	4	1	Albion – 1	N/A	4
Platte	10	9	Columbus – 9	512	26
Nance	1	2	Fullerton – 1 Genoa – 1	N/A N/A	3 8
Howard	0	2	Saint Paul – 2	54	31
Merrick	1	2	Central City – 2	59	13
Hamilton	1	3	Aurora – 3	40[g]	14
Hall	2	19	Grand Island – 19	1,613	29
Adams	6	9	Hastings – 9	501	40
Polk	1	1	Osceola – 1	10	9
Butler	2	1	David City – 1	18	31
York	7	9	York – 9	547[g]	6
Fillmore	0	2	Geneva – 2	28	29
Seward	4	3	Seward – 3	51	33
Total	**63**	**99**	**99**	**4,421[g]**	

Sources: Trip Advisor, n.d., Google Earth Pro, n.d.; HikerCentral.com, n.d.

[a] *A distance of up to 50 miles was used for the analysis of hotels, motels, and inns (approximately the distance from the center point to the ends of each construction spread). This distance would equate to approximately 1 hour of commute time.*

[b] *Campgrounds include campgrounds, recreational vehicle parks, and city or county parks with camping. Some of the campsites are primitive camping.*

[c] *Hotels, motels, and inns.*

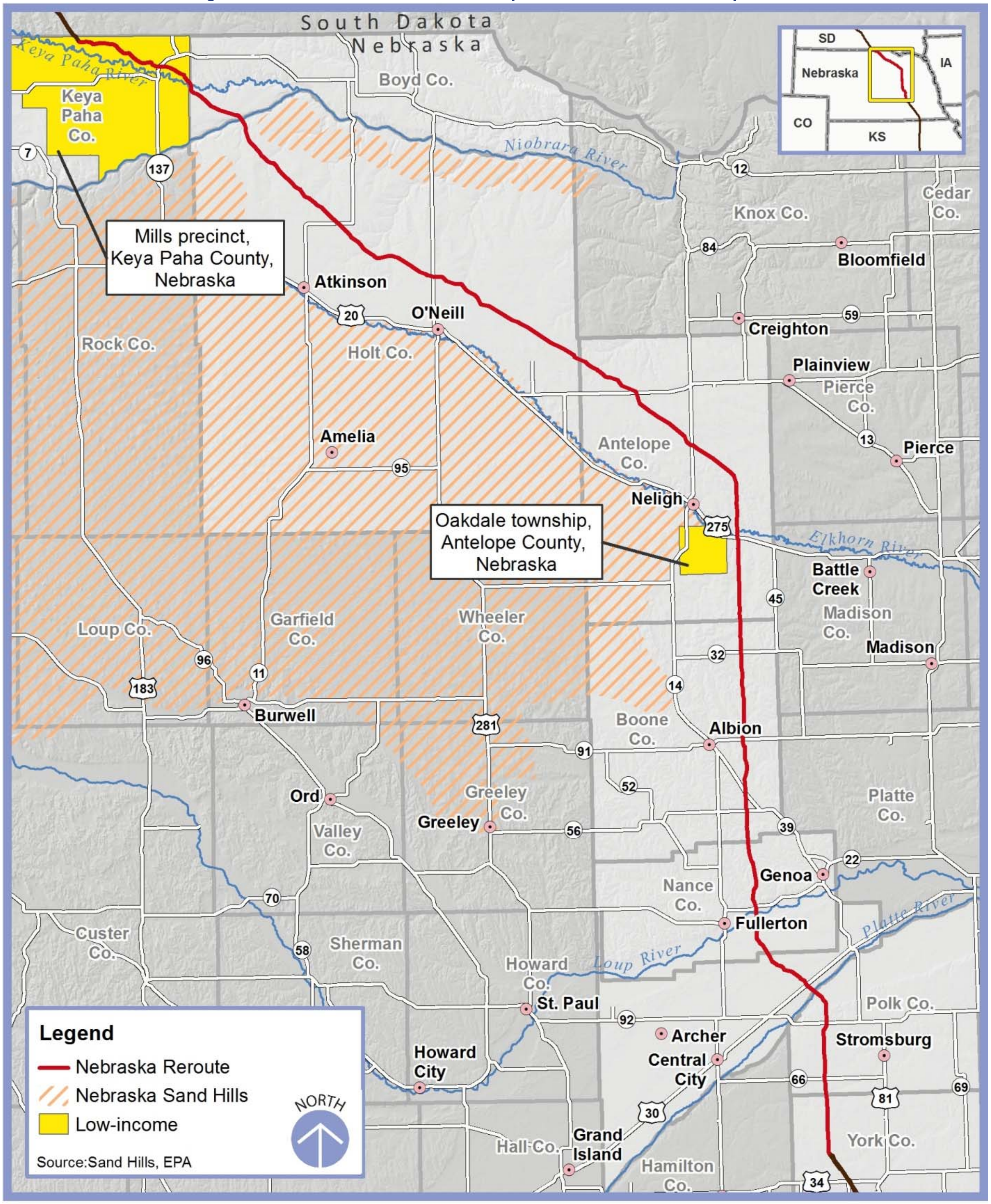
[d] *The number of hotels, motels, and inns in each city.*

[e] *Number of rooms listed on websites.*

[f] *Distance in miles (straight line) from the centerline of the Nebraska Reroute alignment to each city or village with hotels, motels, or inns. Driving distance would be somewhat longer.*

[g] *Some smaller hotels, motels, or inns did not have the number of rooms available on the website (from looking at aerial photographs of these facilities, they appear to have approximately 10 to 15 rooms each). The number of rooms listed in this table includes the room information that is published on the internet.*

Figure E.12-1. Low-Income Populations in the Study Area



Source: NDEQ, 2012

Figure E.12-2. Primary Care Health Professional Shortage Areas (HPSAs) in the Nebraska Reroute Counties

Source: NDEQ, 2012

Appendix E.13

Employment and Fiscal Impacts Technical Memorandum

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EMPLOYMENT AND FISCAL IMPACTS TECHNICAL MEMORANDUM

E.13.1 EXISTING CONDITIONS

The economic impact analysis of the Keystone XL pipeline considers impacts that the construction and operation of the pipeline would have on short- and long-term employment in Nebraska. This analysis breaks the impacts into two regions within which impacts would occur:

- The corridor of counties along the pipeline route that would likely benefit from construction activity, including daily spending by construction workers
- The counties outside the construction corridor but within the state (Rest of State).

The context of the economic effects of the construction and operations of the Keystone XL Pipeline is the entire state of Nebraska. Economic and fiscal effects were analyzed for the pipeline route:

- The entire state of Nebraska was analyzed for economic and fiscal effects.
- The 12 counties[1] along the proposed pipeline route were analyzed for fiscal effects.
- The 12 counties along the proposed pipeline route and 7 counties adjacent to the route were evaluated for economic effects.

Within the Nebraska construction corridor, there is some variation of note in the economic characteristics of counties. The northern part of the corridor is more rural than the central and southern counties in the corridor, with higher distances to nearest micro- and metropolitan areas. Furthermore, the northern spread would use a construction camp because of limited lodging for workers in those counties. Because, the corridor counties differ significantly in economic characteristics between north and the central-south part of the state, the corridor is split in two sections to properly model the impact of the construction activities. Finally, the central-southern corridor would also include additional counties adjacent to the corridor counties that contain nearby micropolitan areas that would draw worker spending during construction. The study areas considered based on this are shown below in Table E.13-1.

1 Elsewhere in this document, only 9 counties crossed by the Nebraska Reroute are considered as the Study Area. For purposes of the economic analysis, the Study Area is the 9 counties crossed by the Reroute, 3 counties crossed by the remainder of the route, and 7 counties not crossed but adjacent to the route. The resulting economic corridor directly affected is 19 counties.

Table E.13-1. Economic Impact Analysis Study Area Defined

Corridor	County	Justification for Inclusion in Analysis
North Corridor	Keya Paha	Would contain pipeline
	Boyd	Would contain pipeline
	Holt	Would contain pipeline
Central-South Corridor	Antelope	Would contain pipeline
	Pierce	Micropolitan area nearby
	Madison	Micropolitan area nearby
	Stanton	Micropolitan area nearby
	Boone	Would contain pipeline
	Platte	Micropolitan area nearby
	Nance	Would contain pipeline
	Merrick	Micropolitan area nearby; Would contain pipeline
	Hall	Micropolitan area nearby
	Howard	Micropolitan area nearby
	Polk	Would contain pipeline
	York	Would contain pipeline
	Fillmore	Would contain pipeline
	Saline	Would contain pipeline
	Jefferson	Would contain pipeline
	Gage	Micropolitan area nearby
Rest of State	Remaining Nebraska Counties	

As shown in Table E.13-1 above, the North Corridor includes 3 counties. The Central-South Corridor includes 16 counties. The corridor counties are primarily rural and agricultural in nature, with larger clusters of nonfarm employment in the micropolitan areas.

E.13.1.1 Employment and Income

Employment in the northern counties totaled 9,500 jobs, while employment in the central-southern counties totaled 171,300 jobs in 2011. More than 50 percent of employees were concentrated in Madison, Platte, and Hall Counties. Employment was 1.8 percent higher than in 2001, but still below 2006 prerecession levels. However, this recovery is in line with the pace of employment growth over the last decade and is not due to the severity of the Great Recession of 2008–2009. Unlike most of the rest of the country, the Study Area was only slightly affected by the collapse of the housing market and the ensuing economic downturn. As shown in

Table E.13-2 below, the highest recorded unemployment rates were in Keya Paha and Gage Counties in 2010 (5.2 and 6.3 percent, respectively), well below the national estimate at the time (9.6 percent). Half of the counties in the Study Area had an unemployment rate below 4 percent[2] throughout the 2000s.

Table E.13-2. Unemployment Percentage Rate by County (2001–2011)

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
North Corridor Counties											
Keya Paha	2.5	3.8	3.5	3.2	3.4	3.0	3.7	4.8	4.8	5.16%	4.3%
Boyd	3.5	3.6	3.1	3.2	3.7	3.1	3.0	3.1	3.9	3.8%	3.6%
Holt	3.1	3.0	3.1	3.1	3.1	2.7	2.5	2.7	3.1	3.3%	3.1%
Central-South Corridor Counties											
Antelope	3.2	3.2	3.3	3.4	3.4	2.8	2.8	3.0	3.8	3.3	3.3
Pierce	2.6	3.0	3.7	3.5	3.4	3.6	2.9	3.0	2.9	4.0	3.9
Madison	3.3	3.6	4.0	4.1	4.0	4.1	3.6	3.1	3.3	4.4	4.2
Stanton	2.6	2.7	3.1	3.3	3.2	3.2	3.0	2.9	2.7	4.2	4.2
Boone	3.1	3.1	3.2	3.2	3.5	2.5	2.4	2.6	3.5	3.0	3.2
Platte	2.8	3.5	4.4	4.8	4.3	3.8	2.7	2.4	2.9	4.1	4.0
Nance	3.5	4.5	5.2	4.5	3.9	2.8	2.5	2.9	3.3	3.5	3.3
Merrick	2.9	3.8	4.1	4.2	3.7	3.5	2.8	3.1	4.2	4.4	4.1
Hall	2.9	3.3	4.0	4.4	4.9	3.9	3.0	2.7	3.1	4.3	4.5
Howard	2.6	3.0	3.7	4.3	4.2	3.6	2.8	2.7	3.0	3.7	4.1
Polk	2.3	2.7	3.2	3.6	3.5	3.3	2.7	2.8	2.8	3.8	3.9
York	2.7	3.0	3.4	3.2	2.9	2.4	2.7	3.7	4.9	4.8	4.5
Fillmore	3.0	3.5	3.8	3.6	3.2	2.6	2.5	2.9	4.1	3.9	3.6
Saline	2.9	3.0	3.3	3.4	3.4	2.7	2.6	3.4	4.6	4.0	4.0
Jefferson	4.5	4.6	4.3	4.2	3.9	3.2	2.7	3.8	4.9	4.6	4.2
Gage	3.0	3.1	3.8	4.3	4.5	4.5	3.6	3.5	4.6	6.3	5.4
Statewide	**2.8**	**3.1**	**3.7**	**4.0**	**3.9**	**3.9**	**3.0**	**3.0**	**3.3**	**4.7**	**4.7**

Source: U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics.
Note: 2007–2011 data reflect controlling to new statewide totals.

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2 Below the Non-Accelerating Inflation Rate of Unemployment (NAIRU), which indicates that an economy has reached full employment.

As shown in Table E.13-3, government and farming are the two main employment sectors in the rural areas, accounting for 14 percent and 16 percent of all jobs in 2010, respectively. The northern corridor counties accounted for 6 percent of total employment and have a high concentration of farm employment. In the entire corridor, nonfarm private employment represented 78 percent of total employment that same year. In the micropolitan areas (Central-South Corridor), major employment comes from manufacturing and retail accounting for 13 and 12 percent, respectively. Manufacturing jobs were heavily concentrated in Madison, Platte, Hall, Saline, and Gage Counties.

