STUDY 1.0

SEDIMENTATION

LIST OF ATTACHMENTS

STUDY 1.0 SEDIMENTATION

The Project is located in Nance and Platte counties, where water is diverted from the Loup River and routed through the 35-mile-long Loup Power Canal, which empties into the Platte River near Columbus. The Project includes various hydraulic structures, two powerhouses, and two regulating reservoirs. The portion of the Loup River from the Diversion Weir to the confluence with the Platte River is referred to as the Loup River bypass reach.

When water is diverted from the Loup River, it enters the 2-mile-long Settling Basin. The Settling Basin is designed for low velocity to allow heavier sediment materials to settle out of the water before it enters the Upper Power Canal. A Sluice Gate Structure adjacent to the Diversion Weir is operated periodically to mobilize and remove accumulated sediment from in front of the Intake Gate Structure. This process conveys sediment into the Loup River bypass reach. As documented in the PAD, a Hydraulic Dredge removes approximately 1 million to 1.5 million tons of sediment from the Settling Basin annually. It has been suggested that the removal of sediment through Project dredging operations at the Settling Basin may affect sediment transport in the Loup River bypass reach and in the Platte River downstream of the Tailrace Canal.

This study will evaluate the physical effects of Project operations on sediment transport within the Loup River bypass reach and the Platte River downstream of the Tailrace Canal.

1. GOALS AND OBJECTIVES OF STUDY

"Describe the goals and objectives of each study proposal and the information to be obtained;" 18 CFR §5.11(d)(1)

The goal of the sedimentation study is to determine the effect, if any, that Project operations have on stream morphology and sediment transport in the Loup River bypass reach and in the lower Platte River because stream morphology relates directly to habitat, and habitat may determine species abundance and success. In addition, the study will compare the availability of sandbar nesting habitat for interior least terns (*Sterna antillarum*) and piping plovers (*Charadrius melodus*) to their respective populations and will compare the general habitat characteristics of the pallid sturgeon (*Scaphirhynchus albus*) in multiple locations.

The objectives of the sedimentation study are as follows:

1. To characterize sediment transport in the Loup River bypass reach and in the lower Platte River through effective discharge calculations.
2. To characterize stream morphology in the Loup River bypass reach and in the lower Platte River by reviewing existing data and literature on channel aggradation/degradation and cross sectional changes over time.

3. To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts (as provided by the Nebraska Game and Parks Commission [NGPC]) and productivity measures.[1]

4. To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn River.

2. RELEVANT RESOURCE MANAGEMENT GOALS

"Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;" 18 CFR §5.11(d)(2)

The U.S. Fish and Wildlife Service (USFWS) is responsible for the conservation and management of migratory, threatened, and endangered fish and wildlife resources under a number of authorities, including the Endangered Species Act of 1973, as amended (16 USC 1531-1544); the Fish and Wildlife Coordination Act, as amended (16 USC 661 et seq.); the Bald and Golden Eagle Protection Act, as amended (16 USC 668a-d); and the Migratory Bird Treaty Act, as amended (16 USC 703-712). Compliance with all of these statutes and regulations is required to be in compliance with the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321-4347).

3. BACKGROUND AND EXISTING INFORMATION

"Describe existing information concerning the subject of the study proposal, and the need for additional information;" 18 CFR §5.11(d)(3)

3.1 Existing Sediment and Stream Morphology Information

The proposed study area includes the Loup River bypass reach and the lower Platte River from the confluence with the Loup River to the U.S. Geological Survey (USGS) gage at Louisville (see Section 5, Study Area and Study Sites).

Both the Loup and Platte rivers are considered braided rivers; therefore, sediment transport is an important factor in retaining their natural characteristics (Donofrio, 1982). A braided river is defined as a river channel in which have been deposited bars and islands around which the river flows. It has been shown that, for a given discharge, braided channels slope more steeply than meandering channels. Braiding occurs when the discharge fluctuates frequently, when the river cannot carry its full

[1] It was determined at the May 27-28, 2009, Study Plan Meeting that productivity measures (fledge ratios) are also an important indicator of the reproductive success of interior least terns and piping plovers. This data was provided to the District by NGPC for use in this study; however, limited data exists for interior least terns and piping plovers on the Loup and Lower Platte rivers. Fledge ratios only exist for a few select sandpit sites adjacent to the Loup and Platte rivers between 2000 and 2008. 2005 is the only year of productivity data provided for sandbars in the Loup River. 2008 is the only year of productivity data provided for sandbars in the Lower Platte River.

sediment load, where the river is wide and shallow, where banks may be easily eroded, and where there is copious bedload. The position of the bars is changeable; sediment may be entrained by scour at channel junctions and then be re-deposited down-channel as flows diverge again and new channels are cut by overbank flooding (Mayhew, 2004).

There have been numerous sedimentation and geomorphology studies on the central Platte River but limited study on the lower Platte River and Loup River. One report, prepared by the Missouri River Basin Commission (September 1975), includes a sediment yield analysis of the Platte River Basin, which includes the Loup River Basin. A selection of studies and reports that will be used to gather data include:

- Blodgett and Stanley, 1980, "Stratification, Bedforms, and Discharge Relations of the Platte Braided River System, Nebraska," *Journal of Sedimentary Research*, 50(1):139-148.
- Chen, Rus, and Stanton, 1999, "Trends in Channel Gradation in Nebraska Streams, 1913-95," U.S. Geological Survey Water-Resources Investigations Report 99-4103.
- Ginting and Zelt, 2008, "Temporal Differences in Flow Depth and Velocity Distributions and Hydraulic Microhabitats Near Bridges of the Lower Platte River, Nebraska, 1934-2006," USGS Scientific Investigations Report 2008-5054.
- Ginting, Zelt, and Linard, 2008, "Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895-2006," USGS Scientific Investigations Report 2007-5267.
- Joeckel and Henebry, 2008, "Channel and Island Change in the Lower Platte River, Eastern Nebraska, USA: 1855-2005," *Geomorphology*, 102(3-4): 407-418.
- Karlinger, Eschner, Hadley, and Kircher, 1983, "Relation of Channel-Width Maintenance to Sediment Transport and River Morphology: Platte River, South-Central Nebraska," U.S. Geological Survey Professional Paper 1277-E.
- Marlette and Walker, 1968, "Dominant Discharges at Platte-Missouri River Confluence" in the *Journal of the Waterways and Harbors Division*, Proceedings of the American Society of Civil Engineers.
- Missouri River Basin Commission, 1972, "Platte River Basin Sediment Budget."
- Missouri River Basin Commission, September 1975, "Platte River Basin—Nebraska, Level B Study, Land Conservation and Sedimentation."

- Rus, Dietsch, and Simon, 2003, "Streambed Adjustment and Channel Widening in Eastern Nebraska," U.S. Geological Survey Water-Resources Investigations Report 03-4003.
- Smith, Norman D., October 1970, "The Braided Stream Depositional Environment: Comparison of the Platte River with Some Silurian Clastic Rocks, North-Central Appalachians," *Technological Society of America Bulletin*.
- Smith, Norman D., December 1971, "Transverse Bars and Braiding in the Lower Platte River, Nebraska," *Technological Society of America Bulletin*.
- U.S. Department of the Interior, Bureau of Reclamation, August 2000, "Physical History of the Platte River in Nebraska."
- U.S. Department of the Interior, Bureau of Reclamation, April 2004, "The Platte River Channel: History and Restoration."
- U.S. Geological Survey, 1983, "Hydrologic and Geomorphic Studies of the Platte River Basin, Professional Paper 1277.
- Yang and Stall, May 1976, "Applicability of Unit Stream Power Equation," *Journal of the Hydraulics Division*, ASCE, 102:5.

3.2 Flow and Gage Data

Flow data from USGS and Nebraska Department of Natural Resources (NDNR) gage stations will be used for this sedimentation study. Each gage station is accompanied by the associated rating curves and velocity and cross sectional data used to create the rating curves. Flow data that will be used for this study include:

- USGS Gage 06793000, Loup River near Genoa, NE – Available discharge and gage height data from April 1, 1929, to current includes daily and 30-minute interval data.
- USGS Gage 06792500, Loup River Power Canal near Genoa, NE – Available discharge and gage height data from January 1, 1937, to current includes daily and 30-minute interval data.
- NDNR Gage 00082100, Loup River Power Canal Return [Tailrace Canal] at Columbus, NE – Available discharge and gage height data from October 1, 2002, to current includes daily and 15-minute interval data.
- USGS Gage 06794500, Loup River at Columbus, NE – Available daily discharge and gage height data from April 1, 1934, to October 10, 1978. This gage was restarted by NDNR on September 23, 2008.

- USGS Gage 06774000, Platte River near Duncan, NE – Available discharge and gage height data from May 3, 1895, to current includes daily and 30-minute interval data.
- USGS Gage 06796000, Platte River at North Bend, NE – Available discharge and gage height data from April 1, 1949, to current includes daily and 30-minute interval data.
- USGS Gage 06796500, Platte River at Leshara, NE – Available discharge and gage height data from June 29, 1994, to current includes daily and 30-minute interval data.
- USGS Gage 068010000, Platte River near Ashland, NE – Available discharge and gage height data from September 1, 1928, to current includes daily and 30-minute interval data.
- USGS Gage 06805500, Platte River at Louisville, NE – Available discharge and gage height data from June 1, 1953, to current includes daily and hourly interval data.

3.3 Relevance to Threatened and Endangered Species

3.3.1 Lower Platte and Loup Rivers

The lower Platte River begins at the river's confluence with the Loup River in Platte County and continues eastward to its confluence with the Missouri River in Sarpy County.[2] This portion of the Platte River receives water from the Loup and Elkhorn rivers and has fairly stable flow. The lower Platte River is a mid-size, shallow, braided river. Sandbars and wooded islands are common within the channel. The width in some downstream areas of the lower Platte River has remained relatively constant, with approximately 90 percent of the historical width remaining (Eschner et al., 1983, as cited in NGPC, December 2008). Much of the stream banks are wooded, with cottonwood and eastern red cedar as the dominant species. Commercial sand pits are common along the river and have provided non-river habitat for a variety of species, including interior least terns and piping plovers. Most of the river floodplain is now cropland, though there are scattered wet meadows and marshes (Schneider et al., 2005).

Flow in the Platte River is seasonally influenced. Flows are relatively high in the spring and early summer due to snow melt and weather events, and flows are low during the late summer and fall due to irrigation and infrequent rainfall. The lower

[2] The lower Platte River is defined in several different ways by various resource agencies, for the purposes of the Loup River Hydroelectric Project relicensing, the lower Platte River is defined as the reach from the confluence with the Loup River down to the confluence with the Missouri River.

Platte River retains many of the important flow characteristics of its historic natural hydrograph. The variable timing of water inputs from upstream sources provides baseflow throughout much of the year. The channel of the lower Platte River still contains a wide range of habitats, from large sandbars to woody islands to shallow sandbars and swift channels (Parham, 2007). The combinations of ample sediment supplies and flows in the effective discharge range maintain the braided morphology and alternatively create transverse bars and then dissect the macroforms into braids, lending support to the development and maintenance of the braided river morphology that is one of the types of habitat used by interior least terns and piping plovers.

Specialized habitats such as backwaters, sloughs, side channels, shoreline, and deep water pools along the edges of sandbars and river banks are examples of the diverse habitat types that occur along the Platte River (NGPC, December 2008). These in-stream features provide year-round habitat for numerous species of plants, invertebrates, amphibians, fish, and reptiles. Emergent sandbar habitat in braided channels is important to a variety of life stages of fish and wildlife, including interior least tern, piping plover, and pallid sturgeon, three species that are Federally listed as threatened or endangered. The long-standing presence of this variety of habitat types is a reflection of the dynamically stable braided river morphology of the lower Platte River.

The Loup River Basin at its confluence with the Platte River has a total drainage area of approximately 15,200 square miles of total land area. In the Loup River Basin, nearly all soils are highly erodible when deprived of vegetative cover. Because of the highly erodible nature of the soils, nearly all streams receive and attempt to carry heavy loads of sediment, which allows for the deposition of sediment and the formation of sandbars (Bliss and Schainost, 1973).

The South Loup, Middle Loup, and North Loup rivers derive their flow from groundwater discharge out of the southern Sandhills and provide a significant source of summer flow to the Loup and lower Platte rivers (Schneider et al., 2005). The South, Middle, and North Loup rivers in these reaches are medium-sized rivers with broad braided, somewhat shallow channels. The river channels have many open sandbars and wooded islands (Schneider et al., 2005). General habitat parameter characteristics of the Loup River are typical of rivers found in similar agriculturally impacted areas of Great Plains grassland ecosystems, tending to be relatively shallow, primarily sandy bottoms, and exhibiting low current velocities that are impacted by strong rain events (NGPC, 1997, as cited in U.S. Department of the Interior, Bureau of Reclamation, September 2002).

Sandbars in the lower reaches of the Loup River support some nesting colonies of interior least terns and piping plovers (Schneider et al., 2005); however, limited data exists on the habitat suitability of the Loup River for these nesting birds. Commercial sand pits and gravel mines are also common along the river and have been used by these birds for breeding, nesting, and foraging.

3.3.2 Interior Least Terns and Piping Plovers

Interior least terns are a migratory bird species and spend approximately 4 to 5 months at their nesting sites. These birds winter in South America, where little is known about their wintering habits and habitats, and they reproduce in the summer months in North America. The interior least tern breeding range extends from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana (USFWS, September 1990). After conducting the first range-wide census of the interior least tern, Lott (2006) found that the lower Mississippi River is the most important breeding area for the this species, with more than 62 percent of all interior least terns surveyed occurring on the lower Mississippi. Four additional river systems accounted for 33.3 percent of the remaining interior least terns, with 11.6 percent on the Arkansas River system, 10.4 percent on the Red River system, 6.9 percent on the Missouri River system, and 4.4 percent on the Platte River system. Lesser numbers of terns were counted on the Ohio River system, the Trinity River system in Texas, the Rio Grande/Pecos River system in New Mexico and Texas, the Wabash River system, two reservoirs in east Texas, and the Kansas River system. Many of these river systems, including some of the most populated such as the Missouri, Red, and Arkansas, have power or flood control facilities that practice varying degrees of hydrocycling.

Interior least terns typically arrive in Nebraska in mid-May to establish feeding and nesting territories. Ziewitz et al. (1992) found interior least terns initiating nesting on the Platte River from May 19 to June 23; however, nest initiation can occur as late as the first two weeks of July (Jorgensen, 2007). Kirsch (1990 and 1992, as cited in Sidle, 1992) found that interior least tern nest initiation dates during 1986 to 1990 on the lower Platte River ranged from May 20 to July 11, with a mode of June 5.