Table E.13-3. Employment by Industry and by County (2010)

2007 North American Industry Classification System (NAICS) Industry	North Corridor Counties			Central-South Corridor Counties																Statewide
	Keya Paha	Boyd	Holt	Antelope	Pierce	Madison	Stanton	Boone	Platte	Nance	Merrick	Hall	Howard	Polk	York	Fillmore	Saline	Jefferson	Gage	
Earnings by place of work	16.2	46.6	281.3	220.5	146.7	1,036.2	126.8	155.7	1,031.6	77.5	137.5	1,759.7	98.0	136.4	410.8	159.9	369.4	162.1	494.1	55,527.8
Farm earnings	10.0	20.0	70.2	106.6	46.9	46.0	32.4	60.9	93.7	30.0	34.2	47.4	31.9	69.9	72.0	55.8	35.7	23.4	56.8	3,440.2
Forestry, fishing, and related activities	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	8,051.0	(D)	(D)	3,019.0	1,631.0	(D)	(D)	5.1	(D)	(D)	(D)	214,327.0
Mining	0.0	0.0	0.5	(D)	(D)	(D)	(D)	(L)	(L)	(D)	(D)	835.0	478.0	(D)	(D)	(L)	(L)	0.5	(D)	80,108.0
Utilities	0.1	0.1	(D)	(D)	(D)	(D)	0.0	(D)	(D)	(D)	0.0	2,652.0	(D)	(D)	(D)	0.0	0.0	0.0	(D)	445,391.0
Construction	(D)	0.7	9.4	10.9	9,143.0	44,968.0	(D)	3.7	56,333.0	1.7	8.8	94,855.0	2,698.0	3,934.0	14.8	13.0	3.6	12.0	20,359.0	3,213,079.0
Manufacturing	(D)	0.4	19.0	7.5	5,137.0	176,555.0	(D)	9.9	330,509.0	(L)	10.3	383,171.0	989.0	658.0	48.5	8.4	150.2	21.1	88,058.0	5,364,786.0
Wholesale trade	(D)	0.8	14.8	11.6	6,942.0	85,054.0	4,788.0	12.1	42,132.0	1.9	12.6	105,940.0	4,254.0	5,211.0	27.5	10.6	11.0	9.4	19,633.0	2,688,292.0
Retail trade	(D)	1.4	18.5	9.0	7,013.0	91,741.0	907.0	6.2	60,198.0	2.6	5.1	161,703.0	6,136.0	6,038.0	28.2	5.7	15.5	14.7	45,399.0	3,409,402.0
Transportation and warehousing	(D)	6.8	(D)	(D)	(D)	(D)	7,176.0	(D)	(D)	(D)	9.7	106,602.0	(D)	(D)	(D)	5.9	24.0	14.5	(D)	3,882,163.0
Information	(D)	(D)	2.0	0.4	1,821.0	11,741.0	(D)	0.4	4,689.0	0.2	0.5	18,011.0	450.0	(D)	3.9	0.3	1.3	3.6	3,752.0	1,201,778.0
Finance and insurance	(D)	1.7	10.3	(D)	(D)	38,066.0	2,715.0	4.6	27,674.0	(D)	5.5	77,231.0	(D)	(D)	20.3	(D)	9.8	4.7	15,670.0	3,999,558.0
Real estate and rental and leasing	(L)	(L)	1.9	(D)	(D)	11,443.0	429.0	0.8	11,704.0	(D)	1.5	14,649.0	(D)	(D)	2.5	(D)	0.8	0.5	2,510.0	558,859.0
Professional, scientific, and technical services	(D)	(D)	3.9	1.8	(D)	30,704.0	(D)	1.3	33,090.0	(D)	2.4	50,734.0	1,701.0	(D)	(D)	0.8	3.1	2.4	(D)	3,615,010.0
Management of companies and enterprises	0.0	0.0	3.7	0.0	(D)	6,386.0	0.0	(D)	1,795.0	0.0	(D)	20,354.0	0.0	(D)	(D)	(D)	0.8	(D)	(D)	1,624,801.0
Administrative and waste management services	(L)	(L)	2.4	0.9	3,857.0	20,969.0	(D)	(D)	32,329.0	(D)	(D)	47,930.0	800.0	835.0	9.3	(D)	1.3	(D)	8,200.0	1,594,970.0

2007 North American Industry Classification System (NAICS) Industry	North Corridor Counties			Central-South Corridor Counties																Statewide
	Keya Paha	Boyd	Holt	Antelope	Pierce	Madison	Stanton	Boone	Platte	Nance	Merrick	Hall	Howard	Polk	York	Fillmore	Saline	Jefferson	Gage	
Educational services	0.0	0.0	(D)	1.2	773.0	7,060.0	55.0	0.4	7,334.0	(L)	(D)	4,148.0	(L)	101.0	(D)	0.1	(D)	0.1	(D)	675,835.0
Health care and social assistance	(D)	1.8	(D)	11.2	8,347.0	154,577.0	(D)	7.0	74,407.0	5.4	(D)	209,382.0	3,838.0	6,287.0	(D)	6.1	(D)	16.7	(D)	6,025,929.0
Arts, entertainment, and recreation	0.0	(D)	0.5	0.4	197.0	3,310.0	(D)	(D)	3,414.0	(D)	0.5	8,495.0	(D)	181.0	1.4	(D)	0.5	(D)	2,365.0	297,175.0
Accommodation and food services	(D)	(D)	4.6	1.6	1,354.0	23,520.0	(D)	(D)	18,156.0	(D)	2.5	43,885.0	(D)	462.0	12.7	(D)	4.5	(D)	9,291.0	1,246,801.0
Other services, except public administration	(D)	1.7	13.7	10.2	4,884.0	40,208.0	3,414.0	8.5	35,003.0	3.4	5.2	56,258.0	4,702.0	(D)	15.9	7.2	12.9	7.0	20,369.0	1,949,269.0
Government and government enterprises	2.5	9.0	38.2	21.7	24,433.0	195,217	14,130.0	29.2	146,503.0	17.2	26.2	302,45	29,037	22,737	65.1	29.8	67.8	26.2	113,869	10,000,089

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Accounts.
Notes:
(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
(L) Fewer than 10 jobs, but the estimates for this item are included in the totals.

Personal income is an important measure of economic well-being for communities and individuals.[3] For the period of 2001 to 2010, personal income increased from $6.7 to $9.5 billion in the corridor, a 41.8 percent increase (or 4.6 percent annually). Antelope County registered the strongest growth (+65.9 percent). There are, however, significant disparities among counties: personal income in Keya Paha County ($31 million) was only 1.4 percent of that in Hall County ($2,166 million) in 2010. Rock and Boyd Counties also posted an annual personal income below $100 million. The Northern Corridor accounted for only 5.6 percent of total income, further exemplifying the difference in economic makeup of the North and Central-South portions Corridors.

Table E.13-4. Personal Income by County, $Millions (2001–2010)

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
North Corridor Counties										
Keya Paha	19	19	24	24	26	23	24	27	25	31
Boyd	57	52	62	58	63	58	63	71	71	81
Holt	274	277	327	342	342	338	381	436	414	422
Total North Corridor counties	350	348	412	424	431	419	469	535	510	534
Central-South Corridor Counties										
Antelope	196	188	223	229	228	211	251	301	303	324
Pierce	199	183	211	219	216	203	230	261	253	271
Madison	919	946	1,004	1,020	1,050	1,067	1,134	1,239	1,183	1,235
Stanton	152	147	163	176	182	178	196	207	215	227
Boone	168	160	181	181	193	164	189	220	214	237
Platte	817	831	880	907	921	973	1,118	1,177	1,146	1,196
Nance	96	88	100	107	111	103	118	136	131	139
Merrick	194	188	206	210	216	222	242	266	279	283
Hall	1,460	1,560	1,640	1,656	1,713	1,820	1,968	2,133	2,091	2,166
Howard	156	150	173	169	181	171	194	218	216	226
Polk	152	140	162	170	177	177	216	239	241	238
York	397	392	450	483	460	420	487	553	547	551
Fillmore	201	187	212	213	202	185	234	277	255	259

[3] **Personal income** is the income received by all persons from all sources. Personal income is the sum of net earnings by place of residence, property income, and personal current transfer receipts. <http://www.bea.gov/newsreleases/regional/spi/sqpi_newsrelease.htm>

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Saline	345	338	368	388	390	386	430	487	463	473
Jefferson	214	204	225	235	231	227	260	290	265	272
Gage	658	638	684	721	712	746	793	872	841	836
Total Central-South Corridor counties	6,324	6,341	6,882	7,085	7,183	7,253	8,060	8,876	8,646	8,933
Total Corridor	6,674	6,689	7,295	7,510	7,614	7,672	8,529	9,411	9,156	9,467
Rest of State	44,662	45,560	48,358	50,395	52,450	55,138	59,041	63,156	60,929	62,886
Statewide	**51,336**	**52,249**	**55,652**	**57,905**	**60,064**	**62,810**	**67,569**	**72,567**	**70,085**	**72,353**

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Accounts.
Note: All estimates are in current dollars (not adjusted for inflation).

As Table E.13-5 shows, earnings by place of work made up 72.5 percent of total personal income in the Study Area in 2010.[4] Farming was the largest source of earnings in the corridor, except in micropolitan areas where manufacturing and government and government enterprises were largest. Farming accounted for 13.7 percent of total earnings in the Study Area as a whole.

[4] Property income is rental income of persons, personal dividend income, and personal interest income. Net earnings are earnings by place of work (the sum of wage and salary disbursements, supplements to wages and salaries, and proprietors' income) less contributions for government social insurance, plus an adjustment to convert earnings by place of work to a place-of-residence basis. Personal income is measured before the deduction of personal income taxes and other personal taxes and is reported in current dollars (no adjustment is made for price changes). <http://www.bea.gov/newsreleases/regional/spi/sqpi_newsrelease.htm>

Table E.13-5. Components of Personal Income by County, $Millions (2010)

2007 North American Industry Classification System (NAICS) Industry	North Corridor Counties			Central-South Corridor Counties																Statewide
	Keya Paha	Boyd	Holt	Antelope	Pierce	Madison	Stanton	Boone	Platte	Nance	Merrick	Hall	Howard	Polk	York	Fillmore	Saline	Jefferson	Gage	
Earnings by place of work	16.2	46.6	281.3	220.5	146.7	1,036.2	126.8	155.7	1,031.6	77.5	137.5	1,759.7	98.0	136.4	410.8	159.9	369.4	162.1	494.1	55,527.8
Farm earnings	10.0	20.0	70.2	106.6	46.9	46.0	32.4	60.9	93.7	30.0	34.2	47.4	31.9	69.9	72.0	55.8	35.7	23.4	56.8	3,440.2
Forestry, fishing, and related activities	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	8,051.0	(D)	(D)	3,019.0	1,631.0	(D)	(D)	5.1	(D)	(D)	(D)	214,327.0
Mining	0.0	0.0	0.5	(D)	(D)	(D)	(D)	(L)	(L)	(D)	(D)	835.0	478.0	(D)	(D)	(L)	(L)	0.5	(D)	80,108.0
Utilities	0.1	0.1	(D)	(D)	(D)	(D)	0.0	(D)	(D)	(D)	0.0	2,652.0	(D)	(D)	(D)	0.0	0.0	0.0	(D)	445,391.0
Construction	(D)	0.7	9.4	10.9	9,143.0	44,968.0	(D)	3.7	56,333.0	1.7	8.8	94,855.0	2,698.0	3,934.0	14.8	13.0	3.6	12.0	20,359.0	3,213,079.0
Manufacturing	(D)	0.4	19.0	7.5	5,137.0	176,555.0	(D)	9.9	330,509.0	(L)	10.3	383,171.0	989.0	658.0	48.5	8.4	150.2	21.1	88,058.0	5,364,786.0
Wholesale trade	(D)	0.8	14.8	11.6	6,942.0	85,054.0	4,788.0	12.1	42,132.0	1.9	12.6	105,940.0	4,254.0	5,211.0	27.5	10.6	11.0	9.4	19,633.0	2,688,292.0
Retail trade	(D)	1.4	18.5	9.0	7,013.0	91,741.0	907.0	6.2	60,198.0	2.6	5.1	161,703.0	6,136.0	6,038.0	28.2	5.7	15.5	14.7	45,399.0	3,409,402.0
Transportation and warehousing	(D)	6.8	(D)	(D)	(D)	(D)	7,176.0	(D)	(D)	(D)	9.7	106,602.0	(D)	(D)	(D)	5.9	24.0	14.5	(D)	3,882,163.0
Information	(D)	(D)	2.0	0.4	1,821.0	11,741.0	(D)	0.4	4,689.0	0.2	0.5	18,011.0	450.0	(D)	3.9	0.3	1.3	3.6	3,752.0	1,201,778.0
Finance and insurance	(D)	1.7	10.3	(D)	(D)	38,066.0	2,715.0	4.6	27,674.0	(D)	5.5	77,231.0	(D)	(D)	20.3	(D)	9.8	4.7	15,670.0	3,999,558.0
Real estate and rental and leasing	(L)	(L)	1.9	(D)	(D)	11,443.0	429.0	0.8	11,704.0	(D)	1.5	14,649.0	(D)	(D)	2.5	(D)	0.8	0.5	2,510.0	558,859.0
Professional, scientific, and technical services	(D)	(D)	3.9	1.8	(D)	30,704.0	(D)	1.3	33,090.0	(D)	2.4	50,734.0	1,701.0	(D)	(D)	0.8	3.1	2.4	(D)	3,615,010.0
Management of companies and enterprises	0.0	0.0	3.7	0.0	(D)	6,386.0	0.0	(D)	1,795.0	0.0	(D)	20,354.0	0.0	(D)	(D)	(D)	0.8	(D)	(D)	1,624,801.0
Administrative and waste management services	(L)	(L)	2.4	0.9	3,857.0	20,969.0	(D)	(D)	32,329.0	(D)	(D)	47,930.0	800.0	835.0	9.3	(D)	1.3	(D)	8,200.0	1,594,970.0
Educational services	0.0	0.0	(D)	1.2	773.0	7,060.0	55.0	0.4	7,334.0	(L)	(D)	4,148.0	(L)	101.0	(D)	0.1	(D)	0.1	(D)	675,835.0