Piping plovers are also a migratory bird species and spend approximately 3 to 4 months on their breeding sites. These birds winter along the southern Atlantic coast in the U.S., the Gulf of Mexico coast in the U.S. and Mexico, and the Caribbean islands, and they reproduce in the summer months in the northern U.S. and Canada. The piping plover breeding range includes the Northern Great Plains from Alberta to Manitoba and south to Nebraska; the Great Lakes beaches; and Atlantic coastal beaches from Newfoundland to North Carolina. The results of the most recent International Piping Plover Breeding Census found that 57.6 percent of birds were found in the U.S. and Canada Northern Great Plains and Prairie Canada regions. The U.S. Northern Great Plains made up 36.6 percent of the total population of piping plovers, with 15.6 percent of the total population being found along the Missouri River (Montana, North Dakota, South Dakota, and Nebraska).

Piping plovers begin arriving at their Nebraska breeding areas in late April and early May (Sharpe et al., 2001). Nest initiation varies depending on local conditions and may begin by late April and continue until early July (USACE, 1998, as cited in USFWS, June 16, 2006). Egg laying typically begins the second or third week of

May (USFWS, November 30, 2000). Kirsch (1990 and 1992, as cited in Sidle, 1992) found that piping plovers initiated nests from May 19 to July 4, with a mode of June 8.

Interior least terns and piping plovers breed, forage, and nest on the Elkhorn, Loup, Missouri, Niobrara, and Platte rivers in Nebraska. Sandbar habitat in the Loup and lower Platte rivers is used by interior least terns and piping plovers for breeding, nesting, loafing, and foraging. Sandpit habitat adjacent to these two river systems has also been used extensively by these birds for nesting and foraging, perhaps more successfully. Lingle (1993) found that hatching rates were much higher on sandpit sites than on riverine sites and Wilson et al (1993) found that during a flood event only 3 percent of nests were lost on sandpits compared to 37 percent on the river.

Physical habitat requirements of the interior least tern and piping plover are difficult to describe. Nesting habitats tend to be ephemeral in quality and abundance. Beaches, sand and gravel spoil piles, sandbars, peninsulas, or other open sandy areas or exposed flats are the principal breeding and nesting habitats of these species (USFWS, June 16, 2006).

Historic Interior Least Tern and Piping Plover Use of the Loup and Lower Platte Rivers

Very limited information exists regarding the historic use of the Loup and lower Platte rivers by interior least terns and piping plovers prior to the 1980s. The little information that does exist does not describe much about the exact location of the sightings, nesting on- or off-river, or the historic density of these birds on the Loup and lower Platte rivers. Furthermore, it does not provide information on the type, density, physical aspects, or other characteristics of the sandbars and channel systems or on the "value" of the habitat during times of use.

The first documented sighting of an interior least tern along the lower Platte River was in The Paul Wilhelm Journey (1823, as cited in Ducey, 2000). The first documented sighting of a piping plover along the lower Platte River was near Columbus in 1938. In 1941, interior least terns were recorded near Columbus (Ducey, 1985). At Merritt's Beach near Plattsmouth, Nebraska, an off-river site, one interior least tern nest and one piping plover nest were observed in 1943 (Heinemann, 1944).

In the 1850s, interior least terns and piping plovers were sighted near the confluence of the Loup and Platte rivers, although no count data were recorded (Ducey, 2000). On the Loup River system, very few early records exist on these species, the earliest being specimens of three interior least terns and five piping plovers that were collected during the Warren Expedition (1875, as cited in Ducey, 1985 and 2000) that were attributed to the "Loup Fork." The exact locality was not given in the expedition narrative. Approximately 100 years later, in 1965, interior least tern nesting was recorded on the Middle Loup River, 3 miles south of St. Paul, Nebraska (Short, 1966, as cited in Ducey, 1985).

Current Interior Least Tern and Piping Plover Use of the Loup and Lower Platte Rivers

In the Loup River system, breeding interior least terns and piping plovers occur as far west as Valley and Howard counties (Sharpe et al., 2001). Currently, interior least tern and piping plover use of the Loup River in relation to use of other Nebraska rivers is minimal. Based on adult census counts and nest counts (for which there is limited data), very few birds have been sighted and recorded nesting on the Loup River. The largest colony of nesting interior least terns and piping plovers along the Loup River is located within the Project Boundary on the North Sand Management Area. This site is where sand dredged from the adjacent Settling Basin is stockpiled, creating a large sandy area with adjacent wetted areas. Interior least terns and piping plovers also use additional sand and gravel pits and housing developments along the Loup and North Loup rivers (NGPC, February 23, 2009). However, very little data has been gathered on interior least tern and piping plover use of the Loup and North Loup rivers themselves. Sand and gravel mines and housing developments adjacent to the Loup River system were last surveyed by NGPC in 2008. The Loup River was last surveyed by Jim Jenniges in June 2009 for interior least terns and piping plovers. Prior to this most recent survey, the Loup River system was surveyed for interior least terns in 2005 during the Range-wide Species Survey and for piping plovers in 2006 for the International Piping Plover Breeding Census.

Presently, interior least terns and piping plovers nest on sandpits adjacent to the lower Platte River as well as on sandbars located in the river. Kirsch (1996) studied interior least tern use of natural riverine sandbars and human-created sandpits along the lower Platte River downstream of Columbus and found that interior least terns showed no preference of riverine sandbars over sandpits or vice versa. Productivity and mortality of young also did not differ between these two habitat types, and it was suggested that interior least terns may not perceive sandbars and sandpits as different (Kirsch, 1996).

Since 1987, NGPC has coordinated and conducted a standardized interior least tern and piping plover survey on the lower Platte River system. The Tern and Plover Conservation Partnership began participating in this survey in 1999. The survey area extends 103 river miles, from near Columbus in Platte County to near Plattsmouth in Cass County (Brown and Jorgensen, 2008). Dates on which the survey is conducted vary based on weather conditions and river flow. The survey consists of counting nesting colonies, adult birds, nests, and chicks on both the river and at associated sand and gravel mines (Jorgensen, 2007).

Exhibits 1-1 and 1-2 (Brown and Jorgensen, 2008) illustrate the total number of interior least terns and piping plovers recorded on the lower Platte River system (both sandbars and sandpits) during the annual mid-summer survey from 1987 to 2008. In reviewing these graphs, it appears that interior least tern numbers have remained fairly stable, while piping plover numbers were much higher in the late 1980s but have steadily fluctuated since. During this time period, the only change to Project

operations has been the suspension of dredging activities (including discharge to the North and South Sand Management Areas) during the nesting season for interior least terns and piping plovers. This operational change was implemented in cooperation with NGPC, USFWS, and the Tern and Plover Conservation Partnership. The 2008 numbers show a slight increase from 2007 for piping plovers, but a relatively large decrease for interior least terns. Potential reasons for this decrease in interior least tern numbers could be attributed to low site fidelity or emigration. Lingle (1993) found that only 29 percent of adult interior least terns returned to nest at the site where they were banded and only 26 percent of chicks returned to their natal site, indicating that there is fairly low site fidelity and high emigration rates.

Exhibit 1-1. Total Number of Interior Least Terns Recorded on the Lower Platte River System, 1987-2008

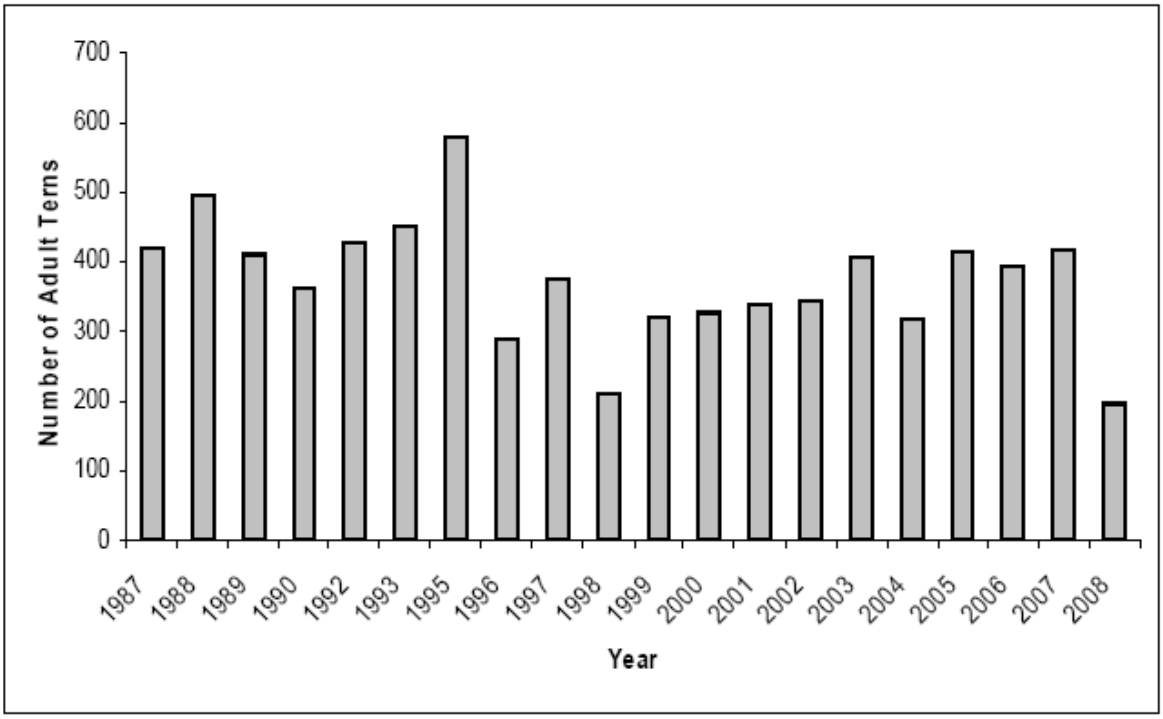
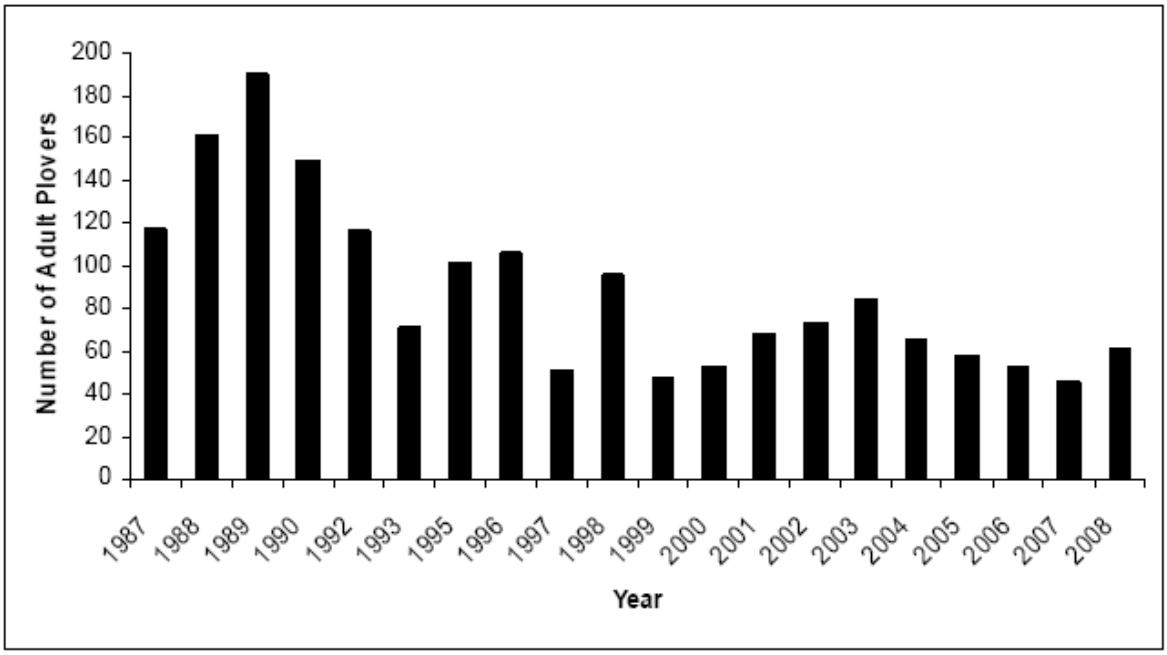


Exhibit 1-2. Total Number of Piping Plovers Recorded on the Lower Platte River System, 1987-2008



Critical Habitat

Critical habitat is defined as the specific areas that contain physical or biological features essential to the conservation of the species that may require special management considerations or protection under the Endangered Species Act of 1973, as amended (National Research Council, 2005). Critical habitat has not been designated for the interior least tern.

Critical habitat was designated for the northern Great Plains breeding population of the piping plover by USFWS on September 11, 2002 (67 FR 57638-57717). Included were approximately 106,030 acres largely associated with lakes in Minnesota, Montana, and North Dakota; about 440 miles associated with rivers in Nebraska; and 77,370 acres and 768 miles (438 miles associated with reservoir habitat and 330 miles associated with riverine habitat) on the Missouri River in Montana, North Dakota, South Dakota, and Nebraska. The final rule reported that for piping plovers breeding on the northern Great Plains in the United States, about 69 percent used the lake habitat and the remaining 31 percent were found on habitat associated with Missouri River reservoirs, tributaries to the Missouri River (such as the Platte and Niobrara rivers), and the Missouri River. Critical habitat was not designated for northern Great Plains piping plovers breeding in Canada.

The critical habitat designation in Nebraska included the Platte River from Lexington, Nebraska, to the confluence of the Platte with the Missouri River (252 miles), the Loup River (68 miles), and the eastern portion of the Niobrara River (120 miles). The shoreline of Lake McConaughy was excluded because USFWS maintained that it was adequately managed under plans developed by the Central Nebraska Public Power and Irrigation District. USFWS also excluded sand pits because they do not meet the physical and biological requirements of critical habitat (National Research Council, 2005).

On February 14, 2003, the Nebraska Habitat Conservation Coalition filed a lawsuit against USFWS before the U.S. District Court in Nebraska. The lawsuit was filed to invalidate the designation of critical habitat for piping plovers in Nebraska. On October 13, 2005, the Nebraska Habitat Conservation Coalition was awarded the case against USFWS. U.S. District Judge Lyle Strom vacated and remanded all critical habitat designations on the Platte, Loup, and Niobrara rivers. The critical habitat designation on the Missouri River along the Nebraska/South Dakota border still stands. Judge Strom ordered USFWS to re-conduct the economic analysis and re-assess the critical habitat designation for the piping plover in Nebraska (U.S. District Court for the District of Nebraska, October 13, 2005). Because of this decision, there is currently no Federally designated critical habitat for piping plover within the state of Nebraska and in the vicinity of the Project.

River Habitat

Climatic conditions that influence river hydrology are a major factor influencing the braided river morphology, which translates to the distribution, abundance, and quality of nesting habitat. Riverine habitat is constantly changing and is formed and maintained by the hydrology of the river and the supply and movement of its alluvial bed material (USFWS, June 16, 2006). Riverine nesting areas of interior least terns and piping plovers consist of sparsely vegetated sand and gravel bars within a wide unobstructed river channel. Nesting locations are usually at higher elevations and away from the water's edge. Interior least terns and piping plovers have been observed to nest on sandbar habitats with less than 25 percent vegetative cover and an abundance of bare or sparsely vegetated sand and gravel (Sidle and Kirsch, 1993) with an average area of 1.45 hectares and at an average height of 0.49 meter (Ziewitz et al., 1992).

In a preliminary assessment of river nesting habitat, Brown and Jorgensen (2008) assessed nine sandbars with nesting interior least tern colonies and fifteen sandbars without nesting colonies from June 28 to July 3, 2008. The goal of this study was to assess the amount and quality of sandbar habitat available to the birds in the lower Platte River. The researchers systematically measured the physical characteristics of sandbars with nesting birds and sandbars without nesting birds.

This assessment was conducted on the lower Platte River from River Mile 57 (near Fremont, Nebraska) downstream to the confluence of the Platte and Missouri rivers

(near Plattsmouth). Sandbar surface area and elevation above the water line were measured and used to determine sandbar "size." River flow measurements from gage stations were used to show the relationship between flow changes and whether a sandbar and the nests on it were inundated or remained dry. This study followed a period of very high flows on the Platte River. On May 31, 2008, the average daily discharge was 96,000 cfs at the USGS gage at Louisville, Nebraska, which is in the top 10 of daily peak discharges for the period of record (1953 to 2009). In addition, the flow volume during that period was approximately 150 percent of normal at Louisville. This higher-than-average event may have caused certain outcomes to be different than a normal flow year.

The results of this assessment showed that average sandbar area and height, with and without nests, were relatively similar. Throughout the study, no interior least tern nests were inundated, despite notable river rises due to weather conditions. One piping plover nest at a relatively low elevation was inundated.

Non-River Habitat

Operating sand and gravel pits provide a barren to sparsely vegetated substrate suitable for nesting habitat (Sidle, 1993). Kirsch (1996) characterized sandpit sites as expansive areas of sand with large surface areas of water. Sidle (1993) identified 32 sandpits and the District's Sand Management Area as suitable for nesting interior least terns and piping plovers. Sidle found that most sandpits examined ranged in size from 0.6 to 79.6 hectares (ha) and averaged 23 ha with the District's Sand Management Area being an outlier at 200.8 ha. The sand and gravel component of sandpits ranged from 0.2 to 37.3 ha, and the water component ranged from 0.4 to 42.3 ha. The District's Sand Management Area was approximately 172.2 ha of sand and gravel and 28.6 ha of water (Sidle, 1993).

Due to recent trends in management of interior least terns and piping plovers, including directing nest sites, monitoring, vegetation control, and predator exclusion and management, many commercial sandpits and sandpit lakeshore housing developments are successfully being used by these species. Brown et al. (2008) reported a steady increase in both interior least terns and piping plovers nesting at non-river habitat over the past 20 years. Jenniges and Plettner (2008) found that productivity at managed sandpits was significantly higher than at unmanaged pits during the same time frame, indicating that management is effective in improving productivity of interior least terns.

The District's North Sand Management Area has provided consistent habitat for nesting interior least terns and piping plovers for a number of years and continually has the largest documented nesting colony of interior least terns and piping plovers located along the Loup River system (NGPC, 2009). Current management practices at the District's North Sand Management Area have used a combination of directing nest sites, protective sand berms, redirecting dredge discharge flow, and interior least tern and piping plover nest monitoring. These management practices, developed in

conjunction with the North Sand Management Area Adaptive Management Plan, have helped to increase bird awareness and to allow these species to successfully coexist with the dredging and sand operations (Tern and Plover Conservation Partnership, July 30, 2008).

Interior Least Tern and Piping Plover Data

The Nebraska Least Tern and Piping Plover database maintained by the NGPC Nongame Bird Program is the most up-to-date and comprehensive available data source on the occurrence and distribution of Nebraska's interior least terns and piping plovers. The NGPC Nongame Bird Program maintains high standards of data quality control; however, "it makes no warranty as to the fitness of these data for any purpose nor that these data are necessarily accurate and complete" (NGPC, 2009). NGPC notes that the data have inherent limitations (NGPC, 2009). Some sites, both natural and human-created, in the state have been surveyed using different methodologies at different times and for different lengths of time. Accurately quantifying the number of individual interior least terns and piping plovers at a site is challenging because both species are very mobile. Interior least terns often forage several miles away from nesting sites. Individual birds may colonize and then leave sites in response to nest failure throughout the nesting season. Observers are not always able to detect all individuals at a site all of the time (Brown and Jorgensen, September 5, 2008).

The District was granted access to information on interior least terns and piping plovers on the Loup and lower Platte rivers from NGPC's Nongame Bird Program Nebraska Least Tern and Piping Plover database on July 24, 2009 (NGPC, 2009). The District also has collected information on interior least terns and piping plovers on the Missouri River (the Fort Randall and Gavins Point reaches) from the U.S. Army Corps of Engineers (USACE) (USACE, March 30, 2009) and on the Niobrara River from the National Park Service (National Park Service, June 30, 2009). Finally, the District has gathered information from the International Piping Plover Breeding Census on Nebraska rivers and sandpits (Elliot-Smith, February 17, 2009) and the Range-wide Least Tern Census (Lott, 2006). A table of the data available for use in the sedimentation study is provided in Attachment A.

3.3.3 Pallid Sturgeon

The pallid sturgeon is considered to be a large turbid river species. The habitat used by different life stages of this species varies widely. Historically, most rivers comprising the range of the pallid sturgeon were characterized by shallow channels with shifting sandbars. The lower Platte River still retains this type of habitat over most of its length. Pallid sturgeon in the lower Platte River use areas associated with the downstream ends of sandbars and in deeper channels along the edge of sandbars (Peters and Parham, 2008; Swigle, 2003).

Between 2001 and 2004, pallid sturgeon in the Platte River were caught in sampling gear as early as April 2 and as late as September 25. From this group, individuals

implanted with radios all exited the Platte River by June 9 (Peters and Parham, 2008; Swigle, 2003). Of 25 hatchery-reared pallid sturgeon juveniles implanted and released in the Platte River during April 1998 and April 1999, six individuals either remained in the Platte throughout the year or returned to the Platte from the Missouri River the spring following their release (Snook, 2001, as cited in Peters and Parham, 2008).

Pallid sturgeon have been found to use the deepest water available in the Platte River, using depths ranging from 0.33 to 1.27 meters, with average column velocities in the range of 0.52 to 0.82 meters per second (Peters and Parham, 2008). Many studies have noted the preponderance of use of sand substrate by pallid sturgeon. In the Platte River, average percentages of sand, silt, and gravel at pallid sturgeon telemetry contacts were 99.9 percent, 0.4 percent, and 0 percent, respectively (Peters and Parham, 2008).

4. PROJECT NEXUS

"Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied;" 18 CFR §5.11(d)(4)

A portion of the flow and sediment in the Loup River is diverted to the Loup Power Canal. The remaining portion of the flow and sediment continues down the Loup River bypass reach. The majority of the total sediment diverted settles out in the Settling Basin. A lesser quantity of finer sediments settles out in the canal segments and regulating reservoirs. The balance of sediment remains in suspension and is conveyed through the Project to the lower Platte River. Project operations have reduced the amount of sediment in the Platte River downstream of the Tailrace Canal. Sediment is dredged from the Settling Basin to the North and South Sand Management Areas. The majority of sediment dredged to the South Management Area eventually returns to the Loup River bypass reach. The majority of sediment dredged to the North Sand Management Area is permanently removed from the river system. Sediment removal during Project operations may affect characteristics of the Loup River bypass reach and the Platte River downstream of the Tailrace Canal.

5. STUDY AREA AND STUDY SITES

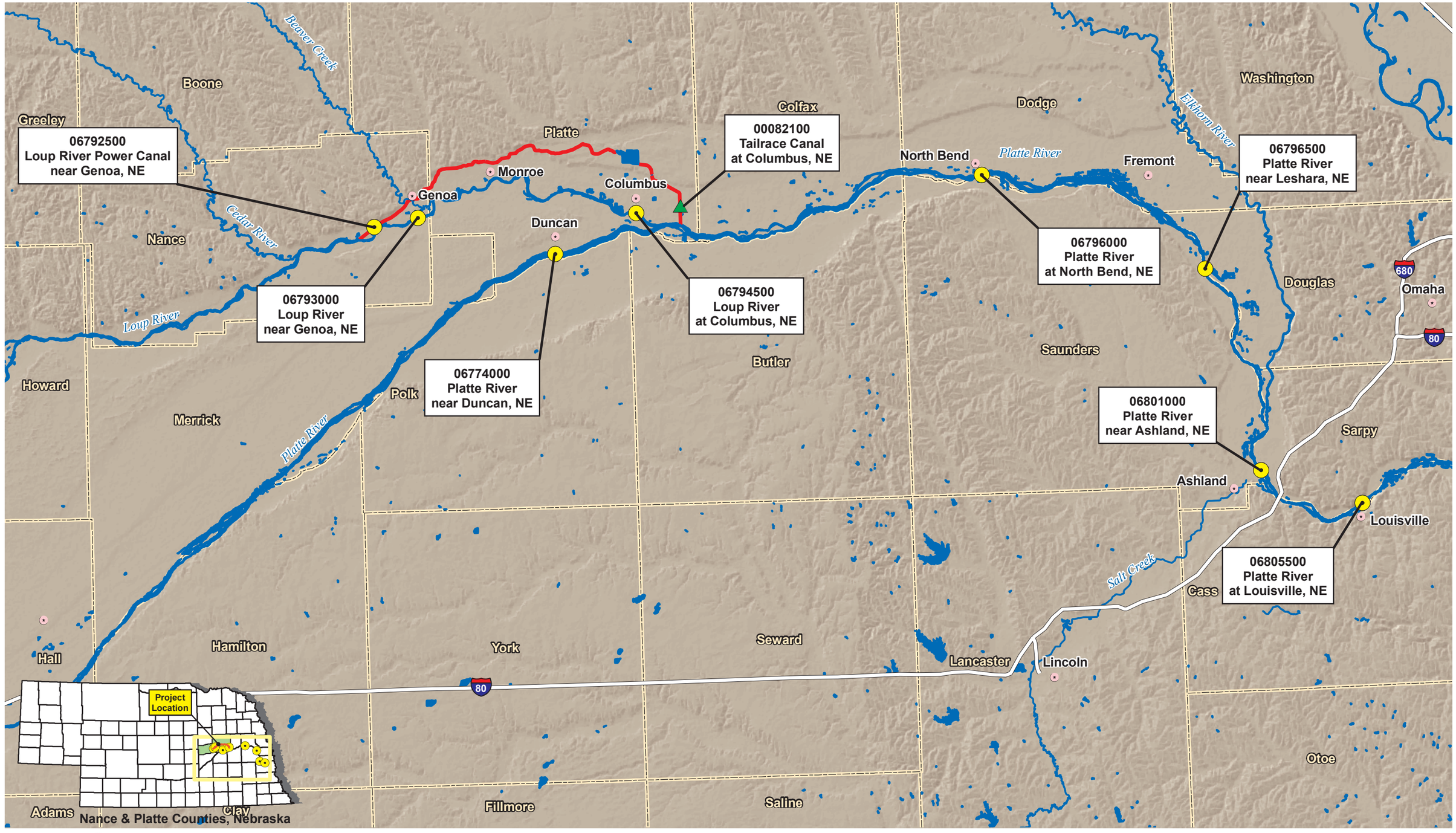
The proposed study area includes the Loup River bypass reach and the lower Platte River from the confluence with the Loup River to the USGS gage at Louisville.

Figure 1-1 shows the extent of the study area and the study sites. The study sites will be those gages listed in Section 3.2, Flow and Gage Data, as well as a point upstream of the Diversion Weir. River flow at the Diversion Weir will be synthesized by using USGS Gage 06793000 on the Loup River near Genoa and USGS Gage 06792500 on the Loup Power Canal near Genoa. Conveyance losses between the gages and the point upstream of the Diversion Weir will be determined and applied appropriately.

At the April 11 and May 27-28, 2009, Study Plan Meetings, USFWS requested that the study area for all studies related to the pallid sturgeon be extended to include the Platte River from the Elkhorn River confluence to the Loup River confluence (thereby extending the reach for analysis to include the reach upstream of the Elkhorn River). This request was based on the capture of a single pallid sturgeon upstream of the Elkhorn River confluence, near Leshara, Nebraska, by researchers from the University of Nebraska-Lincoln on March 31, 2009. The District is not proposing to extend the study area for the following reasons:

- The accepted reach of the pallid sturgeon is the Platte River from the confluence of the Elkhorn River to the confluence with the Missouri River, as documented in the Pallid Sturgeon Recovery Plan (USFWS, 1993) and the National Research Council of the National Academies publication *Endangered and Threatened Species of the Platte River* (National Research Council, 2005).
- This reach is validated by a 2001 to 2004 research/sampling effort conducted by Peters and Parham (2008) that included the lower Platte River from the confluence with the Loup River to the confluence with the Missouri River. The sampling resulted in the capture of 15 pallid sturgeon from the lower Platte River below the Elkhorn River confluence (Peters and Parham, 2008). The study failed to capture any pallid sturgeon above the Elkhorn River confluence.

Until the March 31, 2009, capture at Leshara, there had never been a documented occurrence of pallid sturgeon in the lower Platte River above the Elkhorn River confluence. Although this capture represents an interesting scientific finding, the single and isolated nature of this occurrence does not represent a dataset sufficient to expand the currently accepted reach of the pallid sturgeon reach in the lower Platte River.



Loup Power District Hydro Project

Sedimentation Study Area

Loup River Hydroelectric Project
FERC Project No. 1256
Proposed Study Plan

DATE
July 2009

FIGURE
1-1

Z:\Projects\Loup_Power_District\37104_LPD_FERC_Relicensing\map_docs\mxd\PAD_Figures\Sedimentation_Study_Area_Fig_1_1.mxd\july09\jcm

6. PROPOSED METHODOLOGY

"A detailed description of the study and the methodology to be used;" 18 CFR §5.11(b)(1)

"Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers any known tribal interests;" 18 CFR §5.11(d)(5)

The methodology for the sedimentation study includes six tasks designed to meet the four objectives presented in Section 1, Goals and Objectives of Study. These objectives are repeated below, and the tasks that will be conducted to meet each objective follow. Task 1, Data Collection and Evaluation, is required prior to initiation of the other tasks and is not associated with one specific objective.