2007 North American Industry Classification System (NAICS) Industry	North Corridor Counties			Central-South Corridor Counties																Statewide
	Keya Paha	Boyd	Holt	Antelope	Pierce	Madison	Stanton	Boone	Platte	Nance	Merrick	Hall	Howard	Polk	York	Fillmore	Saline	Jefferson	Gage	
Health care and social assistance	(D)	1.8	(D)	11.2	8,347.0	154,577.0	(D)	7.0	74,407.0	5.4	(D)	209,382.0	3,838.0	6,287.0	(D)	6.1	(D)	16.7	(D)	6,025,929.0
Arts, entertainment, and recreation	0.0	(D)	0.5	0.4	197.0	3,310.0	(D)	(D)	3,414.0	(D)	0.5	8,495.0	(D)	181.0	1.4	(D)	0.5	(D)	2,365.0	297,175.0
Accommodatio n and food services	(D)	(D)	4.6	1.6	1,354.0	23,520.0	(D)	(D)	18,156.0	(D)	2.5	43,885.0	(D)	462.0	12.7	(D)	4.5	(D)	9,291.0	1,246,801.0
Other services, except public administration	(D)	1.7	13.7	10.2	4,884.0	40,208.0	3,414.0	8.5	35,003.0	3.4	5.2	56,258.0	4,702.0	(D)	15.9	7.2	12.9	7.0	20,369.0	1,949,269.0
Government and government enterprises	2.5	9.0	38.2	21.7	24,433.0	195,217	14,130.0	29.2	146,503.0	17.2	26.2	302,45	29,037	22,737	65.1	29.8	67.8	26.2	113,869	10,000,089

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Accounts.
Notes: (D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
(L) Less than $50,000, but the estimates for this item are included in the totals. All estimates are in current dollars (not adjusted for inflation).

Personal income per capita is a more reliable measure of economic well-being than total personal income over time as it is adjusted for demographic growth. From 2001 to 2010, personal income per capita increased by 52.8 percent in the Study Area (or 5.2 percent annually). As reported in Table E.13-6, growth was highest in Keya Paha County (91.4 percent) and lowest in Saline County (35.0 percent). In the same way as personal income, there are significant disparities among counties: personal income per capita was $15,495 higher in Antelope County than in Saline County in 2010.

Table E.13-6. Personal Income ($) per Capita by County (2001–2010)

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
North Corridor Counties										
Keya Paha	19,762	19,764	24,876	25,445	28,888	25,627	28,252	32,648	30,850	37,823
Boyd	23,854	21,920	26,703	25,863	28,166	27,246	29,870	34,000	34,315	38,324
Holt	24,151	24,741	29,590	31,505	31,571	31,841	36,172	41,953	39,767	40,404
Central-South Corridor Counties										
Antelope	27,010	26,024	31,144	32,487	32,564	30,869	37,087	44,946	45,029	48,727
Pierce	22,383	25,697	23,962	27,715	29,345	28,709	27,426	31,455	35,860	34,849
Madison	24,396	25,817	26,381	28,010	28,566	29,480	30,135	33,064	36,103	34,193
Stanton	22,260	23,906	22,706	25,285	27,419	28,474	27,904	31,326	33,721	34,979
Boone	27,389	26,416	30,757	31,204	33,509	29,161	33,913	39,618	38,824	43,107
Platte	25,047	26,102	26,870	28,597	29,575	29,849	31,293	35,602	37,319	35,803
Nance	23,766	22,279	25,998	28,192	28,962	27,091	31,232	36,246	35,206	37,236
Merrick	24,133	23,391	25,699	26,178	27,306	28,376	31,408	34,389	35,757	36,058
Hall	25,520	27,281	29,042	30,341	30,439	31,405	32,969	35,311	37,556	36,084
Howard	22,656	24,174	23,325	26,588	26,114	28,210	26,853	30,631	34,789	34,353
Polk	25,540	27,460	25,224	29,330	31,115	32,421	32,695	39,627	44,312	44,494
York	27,513	27,533	31,740	34,602	32,794	29,716	34,607	39,838	39,950	40,395
Fillmore	30,910	29,378	33,258	33,936	33,018	30,596	39,016	46,591	43,277	44,030
Saline	24,619	23,945	25,842	27,343	27,591	27,620	30,567	34,649	32,717	33,232
Jefferson	25,856	24,723	27,629	28,937	28,835	28,522	33,532	37,801	34,850	36,115
Gage	26,238	28,550	27,721	29,655	31,261	31,159	32,596	34,723	38,619	37,608
Statewide	**28,590**	**29,849**	**30,231**	**32,009**	**33,100**	**34,098**	**35,432**	**37,887**	**40,396**	**38,664**

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Accounts.
Notes: Per capita personal income was computed using Census Bureau midyear population estimates. All estimates are in current dollars (not adjusted for inflation).

Another common measurement of income is median household income.[5] Household income is the sum of money income received in a calendar year by all household members, including household members not related to the householder, people living alone, and other nonfamily members.

Based on information from the U.S. Census Bureau, median household income ranged from $31,764 in Keya Paha County to $49,523 in Platte County in 2010 (Table E.13-7). Between Census 2000 and Census 2010, median household income increased by almost 27.5 percent in the Study Area.[6]

Table E.13-7. Median Household Income ($) by County (2000 and 2010)

County	2000	2010	Percentage Change, 2000–2010
North Corridor Counties			
Keya Paha	26,157	31,764	21.4
Boyd	26,599	34,564	29.9
Holt	32,005	44,835	40.1
Central-South Corridor Counties			
Antelope	31,914	40,652	27.4
Pierce	32,239	48,318	49.9
Madison	35,807	44,089	23.1
Stanton	36,676	47,713	30.1
Boone	33,288	42,265	27.0
Platte	39,359	49,523	25.8
Nance	31,731	41,950	32.2
Merrick	36,073	43,244	19.9
Hall	36,972	46,138	24.8
Howard	33,305	45,453	36.5
Polk	37,819	48,444	28.1
York	39,225	46,247	17.9
Fillmore	37,403	47,551	27.1

5 Household income is the sum of money income received in a calendar year by all household members, including household members not related to the householder, people living alone, and other nonfamily members.

6 This is significantly lower than the growth in personal income reported by the Bureau of Economic Analysis (BEA). This discrepancy can be explained, in part, by definitional differences: namely, personal income's inclusion of imputed income from owner-occupied housing, in-kind federal transfers, adjustments for under-reported income, and income received by pension plans and nonprofits.

County	2000	2010	Percentage Change, 2000–2010
Saline	37,323	43,489	16.5
Jefferson	33,866	41,131	21.5
Gage	34,908	43,311	24.1
Statewide	**39,250**	**49,432**	**25.9**

Source: U.S. Department of Commerce, U.S. Census Bureau, Small Area Income and Poverty Estimates.
Note: All estimates are in current dollars (not adjusted for inflation).

Property and Sales Tax Base

Fiscal revenues (tax revenues) collected in the Study Area are an indicator of the level of services that State, county, and local governments can afford to provide. Fiscal impacts are considered primarily for the 12 counties within which the Keystone XL Pipeline would be constructed. The Nebraska Reroute would likely have long-term impacts on the property tax base in the Study Area. In addition, construction of the pipeline would affect the sales and use tax base to the State and counties. Compensation payments to agricultural landowners for easements may also generate sales and use taxes depending on how the landowners use the payments (savings versus spending).

Property taxes levied in the Study Area (Table E.13-8) were $202.1 million in 2011, with an average effective tax rate of 1.58 percent. Keya Paha County had the smallest property levy along with the lowest effective tax rate in the 12-county corridor. Saline and Nance Counties have the largest effective tax rates in the corridor, but the highest taxes levied are in Holt County.

Table E.13-8. County Property Taxes Levied (2011)

County	Total Valuation ($)	Property Taxes Levied ($)	Effective Tax Rates
Antelope	1,265,502,251	18,813,572	1.5%
Boone	1,109,884,392	16,682,556	1.5%
Boyd	269,987,818	4,353,571	1.6%
Holt	1,753,041,959	26,992,665	1.5%
Keya Paha	258,795,800	3,121,220	1.2%
Merrick	966,425,398	16,834,708	1.7%
Polk	949,903,567	15,357,813	1.6%
Nance	535,354,922	9,356,441	1.8%
Fillmore	1,233,114,185	17,477,745	1.4%
Jefferson	1,070,224,509	17,826,962	1.7%
Saline	1,373,036,896	25,460,643	1.9%

County	Total Valuation ($)	Property Taxes Levied ($)	Effective Tax Rates
York	1,945,337,842	29,774,448	1.5%

Source: Nebraska Department of Revenue; Valuation, Taxes Levied, and Tax Rate Data by County.

In addition to county-levied property taxes, the State of Nebraska is responsible for collecting and distributing property taxes for public services that cross county boundaries. Public services include transmission lines, pipelines, and utilities, among others. Table E.13-9 shows State shares of property tax value; these taxes are currently distributed to counties. Total taxable values in the corridor are $161.5 million. Among the counties, Boyd County had the lowest level of property taxes from centrally assessed public services ($700,169), whereas Jefferson County had the highest level of centrally assessed property values (almost $86.6 million).

Table E.13-9. Centrally Assessed Public Services by County ($) (2011)

County	Taxable Value
Antelope	6,158,327
Boone	6,474,824
Boyd	700,169
Holt	8,723,177
Keya Paha	816,664
Merrick	9,061,124
Polk	3,331,097
Nance	2,328,136
Fillmore	7,964,228
Jefferson	86,620,005
Saline	22,176,141
York	7,123,945

Source: Nebraska Department of Revenue; Public Service Entities and Railroad Companies Certified Value Distributions by County, Tax Year 2011.

Sales and use taxes collected in the Study Area are described in Table E.13-10. The State collects sales taxes at a rate of 5.5 percent. In 2011, the State received $1.7 billion in sales tax revenues. The sales tax collections in the corridor totaled $43.2 million (2.4 percent of State revenues).

Table E.13-10. State and County Sales and Use Tax Rates (2011)

County	Sales Tax Revenues($)[a,b]	Lodging Tax Rates[c]	Lodging Tax Collections($)[d]
State Tax Rates	1,762,331,823		
Antelope	2,409,525	4.0%	10,140
Boone	8,193,979	2.0%	7,280
Boyd	561,858	NA	NA
Holt	6,134,918	4.0%	79,860
Keya Paha	132,269	NA	NA
Merrick	2,199,163	2.0%	2,904
Polk	1,942,677	NA	NA
Nance	969,610	2.0%	4,087
Fillmore	2,229,969	4.0%	2,566
Jefferson	3,403,745	2.0%	9,160
Saline	4,084,586	4.0%	7,256
York	10,660,994	4.0%	266,486

[a] *Nebraska State Sales and Use Tax Rate is 5.5%. Nebraska Department of Revenue; Nebraska Sales Tax Rates Finder*
[b] *Nebraska Department of Revenue; 2011 Net Taxable Sales for Nebraska Counties and Selected Cities; Annual 2011 and Annual 2010.*
[c] *Nebraska Department of Revenue; Chronological History of Nebraska Tax Rates; Table 4, County Lodging Tax.*
[d] *Nebraska Department of Revenue; Sales/Use Tax and Lodging Tax Data Files; Lodging Tax Remitted to Counties (historical).*

Also the project would affect lodging taxes, which are collected by the State and distributed to the counties. Table E.13-10 shows the respective county lodging tax rates and tax collections. In the corridor counties, Merrick County generated the lowest amount of lodging tax collections while Holt County generated the largest tax collections. Boyd, Keya Paha, and Polk Counties do not collect a lodging tax. Although lodging tax revenues are usually small (less than 1 percent of sales and use taxes), construction of the pipeline would be expected to create a short-term boost in these revenues as a result of construction personnel being lodged within the Study Area.