Task 1 Data Collection and Evaluation

Sedimentation studies relevant to this study will be researched. USGS flow, stage, and rating curve data will be collected. Cross sectional streamflow measurements performed by USGS to create the rating curves will be obtained and reviewed. One new cross section will be surveyed at a point upstream of the Diversion Weir. While it is true that the USGS streamflow measurements only provide waterway dimensions below the water surface, the information is valuable to this assessment. District sediment (dredging and stockpiling) records will also be analyzed. Interior least tern and piping plover population, nesting, and habitat information will be obtained from NGPC (for the lower Platte River) and from USACE (for the Missouri River below Gavins Point Dam).

Objective 1: To characterize sediment transport in the Loup River bypass reach and in the lower Platte River through effective discharge calculations.

Objective 2: To characterize stream morphology in the Loup River bypass reach and in the lower Platte River by reviewing existing data and literature on channel aggradation/degradation and cross sectional changes over time.

Task 2 Sediment Budget

An updated sediment budget will be determined based on the sediment budget and sediment yield analysis completed by the Missouri River Basin Commission in September 1975. In that report, the Platte River Basin was divided into subwatersheds, one of which was the Loup River Basin. Annual sediment yields for each subwatershed were calculated by determining the sediment production from all

erosion processes (sheet and rill, gully, and streambank). The sediment yield analysis was then used to create an annual sediment supply available to the river system.

Since 1975, various studies have provided updated sediment yield estimates on the sediment budget completed by the Missouri River Basin Commission. Information from these studies will be used to revise the sediment budget as appropriate. Updated information includes the sediment transported upstream of the Loup River confluence at Duncan (U.S. Department of the Interior, Bureau of Reclamation, August 2004) and District dredge records, which are recorded and summarized annually.

The results of the sediment budget will be compared to the total sediment transport calculation described below to assist in determining whether the reach is "flow limited" or "supply limited" for each flow period or alternative analyzed.

Task 3 Effective Discharges

This methodology follows the procedure described in Hey's "Channel Response and Channel Forming Discharge: Literature Review and Interpretation" (1997). This procedure had previously been successfully applied and related to channel morphology and habitat by USGS in the central Platte River (Karlinger et al., 1983). The median discharge is the discharge associated with the 50 percent exceedance on the flow duration graph while the effective discharge is the flow, or range of flows, that transport(s) the greatest amount of sediment. Two sediment transport indicators, effective discharge and total sediment transported, will be calculated using this method, as described below.

Flow Frequency Curves

Annual and seasonal flow frequency curves will be generated for each gage site listed in Section 5, Study Area and Study Sites, using the daily discharge records, with separate frequency curves for Project operations and alternative conditions. The analysis will be limited to those years for which adequate interior least tern and piping plover population information exists. The flow frequency curve that will be used in this analysis is a plot of the mean daily discharge on the x-axis and flow frequency (number or percent of days a particular ranked and grouped mean daily discharge was exceeded) on the y-axis.

Sediment Discharge Rating Curves

Sediment discharge rating curves will be generated at each study site to coincide with the flow frequency curves for Project operations and alternative conditions. A sediment discharge rating curve shows sediment transport rate (both bed load and suspended load) in units of weight per unit of time versus discharge on a log-log scale. Analyses performed by Leopold and Maddock (1953), Yang and Stall (1974), Hey (1997), and others show a relationship between sediment discharge and water discharge through the use of known values such as channel slope, width, and shear stress.

There are several well-established methods describing this relationship. However, Yang and Stall (1974) showed that for the Middle Loup River, the Unit Stream Power method and the modified Einstein method both adequately predicted sediment discharge. The Unit Stream Power method provides a rating of bed material transport rate versus discharge, which is what is required for effective discharge calculations. The modified Einstein method provides a rating of the total sediment transport rate (wash load plus bed material transport), which is not used in effective discharge calculations. This sedimentation study will use the Unit Stream Power method (Yang and Stall, 1974) to plot bed material transport sediment discharge rating curves. This method employs a relationship between the rate of energy expenditure and rate of sediment transport. Variables used in this method include velocity, slope, sediment particle gradation, and viscosity. The data to support these variables will come from the USGS rating curve surveys and the sediment information sources listed in Section 3.2.

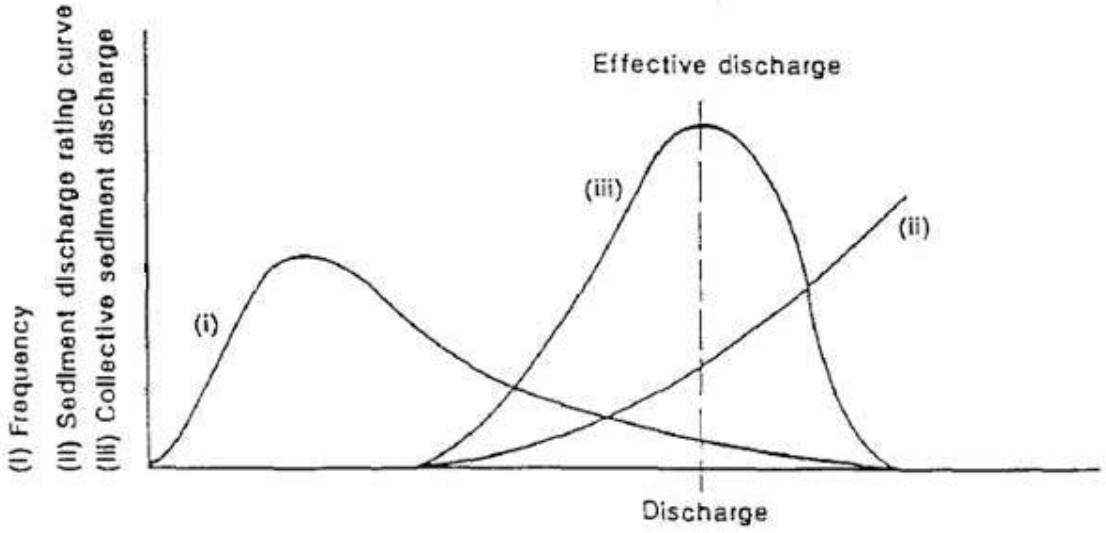
A sensitivity analysis will be performed around the variability of the parameters used in the creation of the sediment discharge rating curves to determine how varying each parameter affects the outcome of the effective discharge calculation.

Effective Discharge and Collective Sediment Discharge

Effective discharge is defined as the flow that transports the bulk of the sediment in a channel. It is found by developing a collective sediment discharge curve. A collective sediment discharge curve is developed by combining the flow frequency and sediment discharge rating curves developed in the previous tasks. It can also be developed by combining the daily discharge rates and the sediment discharge rating curve and then grouping the amount of sediment transported into equal increments of grouped discharges. The flow corresponding to the peak of the collective sediment discharge curve is the effective discharge. The area under the collective discharge curve is the total sediment transported during the period of analysis. The collective discharge curve can be developed on a daily, monthly, seasonal, or annual basis or for the entire period of record, if needed.

Exhibit 1-3 illustrates the concept of using the flow and sediment rating curves to create the collective sediment discharge curve.

Exhibit 1-3. Effective discharge determination from typical sediment rating and flow duration curves. (Hey, 1997)



Effective discharge and total sediment transported will be determined for each study site for Project operations and alternative conditions on an annual and possibly seasonal basis. Effective discharge and total sediment transport will be determined for each study site affected by hydrocycling on a sub-daily basis for a select number of days. The period examined will correspond with those years for which adequate interior least tern and piping plover population information exists. This time period will include years with higher than average flows (wet years) and years with lower than average flows (drought years). The two calculated sediment transport indicators, effective discharge and total sediment transported, will be calculated for current and alternative conditions, and will be compared both spatially and temporally.

Objective 2: To characterize stream morphology in the Loup River bypass reach and in the lower Platte River by reviewing existing data and literature on channel aggradation/degradation and cross sectional changes over time.

Task 4 Stream Channel Morphology

Stream morphology information measured and reported by USGS will be reviewed and evaluated. If the literature review indicates that the morphology of the Loup and lower Platte rivers is not transitioning to another form, evidenced by documented aggradation, degradation, or other factors, it will be concluded that the rivers are currently in dynamic equilibrium. If the literature review indicates that the Loup and lower Platte rivers are transitioning to another form, it will be concluded that the

rivers are currently not in dynamic equilibrium. By definition, a braided river has a surplus of sediment supplies that exceeds its ability to transport the sediment, and as a result could be (and generally is) gradually aggrading (the Platte has been called the "backbone of Nebraska"), yet the river would be morphologically in dynamic equilibrium because it is maintaining its braided morphology. The conclusion that the river is not in dynamic equilibrium would occur only if the river's sedimentation processes have arrived at a threshold of change to a different morphology. Proximity to these thresholds can be assessed using qualitative and quantitative geomorphologic relationships.

The capacity of the flows for total bed material sediment transport will be compared to the sediment budget. If the capacity for total bed material sediment transport for a given time period is essentially equal to or less than the sediment yield, it will be concluded that the braided river is currently in dynamic equilibrium. If the capacity for total bed material sediment transport for a given time period is greater than the sediment yield, the braided river may be supply limited and degrading, and project operations relative to sediment removal could be impacting morphology. As noted above, the resolution of the severity of any impacts is dependent on proximity to thresholds of morphologic change.

In addition, the channel morphology associated with the effective discharges will be calculated according to the methodology described in Leopold and Maddock (1953) and Karlinger et al. (1983). Leopold and Maddock developed general stream morphology relationships between effective discharge and channel characteristics, and Karlinger et al. (1983) calibrated and applied Parker's regime equations (similar to Leopold and Maddock's) to the central Platte River. Channel characteristics include channel cross sectional area changes, width changes, channel aggradation/degradation changes, and the rate at which these changes, if any, occur over time.

If there is no substantive change or trend in channel morphologic characteristics based on effective discharge between time periods analyzed, then it will be concluded that the river is currently in dynamic equilibrium. If there is a substantive change or trend in channel morphologic characteristics based on effective discharge between time periods analyzed, then it will be concluded that the river may currently be either aggrading or degrading. Then threshold analysis will be used to determine if destabilization of the dynamic equilibrium has occurred.

Based on the results of Tasks 3 and 4, the current condition of the Loup River bypass reach and the lower Platte River will be characterized as in dynamic equilibrium or transitioning to another morphology.

The analyses in Tasks 3 and 4 will be performed for alternative conditions. The results of the alternative analysis will be compared to the results from the current conditions analysis.

If the current condition analysis indicates the Loup River Bypass Reach and lower Platte River are either in dynamic equilibrium or flow limited based on the total sediment transport capacity calculations, then no alternatives relative to sediment removal will be evaluated. However, if it is determined that either river is sediment supply limited, then alternatives will be evaluated to determine if a change in operations will beneficially affect the braided river dynamic equilibrium.

The effective discharge and associated channel morphologic characteristics will be computed for alternative conditions and compared to the current conditions. If the results show that the alternative does not change the state of the Loup River bypass reach and/or lower Platte River (i.e., remain in dynamic equilibrium), then it will be concluded that the alternative provides no benefit to channel morphology. Or, if the river is determined to be currently in dynamic equilibrium and the alternative analyses show the river to be crossing a morphologic threshold, then it will be concluded that the Project operations alternative adversely affects channel morphology. If the results show that the Loup River bypass reach and lower Platte River are currently at a morphologic threshold impacting the dynamic equilibrium, and the alternative analysis shows the river to move away from the threshold and toward dynamic equilibrium, then it will be concluded that the Project operations alternative beneficially affect channel morphology.

Objective 3: To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts (as provided by NGPC) and productivity measures.

Task 5 Interior Least Tern and Piping Plover Nesting and Sediment Transport Parameters

Initially, this task will review the sediment transport data developed during Task 3 to determine if the Project is affecting morphology in the lower Platte River. If it is determined that the Project does not affect morphology in this reach, or that the system is in dynamic equilibrium, it will be inferred that the Project does not affect interior least tern and piping plover sandbar nesting habitat parameters related to sediment transport and morphology and that no further analysis is warranted.

If the analysis shows that the Project is affecting morphology, the magnitude of Project effects will be determined using effective discharge calculations and aggradation/degradation or other morphologic change analysis, as detailed in Task 4. Additionally, available interior least tern and piping plover annual nesting count data and productivity data (number of fledglings per adult pair) will be plotted against the two sediment transport indicators calculated in Task 3, including evaluation of wet and dry cycles.

The appropriate use of species data was discussed with NGPC. Based on the amount of available data for analysis, the adult population counts were determined to be the

largest data set. However, this number may not accurately reflect the success of an area of habitat for nesting and breeding. Reproductive success, in the form of fledge ratio,[3] is a standard metric to use to quantify interior least tern and piping plover reproduction and to estimate the success of a particular habitat for sustaining and/or growing a population, but there is a very limited amount of this data from only a few years and there are several problems with using this data as it purely based on observations and not on more rigorous methods such as mark–recapture statistical analysis.

Because there is an unknown amount of error in all of the fledge ratio data provided and based on recommendations from NGPC and the Tern and Plover Conservation Partnership, it was determined that nest counts may be the best available data to use for a regression analysis to determine if there is a relationship between sediment transport parameters and interior least tern and piping plover habitat use because there is a sufficient amount of data available (see Attachment A) and it is fairly representative of successful habitat use.

A regression analysis will be performed and trends examined to determine if a relationship can be detected between the sediment transport indicators and bird nesting or productivity. If no relationship can be detected through this analysis, the conclusion will be made that the sediment transport indicators have no relationship with interior least tern and piping plover reproductive success and thus that Project operations related to sediment transport indicators also have no effect.

If a relationship is found, the degree to which Project operations affect the determining parameter will be reviewed. Potential mitigation measures will be developed in coordination with the agencies.

If the relationship of nesting to sediment transport indicator analysis is inconclusive, the potential relationship between other factors and interior least tern and piping plover nesting will be evaluated. This evaluation will include comparison to other rivers where interior least tern and piping plover nesting is known to occur.

Objective 4: To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn River.

Task 6 Pallid Sturgeon Habitat

Initially, this task will review the sediment transport data and effective discharge information developed during Task 3 to determine if the Project is affecting

[3] The reproductive success of the birds in a given year is often described in terms of fledge ratio, defined as the number of young that survive to fledging age (the age when they can fly) per adult pair. This is calculated by dividing the total number of fledglings by the total number of adult pairs surveyed for a certain area that year.

morphology in the lower Platte River below the Elkhorn River confluence. If it is determined that the Project does not affect morphology in this reach, or that the system is in dynamic equilibrium, it will be inferred that the Project does not affect pallid sturgeon habitat parameters related to sediment transport and that no further analysis is warranted.

If the analysis shows that the Project is affecting morphology, the magnitude of Project effects will be determined using effective discharge calculations and aggradation/degradation and other morphologic change analysis, as detailed in Task 4. Additionally, the existing condition, with regard to sediment transport and braided river morphology in the lower Platte River downstream of the Elkhorn River confluence, would be compared to habitat characteristics of other rivers used by the pallid sturgeon to determine if changes in Project operations relative to sediment transport could affect pallid sturgeon use of the lower Platte River.

Specifically, information on pallid sturgeon use and corresponding habitat characteristics (flow, sediment transport, and morphology) exists for the upper Missouri River and the Yellowstone River. This information will used to perform a qualitative assessment of habitat characteristics. These habitat characteristics will be compared to those of the lower Platte River below the Elkhorn River confluence. The intent is to determine if there is a differentiating factor between the upper Missouri River and the Yellowstone River habitats and the characteristics of the lower Platte River below the Elkhorn River confluence. If a differentiating factor is braided river morphology, then Project effects on this morphology will be reviewed in context with the results of Task 3, Effective Discharge, and Task 4, Stream Channel Morphology, to determine if a change in Project operations could materially affect braided river morphology in the lower Platte River below the Elkhorn River confluence.

7. CONSULTATION WITH AGENCIES, TRIBES, AND OTHER STAKEHOLDERS

This study plan has been developed based on discussions with agencies prior to submittal of the PAD and during multiple study plan meetings that followed the submittal of the Proposed Study Plan.

The District presented an overview of the goals, objectives, and activities associated with Study 1.0, Sedimentation, at the Study Plan Meeting held on April 21, 2009. Additionally, the goals and objectives of the aquatic resources studies, including Study 1.0, were discussed in detail. The meeting was attended by representatives of FERC, NGPC, NDEQ, USFWS, and National Park Service, as well as others. During this meeting, minor comments related to the wording of the study objectives as well as differentiating study objectives versus study activities were received and are incorporated as a result of this meeting.

The District conducted an additional Study Plan Meeting on May 27-28, 2009, to discuss in more depth the specific activities associated with aquatic resources studies, including Study 1.0, Sedimentation. Most of the attendees at the April 21, 2009,

meeting (listed above) also attended this meeting. Discussion specific to this sedimentation study ultimately resulted in the following revisions to the study plan:

- Activities related to sediment transport indicators were clarified to indicate that they will be evaluated for sub-daily and wet and dry weather cycles.
- Evaluation of the relationship between sediment transport parameters and interior least tern and piping plover nesting will include evaluation of productivity measures (to the extent available data allows).
- Objective 5 as presented in the PSP has been eliminated from the RSP.
- Objective 7 as presented in the PSP has been removed from Study 1.0, Sedimentation, and incorporated into Study 12.0, Ice Jam Flooding on the Loup River, in the RSP.

The discussions from both meetings were documented in meeting transcripts, which are available on the District's relicensing website (http://www.loup.com/relicense/html/agencymeetingsresources.html).

USFWS provided comments related to Study 1.0, Sedimentation, in its February 9, 2009, and June 24, 2009, comment letters. The District's responses to these comments are included in Attachments B and C, respectively.

8. WORK PRODUCTS

"Provisions for periodic progress reports, including the manner and extent to which information will be shared; and sufficient time for technical review of the analysis and results;" 18 CFR §5.11(b)(3)

The intended work product for the sedimentation study is a study report. The study report will document the sediment regime in the Loup River bypass reach and the Platte River downstream of the Tailrace Canal. Along with the study report, a database of the data gathered and used in the analysis will be available.

Updates regarding the sedimentation study will be included in the study progress reports to be submitted to FERC in December 2009, March 2010, and June 2010.

9. LEVEL OF EFFORT AND COST

"Describe considerations of level of effort and cost, as applicable." 18 CFR §5.11(d)(6)

It is estimated that the sedimentation study will cost approximately $330,000. This work will be completed by qualified water resources engineers and biologists.

10. SCHEDULE

"A schedule for conducting the study;" 18 CFR §5.11(b)(2)

"The potential applicant's proposed study plan must also include provisions for the initial and updated study reports and meetings provided for in §5.15." 18 CFR §5.11(c)

The sedimentation study is scheduled to begin in the fourth quarter of 2009, and the Sedimentation study report will be available in the third quarter of 2010. In addition, the District will prepare a consolidated Initial Study Report for Studies 1.0 through 12.0 that describes progress and results (as appropriate) for each study. In accordance with the District's Process Plan and Schedule, the Initial Study Report will be available in August 2010, and a study meeting will be held within 15 days, per 18 CFR §5.15(c)(2). An Updated Study Report will be available in August 2011 to provide information on progress and results for second season studies (as needed).

11. REFERENCES

67 FR 57637-57717. September 11, 2002. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Great Plains Breeding Population of the Piping Plover; Final Rule. Department of the Interior, Fish and Wildlife Service.

16 USC 661 et seq. Fish and Wildlife Coordination Act, as amended.

16 USC 668a-d. Bald and Golden Eagle Protection Act, as amended.

16 USC 703-712. Migratory Bird Treaty Act, as amended.

16 USC 1531-1544. Endangered Species Act of 1973, as amended.

42 USC 4321-4347. National Environmental Policy Act of 1969, as amended.

Bliss, Q.P., and S. Schainost. 1973. Middle Platte basin stream survey report. Prepared for the Nebraska Game and Parks Commission, Lincoln, Nebraska.

Blodgett, R.H., and K.O. Stanley. 1980. "Stratification, Bedforms, and Discharge Relations of the Platte Braided River System, Nebraska." *Journal of Sedimentary Research*. 50(1):139-148.

Brown, M.B., and J.G. Jorgensen. 2008. 2008 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report for the Lower Platte River, Nebraska. Joint Report of the Tern and Plover Conservation Partnership and the Nebraska Game and Parks Commission.

Brown, Mary Bomberger, and Joel Jorgensen. September 5, 2008. Letter from Joel Jorgensen, Nongame Bird Program Manager, NGPC, and Mary Bomberger Brown, Program Coordinator, Tern and Plover Conservation Partnership, to

Lisa Richardson, HDR, regarding information on interior least terns and piping plovers.

Brown, M.B., J.G. Jorgensen, and S.E. Rehme. 2008. Endangered species responses to natural habitat declines: Nebraska's interior least terns (*Sternula antillarum athalassos*) and piping plovers (*Charadrius melodus*) nesting in a human-created habitat. The Nebraska Bird Review. 76(2):72-81.

Chen, Abraham H., David L. Rus, and C.P. Stanton. 1999. "Trends in Channel Gradation in Nebraska Streams, 1913-95." U.S. Geological Survey Water-Resources Investigations Report 99-4103. Lincoln, Nebraska.

Donofrio, C.J. 1982. "An Examination of the Bedforms and Flow Phenomena of the North Loup River, Nebraska, A Braided Stream." Lincoln, University of Nebraska, 16th annual meeting, North-Central Section, Geological Society of America, v. 14, no. 5, p. 259.

Ducey, J. 1985. The historic breeding distribution of the least tern in Nebraska. Nebraska Bird Review. 54(4): 72-73.

Ducey, J. 2000. Birds of the untamed west: the history of birdlife in Nebraska, 1750 to 1875. Making History, Omaha, Nebraska.

Elliot-Smith, Elise. February 17, 2009. Personal communication with Elise Elliot-Smith, International Piping Plover Census, and Melissa Marinovich, Environmental Scientist, HDR.

Ginting, Daniel, and Ronald B. Zelt. 2008. "Temporal Differences in Flow Depth and Velocity Distributions and Hydraulic Microhabitats Near Bridges of the Lower Platte River, Nebraska, 1934-2006." USGS Scientific Investigations Report 2008-5054. Available online at http://pubs.usgs.gov/sir/2008/5054/pdf/sir2008-5054.pdf.

Ginting, Daniel, Ronald B. Zelt, and Joshua I. Linard. 2008. "Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895-2006." USGS Scientific Investigations Report 2007-5267. Available online at http://pubs.usgs.gov/sir/2007/5267/.

Heinemann, L.D. 1944. Nesting of the piping plover and least tern. Nebraska Bird Review. 12:9-10.

Hey, R.D. 1997. "Channel Response and Channel Forming Discharge: Literature Review and Interpretation." First Interim Report for U.S. Army, Contract Number R&D 6871-EN-01.

Jenniges, J.J., and R.G. Plettner. 2008. Least tern nesting at human created habitats in central Nebraska. Waterbirds. 31(2):274-282.

Joeckel, R.M., and G.M. Henebry. 2008. "Channel and Island Change in the Lower Platte River, Eastern Nebraska, USA: 1855-2005." *Geomorphology*. 102(3-4): 407-418.

Jorgensen, J.G. 2007. Lower Platte River least tern and piping plover nesting survey. Nebraska W-15-R report. Nebraska Game and Parks Commission, Lincoln, Nebraska.

Karlinger, M.R., T.R. Eschner, R.F. Hadley, and J.E. Kircher. 1983. "Relation of Channel-Width Maintenance to Sediment Transport and River Morphology: Platte River, South-Central Nebraska." USGS Professional Paper 1277-E.

Kirsch, E.M. 1996. Habitat selection and productivity of least terns on the lower Platte River, Nebraska. Wildlife Monograph no. 132.

Leopold, Luna B., and Thomas Maddock, Jr. 1953. "The Hydraulic Geometry of Stream Channels and Some Physiographic Implications." USGS Professional Paper 252.

Lingle, G.R. 1993. Causes of nest failure and mortality of least terns and piping plovers along the central Platte River. *In* Proceedings, the Missouri River and its tributaries: piping plover and least tern symposium. South Dakota State University, Brookings, South Dakota.

Lott, C.A. 2006. Distribution and abundance of the interior population of the least tern (Sternula antillarum), 2005. U.S. Army Corps of Engineers. ERDC/EL TR-06-13.

Marlette, Ralph R., and Richard H. Walker. 1968. "Dominant Discharges at the Platte-Missouri Confluence." *Journal of the Waterways and Harbors Division*. 94(1):23-32.

Mayhew, Susan. 2004. *A Dictionary of Geography*. New York: Oxford University Press.

Missouri River Basin Commission. 1972. "Platte River Basin Sediment Budget."

Missouri River Basin Commission. September 1975. "Platte River Basin—Nebraska, Level B Study, Land Conservation and Sedimentation." Technical Paper.

National Park Service. June 30, 2009. Personal communication between Stephen K. Wilson, Resource Management/GIS Specialist, Missouri National Recreational River, National Park Service, and Melissa Marinovich, Environmental Scientist, HDR.

National Research Council. 2005. *Endangered and Threatened Species of the Platte River*. Washington, D.C.: The National Academies Press.

NGPC. December 2008. Assessment of the Pallid Sturgeon, Least Tern, and Piping Plover in the Lower Platte River. Nebraska Game and Parks Commission Report, Lincoln, Nebraska.

NGPC. 2009. Data provided under the "Nebraska Game and Parks Commission Nongame Bird Program Data Use Agreement" between NGPC and HDR, signed on June 24, 2009.

NGPC. February 23, 2009. 2008 Loup River Sandpit Survey Report. Presentation given by Ben Wheeler, NGPC, at the 2009 Nebraska Least Tern and Piping Plover Meeting, Lincoln, NE.

Parham, James E. 2007. "Hydrologic Analysis of the Lower Platte River from 1954-2004, with special emphasis on habitats of the Endangered Least Tern, Piping Plover, and Pallid Sturgeon." Nebraska Game and Parks Commission.

Peters, Edward J., and James E. Parham. 2008. "Ecology and Management of Sturgeon in the Lower Platte River, Nebraska." Nebraska Technical Series No. 18. Nebraska Game and Parks Commission. Lincoln, Nebraska.

Rus, David L., Benjamin J. Dietsch, and Andrew Simon. 2003. "Streambed Adjustment and Channel Widening in Eastern Nebraska." U.S. Geological Survey Water-Resources Investigations Report 03-4003. Lincoln, Nebraska. Available online at http://pubs.usgs.gov/wri/wri034003/(508)Rus.pdf.

Schneider, Rick, Mark Humpert, Kristal Stoner, and Gerry Steinauer. 2005. *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*. Nebraska Game and Parks Commission, Lincoln, Nebraska. Available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp.

Sharpe, R.S., W.R. Silcock, J.G. Jorgensen. 2001. The birds of Nebraska: Their distribution and temporal occurrence. University of Nebraska Press, Lincoln.

Sidle, J.G. 1992. Flooding, Mortality, and Habitat Renewal for Least Terns and Piping Plovers. *Colonial Waterbirds*. 15(1):132-136.

Sidle, J.G. 1993. Least tern and piping plover use of sand and gravel pits along the Platte and Loup rivers, Nebraska. *In* Proceedings, the Missouri River and its tributaries: piping plover and least tern symposium. South Dakota State University, Brookings, South Dakota.

Sidle, John G., and Eileen M. Kirsch. 1993. "Least Tern and Piping Plover Nesting at Sand Pits in Nebraska." *Colonial Waterbirds*. 16(2):139-148.

Smith, Norman D. October 1970. "The Braided Stream Depositional Environment: Comparison of the Platte River with Some Silurian Clastic Rocks, North-Central Appalachians." *Technological Society of America Bulletin.*

Smith, Norman D. December 1971. "Transverse Bars and Braiding in the Lower Platte River, Nebraska." *Technological Society of America Bulletin*.

Swigle, B.D. 2003. Movements and Habitat Use by Shovelnose and Pallid Sturgeon in the Lower Platte River, Nebraska. M.S. Thesis, University of Nebraska, Lincoln.

Tern and Plover Conservation Partnership. July 30, 2008. Personal communication between Mary Bomberger Brown, Program Coordinator, Tern and Plover Conservation Partnership, and Melissa Marinovich, Environmental Scientist, HDR.

U.S. Department of the Interior, Bureau of Reclamation. August 2000. "Physical History of the Platte River in Nebraska."

U.S. Department of the Interior, Bureau of Reclamation. September 2002. Proposed Title Transfer, Middle Loup Division Nebraska, Final Environmental Assessment. Available online at http://www.usbr.gov/gp/nepa/middle_loup_ea/contents.htm.

U.S. Department of the Interior, Bureau of Reclamation. April 2004. "The Platte River Channel: History and Restoration." Technical Service Center, Denver, Colorado.

U.S. District Court for the District of Nebraska. October 13, 2005. Nebraska Habitat Conservation Coalition (P) v. U.S. Fish and Wildlife Service (D). Case: 4:03-cv-03059-LES-DLP. Document #: 53. Date Filed: 10/13/05.

USACE. March 30, 2009. Personal communication between Gregory Pavelka, Biologist, USACE, and Melissa Marinovich, Environmental Scientist, HDR.

USFWS. September 1990. "Recovery Plan for the Interior Population of the Least Tern (*Sterna antillarum*)." Twin Cites, MN: U.S. Fish and Wildlife Service.