E.13.2 POTENTIAL IMPACTS

E.13.2.1 Impacts on Economic Activity

NDEQ approached underlying assumptions and estimates of economic benefits very conservatively in development of the Draft Evaluation Report (DER). Subsequent to the DER, new information pertaining to Keystone's estimate of employment and expenditures of construction-related services were provided by Keystone in early December, 2012. This information was reviewed and verified by NDEQ and a reanalysis of the economic benefits was prepared for this Final Evaluation Report.

Construction and operation of the Keystone XL pipeline are expected to generate positive economic benefits in the form of increases in economic output, employment, and income within the State. As noted in previous studies (DOS, 2011; Perryman Group Report, 2010), the construction of the Keystone XL pipeline would have positive short-term impacts on employment and income.

Positive impacts in the State would result from local construction expenditures and employment by Keystone. These direct impacts on the region would be due to the project generating sales of goods and services and labor income that would not occur if the project were not to exist. This new influx of construction-related spending and labor income would have additional impacts throughout the Study Area as the consumption of goods and employment would generate additional rounds of economic consumption, employment, and income—"the multiplier effect."

Additionally, if construction were to occur during the growing season, construction access through agricultural areas would require the acquisition of croplands, thereby potentially adversely affecting crop productivity during construction. Agricultural producers would be compensated for losses with payments based on crop values, expected yields, and acreage needed for access.

The economic framework, key assumptions, and Study Area are described below in greater detail.

E.13.2.2 Economic Impacts Methodology

The economic impact analysis framework evaluates impacts that would result from construction and operation of the Keystone XL Pipeline. Construction impacts are short-term and would occur only during the assumed construction phase. Impacts from operations would occur annually over the operational life of the pipeline after it is completed. The following impacts are considered for the economic impact analysis:

Short-term impacts

- Local daily spending by construction workers in the construction corridor
- Employment of "local" workers on construction of the pipeline
- Locally sourced contractor activities
- "Local" workforce household consumption
- Construction of roads, contractor yards, and stockpile sites
- Construction and operation of the work camp
- Construction of transmission lines for powering pump stations
- Lost agricultural production from acquisition of construction easements
- Increased household spending from payments for construction easements and crop damages

Long-term impacts

- Impacts from operations of the pipeline

The economic impact analysis of the Keystone XL Pipeline considered potential increases and decreases in three economic variables: output, employment, and labor income. Economic output is best described as sales of all goods produced by industries.

For each impact, the analysis included two levels of impacts that account for the total impact. The levels of impact are direct and secondary. Direct impacts are the initial increases in economic output and employment. Secondary impacts include: e rounds of economic activity created when suppliers spend their dollars in the economy, which in turn generate additional rounds of spending that would cycle through the economy; and the induce consumption by employees and households within the economy spending their additional dollars from wages and salaries.

The economic impact analysis is carried out using an Microsoft Excel-based model built around multipliers from IMPLAN Pro 3.0 software.[7] IMPLAN is a widely used computer simulation tool that employs input-output techniques to measure the regional impacts of each proposed alternative.[8] IMPLAN uses proprietary datasets based on the Bureau of Economic Analysis (BEA) National Income and Product Accounts (NIPA) datasets. These datasets are available at the county and state levels. The model generates regional multipliers based on spending/or employment of each adversely affected sector. The multipliers are affected by size of the Study Area, the time period of the datasets being used in the model, and the level of economic activity being evaluated.

The Study Area as described at the beginning of the existing conditions is broken into three regions for analysis. The analysis summarized those impacts that would occur within the construction corridor and those that would occur in the rest of the state. Furthermore, because construction durations would be less than 1 year, all impacts on jobs and incomes are presented as average annual. For example, Keystone expects to utilize 900 construction workers for spread number 10, of which 10 percent would be Nebraska hires (90 workers) over a duration of 20 week work period which converts to 34.6 annualized or full time equivalent (FTE) Nebraska jobs.

Key Assumptions

Key assumptions used in the economic impact analysis are:

- Average annual employment of local workforce by Keystone during construction
- Daily construction worker spending
- Construction expenditures by Keystone in the state of Nebraska
- Construction and operations estimates of the construction work camp
- Construction estimates for transmission lines and power stations

The value of agricultural production was estimated from the likely diminished yields discussed in the land use impacts chapter. Keystone provided an estimate of the total value of easement

7 Minnesota IMPLAN Group Inc. (MIG), Software and Data, <www.implan.com>.

8 Input-output models create an accounting framework for a regional economy that describes flows of outputs to and from industries and institutions. In the models, economics sectors can purchase outputs of other sectors, sell to other sectors, sell outside the local economy, and buy outside the local economy. This accounting framework allows the user to estimate how a change in the level of economic activity would affect the local economy.

payments and crop damages paid to corridor landowners ($1.2 million), that would offset agricultural losses. Assumptions for operational impacts are discussed in the energy chapter.

Keystone provided estimates of the necessary workforce for construction of the Keystone XL Pipeline, by construction spread. Each spread is expected to need approximately 900 workers, or 2,700 workers in total with 10 percent hired from the local workforce.[9] These jobs were converted to average annual jobs using estimated construction durations per spread. The total estimated average annual local jobs are 110 full-time equivalents during construction.

Keystone also provided estimated values of awards for construction including: pipeline, facilities, access roads, contractor yards, and stockpile sites that would be needed during construction. The value of those inputs are shown below in Table E.13-11, below. Pipeline and facilities construction contracts are expected to be awarded to companies outside of Nebraska and thus would not have a direct impact. However, the construction activity generated from their actions in Nebraska would have secondary effects on the State.

Table E.13-11. Value of Construction Awards Inputs

Construction Awards	Total Estimated Value
Pipeline Construction	$386.1 million
Facilities Construction	$66.8 million
Access roads	$1.9 million
Contractor yards and stockpile sites	$9.5 million

Additionally, Keystone provided estimates of other indirect costs from construction that would have an impact on the State's economy. The indirect costs include such items as construction management, engineering services, commissioning, environmental, telecom, corporate systems, legal services, real estate, and construction contingency. Keystone provided an estimate of the total cost and an estimate of the percentage that would be allocated to local Nebraska businesses. All of these costs were run through appropriate IMPLAN sectors, with the exception of the contingency, which is discussed below. Table E.13-12 below provides a breakdown of these costs along with the affected IMPLAN sector.

Contingency could affect all or only portions of the construction contract awards. Keystone reasonably expects to spend up to the estimated contingency. Spending the contingency could result in either additional employment, spending on materials, extensions of construction work camps, or extension of construction contracts. A reasonable approach to applying the contingency to the estimated impacts is to increase the impacts by the ratio of contingency to the total value of construction awards. The allotted Nebraska contingency is $59.1 million, which in comparison, to the total contract award of $798.3 million, would increase impacts by 7 percent.

9 The local workforce is defined as the workforce residing within Nebraska.

Table E.13-12. Value of Nebraska Indirect Cost Inputs

Indirect Costs	Total Estimated Value	IMPLAN Sector
Construction Management[a]	$1.6 million	HH $75–100K
Inspections, Commissioning, and Community Safety	$8.4 million	380
Engineering	$6.7 million	369
Environmental	$0.4 million	375
Telecomm	$0.5 million	351
Corporate Systems	$0.3 million	373
Legal	$5.6 million	367
Real Estate	$12.6 million	360

[a] *The construction management primarily consists of labor onsite; as such, the labor income from construction management was run as an impact on households based on the Bureau of Labor Statistics sector 11-9021 with estimated incomes of $95,000 per worker*

The indirect cost estimates provided by Keystone also identified additional jobs beyond the 2,700 workers employed for construction. Keystone estimated it would employ up to 230 Nebraska workers internally for activities related to construction management, inspections, and other activities. These jobs were also converted to an average annual basis using a 20-week construction duration, resulting in 100 average annual jobs. Additionally the contractors employed locally and out of state would hire workers. Job estimates for those categories were obtained using the IMPLAN model by running the indirect cost through each IMPLAN sector. Combining these worker estimates with an average construction duration of 20 weeks on the job site yielded an estimate of the number of workers who would spend money in the construction corridor (as shown in Table E.13-13).

Table E.13-13. Indirect Cost Estimates

Indirect Costs	Workers	Time Spent Onsite
Construction Management	527	90%
Inspections, Commissioning, & Community Safety	158	90%
Engineering	314	50%
Environmental	33	50%

[a] *Source: Keystone, RFI No. 3, received 12-2-2012*

Worker spending assumptions were based on U.S. General Services Administration per diem rates for spending.[10] The following set of assumptions was applied to the total employment by

[10] US GSA per diem rates for spending, <http://www.gsa.gov/portal/content/100715>.

Keystone and its contractors (3,962 persons), along with per diem rates to estimate worker spending:

- Incidentals are mainly general retail.
- The Nebraska lodging per diem is $77 for Central-South Corridor counties.
- Workers in work camp areas travel, on average, 20 miles per day round trip.
- Workers in Central-South Corridor counties, on average, travel 50 miles per day, round trip, because of lodging distances.[11]
- Weekly impacts are per diem rates multiplied by 7 days for expenses (eating, lodging, incidentals) and 6 days for work travel.
- Total impacts are weekly impacts multiplied by number of workers and time of construction.

Construction and operations of the work camp inputs were developed based on data collected from firms that conduct such turn-key operations.

- Complete cost ranges from $18,000 to $22,000 per worker depending on the climate.
- These units would be built at the home facility, then transported and set up onsite.
- Under normal conditions, it would take about 80 workers 10–12 weeks to build and set up the structures.
- While some companies might use their own crews entirely, it is often better to subcontract with local crews for site preparation (earthmoving) and utilities—both water and power. The heavy equipment would already be near the site, and local firms would know how to work with local permitting agencies. On-site costs would likely be approximately $750,000 for both site preparation and decommissioning.

The construction cost for a 600-worker camp should be prorated based on the capacity of the need. Keystone indicated that 300 workers would bring their own recreation vehicle (RV) and park at the camp. Costs for the parking lot and RV hook-ups were not available, but were considered small relative to total costs for a camp.

Construction estimates for transmission lines and power substations were derived from a sample of estimates provided by several power providers in the region. Estimates were provided based on average cost per mile for specific kV requirements as discussed in the energy chapter. The estimated costs are $1.8 million for transmission lines and $30.0 million for substations. It is assumed that only 75 percent of these costs would be construction materials sourced outside of Nebraska; the remaining 25 percent would be labor and materials sourced inside the state.

These assumptions were applied in the economic impact model on a sector-by-sector basis to estimate the total economic effects from the construction and operation of the Keystone XL Pipeline. The results are discussed in the following section.

[11] Most of the lodging in these areas was 20 to 30 miles from the pipeline centerline: Norfolk, Columbus, Grand Island. York is a little closer (about 6 miles at the closest point). An average commute would be approximately 25 to 30 miles. (Workers would most likely drive to contractor yards, not the actual daily work site. A 25- to 30-mile commute to the contractor yard would be needed and then a bus trip of from a few miles up to approximately 30 miles.)

E.13.2.3 Economic Impacts from Construction Related Activities

The impacts during construction are shown in Table E.13-14, Table E.13-15, and Table E.13-16. The first table demonstrates the construction-related activity within the 19 county Study Area. These impacts stem from worker daily spending (per diems) within the Study Area. Spending by construction workers could generate as much as $67.9 million in new economic activity. The construction activity would generate as much as 1,480 jobs within the state, with average annual incomes of $17,700.

Table E.13-14. Construction Activity Impacts Inside the 19-County Study Area (2012)

	Direct	Secondary	Total
Output	$67.9 million	$29.8 million	$97.7 million
Employment	1,190	290	1,480
Employee compensation	$17.2 million	$9.2 million	$26.3 million

Table E.13-15, below, summarizes the economic benefits which would occur within the state as a result of construction activities. These benefits include the impacts of the construction awards and the indirect costs to Keystone. These benefits come from hiring of local workers who in turn have normal household expenditures within the state, as well as construction and operation of the work camp. Keystone expects to employ approximately 270 Nebraska construction workers during construction, or 110 FTEs. As described above Keystone will also employ another 230 workers or 100 FTEs through indirect activities such as construction management, inspections, and environmental services. The combined effect of the direct activities would support up to $285.5 million in economic output and up to 2,740 jobs. The estimated average annual employee compensation would be $42,300.