USFWS. 1993. "Pallid Sturgeon (*Scaphirhynchus albus*) Recovery Plan." Bismarck, ND: U.S. Fish and Wildlife Service.

USFWS. November 30, 2000. Biological Opinion on the operation of the Missouri River main stem reservoir system, operation and maintenance of the Missouri River bank stabilization and navigation project and operation of the Kansas River reservoir system. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

USFWS. June 16, 2006. Biological Opinion on the Platte River Recovery Implementation Program. U.S. Fish and Wildlife Service, Grand Island, Nebraska.

USGS. 1983, "Hydrologic and Geomorphic Studies of the Platte River Basin." Professional Paper 1277.

Wilson, E.C., W.A. Hubert, and S.H. Anderson. 1993. Nesting and foraging of least terns on sand pits in central Nebraska. *The Southwestern Naturalist*. 38(1):9-14.

Yang, Chih Ted, and John B. Stall. July 1974. "Unit Stream Power for Sediment Transport in Natural Rivers." Final Report. University of Illinois Water Resources Center.

Yang, Chih Ted, and John B. Stall. May 1976. "Applicability of Unit Stream Power Equation." *Journal of the Hydraulics Division*. ASCE. 102:5.

Ziewitz, J.W., J.G. Sidle, and J.J. Dinan. 1992. "Habitat Conservation for Nesting Least Terns and Piping Plovers on the Platte River, Nebraska." *Prairie Naturalist*. 24(1):1-20.

Attachment A – Available Interior Least Tern and Piping Plover Data

Table 1. Available Interior Least Tern and Piping Plover Data on the Lower Platte River[1,2]

Year	Interior Least Tern Data								Piping Plover Data							
	Adult Count[3]		Nest Count[4]		Fledge Count[5]		Fledge Ratio[6]		Adult Count[3]		Nest Count[4]		Fledge Count[5]		Fledge Ratio[6]	
	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]	Sandpits[7]	River[8]
1982	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-
1985	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-
1986	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1987	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1988	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1989	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1990	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1991	X	X	-	X	-	X	-	-	X	X	-	X	-	X	-	-
1992	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1993	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1994	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1995	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-
1996	X	X	-	X	-	X	-	-	X	X	-	X	-	X	-	-
1997	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1998	-	X	-	X	-	X	-	-	-	X	-	X	-	X	-	-
1999	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2000	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2001	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2002	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2003	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2004	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2005	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2006	X	X	X	X	X	X	X	-	X	X	X	X	X	X	-	-
2007	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-
2008	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Sources: Brown, M.B., and J.G. Jorgensen, 2008, 2008 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report for the Lower Platte River, Nebraska, Joint Report of the Tern and Plover Conservation Partnership and the Nebraska Game and Parks Commission.
Dinan, John J., 2001, 2001 Piping Plover and Least Tern Census – Nebraska, Nebraska Game and Parks Commission.
Jorgensen, J.G., 2007, Lower Platte River least tern and piping plover nesting survey, Nebraska W-15-R report, Nebraska Game and Parks Commission, Lincoln, Nebraska.
NGPC Non-Game Bird Program Tern and Plover Database, 2009, unpublished data provided by NGPC, received on September 11, 2008; June 19, 2009; and July 16, 2009.

Notes:
1 The lower Platte River, for the purpose of these studies, is defined as the confluence with the Loup River to the confluence with the Missouri River.
2 An "X" indicates that there were numbers available for multiple day counts but they were not summarized. A "-" indicates that there were no numbers provided for this year and habitat type.
3 Adult count is defined as the highest number of adults counted on a single survey day at a site during the annual summer census. These numbers include individual birds with no known attachment to a nest (floaters) seen on- or off-river.
4 Nest count is defined as the total number of nests observed throughout the season.
5 Fledge count is defined as the total number of fledglings (chicks that survive to fledging age [capable of flight]) observed throughout the season.
6 Fledge ratio is determined by dividing the total number of fledglings by the total number of nests.
7 Sandpits are defined as either sand and gravel mine spoil piles or housing development sand bottom lakes.
8 River sites are defined as located within the established banks of the river. These were identified either by boat or aerial surveys.

Attachment B – Response to USFWS February 9, 2009, Study Requests

STUDY 1.0 SEDIMENTATION
RESPONSE TO USFWS FEBRUARY 9, 2009, STUDY REQUESTS

Based on the discussion to follow, the District proposes that certain additional studies or study modifications recommended by USFWS are not reasonable; and/or can be accomplished by alternative means; and/or are inconsistent with generally accepted practice in the field. They were therefore not included in the District's study plan.

USFWS STUDY REQUESTS

In response to the District's Pre-Application Document (PAD) (Loup Power District, October 16, 2008) and FERC Scoping Document 1 (FERC, December 12, 2008), USFWS issued comments on these documents on February 9, 2009.

On pages 6 and 7 of its comment letter, USFWS recommends that the District and FERC perform the following studies or study components in association with the relicensing process:

- "…that the sediment yield analysis be aligned with the life requisites of the pallid sturgeon, least tern, and piping plover. For example, sandbars must not only be viable at the time of nesting for the least tern and piping plover, but must also be viable for up to 10 weeks following."
- "…conduct a study of the Loup River Bypass reach and the lower Platte River to ascertain if the size of sandbar habitats for the least tern and piping plover fits the predictions made by Williams and Wolman (1984) and Parker and Wilcock (1993) on the downstream affects of dams on alluvial rivers."
- "Brown and Jorgensen (2008) showed that the maximum elevation of sandbars on the lower Platte River increased in the downstream direction between North Bend, Nebraska and the Missouri River confluence. Brown and Jorgensen (2008) showed that the large floods of 2008 built bars adequate for least tern and piping plover nesting, but the bars in the upstream end were near the threshold of inundation from daily hydropeaking. In addition, the data also showed that the bar elevation did not change substantially downstream of the Elkhorn River, the largest tributary between the tailrace and the Missouri River. These data indicate that a significant sediment deficit may exist between the tailrace and the Elkhorn River. We suspect that deficit may be more substantial in years when peak floods on the Loup River are lower in magnitude because the Genoa diversion would constitute larger proportions of the total flow in such years. Please incorporate the Brown and Jorgensen study when conducting Study Number 1."

DISTRICT RESPONSE TO STUDY REQUESTS

Request That Sediment Yield Analysis Be Aligned With Life Requisites

It is unclear how USFWS would like the sediment yield analysis revised to align with the (undefined) life requisites of specific listed species. Sediment yield is understood in the literature to be the total quantity of sediment material that is delivered from surrounding watershed lands to a specific waterway location on an annual basis. The value is typically based on empirical relationships among land forms, soil types, and land use.

The District is not proposing to analyze sediment yield; rather, the District intends to use existing published values for sediment yield. The requested analysis was not included in the District's study plan because it is not clearly defined and is not consistent with generally accepted practice in the field.

The effective discharge method proposed by the District and detailed in Study 1.0, Sedimentation, will use stream gage records and sediment rating curves for each study reach to calculate total sediment transport volume for various periods of interest. However, the District knows of no method to predict or determine the viability of particular sandbar nesting habitat 10 weeks into the future.

Request to Ascertain if Size of Sandbar Habitats Fit the Predictions of Williams and Wolman (1984) and Parker and Wilcock (1993)

The District reviewed the referenced publications in detail and determined that neither publication includes a methodology for, or makes any reference to, predicting the sizes of sandbars or sandbar habitats.

Williams and Wolman (1984) is a compendium of measured effects downstream of 21 selected dams constructed on alluvial rivers. It describes changes found in mean channel-bed elevation, channel width, vegetation, bed-material sizes, flow discharges, and sediment loads.

Parker and Wilcock (1993) compare and contrast fundamental differences between two standard modes of operating sediment transport flumes in laboratories. The two operating modes are commonly known as sediment-feed and recirculating. They are used with rectangular laboratory flumes to simulate sediment transport phenomena under various material and hydraulic scenarios.

Therefore, the District's study plan does not include the requested comparative study.

Request to Incorporate the Brown and Jorgensen (2008) Study when Conducting Study 1.0

The District is aware of the Brown and Jorgensen study and will consider it along with other potentially relevant studies when conducting Study 1.0, Sedimentation.

REFERENCES

Brown, M.B., and J.G. Jorgensen. 2008. 2008 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report for the Lower Platte River, Nebraska. Joint Report of the Tern and Plover Conservation Partnership and the Nebraska Game and Parks Commission.

FERC. December 12, 2008. Scoping of Environmental Issues for Relicensing the Loup River Hydroelectric Project. Office of Energy Projects. Washington D.C.

Loup Power District. October 16, 2008. Pre-Application Document. Volume 1. Loup River Hydroelectric Project. FERC Project No. 1256.

Parker, G., and P.R. Wilcock. 1993. "Sediment feed and recirculating flumes: fundamental difference." *Journal of Hydraulic Engineering*. 119:1192-1204.

Williams and Wolman. 1984. "Downstream Effects of Dams on Alluvial Rivers." U.S. Geological Survey Professional Paper 1286.

Attachment C – Response to USFWS June 24, 2009, Study Request

STUDY 1.0 SEDIMENTATION
RESPONSE TO USFWS JUNE 24, 2009, STUDY COMMENTS

INTRODUCTION

In a letter dated June 24, 2009, the U.S. Fish and Wildlife Service (USFWS) provided comments on the District's Proposed Study Plan (PSP) for the Project, as revised at the May 27-28, 2009, Study Plan Meeting. The District identified two general themes in USFWS's comment letter that the District believes merit a general discussion. These are listed below and are discussed in detail in the sections that follow:

- USFWS provided a number of recommendations for changing the District's proposed methodology. The District maintains that these changes are inconsistent with the National Environmental Policy Act of 1969 (NEPA).
- USFWS provided a number of recommendations for including cumulative effects analysis. The District maintains that these recommendations are inconsistent with NEPA guidance and USFWS's Endangered Species Act of 1973 (ESA) procedures.

USFWS Recommended Changes to Proposed Methodology that are Inconsistent with CEQ's NEPA Guidance

Neither NEPA nor the ESA requires a specific methodology to analyze impacts. The standard for both laws is to conduct an analysis that is adequate for the Federal agency's decision. Whatever methodology is used, it must provide an accurate and complete analysis. The Council on Environmental Quality (CEQ) guidance specifically states that the methodology and information used must avoid speculation about potential impacts and be the best information available. The District maintains that its PSP meets both of these criteria.

Specifically, the District proposes to indirectly analyze impacts on threatened and endangered (T&E) species and the aquatic resources of the Loup River bypass reach and the lower Platte River by evaluating geomorphic stability of these reaches. This will be accomplished by determining if Project operations and alternate operating conditions impact this stability. This methodology is based on the fact that habitat is a direct function of geomorphic conditions. This analysis coupled with the hydrocycling analysis will provide FERC with an analysis of Project operations and alternative conditions that is adequate for its decision.

In a number of comments (noted in specific responses provided below), USFWS criticizes the District's proposed methodology based on the fact that it assesses impacts using an indirect measure rather than a direct measure. The District maintains that determining impacts via indirect methods using many years of historical data is the most appropriate method because the District is not proposing any changes to Project operations as part of the license application. Furthermore, the

District notes that the use of historical data provides the ability to evaluate alternatives under identical conditions, eliminating the effects of externalities in methods proposed by USFWS.

USFWS Made Recommendations on Cumulative Effects that are Inconsistent with CEQ's NEPA Guidance and USFWS's ESA Procedures

In its comment letter, USFWS frequently explains that the District's analysis should not be based on current hydrology, but should be based on projected hydrology derived from reasonably foreseeable effects on the hydrograph. The District's main concern with this comment relates to USFWS's position on how this projected hydrology should be determined.

Per CEQ guidance, the standard methodology for evaluating cumulative effects is to use a historic baseline; to add the effects of past, present, and reasonably foreseeable future actions to that baseline; and then to add the incremental impacts of the proposed action to that total.

Alternatively, it is acceptable to use the existing baseline as representing the cumulative effects of past and present actions, then to add the effects of reasonably foreseeable future actions to that, and then to add the incremental effects of the proposed action to that total. The latter of these two approaches is the one the District has proposed to use. None of the accepted methodologies uses USFWS's recommendation of a projected baseline.

Allied with this concern is USFWS's position for determining what constitutes a reasonably foreseeable future action. CEQ's guidance states that the future action must have progressed far enough in its implementation to have some degree of certainty that it will be implemented. These future actions are to have a specific description and some existing evaluation.

Some of the examples that CEQ's guidance provides to make this judgment of certainty include identified or allocated funding, regulatory applications or approvals, and environmental clearance applications or approvals. The intent of CEQ's guidance is to make sure that future actions that are too speculative to have a high degree of certainty that they will be implemented are not included in the cumulative effects analysis.

USFWS's ESA procedures for determining reasonably foreseeable future actions are even more restrictive. The ESA procedures require that only actions that have completed Section 7 consultation be identified as reasonably foreseeable future actions. The stated rationale for this position is that under the ESA, any future action that could have an impact on a listed species must complete Section 7 consultation before it can be implemented. Therefore, any future action that has not completed Section 7 consultation has not met the reasonably foreseeable definition of certainty.

The District is concerned that USFWS's comments may not be consistent with either CEQ's NEPA guidance or its own ESA guidance because of its recommendation to use a baseline based on future conditions. On the surface, this recommendation appears to be inconsistent with CEQ's baseline and reasonably foreseeable future action guidance as well as USFWS's ESA guidance.

Organization of This Document

USFWS organized its comments by study objective and provided specific comments related to the following seven study criteria, as presented in 18 CFR §5.9(b):

(1) Describe the goals and objectives of each study proposal and the information to be obtained;

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study; **(USFWS is a resource agency; therefore, USFWS did not comment on this study criteria.)**

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;

(5) Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate filed [sic] season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge; and

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

This response is also organized by study objective and study criteria. Individual USFWS comments are presented in *italic* font exactly as received. Each comment is followed by the District's response.

USFWS COMMENTS AND DISTRICT RESPONSES

Objective 1: To characterize sediment transport in the Loup River bypass reach and in the lower Platte River through effective discharge calculations.

Study Criteria 1 – Goals and Objectives

USFWS Comment

The Service supports the current Objective 1 as revised in the May 28 and 29 study plan meeting.

District Response

The District appreciates USFWS review and support.

Study Criteria 2 – Relevant Agency Resource Management Goals

USFWS Comment

The Service supports the inclusion of this study because potential Project effects to: a) least tern and piping plover nesting sandbar habitat in the Loup and Platte rivers; b) pallid sturgeon habitat in the Platte River; and c) fish community habitat in the Loup and Platte rivers.

District Response

The District appreciates USFWS review and support.

Study Criteria 4 – Existing Information and Need for Additional Information

USFWS Comment

Recommendations:

a) Develop methods that would directly measure in-stream sediment supply contributions from the Project tailrace.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

Neither the National Environmental Policy Act of 1969 (NEPA) nor the Endangered Species Act of 1973 (ESA) require a specific methodology to analyze impacts. The standard for both laws is to conduct an analysis that is adequate for the Federal agency's decision. The District proposes to analyze impacts on threatened and endangered (T&E) species and the aquatic resources of the Loup River bypass reach and the lower Platte River. This will be accomplished by evaluating geomorphic stability and determining if Project operations and alternate operating conditions

impact this stability. This methodology will provide FERC with an analysis that is adequate for its decision.

Direct measurements of sediment supplies requires extensive spatial and temporal collection programs in order to be meaningful for any future purpose. While a direct measure of in-stream sediment supplies would contribute to the overall body of knowledge of the resources in the lower Platte River, the existing sediment information listed in the literature is sufficient for the proposed methodologies presented to meet the study objective.

USFWS Comment (continued)

b) Sediment supply estimates upstream of the Project diversion should be calibrated based on actual sediment dredged from the settling basin. Sediment supply contributions from small tributaries downstream of the Project diversion (e.g., Beaver Creek, Looking Glass Creek, etc.) should also be calibrated using similar methods.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

As stated in the District's study plan, sediment supply estimates from upstream of the Diversion Weir will in fact be based on actual dredging records from the District. However, because there is no dredging downstream of the Diversion Weir, there is no way to use "similar methods" (dredging-based methods) downstream of the Diversion Weir or on tributaries. Sediment supplies from these streams will be estimated using existing literature sources cited in the District's study plan.

USFWS Comment (continued)

c) Implement methods to quantify the grain-size distribution of sediment contributed from Beaver Creek, Looking Glass Creek, Cherry/Dry Creek, and the Project tailrace. Tributaries with dominant grain sizes in the silt-to-clay range (less than 0.0625 mm) would not provide material that would contribute appreciably to bed-load, and therefore would not be important as sediment sources for sandbar construction in the lower Platte (Jason Alexander, U.S. Geological Survey [USGS]-Lincoln, Personal Communication, 2009). Sediment supply estimates from these tributaries should be adjusted based on information from grain-size distribution sampling.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

Variability in sample results depending on time of year, point of sampling in any transect, point of sampling in any bar or macroform, depth of any sample below bed level, volume of the sample, sampling method, and many other factors prevent definitive determinations of gradation from even moderate numbers of samples. In a study of virtually all available sediment gradations for the Platte River (Parsons, May 2003), variability in sediment gradations measured across single cross sections was found to be greater than the longitudinal variation used to allege "coarsening" in the mainstem river. Further, bed material samples would not be representative of the washload gradation because the washload passes with the flow. Finally, the Missouri River Basin Commission (MRBC) Level B estimates of sediment supplies from these three particular tributaries (MRBC, September 1975) shows that 70 percent of the total estimated sheet erosion yield is bedload, which does not support USFWS's assertion that these tributaries have dominant grain sizes in the silt-to-clay range. The MRBC total yields can be adjusted for bedload yields using the tabulated values of the correction-to-bedload percentages, but grain size sampling is not warranted for purposes of meeting this objective.

USFWS Comment (continued)

d) Quantify the volume of dredged material that is deposited on the South Sand Management Area that contributes to the sediment supply in the Loup River below the Project diversion,

District Response

The District concurs and will incorporate this recommendation into its study plan.

USFWS Comment (continued)

e) Include Beaver Creek as one of the study sites. The USGS operates stream gage for Beaver Creek at Genoa. The streamgage has a long period of record and would better represent conditions for this sub-basin.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

The District proposes to provide FERC with an adequate analysis of Project operations compared to alternative conditions by evaluating the geomorphic stability

of the Loup River bypass reach and the lower Platte River. Therefore, analysis of sub-basins is not needed to comply with NEPA and ESA requirements.

The study plan objectives can be fully met without including tributaries as study sites because the MRBC report adequately covers the tributaries' contributions for purposes of this analysis. Although many tributaries in the region have fair-to-good gauging records, treating any tributary as a study site is not necessary to meet the study plan objectives under Study 1.0, Sedimentation, Study 2.0, Hydrocycling, or Study 5.0, Flow Depletions.

Study Criteria 5 – Project Nexus, Study Results, and License Requirements

USFWS Comment

An update of the Missouri River Basin Commission (MRBC) sediment budget would provide an adequate representation of the present condition. Sediment transport rates derived from effective discharge calculations will provide a generalized view of sediment balance within the Project area for each of the action alternatives.

District Response

The District concurs with the recommendation. As stated in the District's study plan, the MRBC study will be updated using existing information.

Study Criteria 6 – Proposed Methodology

USFWS Comment

While the calculation of effective discharge is conceptually straightforward, the estimate of this value is dependent upon the calculation procedure adopted (ASCE, 2007). Three components that can effect the results include the time base *(using mean daily vs. sub-daily discharge), the* selection of class intervals *(e.g., ASCE recommends equal-width, arithmetic intervals of less than ¼ sample standard deviation), and the* period of record *(ASCE recommends a period of record "sufficiently long enough to include a wide range of morphologically-significant flows). In addition, the PSP references the use of the Unit Stream Power method and the Einstein method to predict sediment discharge in the Middle Loup River. The Service is concerned about the mixing of methods without understanding the uncertainty associated with these methods.*

District Response

The District concurs that mixing methods would not be appropriate, and as such, the District's study plan states that the District will use the Unit Stream Power method

developed by Yang and Stall (1974) and will not be mixing this method with other methods.

USFWS Comment (continued)

Recommendations:

a) Apply different methods of sediment discharge estimation that would quantify the range of uncertainty associated with these types of calculations. Estimates from developed sediment discharge rating curves could be compared against results developed by the MRBC and the USBR (2003).

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

The District'study plan states that the District will use the Unit Stream Power method developed by Yang and Stall and will not be mixing this method with other methods. An earlier study by Yang and Wan (1991) compared various methods of estimating sediment discharge on several rivers, one of which was the Middle Loup River. Among equations for bed material transport, which have been tested against actual transport measurements in the Middle Loup River (Yang and Stall, 1976), Yang's Unit Stream Power equation provided the most reasonable estimates.

The District intends to compare its results with the MRBC data. However, the 2003 report by the U.S. Department of the Interior, Bureau of Reclamation was limited to the Platte River reach between North Platte and Grand Island and is therefore has less relevance to this study.

USFWS Comment (continued)

b) Effective discharge estimates of sediment transport should be calculated for each node for a period of record that includes wet and drought periods. Sediment transport estimates should assess the cumulative effects of sediment surplus or deficit through wet and drought periods.

District Response

The District concurs with USFWS's recommendation and intends to use long-term flow records that contain the range of flow conditions typically experienced when calculating effective discharge, including wet and dry cycles. The District also points out that shorter-term data can be analyzed but with less reliability. The flow records would include the cumulative effects of past and present actions. The District intends to include the cumulative effects of reasonably foreseeable future actions using the NEPA and ESA standards.

USFWS Comment (continued)

c) Effective discharge calculations should include an evaluation of sub-daily discharge effects to sediment transport for nodes downstream of the Project tailrace. Evaluation of sub-daily flows would reflect the intraday effects of hydrocycling.

District Response

The District concurs with USFWS and, as stated in the District's study plan, is proposing to use sub-daily discharge values at North Bend that would therefore reflect the intraday effects of hydrocycling.

USFWS Comment (continued)

d) Effective discharge calculations needed to account for reasonably foreseeable effects to the hydrograph that would apply toward all action alternatives.

District Response

The District concurs with USFWS and, under NEPA and ESA requirements, is proposing to evaluate reasonably foreseeable effects on the hydrograph.

Study Criteria 7 – Level of Effort and Cost

USFWS Comment

The MRBC sediment budget would provide an adequate representation of sediment balance at a Missouri River sub-basin spatial scale. Estimating sediment yields from sub-watersheds by estimating the amount of sediment delivered from various erosion processes (sheet and rill, gully, and streambank) to create a river sediment budget has its limits as such estimates are notoriously unreliable (Kaspersen 2008).

However, an improved level of precision is needed when evaluating Project effects of Loup and Platte River sub-basin scale. Improved methods should be applied to better quantify sediment supply from the Loup River below the Project diversion and small tributaries within it (Beaver Creek, Looking Glass Creek, etc.). These tributaries were reported to be as large as the entire yield of the Platte River upstream of the confluence with the Loup River, and the total yield of the Loup River at Columbus was reported to be four times the sediment yield of the Platte upstream of the confluence. Service recommendations employing more refined method to calculate the sediment budget for the Project.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

In response to the first paragraph provided above, the District concurs that the methods have limitations, but notes that these methods are universally accepted and can be used, as was done by the MRBC Level B study participants, to approximate sediment supply amounts, and in some cases, to estimate supply rates. Since neither NEPA nor ESA require a specific methodology to analyze impacts, this method will provide FERC with adequate NEPA and ESA analyses of Project operations compared to alternative conditions.

In response to the second paragraph provided above, the methods used by MRBC are state of art, specifically the Revised Universal Soil Loss Equation (RUSLE) method, considering the data availability.

Objective 2: To characterize stream morphology in the Loup River bypass reach and in the lower Platte River by reviewing existing literature on channel aggradation/degradation and cross sectional changes over time.

Study Criteria 1 – Goals and Objectives

USFWS Comment

The Service supports the current Objective 2 as revised in the May 28 and 29 study plan meeting.

District Response

The District appreciates USFWS review and support.

Study Criteria 2 – Relevant Agency Resource Management Goals

USFWS Comment

The Service supports the inclusion of this study because potential Project effects to: a) least tern and piping plover nesting sandbar habitat in the Loup and Platte rivers; b) pallid sturgeon habitat in the Platte River; and c) fish community habitat in the Loup and Platte rivers.

District Response

The District appreciates USFWS review and support.

Study Criteria 4 – Existing Information and Need for Additional Information

USFWS Comment

The Service suggests supplementing existing data from USGS gage sites with additional cross section measurements located at selected study sites. Ginting and Zelt (2008) characterized channel cross-sections as near-bridge sites, and the authors identified limitations when extrapolating cross-sections hydraulic information to beyond-bridge sites. Each study site would have systematic spaced channel cross-sections for the following locations: a) the Loup River upstream of the Project diversion; b) Loup River immediately downstream of the Project diversion; c) the Platte River below the Loup River confluence and above the Project tailrace; d) immediately downstream of the Project tailrace to approximately River Mile 96; and e) near the North Bend streamgage [River Mile 80 to 85]. The cross-sections could be sampled at locations where channel width and slope are relatively constant to reduce hydraulics-related variability.

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

The District's proposed methodology to evaluate cross-sectional changes will provide FERC with adequate NEPA and ESA analyses of Project operations compared to alternative conditions in the Loup River bypass reach and the lower Platte River. The District's stated objective (Objective 2) cannot be assessed unless cross-section data at the same location are available over a long period of time. Surveying a few additional transects once, or even several times over a 1- or 2-year period, will not provide meaningful data to help meet this objective. The cross sections at USGS gauging sites have been relied on over many years for establishing aggradation/degradation trends upstream of the Elkhorn River. Based on this, the District considers USGS gauging sites suitable for the purposes of meeting this objective.

For the same reasons noted immediately prior, the methodology proposed by USFWS would not provide any additional, necessary information that could be applied to an effects determination on the noted species of concern.

The District also provides the following, additional text from the USFWS-cited document (Ginting and Zelt, 2008), which supports the use of near-bridge cross-sectional measurements for the proposed analysis:

> Historical cross-sectional measurements made near near-bridge sites can be used as a primary data set in hydraulic-habitat study, before embarking on a more spatially intensive but costly program of streamflow-depth and -velocity data collection. (page 2)

> Generally, streamflow depths for the near-bridge and beyond-bridge sites did not differ during low-flow conditions (table 16). (page 31)
>
> Bridge effect on relative cross-sectional area of hydraulic niches was not significant for five of the nine hydraulic niches (table 17). For the median-flow condition, relative cross-sectional area of the Deep-Moderate and Intermediate-Slow hydraulic niches were significantly larger for the near-bridge sites than beyond-bridge sites only at Louisville; no bridge effect was evidenced for any hydraulic niches at North Bend. Although the predominant niche for the median-flow condition for the near-bridge and beyond-bridge sites was the Deep-Swift niche (table 17), no bridge effect was found in the relative cross-sectional area of the Deep-Swift niche. (page 40)

Study Criteria 5 – Project Nexus, Study Results, and License Requirements

USFWS Comment

The Project has a direct effect on: a) least tern and piping plover nesting sandbar habitat in the Loup and Platte rivers; b) pallid sturgeon habitat in the Platte River; and c) fish community habitat in the Loup and Platte Rivers.

District Response

The District disagrees with this comment that the Project has a direct effect on the above-listed species because the analysis in the District's study plan is intended to provide information to make that determination. Under NEPA, the District proposes to analyze habitat impacts as well as species impacts. However, under the ESA, the standard is to analyze impacts on the species and not their habitat unless it has been officially designated as critical habitat. To date, none of the listed species have officially designated critical habitat within the Loup River bypass reach and the lower Platte River.

Study Criteria 6 – Proposed Methodology

USFWS Comment

Responses of channel downstream of dams or diversions can include channel bed degradation or incision, textural changes such as coarsening or fining of surface grain-size distributions, and lateral adjustments, including both expansion and contraction of channel width (Grant et al. 2003). A comparative approach of geomorphic indices, such as channel width, velocity, and cumulative depth distributions, should be conducted across study sites (e.g., compare study site d *with*

study sites c *and* e, *or compare* study site b *against* study site a). *Additionally, a longitudinal comparison of transects within a study site (e.g., study site c) could identify longitudinal trends in geomorphic indices.*

District Response

The District does not intend to implement this recommendation and provides the following discussion in support of this decision.

Implementation of the District's proposed study would result in sufficient data collection, and associated analysis, to address Objective 2 and provide FERC with adequate Project-required NEPA and ESA analyses. No such additional comparative assessments, other than those already planned, are required.

The District notes that a comparative approach of geomorphic indices, such as channel width, velocity, and cumulative depth distributions, has already been completed by Ginting and Zelt (2008) for the lower Platte River from the North Bend gage downstream to the mouth. The District believes that the results of this analysis are sufficient and applicable for the NEPA and ESA analyses. In addition, the District does not believe that meaningful data could be obtained from short-term observations of cross sections and velocity measurements as compared to the period of record analyzed by USGS, which covered decades.