Table E.13-15. Construction Activities Impacts, Rest of State (2012)

	Direct	Secondary	Total
Output	$47.5 million	$238.0 million	$285.5 million
Employment	630	2,110	2,740
Employee compensation	$23.6 million	$92.4 million	$116.0 million

Table E.13-16, below, summarizes the economic benefits which would occur within Nebraska as a result of connected actions associated with the pipeline. Connected actions include the construction of transmission lines and power substations to provide power to the necessary pump stations. The combined effect of these actions would support up to $17.2 million in economic output and up to 150 jobs. The estimated average annual employee compensation would be $55,300.

Table E.13-16. Construction Activity Impacts from Connected Actions, Rest of State (2012)

	Direct	Secondary	Total
Output	$10.1 million	$7.1 million	$17.2 million
Employment	80	70	150
Employee compensation	$3.5 million	$2.6 million	$6.1 million

During construction, economic impacts would occur as a result of reduced agricultural production resulting in a reduction in farm income in the construction corridor. However, these impacts on agricultural production would be offset by payments to landowners for crop damages and for ROW easements. The net impacts as measured here include the direct loss of production within the Study Area as well as these offsets as measured by changes in household spending in the secondary impacts. While there may be a direct loss of $1.5 million in agricultural production, the payments to landowners would generate an increase in household incomes resulting in an increase of $19.1 million in economic output from increased household expenditures. The total effect would be an increase in economic output of $17.7 million (see Table E.13-17).

Table E.13-17. Net Economic Impacts to Landowners due to Construction Activity inside the 19-County Construction Corridor (2012)

	Direct	Secondary	Total
Output	−$1.5 million	$19.1 million	$17.7 million
Employment	0	190	190
Employee compensation	−$0.3 million	$6.6 million	$6.3 million

E.13.2.4 Summary of Economic Impacts from Construction Related Activities

Table E.13-18 summarizes the economic impacts from construction. The actions would result in $418.1 million in economic output during construction of the pipeline through Nebraska. The construction would support up to 4,560 new or existing jobs. The average per worker annual incomes would be $33,900, for a total of $154.8 million in labor incomes.

Table E.13-18. Total Economic Impacts of Construction Activity (2012)

	Direct	Secondary	Total
Output	$124.1 million	$294.0 million	$418.1 million
Employment	1,900	2,660	4,560
Employee compensation	$44.0 million	$110.8 million	$154.8 million

E.13.2.5 Summary of Economic Impacts from Operations

Operation of the pipeline is expected to require in 15 employees needed during operation and monitoring activities, primarily in the Omaha operations center. In addition to the Keystone employment, further impacts would result from the electricity needed to power the pump stations. Power providers within the state would benefit from revenues from sales of power to

TransCanada. These impacts are summarized below in Table E.13-19. As the table shows, the $14.8 million in revenue to power providers would not result in new direct employment. However the secondary effects would support up to 50 jobs annually, with average annual incomes of $94,000.

Table E.13-19. Average Operational Activity Impacts

	Direct	Secondary	Total
Output	$14.8 million	$4.0 million	$18.8 million
Employment	15	50	65
Employee compensation	$2.1 million	$4.7 million	$6.8 million

E.13.2.6 Fiscal Impacts Methodology

Construction and operation of the Keystone XL pipeline would have impacts on fiscal resources (tax collections) within Nebraska in multiple ways. Sources of fiscal impacts are:

- Sales and use taxes for construction materials purchases and installation
- Sales taxes from indirect multiplier effects during construction
- Sales taxes from employee spending during construction
- Sales taxes from indirect multiplier effects during operation
- Sales taxes from employee spending during operation
- Property taxes from state assessed utilities during operation

Keystone would not pay Nebraska sales taxes on construction materials because the primary materials (pipes, pumps, and valves) would be purchased outside of Nebraska. It would pay "use taxes" for materials following their installation. Keystone would receive credits toward use taxes from the State for sales taxes paid to other states for material purchases (pipe, valves, etc.). This credit would vary depending on how much material would have already been purchased and would already be in inventory and on the amount of taxes paid. The materials for Nebraska have been sourced in Arkansas, which does not collect sales tax. As such, Keystone would pay the full 5.5 percent use tax to Nebraska on materials used in the State.

Centrally assessed utilities in Nebraska are valued for property tax purposes based on a combination of the value of real property, tangible assets, total operating revenue, and net operating income. Because of this, estimating property tax revenue for a centrally assessed utility based solely on construction value alone is difficult. As such, impacts on the Study Area property tax base were evaluated using the taxable value of the recently completed existing Keystone pipeline as a proxy value.[12] The existing Keystone pipeline, also owned by Keystone, entered its first full year of operation in 2012.

The 2012 existing Keystone pipeline total taxable value (real plus personal property value) by county along with the miles of pipe was collected from the State of Nebraska Department of

12 The existing Keystone pipeline, also owned by TransCanada, contains 214.5 miles of pipe in Nebraska. It crosses through Cedar, Wayne, Stanton, Platte, Colfax, Butler, Seward, Saline, Jefferson, and Gage Counties. The existing Keystone pipeline entered its first full year of operation in 2012, with a total taxable value of $538.5 million.

Revenue. The total taxable value was disaggregated to an average value per mile and inches of pipe diameter (30 inches) for counties with and counties without pump stations. These values were then applied to the total miles of pipe in each county for the Keystone XL Pipeline and adjusted for the pipe diameter size (36 inches) of the Keystone XL Pipeline, yielding an estimated valuation for the Keystone XL Pipeline once fully operational. The effective county property tax rates were then applied to estimate potential property tax generation of the pipeline in its first full year of operation. Subsequent years would see a decline in valuation over 15 years as the personal value component would be depreciated.[13]

E.13.2.7 Fiscal Impacts Results

Property tax impacts following completion of the pipeline are shown below in Table E.13-20. The table demonstrates the property tax revenues possible following the first full year of valuation.

Table E.13-20. Nebraska Property Tax Impacts from Construction (2012 $ millions)

County	Construction Value	Year 1 Property Tax High	Year 1 Property Tax Low
Keya Paha	33.82	0.43	0.37
Boyd	18.92	0.32	0.27
Holt[a]	195.07	3.15	2.70
Antelope[a]	153.90	2.41	2.06
Boone	59.04	0.93	0.80
Nance[a]	54.89	0.86	0.74
Merrick	16.05	0.29	0.25
Polk	28.66	0.48	0.42
York	59.61	0.96	0.82
Fillmore[a]	53.91	0.80	0.69
Saline	30.38	0.59	0.51
Jefferson[a]	99.99	1.75	1.50
Total	**804.24**	**12.97**	**11.13**

[a] *Includes property value from transmission lines and substations necessary for the pump stations.*

Sales and use tax impacts from pipeline materials are shown below in Table E.13-21. The table demonstrates the use tax revenues the state would collect on materials sources from outside of

[13] The pipelines assessed value includes real and personal property. Real property includes the value of the nonmovable assets, typically land and buildings. Personal property includes the value of the pipe and pump stations, as well as the operating income of the company.

the state. In order to be conservative, the table below does not include an estimate of sales taxes generate from the indirect economic activity generated by the project.

Table E.13-21. Nebraska Sales and Use Tax Impacts from Construction (2012)

	Value	Use Taxes
Pipeline materials	$300.49 million	$16.53 million

E.13.2.8 Property Value Impacts

During construction, private property damages would be primarily within the vicinity of the pipeline construction, pump station construction sites, and the construction work camp. Land disturbed by construction activities would be restored to the extent practicable. The construction activities could lead to short-term impacts on property values due to short-term visual, noise, and land disturbance effects.

During operation, damages to property owners from the Keystone XL Pipeline would likely be concentrated along the permanent easement and in the vicinity of the pump stations. Potential impacts on property values could be estimated based on literature reviews of studies from other pipeline and utilities corridors. Three studies, INGAA (2001), Fruits (2008), and Palmer (2008), indicate that easements from pipelines would have no significant impact on the value of property.

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Public Services

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PUBLIC SERVICES

Table E.14-1. Existing Airports and Airfields along the Nebraska Reroute Corridor (by county)

County	Airport or Airfield	Facility Description
Keya Paha	Burkinshaw Field, Jamison	No permanent staff, no air traffic control tower, turf runway surface
Boyd	Woolf Brothers Airport	Staffed during daylight hours; no air traffic control tower; turf runway surface
Holt	Stuart-Atkinson Municipal Airport, Atkinson	No permanent staff, no air traffic control tower, concrete and turf runway surface
	O'Neill Municipal Airport – John Baker Field, O'Neill	Staffed from 7 a.m.–6 p.m.; no air traffic control tower, concrete runway surface
Antelope	Antelope County Airport, Neligh	Staffed Monday-Friday from 7 a.m.–6 p.m.; no air traffic control tower; concrete and asphalt runway surface
Boone	Albion Municipal Airport, Albion	No permanent staff, no air traffic control tower, concrete runway surface
Nance	Genoa Municipal Airport, Genoa	No permanent staff, no air traffic control tower, turf runway surface
	CAMP Airport, Fullerton	No permanent staff, no air traffic control tower, turf runway surface
Merrick	Central City Municipal Airport – Larry Reineke Field	Staffed 7 a.m.–6:30 p.m. Monday, Fridays; Saturday 7 a.m.–noon; no air traffic control tower, concrete runway surface
Polk	None found	—
York	York Municipal Airport, York	Staffed from 7 a.m.–5 p.m., no air traffic control tower, concrete and turf runway surface
	Knox Landing Airport, York	No permanent staff, no air traffic control tower, concrete runway surface
	Boardman Aerial Airport, Henderson	No permanent staff, no air traffic control tower, asphalt runway surface

Table E.14-2. Existing Utilities within the Nebraska Reroute Corridor (by County)[a]

Nebraska County	Natural Gas Provider	Water Provider or Rural Water District	Electrical Power Provider	Telephone	Fiber-Optic Cable	Cable	Other Pipelines
Keya Paha	Individual cities	Individual cities	KBR Rural Public Power District	Rocky County Telephone Company; CenturyLink; North East Colorado Cellular, Inc.	None found	CenturyLink	None found
Boyd	Source Gas	Butte Water System, Spencer Rural Water District	Nebraska Public Power District	Northeast Nebraska Telephone Company; Three River Telco	None found	NNTC CenCom	None found
Holt	Source Gas	Individual cities	Nebraska Public Power District	CenturyLink; K & M Telephone Company; Great Plains Communications; Northeast Nebraska Telephone Company	Great Plains Communi-cations	CenturyLink	None found
Antelope	Kinder Morgan Interstate Gas Transmis-sion LLC	Individual cities	North Central Public Power District	Northeast Nebraska Telephone Company	None found	None listed	Trailblazer Pipeline
Boone	Kinder Morgan Interstate Gas Transmis-sion LLC	Individual cities	Loup Power District	Frontier; Great Plains Communications	Great Plains Communi-cations	Cable Nebraska; Great Plains Communica-tions	Magellan Pipeline
Nance	KN Energy Inc.	Individual cities	Loup Power District	Clarks Telecommuni-cations Company; CenturyLink	None found	CenturyLink	None found
Merrick	Central City Natural Gas Pipeline	Individual cities	Southern Power District	CenturyLink	None found	CenturyLink	None found

Nebraska County	Natural Gas Provider	Water Provider or Rural Water District	Electrical Power Provider	Telephone	Fiber-Optic Cable	Cable	Other Pipelines
Polk	Black Hills Energy; Source Gas; Northern Natural Gas	Individual cities	Polk County Rural Public Power District; Nebraska Public Power District	Windstream; Alltel	Windstream	USA Communica-tions; Windstream	Valero Pipeline
York	Black Hills Energy; Source Gas; Kinder Morgan	Individual cities	Nebraska Public Power District; Perennial Public Power District	Windstream; Mainstay Communications; Alltel	Dark Fiber Solutions; Windstream	Time Warner Cable; Windstream	Kaneb Pipeline

[a] *Utility verification would be provided during the design phase.*

Appendix E.15

Cultural Resources

APPENDIX E.15

CULTURAL RESOURCES

Information is privileged and confidential.

Appendix E.16

Air Quality

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APPENDIX E.16

AIR QUALITY

Table E.16-1. National Ambient Air Quality Standards

Pollutant	Primary/Secondary NAAQS[a]	Averaging Time	Level	Form
Particulate matter 10 microns in diameter or less (PM_{10})	Primary and secondary	24-hour	150 micro-grams per cubic meter ($\mu g/m^3$)	Not to be exceeded more than once per year on average over 3 years
Particulate matter 2.5 microns in diameter or less ($PM_{2.5}$)	Primary and secondary	Annual	15$\mu g/m^3$	Annual mean, averaged over 3 years
		24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
Nitrogen dioxide (NO_2)	Primary[b]	1-hour	100 parts per billion (ppb)	98th percentile, averaged over 3 years
	Primary and secondary	Annual	53 ppb	Annual mean
Sulfur dioxide (SO_2)	Primary[c]	Annual	80 $\mu g/m^3$	Annual arithmetic mean
		24-hour	365 $\mu g/m^3$	Not to be exceeded more than once per year
	Primary[b]	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 parts per million (ppm)	Not to be exceeded more than once per year
Ozone (O_3)	Primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Carbon monoxide (CO)	Primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	Not to be exceeded more than once per year
Lead	Primary and secondary	Rolling 3-month average	0.15 $\mu g/m^3$	Not to be exceeded
Total reduced sulfur (TRS)	Nebraska[d]	30-minute rolling average	0.10 ppm	Applies only where human exposure occurs
		1-minute	10.0 ppm	Applies only where human exposure occurs

Source: U.S. Environmental Protection Agency (EPA), National Ambient Air Quality Standards (NAAQS), updated July 16, 2012, <http://www.epa.gov/air/criteria.html>, retrieved July 25, 2012.

[a] *EPA and the Nebraska Department of Environmental Quality (NDEQ) have adopted the standards in this table, unless otherwise noted.*

[b] *This standard has been adopted by EPA only.*

[c] *This standard has been revoked by EPA (on June 2, 2010) but remains in effect until 1 year after an area is designated for the 1-hour standard.*

[d] *This standard has been adopted by NDEQ only.*

Figure E.16-1. Construction Exhaust Emissions

Table E.16-2 Construction Exhaust Emissions[a]

Construction Equipment per Spread

							PM10			PM2.5		
								Emissions			Emissions	
Onroad Vehicles/Eqpt	Fuel Type	Veh Speed (mph)[c]	Hour per Unit (hr/day)	Units per Spread	Hours per Eqpt (hr/day)	Vehicle Miles per Day	EF g/veh-mi[d]	lbs/day	lbs/month	EF g/veh-mi[d]	lbs/day	lbs/month
Automobile	Gasoline	30	2	50	100	3000	0.0248	0.16	4.92	0.0113	0.07	2.24
Bus	Diesel	30	3	7	21	630	0.3073	0.43	12.80	0.2685	0.37	11.19
Pickup 4x4	Diesel	30	5	100	500	15000	0.0515	1.70	51.09	0.0359	1.19	35.62
Welding Rig	Diesel	15	10	30	300	4500	0.0825	0.82	24.55	0.0796	0.79	23.69
Winch Truck	Diesel	15	8	3	24	360	0.0824	0.07	1.96	0.0616	0.05	1.47
Dump Truck	Diesel	15	8	1	8	120	0.0824	0.02	0.65	0.0616	0.02	0.49
Dump Truck (Camp constr)	Diesel	15	8	2	16	240	0.0824	0.04	1.31	0.0616	0.03	0.98
Flatbed Truck	Diesel	15	9	8	72	1080	0.0824	0.20	5.89	0.0616	0.15	4.40
Fuel Truck	Diesel	15	9	2	18	270	0.1112	0.07	1.99	0.0721	0.04	1.29
Grease Truck	Diesel	15	9	1	9	135	0.0824	0.02	0.74	0.0616	0.02	0.55
Mechanic Rig	Diesel	15	10	1	10	150	0.0824	0.03	0.82	0.0616	0.02	0.61
Skid Truck	Diesel	15	10	1	10	150	0.0824	0.03	0.82	0.0616	0.02	0.61
Stringing Tr. and Tr.	Diesel	15	10	15	150	2250	0.1112	0.55	16.55	0.0721	0.36	10.73
Truck and Float	Diesel	15	10	9	90	1350	0.1112	0.33	9.93	0.0721	0.21	6.44
Truck and Lowboy	Diesel	15	10	5	50	750	0.1112	0.18	5.52	0.0721	0.12	3.58
Totals for Onroad/Month									139.53			103.87
Tons for Onroad-Reroute									**0.97**			**0.72**
								Emissions			Emissions	
Offroad Vehicles/Eqpt	Fuel Type	HP	Hour per Unit (hr/day)	Units per Spread	Hours per Eqpt (hr/day)	Load Factor[e]	EF g/hp-hr[e]	lbs/day	lbs/month	EF g/hp-hr[e]	lbs/day	lbs/month
D-7 Dozer	Diesel	240	8	12	96	0.59	0.123	3.70	111.02	0.120	3.59	107.69
D-7 Dozer (Camp constr)	Diesel	240	8	1	8	0.59	0.123	0.31	9.25	0.120	0.30	8.97
D-8 Dozer	Diesel	310	8	22	176	0.59	0.150	10.62	318.73	0.145	10.31	309.15
D-8 Ripper	Diesel	310	0	0	0	0.59	0.150	0.00	0.00	0.145	0.00	0.00
D-5 Tow	Diesel	120	8	2	16	0.59	0.211	0.53	15.82	0.205	0.51	15.35
D-7 Tow	Diesel	240	8	1	8	0.59	0.123	0.31	9.25	0.120	0.30	8.97
D-6 Tack	Diesel	200	8	3	24	0.59	0.123	0.77	23.13	0.120	0.75	22.43
CAT 225	Diesel	150	8	7	56	0.59	0.195	2.13	63.90	0.189	2.07	61.98
CAT 225 (Camp constr)	Diesel	150	8	3	24	0.59	0.195	0.91	27.38	0.189	0.89	26.56
CAT 235	Diesel	250	8	26	208	0.59	0.107	7.22	216.69	0.104	7.01	210.19
CAT 235 w/Hammer	Diesel	260	8	1	8	0.59	0.107	0.29	8.67	0.104	0.28	8.41
Bending Machine 22-36	Diesel	159	8	1	8	0.59	0.246	0.41	12.21	0.239	0.39	11.85
Crane LS-98A (35 ton)	Diesel	230	8	2	16	0.43	0.103	0.36	10.75	0.100	0.35	10.43
Farm Tractor	Diesel	60	8	2	16	0.59	0.423	0.53	15.85	0.411	0.51	15.38
Frontend Loader 977	Diesel	190	8	2	16	0.59	0.143	0.57	17.02	0.139	0.55	16.51
Motor Grader 14G	Diesel	200	8	2	16	0.59	0.121	0.50	15.15	0.118	0.49	14.69
Sideboom 571	Diesel	200	8	1	8	0.59	0.169	0.35	10.56	0.164	0.34	10.24
Sideboom 572	Diesel	230	8	1	8	0.59	0.169	0.40	12.15	0.164	0.39	11.78
Sideboom 583	Diesel	310	8	22	176	0.59	0.218	15.49	464.67	0.212	15.02	450.73
Sideboom 594	Diesel	410	8	4	32	0.59	0.218	3.72	111.74	0.212	3.61	108.39
Hydrlic Lift (Camp constr)	Diesel	50	8	1	8	0.59	0.916	0.48	14.30	0.889	0.46	13.87
Air Compressor 1750 cfm	Gasoline	50	8	9	72	0.56	0.069	0.31	9.17	0.063	0.28	8.44
Generators	Gasoline	10	8	9	72	0.68	0.113	0.12	3.65	0.104	0.11	3.36
Pump - 3"	Gasoline	20	8	1	8	0.69	0.112	0.03	0.82	0.103	0.03	0.75
Pump - 6"	Gasoline	40	8	9	72	0.69	0.069	0.30	9.05	0.063	0.28	8.32
Totals for Offroad/Month									1510.94			1464.46
Tons for Offroad-Reroute									**10.3**			**9.98**
Tons for Spread/Month									0.83			0.78
Totals tons for Reroute[f]									**11.3**			**10.7**

Notes:

a Construction equipment list obtained from FEIS for construction spread and from TC Response to NDEQ, September 10, 2012, for camp construction. Emissions represent an assumed construction year of 2015.

b HC is expressed as VOC.

c Vehicle speed is the assumed average speed during vehicle's operating hours.

d Emission factors for onroad construction vehicles obtained from EPA's MOBILE62 model.

e Load factor and emission factors for offroad vehicles obtained from EPA's NONROAD model.

f Assumes two construction spreads for the Reroute and 7 months of construction duration per spread, per SER, September 5, 2012. Camp construction duration to be up to 3 months.

Table E.16-2 Construction Exhaust Emissions[a]

Construction Equipment per Spread

Onroad Vehicles/Eqpt	Fuel Type	Veh Speed (mph)[c]	Hour per Unit (hr/day)	Units per Spread	Hours per Eqpt (hr/day)	Vehicle Miles per Day	NOx EF g/veh-mi[d]	NOx Emissions lbs/day	NOx Emissions lbs/month	SOx EF g/veh-mi[d]	SOx Emissions lbs/day	SOx Emissions lbs/month
Automobile	Gasoline	30	2	50	100	3000	0.349	2.31	69.25	0.0068	0.04	1.35
Bus	Diesel	30	3	7	21	630	5.120	7.11	213.33	0.0153	0.02	0.64
Pickup 4x4	Diesel	30	5	100	500	15000	0.350	11.57	347.22	0.0056	0.19	5.56
Welding Rig	Diesel	15	10	30	300	4500	2.336	23.17	695.24	0.0109	0.11	3.24
Winch Truck	Diesel	15	8	3	24	360	2.907	2.31	69.21	0.0126	0.01	0.30
Dump Truck	Diesel	15	8	1	8	120	2.907	0.77	23.07	0.0126	0.00	0.10
Dump Truck (Camp constr)	Diesel	15	8	2	16	240	2.907	1.54	46.14	0.0126	0.01	0.20
Flatbed Truck	Diesel	15	9	8	72	1080	2.907	6.92	207.64	0.0126	0.03	0.90
Fuel Truck	Diesel	15	9	2	18	270	3.248	1.93	58.00	0.0144	0.01	0.26
Grease Truck	Diesel	15	9	1	9	135	2.907	0.87	25.96	0.0126	0.00	0.11
Mechanic Rig	Diesel	15	10	1	10	150	2.907	0.96	28.84	0.0126	0.00	0.13
Skid Truck	Diesel	15	10	1	10	150	2.907	0.96	28.84	0.0126	0.00	0.13
Stringing Tr. and Tr.	Diesel	15	10	15	150	2250	3.248	16.11	483.33	0.0144	0.07	2.14
Truck and Float	Diesel	15	10	9	90	1350	3.248	9.67	290.00	0.0144	0.04	1.29
Truck and Lowboy	Diesel	15	10	5	50	750	3.248	5.37	161.11	0.0144	0.02	0.71
Totals for Onroad/Month									2747.19			17.05
Tons for Onroad-Reroute									**18.98**			**0.12**
Offroad Vehicles/Eqpt	**Fuel Type**	**HP**	**Hour per Unit (hr/day)**	**Units per Spread**	**Hours per Eqpt (hr/day)**	**Load Factor[e]**	**EF g/hp-hr[e]**	**Emissions lbs/day**	**Emissions lbs/month**	**EF g/hp-hr[e]**	**Emissions lbs/day**	**Emissions lbs/month**
D-7 Dozer	Diesel	240	8	12	96	0.59	1.855	55.59	1667.64	0.004	0.12	3.73
D-7 Dozer (Camp constr)	Diesel	240	8	1	8	0.59	1.855	4.63	138.97	0.004	0.01	0.31
D-8 Dozer	Diesel	310	8	22	176	0.59	2.528	179.41	5382.29	0.004	0.31	9.28
D-8 Ripper	Diesel	310	0	0	0	0.59	2.528	0.00	0.00	0.004	0.00	0.00
D-5 Tow	Diesel	120	8	2	16	0.59	2.022	5.05	151.51	0.004	0.01	0.32
D-7 Tow	Diesel	240	8	1	8	0.59	1.855	4.63	138.97	0.004	0.01	0.31
D-6 Tack	Diesel	200	8	3	24	0.59	1.855	11.58	347.43	0.004	0.03	0.78
CAT 225	Diesel	150	8	7	56	0.59	1.824	19.93	597.81	0.004	0.05	1.38
CAT 225 (Camp constr)	Diesel	150	8	3	24	0.59	1.824	8.54	256.21	0.004	0.02	0.59
CAT 235	Diesel	250	8	26	208	0.59	1.656	111.99	3359.80	0.004	0.27	8.22
CAT 235 w/Hammer	Diesel	260	8	1	8	0.59	1.656	4.48	134.39	0.004	0.01	0.33
Bending Machine 22-36	Diesel	159	8	1	8	0.59	2.827	4.68	140.30	0.004	0.01	0.22
Crane LS-98A (35 ton)	Diesel	230	8	2	16	0.43	2.271	7.92	237.68	0.004	0.01	0.44
Farm Tractor	Diesel	60	8	2	16	0.59	4.217	5.27	157.97	0.005	0.01	0.19
Frontend Loader 977	Diesel	190	8	2	16	0.59	2.172	8.59	257.65	0.004	0.02	0.51
Motor Grader 14G	Diesel	200	8	2	16	0.59	1.823	7.59	227.62	0.004	0.02	0.52
Sideboom 571	Diesel	200	8	1	8	0.59	2.626	5.47	163.97	0.004	0.01	0.27
Sideboom 572	Diesel	230	8	1	8	0.59	2.626	6.29	188.57	0.004	0.01	0.31
Sideboom 583	Diesel	310	8	22	176	0.59	3.581	254.15	7624.36	0.005	0.32	9.62
Sideboom 594	Diesel	410	8	4	32	0.59	3.581	61.11	1833.42	0.005	0.08	2.31
Hydrlic Lift (Camp constr)	Diesel	50	8	1	8	0.59	5.593	2.91	87.30	0.006	0.00	0.09
Air Compressor 1750 cfm	Gasoline	50	8	9	72	0.56	2.420	10.75	322.65	0.013	0.06	1.73
Generators	Gasoline	10	8	9	72	0.68	2.490	2.69	80.61	0.019	0.02	0.62
Pump - 3"	Gasoline	20	8	1	8	0.69	2.389	0.58	17.44	0.019	0.00	0.14
Pump - 6"	Gasoline	40	8	9	72	0.69	2.035	8.91	267.42	0.013	0.06	1.70
Totals for Offroad/Month									23782.00			43.94
Tons for Offroad-Reroute									**163.8**			**0.30**
Tons for Spread/Month									13.26			0.03
Totals tons for Reroute[f]									**182.8**			**0.42**

Notes:

[a] Construction equipment list obtained from FEIS for construction spread and from TC R construction. Emissions represent an assumed construction year of 2015.