Study Criteria 7 – Level of Effort and Cost

USFWS Comment

Inclusion of Service proposed methods are critical to the understanding direct effects of the Project on sediment transport. It might presume that bars would have lower top elevations, and be less extensive near the return, as compared with downstream bars because the local supply of sediment might be limiting relative to the transport capacity (Jason Alexander, USGS-Lincoln, personal communication, 2009; Grant et al. 2003). More importantly, it also is expected that bars would erode at a faster rate over a season than those upstream of the tailrace, and the seasonal rate of bar erosion would diminish in the downstream direction below the tailrace as the river entrains sediment from the bed, bars, tributaries, and banks (although the banks of the Platte segment between the tailrace and North Bend are extensively protected by riprap, which likely limits their erosion) (Jason Alexander, USGS-Lincoln, personal communication, 2009). The opposite effect may be in effect below the Project diversion where sediment transport varies seasonally and temporally.

The highest erosion of channel bed, bars, and banks within the Project area are likely to occur at the tailrace where the clear water returns enter the Platte River. Similar clear water returns enter the central Platte River from the J2 return (USBR 2006). Effects of the clear water return are pronounced within the first 10 miles downstream

of the return with substantial reduction in impacts 30 miles downstream. This similar effect has been documented in other publications (Alexander et al. 2009; Choi et al. 2005; Elliot and Jacobson 2006; Grant et al. 2003; Williams and Wolman, 1984). A statistically adequate sample would be needed to implement Service proposed methods and would not require the sampling of every bar.

District Response

The District does not intend to implement these recommendations and provides the following discussion in support of this decision.

The District's proposed methodology to evaluate effective discharge as it relates to the morphological stability of the study reaches will provide FERC with adequate NEPA and ESA analyses of Project operations compared to alternative conditions in the Loup River bypass reach and the lower Platte River.

Detailed field observations of the formation, dissection, and erosion of bars in the lower Platte River have already been conducted, and the published reports of the observations were forwarded to USFWS. Because USFWS, in its comments to FERC, does not report any deficiencies in these published explanations of the physical processes of bar formation, the District is confident that it can rely on the previous studies without making new in-stream observations of these processes.

Further, no methods exist for mathematically analyzing rates of bar erosion as described here, and although these are academically good questions that could require years to research, they are not needed to identify impacts of Project operations or alternative conditions. Impacts of the Project on overall channel morphology, which consists of the bars, channels, and islands (the habitat), will be adequately addressed by the effective discharge analysis detailed in the District's study plan.

The studies cited and river mile impacts described for the J2 return are not relevant to Project relicensing and should not be cited as though they describe the tailrace return of this Project. Because the J2 return is mentioned, it is important to note that the findings on downstream effects of the clear water returns at J2 were not established by "statistically sampling" bars downstream. Therefore, suggesting that this method would provide anything of value here is unsupported by standards of practice on what methods are available to assess Project effects. Effective discharge calculations and the data collection and analyses described in the District's study plan are industry standards, and the District contends that they are the necessary and sufficient steps to meet this objective.

Any effect of bank stabilization is included in the gage data. The effective discharge analysis, the total sediment transport capacity analysis, and the literature review on stream morphology in the Platte River will cumulatively be used and are sufficient to assess Project effects on river morphology.

Objective 3: To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts (as provided by NGPC) and productivity measures.

Note: In its comment letter, USFWS slightly modified this objective, stating it as "To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts (as provided by NGPC)."

Study Criteria 1 – Goals and Objectives

USFWS Comment

The Service supports the current Objective 1 [sic] *as revised in the May 28 and 29 study plan meeting.*

District Response

The District appreciates USFWS review and support.

Study Criteria 2 – Relevant Agency Resource Management Goals

USFWS Comment

The Service supports the inclusion of this study because of potential Project effects to least tern and piping plover nesting sandbar habitat in the Loup and Platte rivers.

District Response

The District appreciates USFWS review and support.

Study Criteria 4 – Existing Information and Need for Additional Information

USFWS Comment

The Service proposes the application for the following information to replace information proposed for the PSP. All known nest records for least tern and piping plover for the Loup River (Highway 61 Bridge to its confluence with the Platte River) and the Platte River (Highway 81 Bridge to Highway 79 Bridge) shall be summarized by river mile. River miles with more than one year of nesting should be separated from river miles with one or zero years of documented nesting. Documented nesting should be subdivided into the following stream reaches: a) the Loup River from the Highway 61 Bridge to the Project diversion; b) Loup River below the Project diversion to its confluence with the Platte River; c) the Platte River below the Loup River confluence and above the Project tailrace; d) immediately downstream of the

Project tailrace to approximately River Mile 96; and e) near the North Bend streamgage [River Mile 80 to 85].

Additional information needed for this study would include Service proposed data collected under Sedimentation Objective 2.

District Response

The District does not intend to implement these recommendations and provides the following discussion in support of this decision.

The District intends to organize the nesting data relative to river segments established for the sedimentation analysis as opposed to other geographic boundaries. This organization will correlate the nesting data to the sedimentation analysis for an appropriate means of comparison.

The District's proposed methodology will evaluate the morphological stability of the study reaches to provide FERC with adequate NEPA and ESA analyses of Project operations compared to alternative conditions in the Loup River bypass reach and the lower Platte River.

Study Criteria 5 – Project Nexus, Study Results, and License Requirements

USFWS Comment

The Project has a direct effect on sediment supply in the bypass reach of the Loup and Platte rivers and a direct effect on sediment supply in the Platte River at and below the tailrace. Project effect to sediment supply may indirectly affect nesting habitat for the least tern and piping plover.

District Response

The District concurs with USFWS's comment. The District's proposed study as described in the District's study plan will determine the effect on sediment supply in the Loup River bypass reach and the lower Platte River.

Study Criteria 6 – Proposed Methodology

USFWS Comment

The Service proposes the application for the following methods to replace information proposed for the PSP. Geomorphic indices collected from Sedimentation Objective 2 (i.e., channel width, velocity, and cumulative depth distributions) will be compared against the proportion of nesting frequency per river mile through ordination, discriminant function analysis or similar method.

District Response

The District does not intend to implement these recommendations and provides the following discussion in support of this decision.

Reasons were provided in response to USFWS's comment on Objective 2, Study Criteria 6, above, as to why the District rejects USFWS' recommendations for additional cross section measurements. In addition, the District stated in its responses to USFWS's comment on Objective 3, Study Criteria 4, that it is analyzing nesting data relative USGS gage proximity.

Study Criteria 7 – Level of Effort and Cost

USFWS Comment

By definition, an effective discharge (or "dominant discharge") analysis, if properly implemented, identifies the river discharge *that, on average during the period(s) evaluated,* transported the greatest amount of sediment. *This is not the same as characterizing river morphology and habitat. It was identified at the May 27 and 28 study plan meeting that the application of effective discharge calculations could not be applied in a manner to effectively understand sandbar formation. Given the above uncertainties about effective discharge, it would be difficult to identify any relationship between effective discharge results to least tern and piping plover nesting. However, Service proposed methods under Sedimentation Objective 2 has shown that the long-term effects of dams and diversions on sediment transport can be documented (Alexander et al. 2009; Choi et al. 2005; Elliot and Jacobson 2006; Grant et al. 2003; USBR 2006; Williams and Wolman, 1984). The Service recognizes that study results under this objective will only provide a baseline description of nesting habitat and can not compare action alternatives. A comparison of nesting history with Sedimentation Objective 2 should provide a more rigorous evaluation of Project-related sediment effects to least tern and piping plover nesting.*

District Response

The District's goal, as directed by NEPA and ESA, is to assess Project operations compared to alternative conditions. Therefore, the District would be remiss if it were to employ methods that "can not compare action alternatives" as acknowledged by USFWS. Thus, the District cannot implement USFWS's recommendation as stated.

The Nebraska Game and Parks Commission (NGPC) has used dominant discharge in past publications (NGPC, December 2008) to describe flows that form and shape habitat for threatened and endangered species. The District relied on that information along with many other studies found in the literature to formulate its study plan and is nonplussed about USFWS's apparent rejection of a method relied upon by NGPC in the past. In the Assessment of the Pallid Sturgeon, Least Tern and Piping Plover in

the Lower Platte River, there are frequent references to "habitat-forming flows" for pallid sturgeon, interior least tern, and piping plover habitat (NGPC, December 2008). That discussion links these "habitat-forming flows" to the effective discharge. In addition to defining effective discharge as the habitat-forming flow rate, the NGPC assessment states that the effective discharge "generally does the work that results in the average morphological characteristics."

With regards to USFWS's statement that it would be difficult to identify any relationship between effective discharge results and interior least tem and piping plover nesting, the District points out that because no micro-scale relationships exist, the best means on a macro-scale (the only scale available) of linking habitat with use is through a surrogate for habitat; namely, the braided morphology, which in turn is represented by its surrogate, the effective discharge.

The District believes its proposed methodology to evaluate effective discharge as it relates to the morphological stability of the study reaches will provide FERC with an adequate analysis of Project operations compared to alternative conditions in the Loup River bypass reach and the lower Platte River, which is all that NEPA and ESA require.

Objective 4:	To evaluate whether sandbar availability is limiting interior least tern and piping plover numbers on the lower Platte River.

Study Criteria 1 – Goals and Objectives

USFWS Comment

The Service suggests the elimination of Objective 4. Please reference General Comment 1 [provided below] *for additional information.*

Comment 1. The Service does not support the Sedimentation Objective 4: To evaluate whether sandbar availability is limiting interior least tern and piping plover numbers on the lower Platte River. It would be difficult to associate tern and plover nesting on the lower Platte River to available sandbar habitat because the Platte River does not represent a discrete population segment for either species. As you know, these birds are wide-ranging species and can utilize habitats in several river systems in Nebraska, South Dakota, North Dakota and elsewhere when its available. Habitat can be available on the Platte River, but not be utilized because the species is utilizing sandbar habitats along other areas such as the Lake Sakakawea shoreline in North Dakota. Once shoreline habitats disappear due to rising lake levels or vegetation encroachment, the species may utilize sandbar habitats on the Platte River. For the above reasons, an understanding of nesting habitat availability and selection at the population level is needed to determine if lower Platte River nesting habitat is limiting. Such an evaluation would appear to be outside the scope of this relicensing

project. Furthermore, the current definition of "limiting" is based on existing populations which does not address population objectives as defined in species recovery plans (USFWS 1988; USFWS 1990). The Service believes that the methods in Sedimentation Objective 3 will serve as an adequate surrogate for proposed methods under the current objective because methods in Objective 3 avoid the above study limitations.

District Response

The District eliminated this objective as a result of consensus reached at the May 27-28, 2009, Study Plan Meeting.

Objective 5: To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn River.

Study Criteria 1 – Goals and Objectives

USFWS Comment

The Service suggests the elimination of Objective 4. Please reference General Comment 2 [provided below] *for additional information.*

Comment 2. The Service does not support the Sedimentation Objective 5: To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn River. It would be difficult to segregate factors associated with sediment supply effects to pallid sturgeon habitat from other potential effects. We recommend a cautious approach when comparing sediment transport on other rivers used by the pallid sturgeon. The two most obvious choices of rivers possibly considered for comparison are the Missouri and Yellowstone rivers. However, sediment transport varies widely on the Missouri River due to the effect of the six mainstem dams above Sioux City, Iowa and the bank stabilization and navigation project from Sioux City to Saint Louis, Missouri. Further, the Missouri River flows through a diversity of parent materials from its mouth to its headwaters in Montana. The Yellowstone River is also heavily influenced by a large quantity of bank stabilization and an irrigation diversion weir. Finally, little is known about the availability of spawning habitat for the pallid sturgeon on any of the aforementioned rivers; a critical factor when making comparisons of pallid sturgeons on other river systems. The Service considers tasks under Sedimentation Objectives 1 and 2.

District Response

The District does not intend to eliminate this objective from its study plan and provides the following discussion in support of this decision.

The District believes that this objective may be needed to provide FERC with adequate NEPA and ESA analyses of Project operations compared to alternative conditions in the Loup River bypass reach and the lower Platte River.

The District maintains this objective as a viable means of qualitatively evaluating pallid sturgeon habitat parameters and potential Project effects. The District notes that consensus was reached on this objective and the activities associated with it at the May 27-28, 2009, Study Plan Meeting. Additionally, the District notes that this qualitative, comparative analysis is only required if the quantitative analysis related to sediment transport determines that the Project is affecting sediment transport parameters in the lower Platte River below the Elkhorn River confluence.

The District notes that some of the comments provided by USFWS in its General Comment 2 provide reasons for continuing to include this objective, as follows:

- The fact that pallid sturgeon use the two (USFWS-noted) rivers that are heavily influenced by development would support looking at those rivers to see what role sediment might play in the pallid sturgeon's use of those rivers.
- As stated, "…the Missouri River flows through a diversity of parent materials from its mouth to its headwaters in Montana" and still provides acceptable habitat for pallid sturgeon. This diversity in parent material that supports pallid sturgeon only substantiates the question regarding what is limiting pallid sturgeon in the lower Platte River.

REFERENCES

18 CFR §5.9(b). Content of study request.

16 USC 1531-1544. Endangered Species Act of 1973, as amended.

42 USC 4321-4347. National Environmental Policy Act of 1969, as amended.

Ginting, Daniel, and Ronald B. Zelt. 2008. "Temporal Differences in Flow Depth and Velocity Distributions and Hydraulic Microhabitats Near Bridges of the Lower Platte River, Nebraska, 1934-2006." USGS Scientific Investigations Report 2008-5054. Available online at http://pubs.usgs.gov/sir/2008/5054/pdf/sir2008-5054.pdf.

Missouri River Basin Commission. September 1975. "Platte River Basin—Nebraska, Level B Study, Land Conservation and Sedimentation." Technical Paper.

NGPC. December 2008. Assessment of the Pallid Sturgeon, Least Tern and Piping Plover in the Lower Platte River. Lincoln, Nebraska.

Parsons. May 2003. Technical Memorandum, Results of Investigation B1 – Comprehensive Evaluation of Sediment Gradation Data, Platte River Channel Dynamics Investigation. Prepared for States of Colorado, Nebraska, and Wyoming.

U.S. Department of the Interior, Bureau of Reclamation. 2003. Platte River flow and sediment transport between North Platte and Grand Island, Nebraska: 1895-1999. U.S. Department of the Interior, Bureau of Reclamation Technical Service Center, Denver, Colorado.

Yang, Chih Ted, and John B. Stall. July 1974. "Unit Stream Power for Sediment Transport in Natural Rivers." Final Report. University of Illinois Water Resources Center.

Yang, Chih Ted, and John B. Stall. May 1976. "Applicability of Unit Stream Power Equation." *Journal of the Hydraulics Division*. ASCE. 102:5.

Yang, Chih Ted, and Schenggan Wan. August 1991. "Comparisons of Selected Bed-Material Load Formulas." *Journal of Hydraulic Engineering*. 117(8):973-989.