[b] HC is expressed as VOC.

[c] Vehicle speed is the assumed average speed during vehicle's operating hours.

[d] Emission factors for onroad construction vehicles obtained from EPA's MOBILE62 moc

[e] Load factor and emission factors for offroad vehicles obtained from EPA's NONROAD

[f] Assumes two construction spreads for the Reroute and 7 months of construction duratic Camp construction duration to be up to 3 months.

Table E.16-2 Construction Exhaust Emissions[a]

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Construction Equipment per Spread

Onroad Vehicles/Eqpt	Fuel Type	Veh Speed (mph)[c]	Hour per Unit (hr/day)	Units per Spread	Hours per Eqpt (hr/day)	Vehicle Miles per Day	HC[b] EF g/veh-mi[d]	HC[b] Emissions lbs/day	HC[b] Emissions lbs/month	CO EF g/veh-mi[d]	CO Emissions lbs/day	CO Emissions lbs/month
Automobile	Gasoline	30	2	50	100	3000	0.490	3.24	97.22	6.220	41.14	1234.13
Bus	Diesel	30	3	7	21	630	0.461	0.64	19.21	1.110	1.54	46.25
Pickup 4x4	Diesel	30	5	100	500	15000	0.303	10.02	300.60	0.540	17.86	535.71
Welding Rig	Diesel	15	10	30	300	4500	0.406	4.03	120.83	0.925	9.18	275.30
Winch Truck	Diesel	15	8	3	24	360	0.500	0.40	11.90	1.149	0.91	27.36
Dump Truck	Diesel	15	8	1	8	120	0.500	0.13	3.97	1.149	0.30	9.12
Dump Truck (Camp constr)	Diesel	15	8	2	16	240	0.500	0.26	7.94	1.149	0.61	18.24
Flatbed Truck	Diesel	15	9	8	72	1080	0.500	1.19	35.71	1.149	2.74	82.07
Fuel Truck	Diesel	15	9	2	18	270	0.535	0.32	9.55	1.414	0.84	25.25
Grease Truck	Diesel	15	9	1	9	135	0.500	0.15	4.46	1.149	0.34	10.26
Mechanic Rig	Diesel	15	10	1	10	150	0.500	0.17	4.96	1.149	0.38	11.40
Skid Truck	Diesel	15	10	1	10	150	0.500	0.17	4.96	1.149	0.38	11.40
Stringing Tr. and Tr.	Diesel	15	10	15	150	2250	0.535	2.65	79.61	1.414	7.01	210.42
Truck and Float	Diesel	15	10	9	90	1350	0.535	1.59	47.77	1.414	4.21	126.25
Truck and Lowboy	Diesel	15	10	5	50	750	0.535	0.88	26.54	1.414	2.34	70.14
Totals for Onroad/Month									775.24			2693.29
Tons for Onroad-Reroute									**5.38**			**18.75**

Offroad Vehicles/Eqpt	Fuel Type	HP	Hour per Unit (hr/day)	Units per Spread	Hours per Eqpt (hr/day)	Load Factor[e]	EF g/hp-hr[e]	Emissions lbs/day	Emissions lbs/month	EF g/hp-hr[e]	Emissions lbs/day	Emissions lbs/month
D-7 Dozer	Diesel	240	8	12	96	0.59	0.182	5.47	164.02	0.630	18.89	566.59
D-7 Dozer (Camp constr)	Diesel	240	8	1	8	0.59	0.182	0.46	13.67	0.630	1.57	47.22
D-8 Dozer	Diesel	310	8	22	176	0.59	0.179	12.72	381.45	1.004	71.27	2137.98
D-8 Ripper	Diesel	310	0	0	0	0.59	0.179	0.00	0.00	1.004	0.00	0.00
D-5 Tow	Diesel	120	8	2	16	0.59	0.197	0.49	14.78	0.867	2.17	64.98
D-7 Tow	Diesel	240	8	1	8	0.59	0.182	0.46	13.67	0.630	1.57	47.22
D-6 Tack	Diesel	200	8	3	24	0.59	0.182	1.14	34.17	0.630	3.93	118.04
CAT 225	Diesel	150	8	7	56	0.59	0.186	2.03	60.80	0.797	8.70	261.09
CAT 225 (Camp constr)	Diesel	150	8	3	24	0.59	0.186	0.87	26.06	0.797	3.73	111.89
CAT 235	Diesel	250	8	26	208	0.59	0.173	11.67	350.04	0.555	37.53	1125.89
CAT 235 w/Hammer	Diesel	260	8	1	8	0.59	0.173	0.47	14.00	0.555	1.50	45.04
Bending Machine 22-36	Diesel	159	8	1	8	0.59	0.258	0.43	12.82	1.106	1.83	54.92
Crane LS-98A (35 ton)	Diesel	230	8	2	16	0.43	0.201	0.70	21.00	0.491	1.71	51.36
Farm Tractor	Diesel	60	8	2	16	0.59	0.409	0.51	15.32	3.003	3.75	112.49
Frontend Loader 977	Diesel	190	8	2	16	0.59	0.201	0.79	23.85	0.723	2.86	85.79
Motor Grader 14G	Diesel	200	8	2	16	0.59	0.181	0.75	22.57	0.620	2.58	77.43
Sideboom 571	Diesel	200	8	1	8	0.59	0.232	0.48	14.47	0.862	1.79	53.84
Sideboom 572	Diesel	230	8	1	8	0.59	0.232	0.55	16.64	0.862	2.06	61.92
Sideboom 583	Diesel	310	8	22	176	0.59	0.244	17.30	518.94	1.560	110.69	3320.72
Sideboom 594	Diesel	410	8	4	32	0.59	0.244	4.16	124.79	1.560	26.62	798.53
Hydrlic Lift (Camp constr)	Diesel	50	8	1	8	0.59	1.730	0.90	27.00	6.316	3.29	98.59
Air Compressor 1750 cfm	Gasoline	50	8	9	72	0.56	1.556	6.91	207.45	25.067	111.41	3342.25
Generators	Gasoline	10	8	9	72	0.68	11.378	12.28	368.44	299.916	323.72	9711.57
Pump - 3"	Gasoline	20	8	1	8	0.69	8.238	2.01	60.15	298.543	72.66	2179.84
Pump - 6"	Gasoline	40	8	9	72	0.69	1.618	7.09	212.70	21.238	93.04	2791.32
Totals for Offroad/Month									2718.79			27266.50
Tons for Offroad-Reroute									**18.7**			**189.4**
Tons for Spread/Month									1.75			14.98
Totals tons for Reroute[f]									**24.0**			**208.2**

Notes:

[a] Construction equipment list obtained from FEIS for construction spread and from TC R construction. Emissions represent an assumed construction year of 2015.

[b] HC is expressed as VOC.

[c] Vehicle speed is the assumed average speed during vehicle's operating hours.

[d] Emission factors for onroad construction vehicles obtained from EPA's MOBILE62 moc

[e] Load factor and emission factors for offroad vehicles obtained from EPA's NONROAD

[f] Assumes two construction spreads for the Reroute and 7 months of construction duratic Camp construction duration to be up to 3 months.

Table E.16-2 Construction Exhaust Emissions[a]

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Construction Equipment per Spread

							CO2		
								Emissions	
Onroad Vehicles/Eqpt	**Fuel Type**	**Veh Speed (mph)[c]**	**Hour per Unit (hr/day)**	**Units per Spread**	**Hours per Eqpt (hr/day)**	**Vehicle Miles per Day**	**EF g/veh-mi[d]**	**lbs/day**	**tons/month**
Automobile	Gasoline	30	2	50	100	3000	368.0	2434	36.51
Bus	Diesel	30	3	7	21	630	1645.0	2285	34.27
Pickup 4x4	Diesel	30	5	100	500	15000	598.6	19795	296.92
Welding Rig	Diesel	15	10	30	300	4500	1169.3	11600	174.00
Winch Truck	Diesel	15	8	3	24	360	1351.8	1073	16.09
Dump Truck	Diesel	15	8	1	8	120	1351.8	358	5.36
Dump Truck (Camp constr)	Diesel	15	8	2	16	240	1351.8	715	10.73
Flatbed Truck	Diesel	15	9	8	72	1080	1351.8	3219	48.28
Fuel Truck	Diesel	15	9	2	18	270	1545.9	920	13.80
Grease Truck	Diesel	15	9	1	9	135	1351.8	402	6.03
Mechanic Rig	Diesel	15	10	1	10	150	1351.8	447	6.71
Skid Truck	Diesel	15	10	1	10	150	1351.8	447	6.71
Stringing Tr. and Tr.	Diesel	15	10	15	150	2250	1545.9	7668	115.02
Truck and Float	Diesel	15	10	9	90	1350	1545.9	4601	69.01
Truck and Lowboy	Diesel	15	10	5	50	750	1545.9	2556	38.34
Totals for Onroad/Month									877.8
Tons for Onroad-Reroute									**12171**
								Emissions	
Offroad Vehicles/Eqpt	**Fuel Type**	**HP**	**Hour per Unit (hr/day)**	**Units per Spread**	**Hours per Eqpt (hr/day)**	**Load Factor[e]**	**EF g/hp-hr[e]**	**lbs/day**	**tons/month**
D-7 Dozer	Diesel	240	8	12	96	0.59	536.284	16072	241.07
D-7 Dozer (Camp constr)	Diesel	240	8	1	8	0.59	536.284	1339	20.09
D-8 Dozer	Diesel	310	8	22	176	0.59	536.296	38059	570.89
D-8 Ripper	Diesel	310	0	0	0	0.59	536.296	0	0.00
D-5 Tow	Diesel	120	8	2	16	0.59	536.241	1339	20.09
D-7 Tow	Diesel	240	8	1	8	0.59	536.284	1339	20.09
D-6 Tack	Diesel	200	8	3	24	0.59	536.284	3348	50.22
CAT 225	Diesel	150	8	7	56	0.59	536.276	5859	87.89
CAT 225 (Camp constr)	Diesel	150	8	3	24	0.59	536.276	2511	37.67
CAT 235	Diesel	250	8	26	208	0.59	536.313	36274	544.12
CAT 235 w/Hammer	Diesel	260	8	1	8	0.59	536.313	1451	21.76
Bending Machine 22-36	Diesel	159	8	1	8	0.59	536.061	887	13.30
Crane LS-98A (35 ton)	Diesel	230	8	2	16	0.43	530.443	1850	27.76
Farm Tractor	Diesel	60	8	2	16	0.59	594.938	743	11.14
Frontend Loader 977	Diesel	190	8	2	16	0.59	536.230	2120	31.80
Motor Grader 14G	Diesel	200	8	2	16	0.59	536.289	2232	33.48
Sideboom 571	Diesel	200	8	1	8	0.59	536.140	1116	16.74
Sideboom 572	Diesel	230	8	1	8	0.59	536.140	1283	19.25
Sideboom 583	Diesel	310	8	22	176	0.59	536.105	38045	570.68
Sideboom 594	Diesel	410	8	4	32	0.59	536.105	9149	137.23
Hydrlic Lift (Camp constr)	Diesel	50	8	1	8	0.59	690.759	359	5.39
Air Compressor 1750 cfm	Gasoline	50	8	9	72	0.56	712.675	3167	47.51
Generators	Gasoline	10	8	9	72	0.68	1046.217	1129	16.94
Pump - 3"	Gasoline	20	8	1	8	0.69	1046.375	255	3.82
Pump - 6"	Gasoline	40	8	9	72	0.69	708.515	3104	46.56
Totals for Offroad/Month									2595.5
Tons for Offroad-Reroute									**35642**
Tons for Spread/Month									3473.3
Totals tons for Reroute[f]									**47813**

Notes:

[a] Construction equipment list obtained from FEIS for construction spread and from TC R construction. Emissions represent an assumed construction year of 2015.

[b] HC is expressed as VOC.

[c] Vehicle speed is the assumed average speed during vehicle's operating hours.

[d] Emission factors for onroad construction vehicles obtained from EPA's MOBILE62 moc

[e] Load factor and emission factors for offroad vehicles obtained from EPA's NONROAD

[f] Assumes two construction spreads for the Reroute and 7 months of construction duratic Camp construction duration to be up to 3 months.

Appendix E.17

Noise

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APPENDIX E.17

NOISE

Table E.17-1. Population Density in Nebraska Counties

County	Population per Square Mile
Keya Paha	1.1
Rock	1.5
Holt	4.3
Antelope	7.8
Boone	8.0
Nance	8.5
Merrick	16.2
Boyd	3.9
Polk	12.3
York	23.9

Source: U.S. Census Bureau, 2012

Table E.17-2. Existing Noise Levels in Nebraska Counties

County	Existing Day-Night Noise Level (A-weighted decibel)
Keya Paha	45
Rock	35
Holt	42
Antelope	47
Boone	47
Nance	48
Merrick	46
Boyd	35
Polk	50
York	35

Source: HDR Engineering, Inc., 2012

Table E.17-3. Minimum Equipment Required for Selected Construction Activities (Final Environmental Impact Statement [FEIS]: Table 2.3.2-1)

Activity	Minimum Equipment	Quantity
Clearing and grading	D8 dozers	6
	330 trackhoe (thumb and hoe pack)	1
	345 trackhoes	6
	D8 dozers with ripper attachment	2
	140 motor grader	1
Trenching	345 trackhoes	6
	345 trackhoe with hammer	1
	ditching machines	4
Stringing, bending, and welding	345 trackhoes vacuum fitted	2
	D7 tow cat	1
	string trucks	15
	583 side booms	10
	automatic welding machines w/end-facing machine	6
	bending machines	2
	572 side booms	10
	ultrasonic testing units	8
	NDE unit	1
	heat rings	2
	coating rings	4
	sled with generators	3
Lowering in and backfilling	345 trackhoes	3
	583 side booms	10
	padding machines	2
	D8 dozers	6
	ultrasonic testing units	8

Activity	Minimum Equipment	Quantity
Tie-ins to the mainline (six crews per spread; equipment listed for each crew)	welding rigs	4
	572 side booms	7
	ultrasonic testing units	2
	heat rings	2
	coating rings	2
	sled with generators	1
	345 trackhoes (1 equipped with long neck)	2
	583 side booms	2
	D8 dozers	1
Cleanup and Restoration	D8 dozers	6
	345 backhoes	3
	tractors with mulcher spreaders	2
Equipment deployed for each spread	pickup trucks	100
	water trucks	2
	fuel trucks	2
	equipment low-boys	7
	flat bed trucks	7
	2-ton boom trucks	5

Table E.17-4. Construction Equipment per Spread for the Project[a, b] (FEIS: Table 3.12.1-8)

Equipment Description	Units per Spread	Equipment Rating (hp)	Hours of Operation (hours/day)	Fuel Type
Automobile	50	500	2	Gasoline/Diesel
Bus	7	190	3	Diesel
Pickup 4×4	100	500	5	Gasoline/Diesel
Welding Rig	30	400	10	Gasoline/Diesel
Winch Truck	3	650	8	Diesel
Dump Truck	1	650	8	Diesel
Flatbed Truck	8	650	9	Diesel
Fuel Truck	2	650	9	Diesel
Grease Truck	1	1	9	Diesel
Mechanic Rig	1	500	10	Diesel
Skid Truck	1	650	10	Diesel
Stringing Tr. And Tr.	15	650	10	Diesel
Truck and Float	9	650	10	Diesel
Truck and Lowboy	5	650	10	Diesel
D-7 Dozer	12	240	8	Diesel
D-8 Dozer	22	310	8	Diesel
D-8 Ripper	0	310	0	Diesel
D-5 Tow	2	90/120	8	Diesel
D-7 Tow	1	200/240	8	Diesel
D-6 Tack	3	200	8	Diesel
CAT 225	7	150	8	Diesel
CAT 235	26	250	8	Diesel
CAT 235 w/Hammer	0-1	260	8	Diesel
Bending Machine 22-36	1	159	8	Diesel
Crane LS-98A (35 ton)	0-2	230	8	Diesel
Farm Tractor	2	60	8	Diesel
Frontend Loader 977	2	190	8	Diesel
Moto Grader 14G	2	200	8	Diesel
Sideboom 571	1	200	8	Diesel
Sideboom 572	1	200/230	8	Diesel
Sideboom 583	22	300/310	8	Diesel
Sideboom 594	4	410	8	Diesel
Air Compressor 1750	3-9	50	8	Gasoline

Equipment Description	Units per Spread	Equipment Rating (hp)	Hours of Operation (hours/day)	Fuel Type
cfm				
Generators	9	10	8	Gasoline
Pump - 3"	1	20	8	Gasoline
Pump - 6"	9	40	8	Gasoline

Sources: Keystone, 2009c, 2010a.

[a] *In addition to the equipment listed above, ten 10-horsepower diesel or gasoline generators could be used per spread.*

[b] *Construction equipment listed in this table does not directly correlate to equipment listed in Table 2.4.2-1; however, total horsepower is similar for the purposes of the air emissions analysis. In addition, the list does not include generators proposed for construction camps (emissions from generators at construction camps are included in Table 3.12.1-9).*

Table E.17-5. Construction Noise Levels

Minimum Equipment	Quantity	Equivalent Sound Level (A-Weighted Decibels)					
		Sound Watts Level (SWL) per Unit	Total SWL	Sound Power Level (SPL) at 25 feet	SPL at 500 feet	SPL at 1,000 feet	SPL at 2,000 feet
Clearing and grading							
D8 dozers	6	122	129	100	74	68	62
330 trackhoe (thumb and hoe pack)	1	117	115	87	61	55	49
345 trackhoes	6	117	123	95	69	62	56
D8 dozers with ripper attachment	2	122	124	95	69	63	57
140 motor grader	1	117	115	87	61	55	49
Total combined noise for activity				**102**	**76**	**70**	**64**
Trenching							
345 trackhoes	6	117	123	95	69	62	56
345 trackhoe with hammer	1	117	115	87	61	55	49
ditching machines	4	122	127	98	72	66	60
Total combined noise for activity				**100**	**74**	**68**	**62**
Stringing, bending, and welding							
345 trackhoes, vacuum fitted	2	117	118	90	64	58	52
D7 tow cat	1	122	121	92	66	60	54
string trucks	15	120	130	102	75	69	63
583 side booms	10	122	131	102	76	70	64
automatic welding machines with end-facing machine	6	107	113	85	59	52	46
bending machines	2	107	108	80	54	48	42
572 side booms	10	122	131	102	76	70	64
ultrasonic testing units	8	107	118	90	64	58	52
NDE unit	1	107	111	83	57	51	45
heat rings	2	107	116	87	61	55	49
coating rings	4	107	120	91	65	59	53

Minimum Equipment	Quantity	Equivalent Sound Level (A-Weighted Decibels)					
		Sound Watts Level (SWL) per Unit	Total SWL	Sound Power Level (SPL) at 25 feet	SPL at 500 feet	SPL at 1,000 feet	SPL at 2,000 feet
sled with generators	3	107	119	91	65	59	53
			Total combined noise for activity	**107**	**81**	**75**	**69**
Lowering in and backfilling							
345 trackhoes	3	117	120	92	66	59	53
583 side booms	10	122	131	102	76	70	64
padding machines	2	107	109	80	54	48	42
D8 dozers	6	122	129	100	74	68	62
ultrasonic testing units	8	107	114	86	60	54	48
			Total combined noise for activity	**105**	**79**	**73**	**67**
Tying in to the mainline (six crews per spread; equipment listed for each crew)							
welding rigs	4	107	111	83	57	51	45
572 side booms	7	122	129	101	75	69	63
ultrasonic testing units	2	107	108	80	54	48	42
heat rings	2	107	108	80	54	48	42
coating rings	2	107	108	80	54	48	42
sled with generators	1	113	111	83	57	51	45
345 trackhoes (1 equipped with long neck)	2	117	118	90	64	58	52
583 side booms	2	122	124	95	69	63	57
D8 dozers	1	122	121	92	66	60	54
			Total combined noise for activity	**103**	**77**	**71**	**65**
Cleaning up and restoring							
D8 dozers	6	112	118	90	64	57	51
345 backhoes	3	117	120	92	66	59	53
tractors with mulcher spreaders	2	112	113	85	59	53	47
			Total combined noise for activity	**94**	**68**	**62**	**56**

Minimum Equipment	Quantity	Equivalent Sound Level (A-Weighted Decibels)					
		Sound Watts Level (SWL) per Unit	Total SWL	Sound Power Level (SPL) at 25 feet	SPL at 500 feet	SPL at 1,000 feet	SPL at 2,000 feet
Equipment deployed for each spread							
pickup trucks	100	107	125	97	71	65	59
water trucks	2	116	117	89	63	57	51
fuel trucks	2	116	117	89	63	57	51
equipment low-boys	7	120	127	98	72	66	60
flat bed trucks	7	116	123	94	68	62	56
2-ton boom trucks	5	122	128	99	73	67	61
Total combined noise for activity				**104**	**78**	**72**	**66**
Construction camp							
LS 98A crane	1	122	121	92	66	60	54
D7 dozer	2	112	113	85	59	53	47
moto grader 14G	1	117	116	87	61	55	49
welding rigs	5	107	112	84	58	52	46
2200 cfm air compressors	2	107	109	80	54	48	42
650 hp dump trucks	2	116	117	89	63	57	51
650 hp flat bed trucks	2	116	117	89	63	57	51
pickup trucks	6	107	113	85	59	52	46
Total combined noise for activity				**97**	**71**	**65**	**59**

Sources: HDR Engineering, Inc., and TransCanada Keystone Pipeline, LP (responses to NDEQ Data Request 1.0)

Table E.17-6. Pump Station Noise

Distance from Pump Station (feet)	Range in Hourly Equivalent Noise Level (A-weighted decibel)	
	Low	High
300	60	62
700	53	55
1,000	51	53
1,300	49	51
1,600	46	48
2,000	45	47
2,300	45	47
2,600	44	46
3,000	43	45
3,300	42	44
2,600	42	44
3,900	342	44
4,200	41	43
4,600	41	43
5,000	41	43

Source: HDR Engineering, Inc., 2012

Appendix E.18

Energy

APPENDIX E.18

ENERGY

No supporting information.

Appendix E.19

Waste Management

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APPENDIX E.19
WASTE MANAGEMENT

Table E.19-1. State and Federal Environmental Databases

Nebraska Department of Environmental Quality Data	U.S. Environmental Protection Agency Database
▪ Leaking Storage Tanks ▪ On-site Water Treatment Systems ▪ Livestock Waste Control ▪ Integrated Waste Management Facilities ▪ Clean Air Act ▪ Brownfields ▪ National Pollutant Discharge Elimination System Permits and Compliance ▪ Petroleum Release Remediation ▪ Release Assessment ▪ Superfund ▪ Resource Conservation Recovery ▪ Superfund Amendments and Reauthorization Act Title III ▪ Underground Injection Control ▪ Spill Sites <http://dnrdata.dnr.ne.gov/clearinghouse/> (maintained by the Nebraska Department of Natural Resources)	▪ Office of Brownfields and Land Revitalization, Brownfields Properties ▪ Biennial Reporters ▪ Clean Air Markets Division Business System ▪ Clean Watersheds Needs Survey ▪ Emissions and Generation Resource Database ▪ Emission Inventory System ▪ National Compliance Database (Federal Insecticide, Fungicide, and Rodenticide Act/Toxic Substances Control Act Tracking System) ▪ Leaking Underground Storage Tank – American Recovery and Reinvestment Act ▪ National Emissions Inventory ▪ Permit Compliance System ▪ Resource Conservation and Recovery Act Info ▪ Safe Drinking Water Information System ▪ State Environmental Programs ▪ Toxic Substances Control Act ▪ Aerometric Information Retrieval System Facility Subsystem ▪ Base Realignment and Closure ▪ Comprehensive Environmental Response, Compensation, and Liability Information System Superfund System ▪ National Priorities List ▪ Electronic Greenhouse Gas Reporting Tool ▪ Energy Information Administration – 860 Database ▪ Facility Response Plan ▪ Integrated Compliance Information System ▪ National Center for Education Statistics ▪ Office of Transportation and Air Quality Fuels Registration ▪ Reasonably Available Control Technology/Best Available Control Technology/Lowest Achievable Emission Rate Clearinghouse ▪ Renewable Fuel Standard ▪ Section Seven Tracking System ▪ Toxic Release Inventory System